The Use and Significance of Early Bronze Age Stone Battle-axes and Axe-hammers

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Abstract

Previous understandings have assumed battle-axes were purely ceremonial, while the rougher axe-hammers were neither functional nor prestigious, being too large and too crude to be prestige implements. The principal sources have focussed on creating a typology and understanding the manufacture and petrological sources of the stone. However, there is yet to be a study which primarily focusses on use.

A reassessment of outdated interpretations, which have not been critically evaluated since the 1980s, is overdue. This has left space for more accurate assessments of the roles and meanings of the objects based on new information. In order to do so, this PhD project is focussed on the use and significance of perforated ground stone battle-axes and axe-hammers from the Early Bronze Age in Northern Britain and the Isle of Man. The primary purpose of this research is to employ the techniques of use-wear analysis, experimental archaeology, and a theoretical contextual assessment, in order to determine the main uses and significance of these implements. This project is the first time that use-wear analysis is applied to a large sample of British Early Bronze Age battle-axes and axe-hammers, providing an opportunity to reassess the role and significance of these objects.

This thesis argues that both battle-axes and axe-hammers were functionally used, with the potential for their use over prolonged periods and by multiple users. The evidence indicates that those implements found in burial contexts were both functional and symbolic. The data suggests that their inclusion in burial contexts drew upon relational links which developed through the itineraries of these objects, which means that their roles and significances were varied and multiple. This thesis also argues that the differences between battle-axes and axe-hammers are few in life. It is in death – their deposition – that the change in significance is apparent.

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Chapter 1: Introduction

1.1 Introduction

Few major works have investigated Early Bronze Age (EBA) perforated stone battle-axes and axe-hammers[1] despite their presence in EBA funerary contexts and the vast number of stray finds spread across the UK. The principal sources have focussed on creating a typology and understanding their manufacture and the petrological sources of the stone (Roe, 1966; 1968 & 1979; Saville & Roe, 1984; Fenton, 1984 & 1988). The depositional context of EBA battle-axes and axe-hammers has been used as the basis for the previous interpretations of their use and significance. Stereotypical interpretations were often influenced by an awareness of the single grave culture in Europe which argues that 'exotic' artefacts in burials signify an elite (Mortimer, 1905, 159; Anderson, 1942, 80; Evans, 1872, 185; Greenwell, 1877, 159, 298; Smith, 1925, 80; for the Continental studies of elite see: Brumfield & Earle, 1987; Earle & Kristiansen, 2010, 4; Knutsson & Knutsson, 2003, 70; Lekberg, 2002, 68); for example, battle-axes have been found in burial contexts with 'exotic' items such as jet beads. Previous understandings have assumed battle-axes were purely ceremonial (Saville & Roe, 1984), while the rougher axe-hammer was neither functional nor prestigious, being too large and too crude to be prestige implements (Leahy, 1986). But, there is yet to be a study which primarily focusses on their use.

Battle-axes and axe-hammers are stone implements with a central or off-centre perforation to accommodate a haft. They have a blade parallel with the perforation at one end, and a butt at the opposite end. Their size distinguishes them from one another; battle-axes are less than 190mm long and 80mm broad, and axe-hammers are greater than battle-axes in either dimension (figure 2.1). The study area includes all counties in the north of England and Scotland, including the Scottish Isles and the Isle of Man. The area south of Yorkshire and Lancashire is not included to keep the sample size manageable. There is a total of 183 battle-axes and 362 axe-hammers from Northern Britain and the Isle of Man (Figure 1.1).

A reassessment of outdated interpretations, which have not been critically evaluated since the 1980s, is overdue. This will allow for more accurate assessments of their roles and meanings based on new information. In order to do so, this PhD project is focussed on the use and significance of perforated ground stone battle-axes and axe-hammers from the Early Bronze

[1] The terms battle-axe (B-A) and axe-hammer (A-H) are used to refer to battle-axe heads and axe-hammer heads.

Age in Northern Britain and the Isle of Man. The main purpose of this research is to employ the techniques of use-wear analysis, experimental archaeology, and an assessment of the contexts in which the objects were found, in order to determine the main uses of these implements.

The project considers several research questions with the overall goal of understanding the use and level or type of significance of EBA stone battle-axes and axe-hammers. The research questions are as follows:

- How were battle-axes and axe-hammers used before they were deposited?
- Were those battle-axes and axe-hammers deposited with the remains of the dead used differently to those found as stray finds?
- To what extent were these implements used as tools or weapons?
- Does the wear indicate the length of use and events of re-sharping and re-polishing?
- To what extent were some implements more significant to the society who used them, than others, and can this be implied through length of use?
- What evidence is there for regional variation, and to what extent is this related to typology, significance and use?
- To what extent does petrological material variation relate to regional variation, significance, and uses?

The aim of understanding the use and significance of EBA stone battle-axes and axe-hammers is spilt into objectives to allow a full assessment of the use and significance of these implements. Those objectives to assess use are as follows:

1. Clearly define the possible varied uses of battle-axes and axe-hammers, using the evidence from use-wear analysis, experimental archaeology, and a contextual assessment.
2. Assess the extent to which such implements were used as tools or weapons.

Those objectives to assess significance are as follows:

3. Explore how the level of significance differs between the different types through an examination of deposition, material, type, distribution, and use.
4. Assess the level of variation between and within implement types in relation to use, deposition, material and type of significance.

Figure 1.1: A map showing the distribution of all battle-axes and axe-hammers from Northern Britain and the Isle of Man.

The importance of the research is twofold: this is the first time that use-wear analysis is applied to a large sample of British Early Bronze Age battle-axes and axe-hammers, providing an opportunity to reassess the role and significance of these objects; furthermore, this is a valuable methodological addition to traceological research on ground stone tools, which have thus far received less attention than knapped and flaked industries.

1.2 Chapter Outline

In Chapter 2, I discuss the previous research of British battle-axes and axe-hammers which introduces their contextual associations and past interpretations of use and significance. In Chapter 3, I move on to introduce use-wear analysis as a form of data collection and analysis to understand the function of battle-axes and axe-hammers. The chapter presents the current state of play of wear analysis methods; for instance, the advantages of using a multi-scalar microscopy approach. The chapter culminates with an assessment of the most beneficial methods of use-wear analysis to understand the function of battle-axes and axe-hammers. This is followed up in Chapter 4 which sets out the methodology used for this project. The chapter begins by presenting the methodological approach used for the microscopic analysis of the dataset, using high and low power approaches to gain a more accurate understanding of the functionality of EBA battle-axes and axe-hammers. This includes the use a new methodology created for the project using acetate to replicate the wear on the stone surface. Further methodological approaches for data analysis are also discussed: such as the addition of experimental tests to understand how wear forms through specific uses; and the contextual assessment of these implements, including typological, chronological, petrological and spatial and stratigraphic contexts. The chapter ends with a discussion on the parameters followed to select implements to analyse and the processes to secure access.

In Chapter 5, the contextual information for battle-axes and axe-hammers from Northern Britain and the Isle of Man is analysed and discussed. The assessment uses Hodder's five categories of contexts: typological; chronological; stratigraphic; spatial; and cultural. Hodder developed a systemised approach to interpret the past meaning of material culture by identifying various types of similarities and differences built up into several types of contextual associations (Hodder & Hutson, 2003, 173). To improve this approach, I expanded it by adding two further contexts – petrological and use contexts – to provide a more nuanced and extensive understanding of the possible roles and meanings of EBA battle-axes and axe-hammers. Using this approach has allowed an assessment of all known information concerning these implements. The interpretation of use and function is expanded in chapter 6 which presents the experimental tests using replica battle-axes and axe-hammers to assess the wear patterns produced from specific use actions. The development of wear was assessed throughout use to better understand the wear marks seen on those implements in the archaeological record.

To further understand the use and function of these implements, Chapter 7 presents the wear analysed on a total of 121 shaft-hole implements – 63 battle-axes and 59 axe-hammers – from museums across the British Isles. The data presented in this chapter demonstrates their varied functionality, including different contact materials, use motions, extent of use, and treatments such as re-grinding. Similarities in wear formation between the experimental replicas and those implements analysed from the archaeological record is clear; the chapter demonstrates new information regarding the development of wear throughout use – the 'three-group arrangement' of striations is seen to develop on the blade edges during the early stages of contact with wood using a chopping motion. The results of wear analysis and the experimental tests demonstrate the clear functionality of battle-axes and axe-hammers. They provide the basis to draw inferences about the use context for these artefacts in Chapter 8.

In Chapter 8, I bring together the data analysed throughout the thesis to assess the use and significance of EBA battle-axes and axe-hammers from Northern Britain and the Isle of Man. The chapter begins by discussing the funerary practices and the life histories of battle-axes and axe-hammers together. In this section I compare the contextual information and wear analysed on both implement types to understand their differences and similarities. Following this, the uses and key points in the life-histories of battle-axes and then of axe-hammers are discussed separately. In sections 8.3 and 8.4 of Chapter 8, I examine the itineraries of these objects further, beginning with the manufacture of battle-axes and axe-hammers and the potential for their use as tools and weapons. I argue for the functional use of both battle-axes and axe-hammers as tools, while their potential use as weapons is more uncertain. A regional assessment of the distributions of these artefacts demonstrates that there are certain areas where one type is more prevalent. For instance, axe-hammers are more common than battle-axes in the south west of Scotland and the Northwest of England. The wear analysed on these implements does not differentiate them from the implements from north Britain and the Isle of Man. The chapter also establishes that there is no correlation between use and depositional context, use and petrology, or use and typology. Chapter 8 ends with a discussion of the level of significance considered by users of EBA battle-axes and axe-hammers in light of the data gathered through contextual assessment, wear analysis and experimental tests. It determines that there are multiple possibilities for the creation or perception of a significance or prestige for those using the implements and that the placement in a burial is just one aspect within a web of potential causes for meaning involved in function, treatment and deposition.

In Chapter 9, I bring together the conclusions and interpretations of the use and significance of battle-axes and axe-hammers from Northern Britain and the Isle of Man drawn from the data examined throughout the thesis. Summarising the answers to the questions above, chapter 9 determines the key arguments before addressing the potential for future research.

It has long been known that battle-axes were associated with funerary deposition, while axe-hammers have a more elusive nature due to the high percentage of stray finds. In the past interpretation of their use and significance has focussed on the depositional context, using understandings of the single grave culture in Europe to aid the interpretation that battle-axes were prestigious implements related to an elite. In this thesis I argue for the functional use of EBA battle-axes and axe-hammers prior to their inclusion in both funerary and non-funerary contexts and that their potential meanings and roles were numerous of which claims to, signalling, and negotiating prestige are elements among many. The development of Hodder's five contexts into an approach which considers use context as a new dimension has added to an assessment of their other contextual dimensions, providing new information (Hodder & Hutson, 2003, 173). The results of wear analysis and the experimental tests demonstrate the clear functionality of battle-axes and axe-hammers. They provide the basis to draw inferences about the use context for these artefacts. As a result, it is now possible to produce a much-improved consideration of these two Early Bronze Age artefact types. For example, it is now evident that both artefact types had similar functions and meanings. It is apparent that the similarities in use between battle-axes and axe-hammers reinforce the idea derived from their similar treatment that they had parallel cultural significances.

Chapter 2: Literature on Ground and Polished Battle-axe and Axe-hammers

2.1 Introduction

There have been few major works regarding stone battle-axes and axe-hammers in Britain. The most notable of these works were by Roe who focussed on the typologies and distributions of such implements (Roe, 1966; 1968 & 1979). Her contribution has formed the basis for all subsequent work. Later Fenton added to the discussion with an assessment of their sourcing and manufacture (Fenton, 1984 & 1988). Since then, no major work has been published. Therefore, a new collection of information and data discussing the uses and significance of these implements considering modern advancements in archaeological thought and practice is needed. In this chapter, I will present the previous understandings of typology, manufacture and use. I will demonstrate the typological recognition of these implements and the manufacture processes. The chapter will also show how the interpretations of their depositional contexts and size has resulted in a variety of arguments for their meanings and roles. British and European research will be put forward to demonstrate the current and past arguments for the meanings and uses of these implements. The chapter will conclude that research on battle-axes and axe-hammers needs to expand to understand the use and significance of these artefacts properly, using all information available.

2.2 Typological recognition

The major categories of perforated implements were first outlined by Evans in *Ancient Stone Implements, Weapons and Ornaments of Great Britain*, 1897. However, he provided little differentiation between axe-hammers and battle-axes. Ashbee later suggested that there were five types of battle-axe, Types I to V, depending on the expansion of the blade: Type I was not expanded at all, and Type V was fully expanded (Ashbee, 1960). However, it was Roe who distinctly separated the two artefact types (Roe, 1966). Roe defined battle-axes as implements less than 190mm long and 80mm broad with a perforation, hammer-face and, at one end, a blade; axe-hammers were implements that were greater than battle-axes in either dimension, with a perforation, hammer-face and a blade at one end (figure 2.1).

Figure 2.1: Images of an axe-hammer, Newcastle 1942.10, ID 123 (left) and a battle-axe NMS AH 44, ID 145 (right) to illustrate the difference in size

She also developed a typology for battle-axes which split them into groups, stages and variants, dependant on their form and find location. With this information, Roe was able to develop trends associated with each battle-axe group (Roe, 1966). Within this, the battle-axe stages were made to represent the expansion of the blade and butt of the battle-axes (for an example, see figure 2.3), and they were divided chronologically, into Early, Intermediate, and Developed. Despite this advancement in typological separation, the division used is questionable. Sheridan has criticised the plausibility of her division between 'intermediate' and 'developed' (Sheridan, 2007). Indeed, differentiation between these two types is often difficult to discern due to their similarity in shape. Indeed, in his assessment of the Irish battle-axes, Simpson argued that a combination of the Early and Intermediate series would be ideal due to their similarities (Simpson, 1996).

Roe's extensive typology suggests diversity in the form of battle-axes. On the other hand, Roe split the larger axe-hammers into two groups, I and II, which suggests a limited diversity among this object type.

2.3 Manufacture

Following Roe's ground-breaking work Fenton focussed on the production of battle-axes and axe-hammers in Scotland (Fenton, 1984). His 1984 publication assessed the manufacture processes and methods with the use of experimental tests. Fenton concluded that the vast majority of these implements were made from cobbles. He suggested that this conclusion may extend to the rest of Britain (Fenton, 1984, 217). Following this, Fenton's 1988 article in *Stone Axe Studies vol. II*, a leading publication in the development of the petrology of stone axes and other stone tools, attributed a large number of battle-axes and axe-hammers to petrological groups. The assignment to petrological groups allowed for the distributions and sources of grouped battle-axes and axe-hammers to be assigned and analysed. Fenton found that there was haphazard exploitation of suitable and easily sourced rock types; local sources were utilised as well as glacial erratics (Fenton, 1988, 116). Limited use of quarries and mines, after their extensive use during the Neolithic, may imply quarries and mines lack of significance in the EBA compared to the Neolithic. However, this could be attributed to a change in the political geography during the Chalcolithic and Early Bronze Age.

The hafting of perforated implements has received limited attention. Both Evans and Fenton have focused on the making of the perforation by using techniques such as grinding and pecking (Evans, 1897; Fenton, 1984). In Keeley’s assessment of the effect of hafted tools on the archaeological record, he suggests the hafts would have been secured with the use of wooden wedges. However, it is still unclear what techniques were primarily used since few hafts have survived in the archaeological record.

2.4 Contextual and social factors

Roe was the first to assess the contextual associations of battle-axes together, allowing her to understand any possible trends. The literature on battle-axes has notably focused on their burial associations. Such a focus has resulted in the assumption that battle-axes were purely ceremonial (Saville & Roe, 1984, 20) and of the elite (Evans, 1897; Mortimer, 1905; and for European battle-axes: Kristiansen 1998, 161–180; Demokopoulou et al. 1999; Kristiansen 1987; Kristiansen and Larsson 2005; Treherne 1995). The name “battle-axe” signifies a further interpretation of the use and meaning of these objects – as weapons. General opinion in the late nineteenth and early twentieth centuries regarded these implements as weapons wielded by warriors whom, upon their death, were interred with them in burials signifying their status (Mortimer, 1905, 159; Anderson, 1942, 80; Evans, 1872, 185; Greenwell, 1877, 159, 298; Smith, 1925, 80). The inclusion of battle-axes in burials is associated with males since the few sexed examples were male. This interpretation has been used, in combination with the idea that battle-axes signify the status of the deceased, to argue that battle-axes were a sign of a male elite (Evans, 1897; Mortimer, 1905). A recent interpretation by Sheridan has looked at battle-axes with regards to their function and symbology, she saw them as being able to be both symbolic and functional: ‘prestigious possessions – symbols of power as much as functional weapons’ (Sheridan, 2007, 110).

More recently, British EBA scholars have argued against the view that funerary assemblages reflect the identity of the deceased and that it was the mourners’ choice that resulted in the deposit of artefacts in burials (Needham, 2011, Brück, 2004; 2006; 2019; Barret, 1991, Thomas, 1991). They have concluded that the deposition of artefacts in burial deposits may have been used to express ideals, emotions, memories, beliefs of the mourners, and could create, negotiate and maintain interpersonal links, power and relations (Brück, 2006; Thomas, 1992; Barrett, 1991; Thomas, 1991). For instance, the funerary assemblage could have reflected upon the exchange of objects to maintain and forge interpersonal links within society and between societies, thus playing and negotiating power relations and identities (Brück, 2004, 2006 & 2019; Thomas, 1992; Barrett, 1991). In her most recent monograph, Brück explained this as items commenting on the relationship with the living (Brück, 2019, 78). Her previous publications have also demonstrated this:

‘Objects placed in the grave allowed the mourners to comment metaphorically on the links between the dead and the living, as well as on the changes experienced by a community torn asunder by death... that identity was a relational attribute; it was people’s relationships with others that made them who they were’ (Brück, 2004, 307 & 311).

Axe-hammers have received fewer assessments due to their limited depositional information. Despite this, several assumptions have been made regarding the use and the level of significance of these implements. This larger implement is thought of as being too large and too crude to be prestigious (Leahy, 1986). Leahy also argues that few show signs of hard use (Leahy, 1986, 148). While some assumed their size meant they could not be used functionally, others used this to suggest possible uses. Pegge considered their use as weapons would be too unwieldy due to their size, and instead suggested that they were much more likely to be used as domestic tools to slaughter animals (Pegge, 1773, 126-127). Woodworking, agricultural, and metal ore preparation roles were also suggested (Bradley, 1978, 13; Roe, 1967, 69). Roe has correlated the location of axe-hammer finds with areas of metal ore, suggesting that there was a relationship between the two (Roe, 1967, 69). Any inference of their use in metal ore production, again, has not been tested. Bradley put forward a suggestion that axe-hammers were used as wedges to split wood into planks, which has been disputed by some who see this implement as being too weak for such a task (Leahy, 1986, 148). No tests were carried out to investigate this assumption before this PhD project. A further suggestion for the use of axe-hammers as ard points to plough soil stemmed from the discovery of the tip of an axe-hammer within a middle Bronze Age plough furrow, Gwithian, Cornwall (Thomas, 1970, 13). The use of an axe-hammer or battle-axes as an ard point to plough has yet to be tested experimentally, although two of this projects' experimental tests were to dig soil and clear earth and roots. These presented wear from contact with soil and stones and soil and roots which may be comparable to the type of contact materials present when ploughing.

More recently, Needham's 2011 Rhind lectures discussed the purpose of EBA funerary assemblages, burials and their sites to provide a fresh interpretation of the meaning of these burial modes. In his lecture, *Blunt Instruments of Power*, Needham considered contextual and social factors of both battle-axes and axe-hammers in more detail. His presentation was the first time the social and ceremonial factors of these implements were assessed without making assumptions based on their form. Needham's thorough assessment of their cultural context, typology and distribution added to the understanding of these implements in relation to other EBA objects. Needham has described battle-axes as initially being used to reinforce the status of dagger bearers in dagger burials. Battle-axes then, he argues, became a statement in their own right and there forth remained an 'enduring status symbol' for up to seven centuries (Needham, 2011). Instead of basing the interpretation of battle-axes on just their presence in burial deposits, Needham used several elements of battle-axes contexts in his interpretation, including their typology, distribution and cultural context. In doing so he was able to look at battle-axes in relation to other funerary artefacts from the EBA, such as daggers; he considers battle-axes as part of a broader group of identity-related items used in EBA society.

Additionally, his assessment of their distribution found that regional preferences were at play in determining which implement, battle-axe or axe-hammers, was appropriate for use in specific areas. For instance, the south-west of Scotland was a hub for axe-hammers and had far fewer battle-axes (Needham, 2011). However, there is yet to be a scientific and accurate assessment of the functionality and uses of these objects across those different regions. As such, no interpretation of use and significance is accurate without a proper assessment of their functionality.

2.5 Parallel research: Ireland

Artefacts with a similar form to the British battle-axes and axe-hammers are found in Ireland and across Europe. Interpretations of their typology, meanings and use have also been carried out for these assemblages. There are many similarities with the literature discussed above.

The Irish assemblage of battle-axes and axe-hammers has primarily been worked on by Simpson (1988; 1989; 1996). Due to the close similarities in form, Simpson used Roe's typology to describe the Irish implements. He used their form and contextual associations to demonstrate the similarities between Ireland and Britain. In a later publication (1996) Simpson concluded the Irish evidence does not support Roe's tripartite division of Early, Intermediate and Developed. Instead, he suggested that the Early and Intermediate types should be combined into a single Early series, and the late forms should be split into several sub-groups because they are more variable; an aspect he also argues should be the case with the British battle-axes (Simpson, 1996, 69).

2.5.1 Interpretations

Interpretations of the use of Irish battle-axes and axe-hammers are few and far between. Simpson has suggested a few potential uses of axe-hammers based on British evidence. Simpson believed that they could not have been weapons, due to their size and weight. Nor could they have had a ceremonial function owing to their rough finish (Simpson, 1990b, 53). He also disregarded agricultural use because, although there is a concentration of axe-hammers in the lowland arable areas of Cumbria, this pattern was not seen in other areas where there is clear evidence of arable farming, such as Wessex and Sussex which have limited numbers of axe-hammers (Simpson, 1996, 74). In light of the regional preferences which Needham suggested, it is possible that those areas of good arable soil and limited axe-hammers preferred the use of battle-axes. If this is the case, then Simpson's argument against an agricultural use must be inaccurate.

Like the British examples, the Irish battle-axes have been interpreted as non-functional due to their thin nature, fine finish, and narrow perforations deemed unsuitable for functional use (Simpson, 1990a, 12). Frazer considered the use of battle-axes as weapons in his assessment of the Clonmore, Co. Carlow battle-axe. He reasoned that the proportions and balance of these implements would make it a 'formidable missile' and assumed that these implements would have been projectiles due to the small nature of the perforation, too small to insert a shaft

(Frazer, 1891, 216). Instead, Frazer argues that they would be ideal for stringing a thong made of hide or cord through. However, he too questioned whether those finely worked examples with a ceremonial context were ever designed to be used (Frazer, 1891, 216).

2.6 Parallel research: Europe

Forms of perforated implements, much like British battle-axes, appeared in Europe well before the British examples (for a comparison, see figures 2.2 and 2.3). Such implements have been central to the ideas of many concerning a change in material, monuments, and way of life in Europe during the Neolithic and Early Bronze Age. As such, there has been a greater focus on these implements in the European literature compared to the British counterparts, in particular publications concerning the Battle-Axe Culture, also known as the Single Grave Culture, in Scandinavia, c. 2850-2350 BC.

Various typologies tackle the form and chronology of these battle-axes. Zápotocký created a typology for the central and southeastern European and southern Scandinavian battle-axes. This typology covers a broad spectrum of battle-axe types from the Funnel Beaker Culture, c. 4300 BC – 2800 BC, representing the sheer diversity of this implement (Zápotocký, 1992). Ebbesen created a typology solely for the Scandinavian battle-axes which consisted of a similarly broad spectrum of types, from I to V. Further typologies of varied types were created by Butler & Fokkens and Malmer. Both typologies suggest a chronological order based on contextual associations, Butler and Fokkens' typology runs through chronologically from type 1 to 16 between c.2900-500 BC (see figure 2.2) (Butler & Fokkens, 2005, 394-395; Malmer, 2002). The quantity of developed typologies suggests the variation in their form was complex and that there was of high interest in these objects.

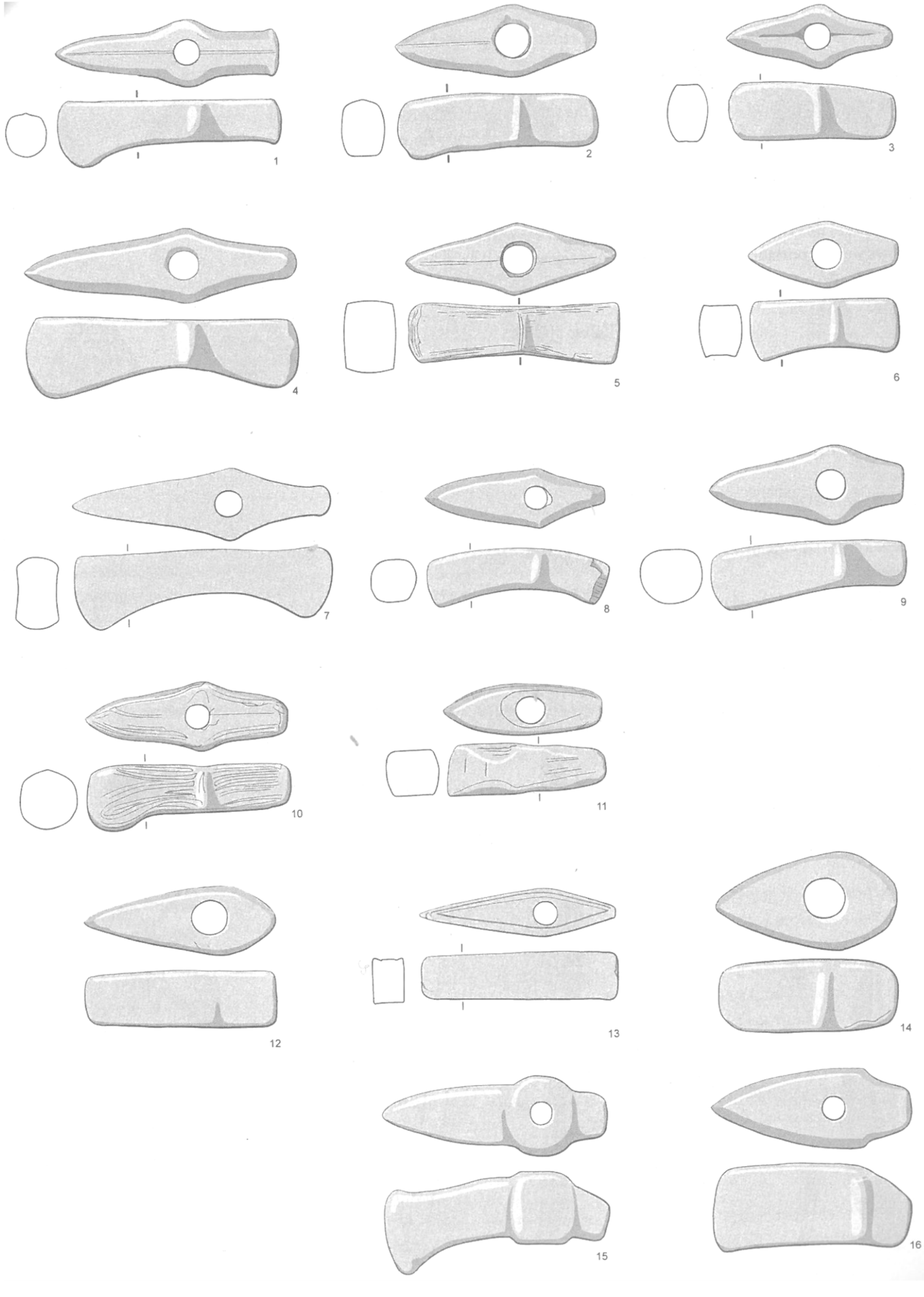
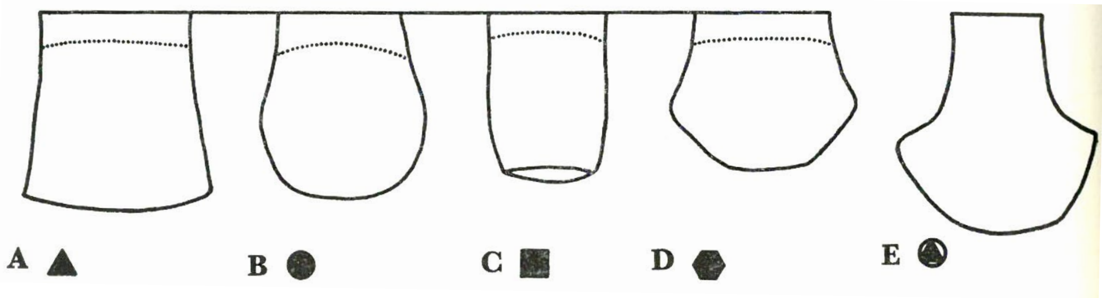


Figure 2.2: Butler and Fokkens' typology of battle-axes of the battle-axes in Scandinavia (Butler & Fokkens, 2005, 394)

laat-neolithicum		
1	A-hammer	c. 2900-2800 BC
2	B-hammer	c. 2800-2700 BC
3	C-hammer	
4	D-hammer	c. 2700-2600 BC
5	E-hammer	
6	F-hammer	all c. 2600-2450 BC
7	G-hammer	
8	H-hammer	
9	P-hammer	
10	facettede hamer	
11	R/S-hamer	
Early and Middle Bronze Age		
12	Emmen type	c. 2000-1800 BC
13	Zuidvelde type	
14	*Arbeitsaxt*	c. 1800-1500 BC
Late Bronze Age and Iron Age		
15	Baexem type	c. 900-500 BC
16	Muntendam type	

Figure 2.3: The chronology of Butler & Fokkens battle-axe typology (Butler & Fokkens, 2005, 395)



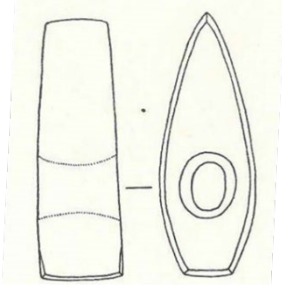
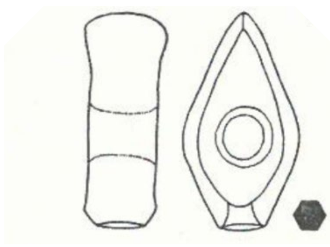
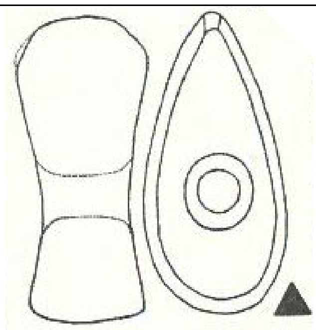
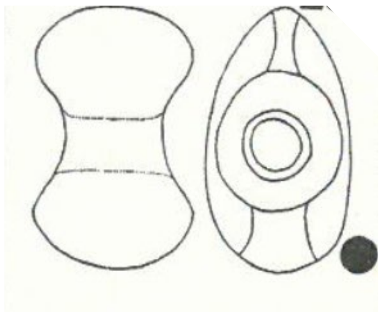
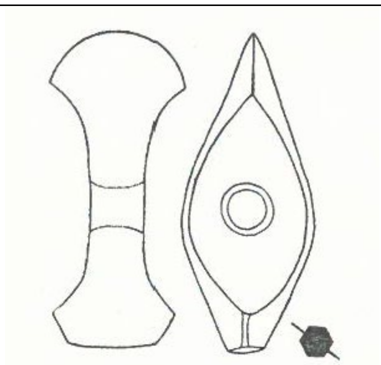
	
A Stage I battle-axe, butt shape C	**A Stage II battle-axe, butt shape D**
	
A Stage III battle-axe, butt shape A	**A Stage IV battle-axe, butt shape B**
	
A Stage V battle-axe, butt shape E	

Figure 2.4: Illustrations demonstrating Roe's typology for British battle-axes, see chapter 6 for a description (Roe, 1966)

2.6.1 Interpretations

The interpretations of the use and meaning of European battle-axes correspond with those of the British examples, in particular, the idea that they are status symbols. Across Europe, from Aegean to the Balkans, the Black Sea steppes, Bulgaria and Belorussia, c. 4000-3900 BC, and up to Scandinavia, c.2900-500 BC, battle-axes were found. They are considered to be a metaphor entwined with the construction of a hierarchical system that promotes individual status through the display of wealth, such as their use in individual burials (Earle & Kristiansen, 2010, 4; Knutsson & Knutsson, 2003, 70; Lekberg, 2002, 68; Jensen, 1995; Gimbutas, 1953). The most common view in the literature supports the idea that an elite or warrior elite used battle-axes to gain and maintain status, power, and wealth. Gimbutas' labelling of battle-axes as cult axes, for instance, suggests an association with status through the threat of violence, or symbols of rank associated with ancestral access to trade networks (Gimbutas, 1953).

Similarities between Scandinavia and Britain during the Bronze Age are apparent. The interpretation of battle-axes as artefacts of status and power is also common here. The Battle Axe Culture is characterised by the appearance of single graves with seemingly prescribed rules on orientation and position, with men lying on their right, and women on their left, in an east-west, orientation. Specific grave goods including the cord-decorated beaker, flint axes, beads, and battle-axes - the latter found only in male burials – were present in set locations. Battle-axes, for instance, were always placed by the head. Such burial modes have been interpreted as a sign of a male elite (Gimbutas, 1953; Jensen, 1995, Prescott, 1991, 46).

However, recent interpretations of the contexts of these battle-axes have suggested alternative meanings and roles for these implements. Knuttson and Knuttson suggest a process whereby the grave goods are actors in ancestral stories linking the dead with their ancestral histories (Knuttson & Knuttson, 2003, 66). Ancestral links may have been used to maintain relationships with areas of land for agricultural, wealth and power purposes instead of to represent the status of an elite. Lekberg's recent PhD thesis demonstrated the varied roles that Scandinavian battle-axes played on their deposition. He found that the axeheads were approximately 20 – 35 cm when manufactured but reduced in size throughout their lifetime. They were deposited at various stages of their use-life, and thus also at various lengths. When Lekberg mapped find spots for the axeheads and their lengths, he found that they marked specific locations. The short axes, often found in graves, generally exhibited linear distributions patterns, marking paths and roads along ridges, eskers or waterways. Whereas, the long axes, found in hoards or other offerings, were most often placed in coastal zones or at places along the inland paths, marking nodal points in the landscape (Lekberg, 2002, 307).

Further interpretations have questioned and evaluated the value and status of battle-axes. Tilley revealed that battle-axes were only present in a quarter of all known burials, while Olausson concluded that the production of these implements did not require any skill, allowing them to be self-manufactured for individual possession. She, therefore, determined that they were not of high value (Olausson, 1998, 136). Equally, Damm has argued that the associated status was not from the axes themselves. Instead, she sees the status of these objects as relational, being from a status acknowledged through other means, such as through their trade, which maintained vast networks (Damm, 1991, 65).

The varied interpretations of Scandinavian battle-axes surpass that of their British counterparts. It suggests that research on the British battle-axes and axe-hammers must be expanded to properly understand the possible uses, meanings and roles of these objects. Additionally, recent research by British EBA scholars, such as Brück, have argued that the creation of funerary assemblages was to represent the identity and relationships of the living, instead of characterising the identity of the deceased. A multitude of different relationships could be drawn upon, therefore, demonstrating that these assemblages are more complex than previously thought. As a result, research of EBA funerary assemblages and the items within them must take into consideration their itinerary to understand the different relationships that could be drawn upon during their deposition.

Chapter 3: Use-wear Analysis of Ground Stone Tools

3.1 Introduction

Wear is defined as the progressive transformation of a surface due to the relative motion between it and another contact surface (Adams et al. 2009, 46). The study of this wear by archaeologists through use-wear analysis allows the attribution of wear traces to specific kinds and extents of contact and potentially use. These traces can be used in conjunction with other types of analysis, such as residue analysis, context, ethnography and experimental archaeology to answer questions regarding manufacture, function and activities and other processes and actions. Such knowledge can shed light on the social structures and economic organisation of past societies (Adams, 2008). This chapter will demonstrate the protocols and approaches that have developed for the analysis of ground and polished stone using use-wear analysis. The aim is to reflect on the ability of these methods for understanding and interpreting wear formation on ground and polished stone.

Since the English translation of Semenov's pioneering Russian text, *Prehistoric Technology* (1964), on traces of manufacture and wear on tools and artefacts, use-wear studies have developed extensively and are now well established. Currently, use-wear analysis is used by archaeologists across the globe to gain a better understanding of the manufacture process and function of objects from the past. Such information significantly enhanced the understanding of how they contributed to human behaviour and the economic and social organisation of past societies.

Since its establishment as a scientific method applied to archaeology, wear analysis has been used to analyse multiple materials including pottery, bone, shell, metal, chipped and flaked stone, and ground and polished stone (Szabó, 2008; Gates & Walker, 2007; Dolfini, 2011; Van den Dries & van Gijn, 1997; van Gijn, 1990; Adams, 1989; 1993; 2002; 2003; 2010; 2014). The analysis of chipped and flaked stone such as flint and obsidian has received far more attention than objects of ground and polished stone, such as hammer-stones, axes, adzes, and grinding slabs, which have been mainly been neglected until recent years. As a result, the analysis of ground stone tools (GST) has seen the development of varying methods and terms. Scholars are now calling for a homogenous method to tackle this, with standardisation of concepts, to allow for comparative analysis between results (Adams, 1989;

1993; 2002; 2003; 2010; 2014, & Dubreuil & Savage, 2004). Within this, assessments of the most accurate techniques available, such as the collaboration of scanning electron microscopy (SEM) and optical light microscopy (OLM), have also emerged (Borel et al. 2014). The new approaches for wear analysis as a growing method will be discussed in sections 3.3 and 3.4 of this chapter

This chapter will critically assess the literature available on GST use-wear analysis to provide a context for the methodology adopted in this PhD thesis. This includes a review of the definitions, methods and types of wear that are being put forward by scholars for use in a homogeneous way (Adams, 1989; 1993; 2002; 2003; 2010; 2014; van Gijn, 1954 Hamon, 2008). The chapter will close with a final paragraph on the usefulness of use-wear analysis on ground stone tools in an overall assessment of the method.

3.2 'The core method: experimental use-wear and the comparative analysis of use-wear traces.'

Semenov's work contributed significantly to the development of use-wear analysis on stone tools, particularly after the translation of *Prehistoric Technology* into English in 1964. He provided a methodology for the investigation of tool functions through "experimental-traceological analysis". This is the functional analysis of tools whereby it is possible to reconstruct the technological processes implemented during production and use. Through experimentation, an understanding of the cultural processes enacted during the use-life of these objects is also attainable (Semenov 1964).

Semenov studied the development of working processes, and the different kinematics (the features or properties of the motion of an object), at play during production and use. This enabled him to understand how wear formed during specific motions and actions. To aid interpretation, Semenov conducted numerous experiments across the world to test the formation of wear during production and use. His experimental tests and study of the kinematics and processes involved in prehistoric technologies such as flint knapping universally demonstrated the potential for combining experimental archaeology with wear analysis. He applied his understanding of function to broader questions of transitions into new forms of society and economy and demonstrated the importance in reconstructing past societies and solving unresolved questions (Semenov, 1964). For example, Semenov's contribution to the questions surrounding the processes involved in the abrasive working of

GSTs demonstrated the different ways of abrasive working gave efficiency to Upper Palaeolithic, Neolithic, and Bronze Age tools by standardising artefacts (Korobkove, 2008, 3).

Although much of Semenov's work focussed mainly on flaked stone, such as flint, it was also an early in-depth study of ground stone tools including axes, adzes, pestles, abraders, and mortars (Dubreuil et al. 2015, 105; Dubereuil & Savage, 2014, 140; Semenov, 1964). Semenov's work was highly influential in the expansion of wear analysis as a methodology and remains an indispensable source of reference for wear analysts. However, the development of wear analysis as a method to assess the manufacture processes and functional use of archaeological GSTs developed at a slower rate than it did for flaked stone tools. It was not until the 1990s and early 2000s that both the quantity and quality of research on GSTs gained pace (Adams, 2014, 129; Dubereuil & Savage, 2014, 140). Such research, provided by scholars such as Adams and Dubereuil and Savage, set forth improved methods to study GSTs using experimental tests and multiple scales of microscopy to understand how wear forms (Adams, 2014, 129; Dubereuil & Savage, 2014, 140).

More recently, scholars have begun to attempt to standardise the study of GSTs. Adams has been at the forefront of this movement with several publications (1993; 2002; 2003; 2010; 2014) focusing on the creation a new standard of classification to homogenise analyses and make a comparison of research easier. Her early 1989 publication emphasised the importance of using tribology - the study of friction, lubrication, and wear between interactive surfaces - to improve analysis on GSTs. It is through this emphasis that Adams first proposed four processes of wear formation as being useful for understanding how wear forms between contacting surfaces: abrasive wear, adhesive wear, surface fatigue, and tribochemical wear (Adams, 1989, 262). In understanding the formation of these processes, the extensiveness and intensiveness of use can be assessed, along with the strategy of tool maintenance, and the different motions, directions of wear (the kinematics), the softness or hardness of the contact material and the type of contact material (Adams, 2002; 2003; 2014). Adams explained in detail the types of wear which we would expect to find during different processes, such as, the wear which will form during contact between stone and stone, wood and stone, and stone and hide (Adams, 1988; 1994).

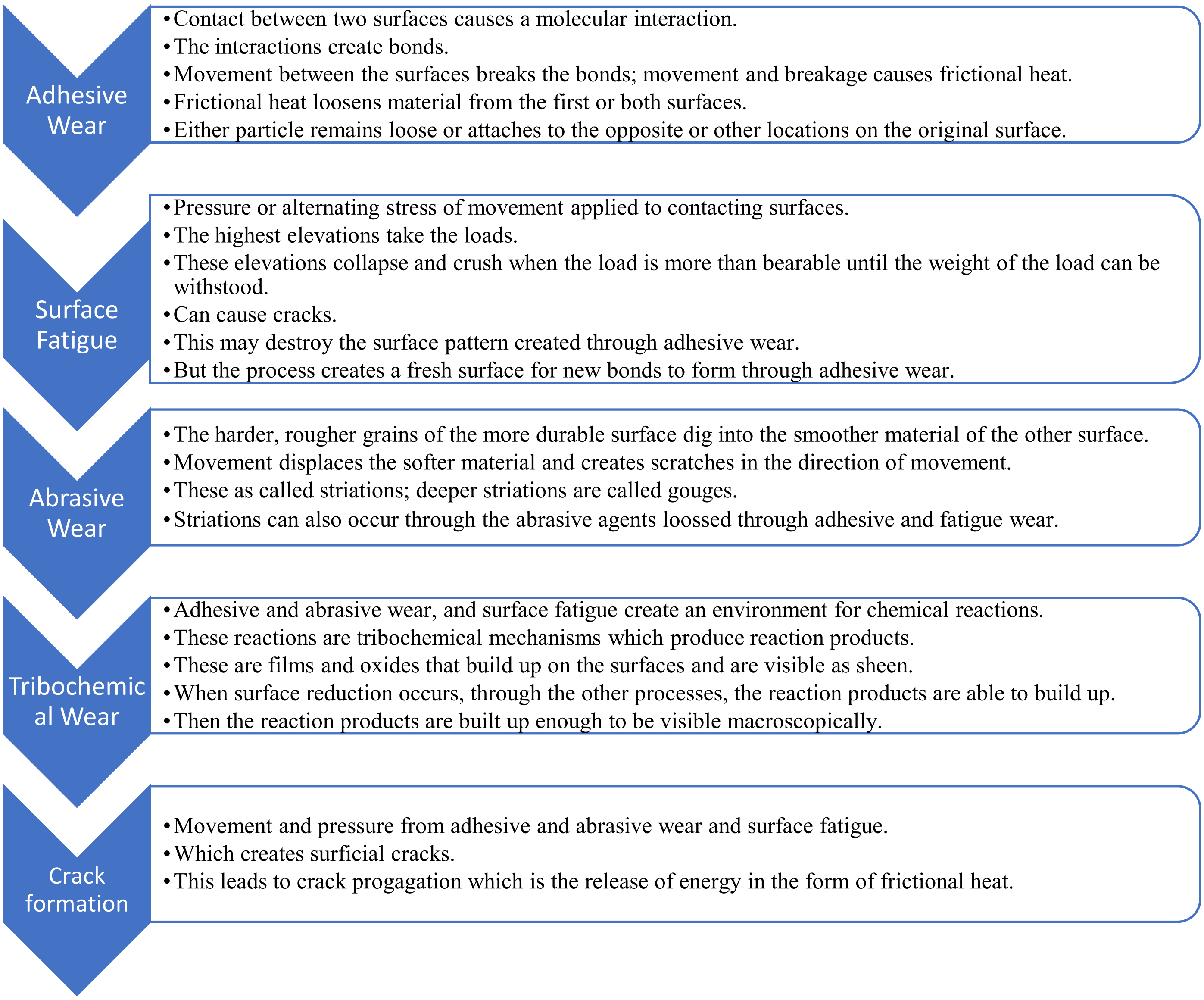


Figure 3.1: Tribological wear mechanisms (Adams, 1993)

To recognise the formation of wear between difference contact materials Adams built upon Semenov's work by demonstrating how these processes can be analysed through experimentation and microscopic use-wear analysis. In her food processing experiments, Adams also used ethnographic studies in the development of her experimental tests. The grinding processes involved in the use of handstones, grinders, mortars and pestles in the U.S West and Southwest was documented in detail (Bartlett, 1933; Doelle, 1976; Euler and Dobyns, 1983; Hough, 1915; Jackson, 1991; Parsons, 1939; Spier, 1933:127; Stephen, 1936; Underhill 1979). Adams used such documentation as guides for the development of her experiments testing the grinding processes of food production. Her experimental tests created a reference collection for understanding the formation of wear between different materials. The use-wear on the experimental implements was analysed macro- and microscopically in order to allow a comparison with the wear on archaeological implements (Adams, 1994). This approach allows for a better understanding of the formation of wear through different uses and between different contact materials which can be used to interpret the use life of objects in the archaeological record.

The microscopic analysis of Adam's experimental stones was carried out at several different magnifications: x40; x80; x100; and x500. She described the wear at a macroscopic and microscopic level. The general appearance of the surface topography was macroscopically described by answering several questions: what the natural texture of the stone was, was wear spread uniformly; how consistently levelled was the surface from use, were any individual grains removed, and if so, was this a result of a poorly cemented material or from several wear processes. At a microscopic level, the wear was described by the wear mechanisms at play and how much of the grain's surface was involved in such process (Adams, 1989, 266). The results from this assessment have been published in several of Adams' publications with the aim of creating a baseline for the development of use-wear patterns as well as a homogenous method of analysis and descriptions for use-wear analysis on GSTs (Adams, 1989; 2002; 2003; 2010). Overall, the results from these experiments allowed Adams to propose many further research questions for subsequent experiments and analyses which are imperative to understanding function and the formation of wear. They clarify that the use of experimental archaeology to analyse wear patterns provides information that can be transferred to archaeological finds with comparable use traces.

The validity of Adams' work as a standard method is emphasised further with its use by other scholars. Several scholars have undertaken analysis into the use-wear patterns of contact between different materials since Adams first published her experimentation in 1989 and many have moved it forward to focus on one specific material closely, and to compare different activities (Olle et al. 2014; Hardy, 1998; Lunardi; 2008; Hortelano Piqueras, 2014). Others have implemented a similar methodology to Adam's for the study of wear on flaked stone, bone and metal to interpret their function. They follow a method similar to Adams' with the replication of an object seen in the archaeological record, followed by its use and then the analysis of the object to assess the formation of wear patterns. These patterns were then compared with those assessed on the archaeologically recovered tools to allow a more accurate assessment of the use-life of the object. This approach has become an essential part of use-wear analysis which can be found across the majority of analyses. For instance, the reference collection of experimental objects at Leiden University Material Culture Laboratory is used to understand better how wear forms over time on a variety of materials, including ground stone, flaked stone, bone and pottery, and motions. This experimental collection was used as a reference in my work. The wear analysed at museum collections undertaken by myself drew upon the analysis of this reference collection. It allowed me to understand how wear forms and the type of wear that forms through different contact materials, motions and length of time.

Olle and Verges have stressed the importance of analysing the experimental implement at several stages during use in order to assess the development of wear through time. This is because some processes may be missed through their elimination during subsequent use (Olle & Verges, 2008, 39). Hamon has carried out research specifically on ground stone. She used Adams' understanding of the formation of wear processes, such as tribochemcial wear, in recognising interactions between stone and other materials. Her experiments reconstructed grinding, hammering, pounding and abrading activities in order to understand the function of sandstone tools in the Early Neolithic of Southwest France (Hamon, 2008). In doing so, she elaborated on Adams' method and description of the processes by noting the change in the form of the stone grains during and throughout different actions. For instance, she noted that during a mechanical action the angles of the stone grains were first smoothed. Continued use levelled the edges of the grains and subsequently caused fractures of the grains (Hamon, 2008, 1508). The changing shape of stone grains due to mechanical action can be identified when analysed under a microscope. Experimental tests allowed Hamon to understand which actions and uses caused the changes in the form of stone grains (see figure 3.2).

Despite the increase in the understanding of wear formation on GSTs, experimental activity with polished stone tools is still not as developed as it is with flaked and chipped tools (Lunardi, 2008, 369). The methodologies and experiments have been limited to GSTs used for grinding and pounding processes. Experimental tests coupled with wear analysis at Leiden University have focussed on Neolithic polished stone axes within a broader focus of diverse tools. The Horstorwold and Vlaardigen house experiments at Leiden University used a variety of tools made of stone, flint, antler, bone and wood to understand the labour input, the manufacturing process, the time various phases took, the constraints of materials used, and the required levels of knowledge and skill. The experiment included ground and polished axes and adzes which, along with the other tools, were microscopically analysed at various points throughout the experiment. The experiment demonstrated the effectiveness of using stone axes and adzes for wood chopping trees and wood (Wijnen et al, 2018). This ongoing project records the development of wear; however, the project's current focus on its research questions means the wear type and its development on these stone tools have not been published.

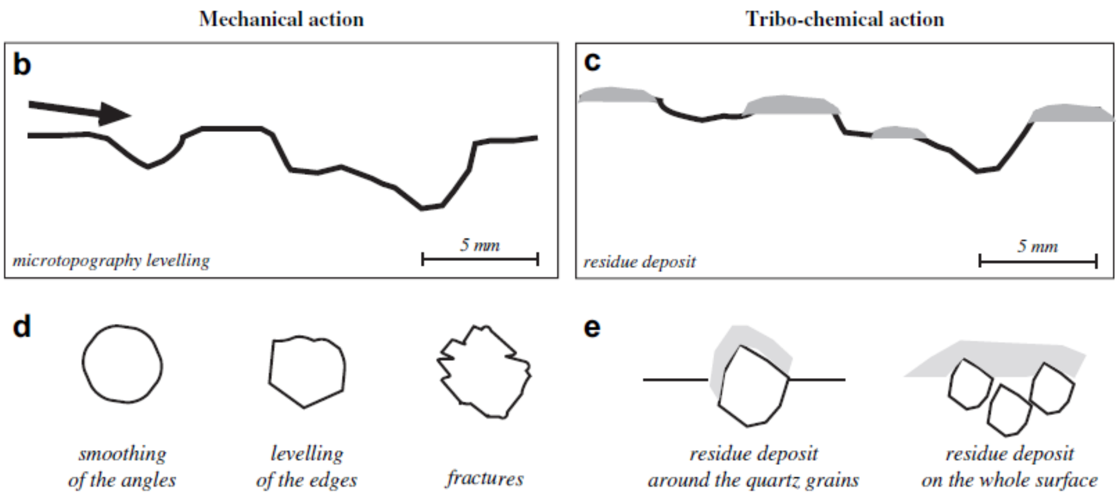


Figure 3.2: Changes to the form of stone grains through mechanical levelling (b), residue deposit (c), modification of grain edges (d), and residue deposit at a micrographic scale (Hamon, 2008, 1508)

The experimental reference collection at Leiden University has been used to aid the understanding of wear on archaeological sites for various research projects. One example considered stone procurement and use at the Neolithic site of Schipluiden, Western Netherland, by assessing the function of a variety of tools, including stone axes (van Gijn & Houkes, 2006). They analysed several variables in their sample including the dimensions (in cm), weight (in grams), primary classification (was it a flake or core etc.), raw material, typology, modification, degree of burning, fragmentation, grain size, patination, and extent and character of the cortex. A stereomicroscope was used at magnifications of 10 to 64-power for the identification of stone types, and traces of modification, manufacture and use.

Although the van Gijn & Houkes article explained the levels of microscopy and the type of microscopes used, their conclusion of manufacture and function did not specify the type of wear that was observed. They established that the axes and axe flakes were used for chopping wood and wood construction. Evidence from several grinding stones suggests that blanks were processed into finished tools on site and the axes were maintained to continue their use (van Gijn & Houkes, 2006, 190-191). It is unfortunate that the authors did not elaborate further on the type of wear they assessed, such as through micrographs or with explanations of wear formation. This restricts the ability for this research to be a comparable reference for further functional tests. However, many other researchers have presented their 'working' with detailed descriptions and micrographs of wear formation through mechanical processes, such as from experimental tests (Hardy & Garufi, 1998; Hortelano Piqueras, 2014; Lunardi, 2008; Dubreuil, 2004; Mansur, 1997; Aranda et al. 2014; Olle et al. 2014; Chriazomenou et al. 2014; D'Errico, 2014; Adams, 1989; 1993; 2002; 2003; 2010).

The development of use wear methodology to understand GSTs has furthered the knowledge of their manufacture, function and roles. As a result, more is known about the life histories of these artefacts and their itineraries which allows a more accurate assessment of their place in past societies. However, much of the development in wear analysis on GST has focussed on grinding tools, such as quernstones and, as such, there remain GSTs which have received little attention and require further research.

It is clear from this review that assessment of wear on bladed ground and polished stone implements is limited across Europe and Scandinavia. In particular, comparable examples of wear formations for their functional use is lacking. For instance, there is yet to be a wear analysis study on British EBA battle-axes and axe-hammers. There continues to be a need for future research to assess the development of wear on more diverse ground and polished stone objects, particularly those with blades.

3.3 Recording protocols

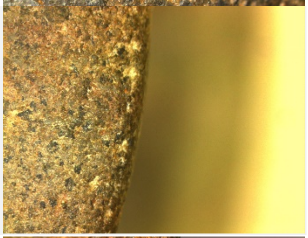
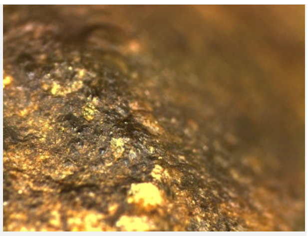
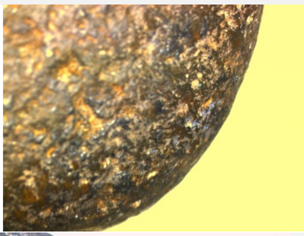
Both Adams and Hamon published the recording protocols they followed when analysing wear (Adams et al. (2009). These protocols followed an understanding of how stone grains change form through different processes, such as becoming fractured or levelled through mechanical actions. By doing so, the relationships between types of wear during specific actions causing an interaction between multiple materials were better understood. These are highly useful in understanding how stone grains react and thus what wear will form. However, these remain broad classifications of wear processes and cannot be specifically used for the description of use-wear. As such, furthermore detailed and specific classifications are needed to describe use-wear including density, orientation and location.

The protocol Adams et al. published (2009) provides classifications which allow for an assessment of specific types of wear that occur during specific uses (Adams, 1989; 2002; 2003; Hamon, 2008, 1517). This use of a comparable methodology culminated in a paper co-authored with three others in which they set out a precise classification of the types of wear to consider during analysis of ground stone tools (Adams et al. 2009). They identified the following analytical areas for functional interpretation: descriptive analysis of wear traces, petrography, morphology and size, and context (Adams et al. 2009, 44). By assessing these four areas an understanding of the design factors can be achieved, as shown by the petrology, size, shape, weight and wear patterns attributed to the manufacturing process. The use-life is also understood by wear patterns attributed to the use and maintenance of the object. This paper set out the distinctive terms for wear one might see on ground and polished stone under low magnification stereomicroscopic analysis (Tables 3.1 and 3.2). Each term designated fields for attributes of that term, such as density, distribution, orientation, and length. The fields were described using set descriptions, such as loose, covered or concentrated, to describe the distribution of a linear feature (Adams et al. 2009, 49-53). Such terminology allows for a thorough assessment of the wear patterns, the form they take, and the extent they have developed across the used surface. The detail and description visible in Table 3.1 are integral to understanding the use-life of objects. By combining this thorough analysis with an assessment of the spatial and typological one can attain crucial data for the understanding of the function, the context of discard behaviour and the significance of the object (Dubreuil et al. 2015, 209).

Table 3.1: Descriptive terms for wear patterns at low magnification (Adams, 2009, 49-53)		
Trace	**Aspects of trace**	**Description**
Linear	Distribution: The patterning of linear traces across the surface	As loose, covered or concentrated
	Density	Separated, close or connected linear traces
	Incidence: location of the striation on topographic highs or lows and their relative depth	As shallow or deep
	Disposition: the spatial arrangement of striations in relation to each other	As random, concentric, parallel, oblique or perpendicular
	Orientation: of striations in relation to major axis of the surface	Longitudinal, transversal or oblique
	Width	0.5mm or less is a striation and more than 0.5mm is a scratch.
	Length	Long traces that extend across the working surface and short linear traces that extend only part way
	Longitudinal Morphology	The distinction between continuous and intermittent striations
	Transverse morphology: the shape of the linear profile	V-shaped or U-shaped
Polish or sheen	Distribution: of polish	Loose, covered or concentric
	Polish density	Separated, closed, or connected
	Reflectivity	Slightly, moderately, or highly reflective
	Incidence	Whether polish is only on the topographic highs or also in the interstices.
Levelling	Distribution	As loose, covering, or concentric

	Density: describes the pattern of levelled relief or grains	As separated, close or connected
	Incidence: location of levelling	High or low topography
	Morphology: of levelled topography	Flat, sinuous or rounded at the Level 1 scale of observation
	Texture	Rough or smooth
Pits and grain extraction	Distribution: of pits	Loose, covering or concentrated
	Density	As loose scattering of pits across the surface, as a closed or dense pattern of pits that do not overlap, or as a connected pattern of overlapping pits.
	Orientation (provides information about the kinetics)	Longitudal, transerve, or oblique positioning on surface
	Depth	Fine or superficial and wide or deep
	Pit shape in plan view (to distinguish nature of surface, movements, and kinetics)	Irregular, circular, triangular, or comet shaped
	Pit shape in cross-section	U- or V-shaped
Fractures	Distribution	Loose, covering or concentric
	Density	Loose scattering across surface, as a closed or dense pattern, or as a connected pattern of overlapping fractures
	Orientation (provides information about kinetics)	Longitudal, transverse, or oblique positioning
	Depth: a relative description of fracture dimension	Fine or superficial and wide or deep
Grain edge rounding	(Occurs when soft contact surfaces work into interstices, gradually eliminates edges)	Present or absent

Table 3.2: Wear types as set out by Adams et al. (2009) with examples, micrograph images by author

Mark type	Description	Example Image
Striations	Linear feature(s) that indicate the direction of use	
Grain removal pits	The removal of stone grains from use	
Fractures	Scars from use, can indicate hardness of contact material	
Grain edge rounding	The edges of stone grains take on a rounded appearance	
Polish	Shiny surface reflects light	
Crushing	Stone grains are deformed due to force and take on a crushed appearance	

3.4 Combining ethnographic and ethnoarchaeological information with use-wear analysis

The use of ethnographic case studies in combination with experimental archaeology has been a part of use-wear analysis since Semenov used both in his assessment of the function of flint tools (Semenov, 1964). Ethnography is used by archaeologists to aid their understanding of past societies. They assess the human interactions, social structures and activities in those societies that bear similarities to those in the past. For analysis of GSTs, work by ethnographers has been used to consider scenarios concerning how tools might have been manufactured, used and considered by those handling them. Assessments of these processes can also inform one of the social structures involved in these actions. Experimental tests created to understand the function and development of wear on objects have used ethnographic assessments to aid the development of experiment methodologies. The motions and contexts objects are used in ethnographic groups are useful to understand how an object might have been used. For instance, Adams used documented ethnographic accounts of grinding processes in U.S West and Southwest to develop her experimental tests (Adams, 1994). However, there are rarely directly homogenous examples of tools in ethnographic contexts, and therefore archaeologists must not rely too heavily on ethnographic data for the interpretation of archaeological objects. Instead, the most appropriate and relevant information must be extracted to be used alongside use-wear analysis, assessment of archaeological context, and experimental archaeology (Adams, 2003, 6).

The information that analogous ethnographic studies can provide is valuable to aid understanding of manufacture, function and process (Adams, 2003). The limited use of analogous ethnography in wear analysis studies is a result of a few exact ethnographic parallels. The use of comparable ethnographic parallels increases the accuracy of use interpretations; however, if object parallels do not exist this is difficult to implement reliably. As a result, many scholars have analysed stone tools without the use of ethnography. For example, van Gijn and Houkes' article on stone use and procurement in the western Netherlands accompanied a discussion of use-wear with an assessment of the raw material, its context and typology and residue analysis but gave no mention of ethnographic parallels or similarities (van Gijn & Houkes, 2006). Similarly, Gibaja and Carvalho's analysis of chipped stone assemblages from Neolithic burial caves in Portuguese Estremadura uses use-wear analysis, find contexts and typology to conclude the uses of the assemblages (Gibaja &

Carvalho, 2014). Here it seems the focus was more on the scientific method of use-wear analysis itself and is an excellent example of the recent focus on the methodology of use-wear analysis. The drawback a lack of analogous ethnography creates can be overcome by implementing other methods to understand manufacture, function and process, such as experimental tests.

3.5 New approaches to wear analysis

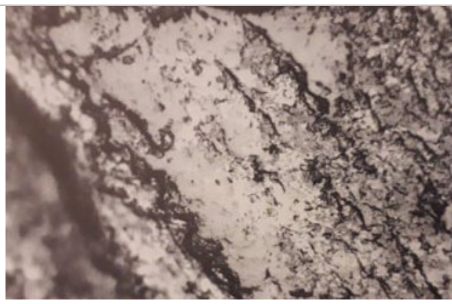
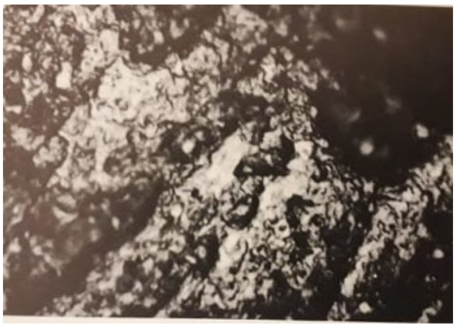
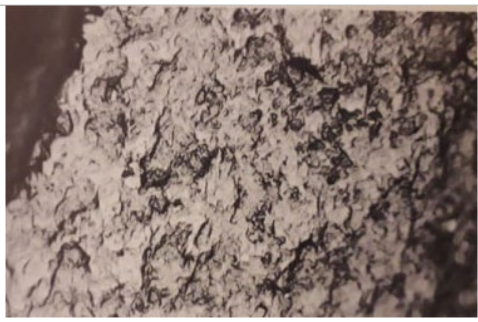
In recent years, scholars have emphasised the combination of specific methods within use-wear analysis, and, in particular, the use of different and multiple scales of microscopy. The benefits of using higher magnifications, such as those gained by metallographic microscopy and scanning electron microscopy (SEM), have been demonstrated (Olle & Verges, 2008; Dubreuil et al. 2015). High magnification allows for higher control, greater magnification and better precision than is possible when using the lower magnification of optical stereomicroscopy. The success of this method is evident in its sole use in numerous research projects. Aranda and colleagues used these higher magnifications to observe wear on tool edges since it allowed them to document slight development and wear management (Aranda et al. 2014, 45).

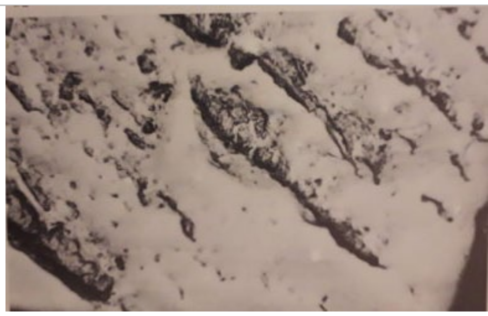
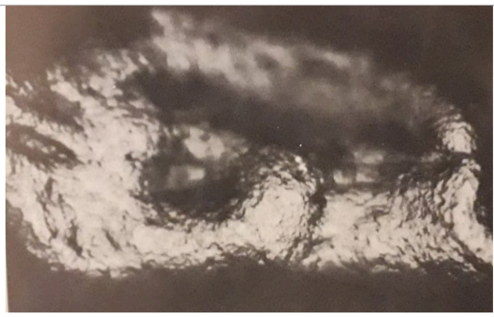
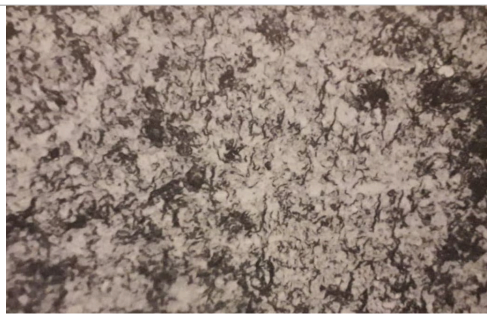
Similarly, others have used high magnifications to discover the directions and angle of working, the extent of polish as well as linear features (Olle et al. 2014, 273; van Gijn & Houkes, 2006, 168). For instance, Olle and colleagues conducted an experimental program for the detection of use-wear in quartzite, using SEM observation on tool edges to assess the development of wear over time. Activities such as woodworking and butchery were undertaken with various quartz tools. Analysis of the wear revealed that the different activities produced differing wear (Olle et al. 2014). A focus on the edge of the tools to assess wear was used to demonstrate the advantages of using a high-power magnification approach, such as SEM.

However, despite the apparent advantages of using SEM and metallographic microscopy, it is also clear that a multiple-scale approach will allow a broader range of results. Such emerging approaches are complementary to approaches using the lower magnifications of stereomicroscopy because they focus on specific aspects of use-wear that are not visible at lower magnifications (Dubreuil et al. 2015, 124; Borel et al. 2014, 47 & 57). Dubreuil et al. demonstrated that the combination of both low and high magnifications allowed for a more accurate assessment of use. They used both low magnification stereomicroscopy and high magnification SEM analysis on 166 basalt grinding stones from the Natufian period (12,500 – 10,200 BP) of the Levant. The application of both approaches allowed for the discovery of different types of wear. The use of a higher magnification discovered a significant amount of grease and other natural lubricants, whereas the low magnification revealed a variety of abrasion from contact with different materials (Dubreuil, 2004).

Many experiments have used high magnifications to observe micropolish which cannot be viewed through low magnification (Dubreil & Savage, 2014; Mansur, 1997). The form of polish will differ depending on the contact materials during use, and therefore its analysis is essential for the interpretation of contact material. Vaughan (1985) set out a classification of polish types. He described the form polish took when wood, bone, antler, reed, plant, hide, and soil and grit came into contact with stone. His interpretations of polish form were based on numerous experiments which tested flaked stone tools with a sawing action and a transverse and grooving motion against various materials to assess how the polish formed over time, what form the polish took and what aspect of the polish indicated the direction of use (table 3.3). As Vaughan's polish types are based on experiments using flaked stone, such as flint, they are not wholly comparable to ground and polished stone.

Additionally, the motions he used during his experimental tests are not likely to be similar to those employed in my experiments and so are less likely to be useful for my dataset. In particular, sawing motions will be challenging to create with a battle-axe or axe-hammer, both of which have a blunt blade probably designed for impact. Wear also forms differently on ground and polished stone compared to flaked stone as it is composed of stone grains and flaked stone is not. Nevertheless, Vaughan's work provides a strong basis for the understanding of polish formation which can be built upon for ground and polished stone.

Table 3.3: Descriptive terms for micropolish under high magnifications based on flint tools (Vaughan, 1985)		
Bone Polish	Rather pitted appearance Bright Sawing action: bright, smooth-pitted lattice of polish, possibly scored with grooves and troughs Transverse and grooving motions: very bright, flat polish bevel or band with numerous comet-tails in the polish surface	 Polish from sawing bone
Antler Polish	Sawing action: bright smooth-pitted polish, possibly small areas of diffuse depressions near the working edge Transverse and grooving motions: very bright, localized heavy linkage (polished extends down sides of grains and links), diffuse depressions in polish surface, and undulating smooth rounded bevels with some vague directional troughs. Less developed: similar to wood polish: raised domes in various stages of linkage	 Polish from sawing antler
Wood Polish	Forms slowly Individual domed grains develop initially, the domed the bulge and sag, followed by and undulated polish cover. Finally the polish form a smooth blanket. Polish occurs in localised clumps Sawing action: bright, smooth-pitted polish; Transverse and grooving motions: very bright, smooth polish domes in various stages of linkage, more widespread coverage of the stone surface than from bone or antler but less than plants.	 Polish from traversing wood
Reed Polish	Resembles wood Sawing motion: a bright smooth-pitted polish; or if well developed a well-linked pattern of domed polish agglomerates and interstitials, highly reflective Transverse motions: either wood-like or anter-like polishes on the contact edge. A continuous terraced-bumpy polish alone on the non-contact surface. Or, a very flat, smooth, highly reflective polish with a bevel on the contact	 Polish from sawing reed

	surface of the edge. The more developed sections had an extensive cover of smooth, very bright, gently undulating polish with depressions in the polish surface.	
Plant Polish	Forms slowly The most developed stage is called sickle gloss, which occurs closest to the working edge and is a highly reflective, solid, level expanse. The individual polish components are no longer visible (e.g. polished grains) Striations signify direction of use	 Sickle gloss for havesting barley
Hide Polish	Dry hide: Dull, highly pitted wrinkled surface to the polish; widespread coverage over the used edge and extensive rounding of the working edge, surface ridges and elevations. When grit is added in the process of hide preparation numerous striations occur. Fresh hide and meat: patches of dull less developed, spots of polish. Difficult to distinguish.	 Polish from scraping hide
Soil and Grit Polish	Smooth polish and rough polish occur together	 Polish from a linear mtion with grit

There are some drawbacks to using a combination of high and low magnification, mainly being the cost and availability of the equipment need to undertake higher magnification analysis. SEM analysis also requires the stone implement to be coated in a layer of gold, which can be expensive. A solution would be the use of a metallographic microscope which does not require this process. Also, both approaches are time-consuming; consequently, time constraints may restrict their dual use. Likewise, restrictions on available equipment and the need to travel to objects may also reduce their dual use. The use of smaller, carefully chosen samples for higher magnification analysis may be a possible solution. However, the size of many GSTs offers a further disadvantage since it does not allow them to fit under a regular high-magnification microscope (Adams et al. 2009, 54). Metallographic microscopes with longer arms have more space so larger objects can be analysed, but they are often difficult to transport. The most common solution is the application of casting media to replicate the surface of the object for analysis under the high magnification microscope later. Silicon-based casting products are commonly used in archaeology and other disciplines including geology (Goodall et al. 2015; Adams et al. 2009, 54). The use of casts does not allow an analysis of the entire object, which is often needed with many GSTs (Aranda et al. 2014, 47; Olle et al. 2014, 272). Therefore, careful selection of the appropriate areas during low magnification analysis is needed to avoid a reduction in the accuracy of the analysis. Any drawbacks must also be considered to reduce and avoid any inaccuracies.

3.6 Conclusions

The development of a methodological framework with clear terms for wear processes and types of wear is highly useful. The range of wear processes and wear types that are now known for GST technology at both low and high magnifications allow the application of wear analysis to answer a broad range of research questions including those relating to function, the maintenance of the object, and manufacture. Such information can be used to understand the role and meaning of objects. This is especially true when combined with other types of analysis such as contextual analysis. The application of a similar methodology in this PhD research will answer the research aim regarding the function and significance of Early Bronze Age battle-axes and axe-hammers. A comparable method will allow for the comparison of the results with other research projects and experimental research collections.

The accuracy of using multiple scales of magnification demonstrates the advantages of its application. This research project will benefit for its application. It is apparent that using high magnifications can have certain downsides, however, with the use of replicative casts, these can be minimised to mitigate the problems. Chapter 4 will discuss the methodological framework developed for this research project.

Chapter 4: Methodology

4.1 Introduction

My project focusses on the use and significance of perforated ground stone tools from the Early Bronze Age in Northern England and Scotland. The main purpose of this research is to employ the techniques of use-wear analysis, experimental archaeology and a contextual assessment to evaluate the uses of stone battle-axes and axe-hammers from across Northern England and Scotland. This chapter sets out the methodology of the collection of data to meet the aims of the project.

4.2 Method of microscopic analysis

In order to assess the use of an implement, it was first analysed under a stereomicroscope using low power microscopy. This allowed for the analysis of wear patterns including striations, grain and flake removal, and the presence of polish. A stereomicroscope was transported to the relevant museums for analysis of the battle-axes and axe-hammers in their collections. During analysis, a piece of foam was placed on the microscope base to ensure the metal base did not damage the implements under analysis. The wear analysed at low magnifications was recorded on an analysis form (figure 4.1). Each object was measured, drawn to scale, and its form described, including rock texture, the state of the implement, and the type of use-face, convex, concave or straight, and the type of perforation, convex or concave. All wear analysed was recorded on an analysis form where the drawing is also annotated using a colour-coded system to denote different types of wear (figure 4.2). The analysis form was based on my own experience and training to carry out use-wear analysis and on the methodological literature (Hamon, 2008; Adams et al. 2009; Dubreuil et al. 2015). To further the recording process digital micrographs were taken. Each micrograph was saved with a name referring to the museum accession number, the type of microscope, the magnification, and the location on the implement. For example, battle-axe 114 was recorded as AH60_Ste_x2.0_Loc.1 to name its accession number, followed by the microscope it was analysed under, STE for stereomicroscope and MET for metallographic microscope, and then the magnification, followed by the location number which was noted on an illustration of the implement. The locations of the micrographs were also annotated on the drawing. Blu-tac was used to support the implement at various angles while taking the micrographs. It is important to note that Blu-tac will leave a greasy stain upon the stone if not covered; the use of Parafilm to cover the Blu-tac prevented this from occurring.

Use-Wear Attribute Form P.1

Museum					
Implement					
Typology					
State of imp.					
	Length	Breadth	Width	Diameter of S-Ha	Diameter of S-Hb
Type of use-face	Straight	Convex	Asymmetrical		
Type of perforation	Biconical	Conical	Straight		
Measurements					
Petrology					
Rock type	Sedimentary	Igneous	Metamorphic		
Rock texture	Fine	Medium	Coarse		
Drawing no(s)					
Photograph no(s)					

Use-wear analaysis attribute form: wear from production

								Location(s)	Description - how does the wear relate?
Linear Features	Distribution:	Sparce	Covered	Concentrated					
Y / N	Density:	Seperated	Close by	Connected					
	Incidence:	Shallow	Deep						
	Spatial Arrangement	Random	Concentric	Parallel	Oblique	Perpendicular			
	Orientation:	Longitudal	Transversal	Oblique					
	Width:	<0.5mm (Striation)		>0.5mm (Scratch)					
	Length:	Long	Short	Both					
	Pattern:	Continuous		Intermittent					

	Transverse Shape:	V-Shaped U-Shaped		P.2
Polish or Sheen	Distribution:	sparse Covered Concentrated		
Y / N	Density:	Seperated Close by Connected		
	Reflectivity:	Slightly Moderately Highly		
	Incidence:	Highs Lows Both		
Levelling	Distribution:	Sparse Covering Concentrated		
Y / N	Density:	Seperated Close by Connected		
	Incidence:	High Low		
	Morphology:	Flat Curvered Rounded		
	Texture:	Rough Smooth		
Pits and Grain Extraction	Distribution:	Sparse Covering Concentrated		
	Density:	Sparse Scattering Close by Dense		
Y / N	Orientation:	Longitudal Transverse Oblique		
	Depth:	Narrow Superficial Wide Deep		
Fractures	Distribution:	Loose Covering Concentrated		
	Density:	Sparse Scattering Close by Dense Connected		
Y / N	Orientation:	Longitudal Transverse Oblique Irregular		
	Depth:	Narrow Superficial Wide Deep		
	Bruising:	Present Absent		

	Flake Removal:	Absent Overlapping Close/even Wide/even Clump Singular		P.3
	Location:	Unifacial Bifacial		
Edge Rounding	Present Absent			
Residue	Present Absent			
Re-sharpening	Present Absent			

Use-wear analaysis attribute form: wear from use

			Location(s)	Description/notes
Linear Features	Distribution:	Sparce Covered Concentrated		
Y / N	Density:	Seperated Close by Connected		
	Incidence:	Shallow Deep		
	Spatial Arrangement	Random Concentric Parallel Oblique Perpendicular		
	Orientation:	Longitudal Transversal Oblique		
	Width:	<0.5mm (Striation) >0.5mm (Scratch)		
	Length:	Long Short Both		
	Pattern:	Continuous Intermittent		
	Transverse Shape:	V-Shaped U-Shaped		
Polish or Sheen	Distribution:	sparse Covered Concentrated		
Y / N	Density:	Seperated Close by Connected		
	Reflectivity:	Slightly Moderately Highly		
	Incidence:	Highs Lows Both		

	Linkage:			
	Directionality			P.4
Levelling	Distribution:	Sparse Covering Concentrated		
Y / N	Density:	Seperated Close by Connected		
	Incidence:	High Low		
	Morphology:	Flat Curvered Rounded		
	Texture:	Rough Smooth		
Pits and Grain Extraction	Distribution:	Sparse Covering Concentrated		
	Density:	Sparse Scattering Close by Dense		
Y / N	Orientation:	Longitudal Transverse Oblique		
	Depth:	Narrow Superficial Wide Deep		
Fractures	Distribution:	Loose Covering Concentrated		
	Density:	Sparse Scattering Close by Dense Connected		
Y / N	Orientation:	Longitudal Transverse Oblique Irregular		
	Depth:	Narrow Superficial Wide Deep		
	Bruising:	Present Absent		
	Flake Removal:	Absent Overlapping Close/even Wide/even Clump Singular		
	Location:	Unifacial Bifacial		
Edge Rounding	Present Absent			

Residue	Present Absent			

Use-wear analaysis attribute form: wear from re-use P.5

			Location(s)	**Description/notes**
Linear Features	Distribution:	Sparce Covered Concentrated		
Y / N	Density:	Seperated Close by Connected		
	Incidence:	Shallow Deep		
	Spatial Arrangement	Random Concentric Parallel Oblique Perpendicular		
	Orientation:	Longitudal Transversal Oblique		
	Width:	<0.5mm (Striation) >0.5mm (Scratch)		
	Length:	Long Short Both		
	Pattern:	Continuous Intermittent		
	Transverse Shape:	V-Shaped U-Shaped		
Polish or Sheen	Distribution:	sparse Covered Concentrated		
Y / N	Density:	Seperated Close by Connected		
	Reflectivity:	Slightly Moderately Highly		
	Incidence:	Highs Lows Both		
Levelling	Distribution:	Sparse Covering Concentrated		
Y / N	Density:	Seperated Close by Connected		
	Incidence:	High Low		
	Morphology:	Flat Curvered Rounded		

	Texture:	Rough Smooth		
Pits and Grain Extraction Y / N	Distribution:	Sparse Covering Concentrated		P.6
	Density:	Sparse Scattering Close by Dense		
	Orientation:	Longitudal Transverse Oblique		
	Depth:	Narrow Superficial Wide Deep		
Fractures Y / N	Distribution:	Loose Covering Concentrated		
	Density:	Sparse Scattering Close by Dense Connected		
	Orientation:	Longitudal Transverse Oblique Irregular		
	Depth:	Narrow Superficial Wide Deep		
	Bruising:	Present Absent		
	Flake Removal:	Absent Overlapping Close/even Wide/even Clump Singular		
	Location:	Unifacial Bifacial		
Edge Rounding	Present Absent			
Residue	Present Absent			

Initial Interpretation

Figure 4.1: An example of an attribute form used to record wear

A multi-scalar microscopy approach was used for a more accurate assessment of use (Olle & Verges, 2008; Dubreuil et al. 2015). Wear was analysed under a metallographic microscope to understand the types of wear visible at high magnifications, such as the type of polish. However, it is impractical to transport two microscopes. Therefore, casts using acetate film were taken from the relevant areas on the implement, as assessed during stereoscopic analysis, to replicate the wear. The casts were then analysed under a metallographic microscope in the archaeology laboratory at Newcastle University. This method allows the analysis of the type of polish and thus the type of contact material during use. I developed a method for using acetate to replicate the surface which was previously tested on over 40 stone implements (Roy, 2018). The results indicated that this method recreates the wear well enough for analysis, and although it does not reach the lowest micro-topography, this does not impede on the interpretation. My methodology was developed and based on four month's training and experience at the Material Culture Laboratory in the Archaeology Faculty of Leiden University, and also draws on the previous work by others such as Adams and Hamon discussed in Chapter 3 (Adams, 1989; 1993; 2002; 2003; 2010; 2014; Hamon, 2008; Olle & Verges, 2008; Dubreuil et al, 2015).

The method for analysis using a stereomicroscope, Huvitz HSZ-600 with a GXCAM microscope camera using GXcapture 7 software, is as follows:

1. Wash the implement with warm soapy water;
    a. For grease and dirt that cannot be removed in this way, dab a small amount of ethanol on a cotton pad onto the surface (This step could be excluded if museums required, although it is a commonly used technique in the material culture lab at Leiden University to remove greasy stains which reduce the effectiveness of analysis as grease can cover wear and cause areas to look polished);
2. Draw the implement to scale on the use-wear attribute form;
3. Record the measurements and the type of perforation, rock texture, the type of use-face, and the stone petrology, using a paper tape measure and pencil;
4. Photograph different views of the object using blu-tac, covered in Parafilm to protect the stone from damage and grease transfer, to support it;
5. Examine the object macroscopically and note the wear on attribute form and drawing;
6. Examine the object microscopically under a stereomicroscope;
7. Record all wear on the drawing, using the colour coded annotations, and fill in the attribute form;
8. Take micrographs of the notable wear using location on the drawing using GXcapture7;
9. Use Parafilm covered blu-tac to support the object where needed
10. Based on the wear analysed at low magnifications, note the areas of interest for replication and further analysis under a metallographic microscope.

Table 4.1: Key for colour coding wear analysed under low magnifications	
Type of wear	**Corresponding colour**
Polish	Blue
Linear features	Grey (pencil)
Grain extraction	Green
Fractures	Purple
Residue	Orange
Edge rounding	Red
Abrasion	Yellow
Crushing	Pink

Analysis under high magnifications using a metallographic microscope was needed to increase the accuracy when interpreting the use-wear. Acetate, a material that softens on contact with acetone and, when dry, replicates the surface it was set against, was used to take replicated casts of areas of the objects analysed. Silicon-based casting products, such as Provil and President Jet, are more commonly used to replicate wear. However, silicone-based casting products stain the surface of porous ground and polished stone and, therefore, could not be used for this project. The method using acetate was developed to overcome this problem (for the testing and development of the acetate casting method see chapter 5). In short, the process was as follows:

1. Clean the part of the implement to be cast by dabbing and wiping the surface gently with a cotton bud or non-abrasive cloth wetted with water (preferably deionised);
    a. For grease and dirt that cannot be removed in this way, dab a small amount of ethanol on a cotton pad onto the surface (This step could be excluded if museums required, although it is a commonly used technique in the material culture lab at Leiden University to remove greasy stains which reduce the effectiveness of analysis as grease can cover wear and cause areas to look polished);
2. Allow the implement to dry;
3. Apply preliminary casts to the relevant areas on the object;
    a. Ensure that the acetate is not too large and it is applied quickly to reduce the formation of bubbles;

    b. A preliminary cast will remove any excess dirt, so none is present during the secondary casting;

4. Wait until the cast is dry;
    a. The acetate will start to lift at the edges when dry;
5. Apply the secondary casting;
6. Wait until the cast is dry;
7. Place secondary cast between two cardboard slides, lightly tape together and labelled to ensure it remains flat;
8. Gently clean area with acetone using a cotton pad to remove any remaining acetate;

When analysing the acetate under a metallographic microscope, Leica DM2700 M, the surface must be ninety degrees to the lens to ensure the wear is interpreted from above. If the cast is not at the correct angle, the image will be distorted, reducing the reliability of the interpretation. During analysis, a coloured piece of card was placed beneath the surface of the acetate to increase the visibility of the replicated wear as the acetate is clear. To record the wear, an analysis form was filled out (table 4.1), and the wear was drawn using a colour-coding system similar to the one used for stereoscopic analysis (Table 4.2). Micrographs were also taken using a Leica DMC6200 camera, using LAS X software, attached to the microscope, and their location annotated on the cast drawing.

Table 4.2: Key for colour coding polish under high magnification	
Type of polish	**Corresponding colour**
Dull	Green
Reflective	Blue
Highly reflective	Purple

The wear analysed under microscopic observation was recorded in an Excel database. It includes fields for types of wear, contact material, motion, re-use and re-grinding to reproduce the wear recorded during analysis and aid the interpretation of function. Other details were also entered into fields, including accession number, the find location, the typology, petrology and the contextual details. The database was then used to assess the trends found in the dataset.

Experimental archaeology is commonly used by archaeologists alongside use-wear analysis to understand the formation of wear through tests of functional use (Keeley, 1982; van Gijn, 1990; Adams, 1993, 2010 & 2014; Hamon, 2008). Experimental tests were carried out as part of this project to assess the development of wear replica battle-axes and axe-hammers throughout use and to understand if they could be used functionally (for an expansion of the methodology for the experimental tests, see Chapter 8).

4.3 Acetate Casting - Using cellulose acetate to replicate the surface of ground and polished stone: A new methodological approach in wear analysis.

Archaeologists often face limitations when analysing the use-wear of an object. In particular, most museums will not allow their collections to be removed and taken to a suitable laboratory for analysis. This can be a significant drawback; because often microscopes commonly used in such analysis cannot be transported due to their size and fragility and therefore alternative methods of analysis are required. The most common method uses silicone-based dental casting products, such as Provil®, to replicate the wear on the surface of the implement under question. The resulting cast is easily transported, and small enough to fit under all types of microscope, thus not needing a microscope with an extendable arm. (Larger implements do not fit underneath a 'regular' sized microscope.) However, despite the benefits of using this method, there is a drawback – the fact that silicone-based casting products damage ground and polished stone by leaving an irreversible greasy stain.

Use of Provil®, or other similar products that have a silicone base, would leave an irreversible greasy stain upon implements under examination. This stain may only get lighter over time as the stain penetrates deeper into the stone. This problem affects porous stones the most, ground stone implements made of igneous, metamorphic and sedimentary rocks, are affected while those made of non-porous material including flint, metal, and bone are unaffected. The dataset for this research project is ground and polished stone. In order to avoid object damage during casting, a new casting method must be used. Without this method, analysis under high magnifications would not have been possible; this would have limited the possibilities for interpreting use and function.

One possible solution is using acetate film. However, acetate film is fragile and does not replicate wear patterns as well as silicone-based casting products such as Provil®. This is because it frequently fails to reach the lower interstices (i.e. the deeper areas in the stone topography). Moreover, there are few published works relating to the methodology of using acetate film to replicate wear on an implements surface. This part of the chapter presents an assessment of Knuttson and Hope's (1984) acetate film casting method as well as the creation of a new methodology, which is deemed more suitable for the replication of wear on ground stone surfaces.

4.3.1 Acetate

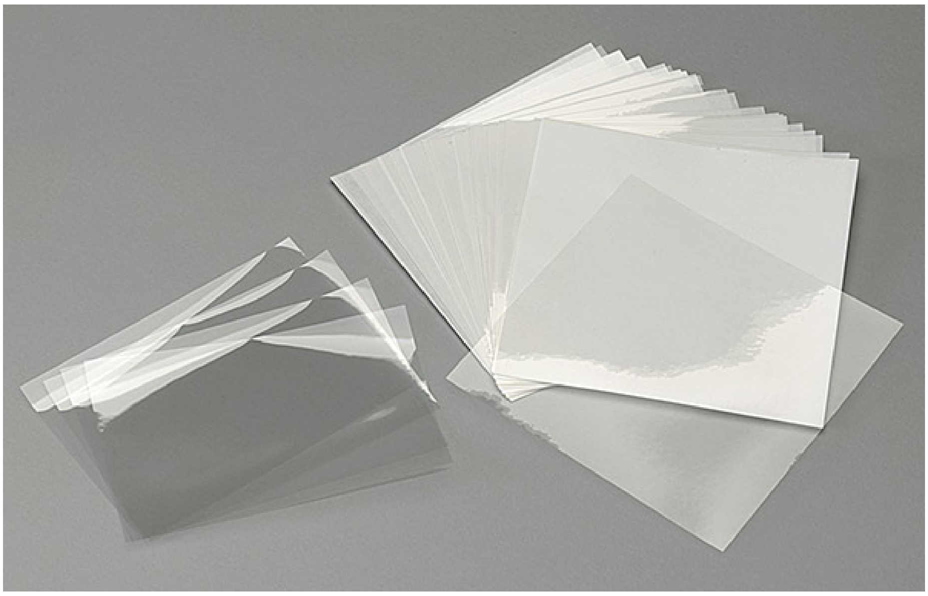


Figure 4.2: An image of acetate film (Agar Scientific)

An acetate film (or peel/cast) is made with the use of cellulose acetate (figure 4.2), a material which, in the past, was used to make glue by using acetone to dissolve it. The application of a small amount of acetone, however, will soften the film to allow it to be applied to surfaces. The acetone evaporates and, as the acetate re-hardens, it replicates the surfaces with which is in contact. The resulting cast can then be analysed under a microscope. Although the thickness of the film can vary, it will always be thin enough to fit under a microscope without the need of an extendable arm. This is very useful when analysing wear, such as polish, under high power, using scanning electron microscopy (SEM) or metallographic microscopes which cannot be transported to museum collections and may not have space to allow for a larger object to be analysed.

4.3.2 Literature on the implementation of acetate casting

There is a small amount of literature regarding the methodology and use of acetate for the replication of use-wear. Most recently, Dubreuil et al. (2015) mentioned the alternative method of using acetate film instead of silicone-based casts to avoid greasy stains, stating that they are, however, fragile and deform easily. Adams et al. (2009) also refer to the use of acetate accurately replicating the micro-topography despite not capturing the lowest micro-topography. They go on to express the benefits of using acetate films under high power magnification as, like all casting methods, it does not replicate the colour variation the occur between stone grains and crystals – an aspect which can make the identification of wear patterns more difficult. However, the method and results of their use are not considered further.

In 1984, Knutsson and Hope published a methodology, testing the use of acetate films in replicating use-wear on used and unused flint tool replicas. These replications were involved in an experimental project which examined on-site activities that were thought to produce wear patterns visible on prehistoric tools in the archaeological record (Knutsson & Hope, 1984, 49). They examined the acetate under a metallographic microscope with incident lighting to assess if features of wear were visible and could be interpreted. The method used is as follows (Knutsson & Hope, 1984, 50):

1. Clean the tools with warm detergent;
2. Allow to dry;
3. Carry out an initial preliminary casting to remove excess material;
4. Perform a second casting for analysis.

The casting process Knuttson and Hope applied is as follows:

1. Apply a few drops of acetone to the part of the tool to be cast;
2. Apply a pre-cut piece of acetate onto the tool surface, they advise a size of 20x30mm, leaving 10mm of an edge as a handle;
3. Blow for a short time to remove excess acetone;
4. Gently press an eraser on the acetate for 15-30 seconds to secure it to the surface;

5. Wait five minutes before removing the acetate from the tool surface;
6. Immediately place the acetate in a glass slide mount to flatten it and prevent it from being polluted.

The authors tested the casts to assess if the wear was replicated well enough to be interpreted. The material worked for all four tests, which were correctly assessed showing the acetate reproduced micro-wear features clearly (Knutsson & Hope, 1984, 59-60). However, the process also revealed several drawbacks. The authors found that the edges of the acetate tended to roll, thus obscuring wear at these locations; and due to the speed of the acetate hardening varied topographies were challenging to replicate over large areas. However, the flatness of the acetate was a distinct advantage – this may be used to study the wear within a perforation since this area is difficult to cast with Provil®, and even more difficult to analyse directly with a microscope.

It is clear that the use of acetate film to replicate microwear on flint tools can be used with successful outcomes. However, this methodology must be tested for its applicability on ground stone.

4.3.3 Creating a methodology

Using the collection of experimental tools at Leiden University's Material Culture Laboratory, Faculty of Archaeology, I tested Knuttson and Hope's methodology on a variety of ground stone tools. Initially, I followed their methodology using experimental grinding stones to assess how well the process worked when applying the methodology to ground stone. Immediately I discovered the process by which acetone is dropped onto the surface of the tool, followed by the placement of the acetate, does not work. The surface of ground stone is not smooth like that of flint, therefore even when placed flat (mounted) ground stone the acetone rolls off the surface before the acetate can be placed upon it. The resulting outcome did not replicate the entire surface the acetate was placed upon, instead just the centre was cast, despite using an eraser to apply light pressure.

To overcome this issue, I tested a hypothesis that if the acetate is dipped into the acetone, rather than being placed on top of it, it will adhere to the surface of the implement much better. I dipped the acetate into a pool of acetone, placed in a petri dish, for varying time periods to assess the correct dipping time needed for the acetate to adhere to the ground stone surface and replicate the wear well enough to be interpreted correctly. Starting with a 30-second submersion within the acetone, which made the acetate much too soft, I narrowed the submerging time down to 2 seconds (a 1-second soak did not adhere to the surface correctly). To assess if the acetate replicated the wear correctly, I compared it with the area of the implement from which the cast was taken. I found that the acetate reproduced the wear features seen on the implement when submerged for 2 seconds (see table 4.3).

Table 4.3: The experimental tests dipping acetate in acetone

Application of acetone to acetate	**Result**
A few drops applied to the surface of the stone before the acetate was placed in position as specified in the Knuttson & Hope method (1984)	Acetate cast did not adhere to the surface as it was not soft enough, contact with more acetone was needed
30 seconds submerged in acetone	Acetate cast was too soft, it was more likely thick glue, and did not replicate the wear.
15 seconds submerged	The cast was too soft, difficult to peel off the stone and only 10% of the cast replicate wear
5 seconds submerged	Cast replicated more wear, approximately 50%, and left some acetate on the surface of the stone when removed
2 seconds submerged	All of the cast in contact with the stone replicated the wear, it peeled off well and did not leave any part of the cast behind
1 second submerged	Too hard, not soft enough for all of the cast to adhere to the stone surface; limited wear replicated.

Other parameters were also tested. Most notably the extent of time the acetate must be left on the implement. Knuttson and Hope waited five minutes before taking the acetate off the implement under question. However, I undertook over 40 acetate casts from various ground stone experimental tools, and it is clear a specific time cannot be given for the acetate to dry on a selected surface. The longer the acetate is soaked in the acetone, the longer it takes to dry. Also, drying time is determined by the environment in which the casting takes place as temperature and humidity can change the length of time needed for acetate to dry, as too can the age of the acetate. The higher/longer of all three, the longer the acetate must remain on the implement's surface.

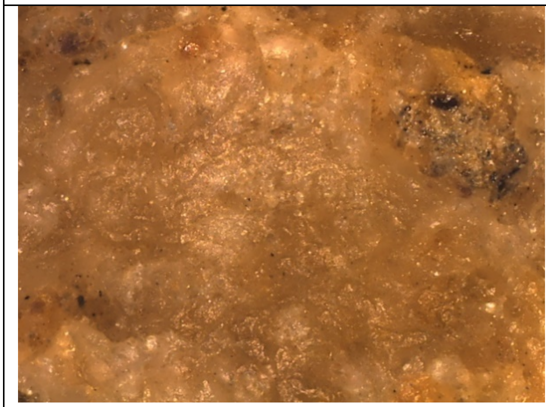
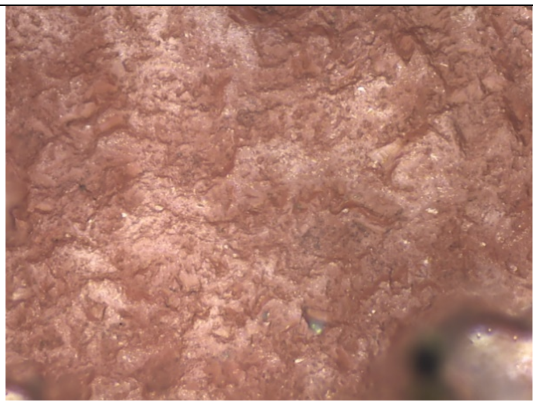
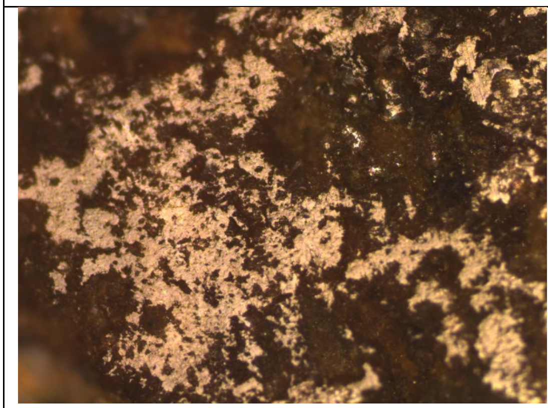
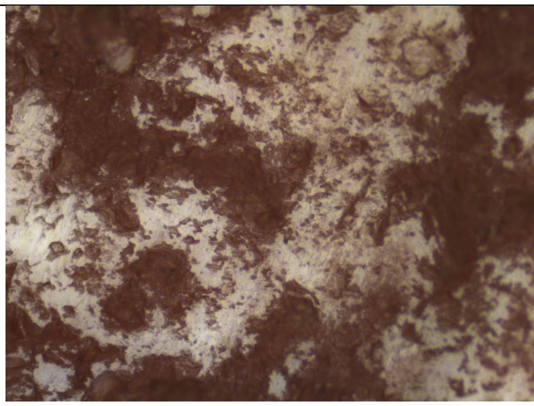
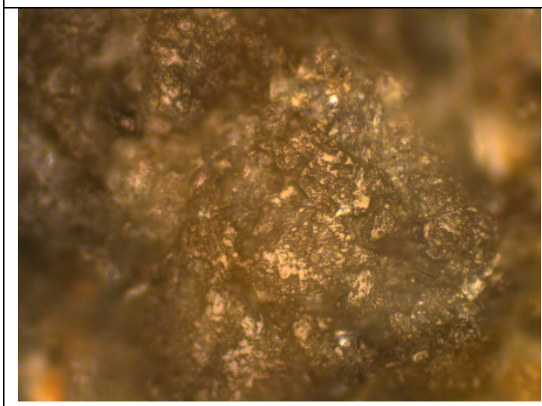
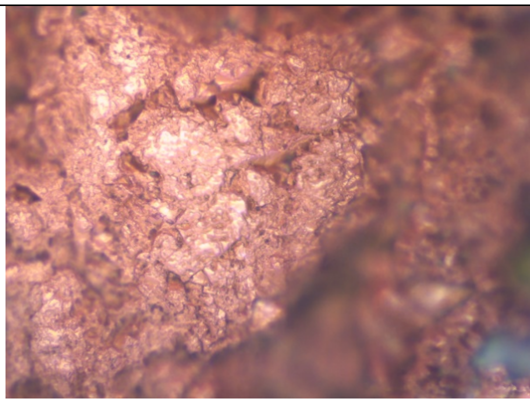
To ensure the dipping method replicated wear correctly I used it to cast several different experimental tools and compared the wear of both the cast and the experimental tool under a metallographic microscope. Tools with different types of polish were present in this sample. For instance, I included wood polish, cereal polish, polish created through contact with stone and, also with bone. For all polish types represented in this study, all were correctly replicated. Thus, the contact material was also able to be interpreted correctly (see figure 5.2). To further test this method, the surface of an experimental polished stone axe used to chop wood was also replicated.

The results demonstrated that this method can be used to replicate the surface of a variety of stone – smooth and rough; polished, ground, and pecked. It is also a valuable method to replicate the inside of perforations, which is tricky to analyse directly under a microscope. However, as Knuttson and Hope found, the lowest micro-topography cannot be replicated, although this did not limit the interpretation of the contact material. In all forty cases, the interpretation of the type of polish, which was used to interpret the contact material, was successful. Impartial blind tests were carried out to confirm that use polish is accurately replicated wear. Casts were taken of eight experimental ground stone tools. Their use was hidden prior to, and during analysis to create blind conditions for more accurate interpretations of wear. The tests were carried out by myself on objects I had not previously analysed and was blind to their function. The successful interpretation of all acetate casts confirms the ability for acetate to replicate the micro-wear on ground and polished surfaces (for which, see Table 4.4).

Table 4.4: The successful interpretations of use polish on acetate casts – blind test

Experimental implement	**Function**	**Interpretation based on the polish replicated with the acetate casts**
Quartzite rubbing stone	Grinding linseed plant	In contact with plant
Sandstone grinder	Grinding basalt	In contact with stone
Sandstone grinder	Grinding animal bone and antler	In contact with bone and antler
Sandstone grinder	Grinding wood	In contact with wood
Stone axe	Chopping wood	In contact with wood
Sandstone grinder	Grinding emmer wheat plant	In contact with plant
Sandstone pounder	Pounding burnt bone	In contact with bone
Hammerstone	Pounding bone	In contact with bone

It also appears that the thickness of the acetate may determine how well the surface of the chosen implement is replicated. Thus far, three thicknesses have been tested: 35um, 50um and 75um. Acetate with the thickness of 75um replicated wear most effectively, whereas, the thinnest, 35um, appears to be worse at replicating the surface. More tests are required to confirm this statement.

Quartzite grinder – used for grinding plant (dry linseed) for 90 minutes	
Experimental tool (10x)	Acetate (10x)
	
Sandstone grinder – used to grind basalt (with water) for 180 minutes	
Experimental tool (10x)	Acetate (10x)
	
Sandstone grinder – used to grind bone and antler (soaked in water) for 494 minutes	
Experimental tool (20x)	Acetate (20x)
	
Sandstone grinder – used to grind wood (Hazelwood with water) for 3200 strokes	
Experimental tool (20x)	Acetate (20x)

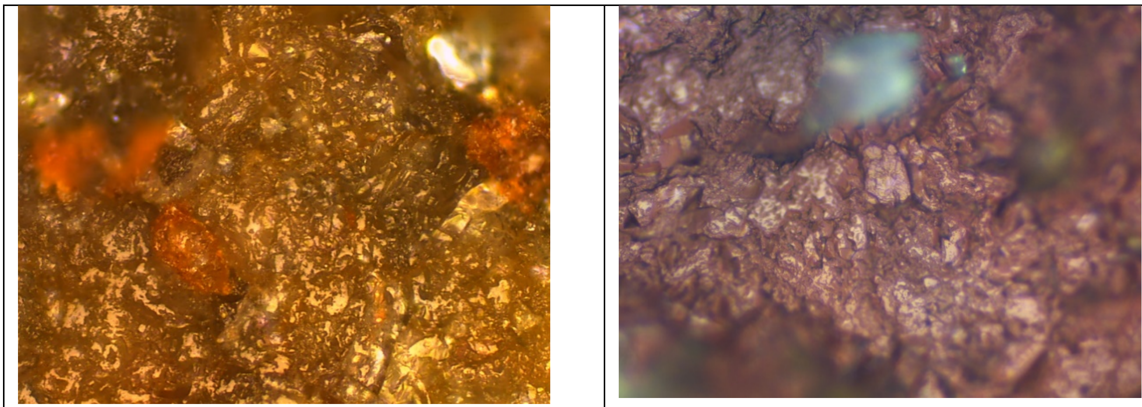


Figure 4.3: A comparison of wear for different contact materials (photos taken with an orange background beneath the acetate)

4.3.4 Outcome

To replicate the surface of ground stone correctly, I developed a new, more suitable, methodology. It is a development of Knutson and Hopes' methodology, therefore, elements from this have been used. It is as follows:

1. Clean the tool with warm water a mild soap;
    a. For more subborn dirt use a small amount of alcohol applied with a cotton pad;
2. Allow the surface to dry;
3. Apply the preliminary cast;
    a. Ensure the acetate is not too large and it is applied quickly to reduce the formation of bubbles;
    b. This will remove any excess dirt, so none is present on the secondary casting;
4. Wait until the cast has dried then remove;
    a. Wait two to five minutes;
    b. The acetate will start to lift at the edges when dry;
5. Apply secondary casting;
6. Wait until the cast has dried;
7. Place the secondary cast between two glass slides or stiff pieces of cardboard to avoid the edges curling, lightly tape it together and label;
8. Clean the replicated area with acetone to remove any remaining acetate.

To replicate the surface well when casting, the acetate must be dipped within a bath of acetone for no more than 2 seconds. After which it must be placed upon the surface required to be replicated as quickly as possible. Press lightly, with an eraser, or a gloved fingertip, across the acetate to ensure it sticks to the surface. Bear in mind it takes practice to reduce the bubble formation, however applying the acetate quickly and using a small piece of acetate, i.e. 2x2 to 2x3 cm, also helps reduce bubble formation.

It is essential to recognise that the acetate must remain in good condition. The acetate will not replicate wear correctly if it has been bent or folded. It cannot be bent over a tight angle, such as a blade edge. The blade edge can, instead, be replicated by taking two separate casts of the blade edge as well as along the ridge of the edge. One must also ensure any replicable surface is clean well before its replication since the casting process will remove any remaining dirt. Dirt will inhibit the interpretation of the replicated surface, as well as leaving a clean area on the tool which may look different to the rest of a dirty tool.

This methodology was used to replicate the surface of all battle-axes and axe-hammers I analysed. Analysis of the casts under a metallographic microscope enabled the polish type to be assessed which aided the interpretation of the contact material, or materials, of each implement during their use-life.

4.4 Contextual assessment

The context in which an implement was found is an important parameter to assess. It can give us information regarding the end of the use-life of the object and its associations, such as typological, chronological, petrological and spatial and stratigraphic contexts. An assessment of contexts allowed for the analysis of the treatment and meaning of battle-axes and axe-hammers. Comparative studies of contextual information looked for trends and associations between object type, petrology, depositional context and the associated artefacts. This assessment of various contexts picked up on the trends and associations of battle-axes and axe-hammers, such as regional preferences for type and deposition. By analysing the contextual association of battle-axes and axe-hammers, their significance and the roles they played were assessed. To understand all the possible associations and related roles and meaning these implements may have had during their itinerary, information from all contexts was assessed. These include all five of Hodder's contexts, as well as the petrological context and the use context. This allowed for an understanding of these implements from their manufacture, through their use and to their deposition and added to the knowledge of their meaning, associations and significance across time and space (Hodder & Hutson, 2003, 173; Crellin, 2017; Ingold, 2007; Bailey, 1981 & 2007; Deleuze & Guattari, 2004).

4.5 Parameters

Rushing use-wear analysis will result in unreliable results, so I used an appropriate sample size to avoid this and remain within the time scale of this research project. There are 709 axe-hammers and 352 battle-axes from across the British Isles according to the IPG data. The size of this assemblage is too large to study within the time scale of the project, so this project will focus on those implements from northern Britain and the Isle of Man. However, there are 371 axe-hammers and 183 battle-axes from the northern Britain and the Isle of Man. The size of this assemblage is also too large to allow for analysis of all implements within the time scale of this project. Therefore, certain parameters were followed to create a sample of battle-axes and axe-hammers for analysis; 63 battle-axes and 59 axe-hammers, 121 in all. They were chosen to help answer the research questions and were as follows:

- The sample chosen had to have implements from every county in the study area where possible;
- Every type of battle-axe, from stage I to V, and axe-hammers, Class I and II, from each county was present where possible, these numbered two to three for each type in each county;
- A variety of petrologies were represented in the sample for each county;
- Those implements that were severely weathered or fragmented were not included;
- All implements available to analyse with depositional information, such as a funerary context, were included.

The information used to limit the sample size came from Roe's 1966 publication, the Implement Petrology Group (IPG) database, and the Canmore and Pastscape websites which were used to compile data on the battle-axes and axe-hammers (for the spreadsheets, see the appendix). This includes the accession number, the find location, typology, whether they are fragmentary, their petrology and their context if the information is known. Furthermore, digital museum collections were searched to find any implements missing from the other sources. Using this information, a sample of appropriate size was chosen.

In order for the sample size to evenly represent the northern British Isles, a selection of battle-axe and axe-hammers from locations across the study area were analysed. While it would be interesting and beneficial to study the use of these implements across the British Isles, this would encompass a much larger project. This project is focussed on northern

British and the Isle of Man only, as a sizeable pilot study to assess the benefits of the methodology. The implements from the study area were easily accessible at various museums throughout Britain and on the Isle of Man. It was important to be able to compare implements from different locations to find out if this parameter had influenced their use and treatment. For example, Needham has suggested that fluted axe-hammers are predominantly found in Dumfriesshire and which indicates a possible preferential treatment of type in different areas (Needham, 2011). Needham also suggested that some regions of Britain preferred either axe-hammers or battle-axes (Needham, 2011).

The form of the battle-axes and axe-hammers in the sample represented all types in the battle-axe and axe-hammer typologies to allow for a comparison between object types. For example, I was interested in finding out if the more expanded battle-axe types were used differently or not at all as has been suggested (Simpson, 1988; 1989; 1996). In order to represent all types while affording the possibility to explore regional variation, I ensured that there were at least two of each type analysed from each county within the study area. In some cases, the aim of two of a single type was not met as they did not exist or were not accessible. The two types of axe-hammer, Class I and Class II, were not equally represented across all areas due to the limited number of Class II axe-hammers. The Class II axe-hammers were represented in the samples in all areas where they exist. Those that were fluted were also analysed to understand if the wear interpreted on this group of axe-hammers was different from other types of axe-hammer and axe-hammers in different areas.

The petrology of battle-axes and axe-hammers varies. To understand if there is a trend relating the petrology of the stone with their function, significance, location and type, the sample of implements analysed represented a variety of petrological stones from each county (for a list of the artefacts analysed see appendix).

The condition of the battle-axes and axe-hammers was taken into consideration when deciding on the implements to analyse. The weathering of ground and polished stone alters the wear formation on the stone surface. Prolonged weathering removes wear completely. Therefore, highly weathered objects were not analysed. Online museum collection databases were used to understand the condition of the implements before the museum trips. When this information was not available, the implements were assessed directly at museums.

There are also several battle-axes and axe-hammers that are fragmentary or unfinished. To reduce the sample size, these were not analysed. Fragments of implement will provide less information and are therefore less reliable for this interpretation of function. Some battle-axes and axe-hammers are broken across the perforation. In some cases, both ends of these implements have been fixed back together well enough to analyse the entire object. The condition of these implements was considered on direct observation at the museums to assess if they were in a state worth analysing. It is also not within the scope of the project to assess the function of unfinished battle-axes and axe-hammers. There is potential for future research to assess if unfinished battle-axes and axe-hammers were used functionally.

One final parameter was chosen for picking the implements to analyse. All those battle-axes and axe-hammer excavated from recorded spatial and stratigraphic contexts were analysed where they were available. Since only 18 axe-hammers and 47 battle-axes have been excavated from spatial and stratigraphic contexts in northern Britain and the Isle of Man, it was essential to include as many of this group as possible. A comparison of wear and function occurred between implements from funerary and non-funerary contexts to assess if the deposition of these implements was related to their function and treatment. Information regarding the deposition and spatial and stratigraphic contexts of battle-axes and axe-hammers was found in numerous sources. Roe's 1966 article cited several of these sources, including small journals and museum accession reports (Roe, 1966). Others were found through a search of their find location in Canmore and Pastscape. The information these sources gave was varied; some described the type of burial monument and the different burials and associated artefacts in detail, while many others had limited information. Often those with limited information just described the shape and measurements of the implement and who found it or gave it to a museum. As such, the location of the find of these artefacts is not accurate.

4.6 Securing access to museum collections

The body of implements I analysed was held at various museums across the northern British Isles, and also includes objects from northern Britain that were kept at the British Museum. The remaining museums included: The Great North Museum; The Yorkshire Museum; Sheffield Museum; Manchester Museum; Tullie House, Carlisle; The Manx Museum; The National Museum of Scotland, Edinburgh; Dumfries Museum and Camera Obscurer, and; Stranraer Museum. Access and permission to analyse the battle-axes and axe-hammers in these museum collections were gained through email contact with the curators and other relevant persons. During this process, the museums were notified of the specific implements chosen for analysis by creating a list of accession numbers from the IPG spreadsheet and museum website. A text explaining the aim of this project, and a description of the methodological process was also presented to curators and relevant persons in requesting permission to carry out the analysis of the implements. The non-invasive acetate casting technique used chemicals which come into contact with the stone implements directly. Museums are rightly concerned about such techniques, which required a detailed description of the methodology and evidence that the process does not damage the stone it is in contact with; photographs of stone implements before, during, and after acetate application was used to demonstrate the method does not damage the stone.

Chapter 5: The context of battle-axes and axe-hammers in northern Britain and the Isle of Man

5.1 Introduction

In this chapter, I present a summary of the typology, chronology and context of battle-axes and axe-hammers from Northern Britain and the Isle of Man. The chapter analyses the implements according to each of Hodder's five contexts: typological; chronological; stratigraphic and spatial; and cultural. Hodder developed a systemized approach to interpreting the past meaning of material culture by identifying various types of similarities and differences built up into various types of contextual associations (Hodder & Hutson, 2003, 173). By assessing battle-axes and axe-hammers within each of Hodder's five contexts, relationships between objects, and people and objects were apparent. This allows for a discussion of the cultural contexts of battle-axes and axe-hammers in the Early Bronze Age. A sixth, petrology, and a seventh, use context were added to this assessment to consider all the known information about the itinerary of these implements – use context is discussed in Chapter 7.

The majority of the axe-hammers and a large number of the battle-axes lack associations and often only the find location is known. Using contextual analysis alone cannot assess the range of different associations, uses and meanings such objects may have had. More dynamic approaches to EBA burial assemblages have shed light on the relational links between materials and society. They have concluded that their deposition may have been used to express ideals, emotions, memories, beliefs, and can create, negotiate and maintain interpersonal links, power and relations (Brück, 2006; Thomas, 1992; Barrett, 1991; Thomas, 1991). Using these new ways of looking at assemblages are tools for understanding the life histories of artefacts and how their itineraries might influence their use and treatment in life and death.

This chapter focusses mostly on those implements with contextual associations to allow for a more accurate interpretation of the contextual meaning. In assessing the cultural meaning of battle-axes, for instance, I argue for the use of specific funerary kits to reflect the society of the deceased, those burying the deceased, and the deceased themselves. This means that there could have been many different reasons to place a single battle-axe in a given burial context dependant on the relationships it was involved in through its use life, such as through manufacture, functional use and movement. As such, I do not think the idea that battle-axes reflect the identity of the deceased as their only purpose in a burial holds up. We must be careful arguing that the identity of the deceased as an elite or high status is the sole purpose for battle-axe presence in burial deposits. Although the word elite is now used to a lesser degree, its meaning can be found in the use of the word status which often implies the high-status position of the individual. In other words, the elite status of the individual. The use of these implements is also often only interpreted with the assessment of select parts of the contextual information, rather than all the information available, such as the use context. Hence, many battle-axes were interpreted as weapons for a warrior elite (Mortimer, 1905; Elgee, 1933; Greenwell & Rolleston, 1877). Often such interpretations are based upon an assessment of form and their presence in burial deposits which was used to interpret the identity of the deceased, such as the idea of a high-status member of society. This chapter uses the petrological, typological, chronological, stratigraphic, spatial, and cultural contexts of battle-axes to assess if the stereotypical interpretations of battle-axes and signifying the identity of the deceased, as elite or high status, is correct. The variation in the funerary and non-funerary assemblages was used to demonstrate that the roles they played were also varied and therefore it is inaccurate to argue that they are only representing the identity of the deceased (Thomas, 1991; 35-6).

Authors such as Needham have expressed the importance of status in placing a battle-axe with the deceased (Needham, 2011). Needham has described battle-axes as initially being used to reinforce the status of dagger bearers in dagger burials. Battle-axes then, he argues, became a statement in their own right and therefore remained an 'enduring status symbol' for up to seven centuries (Needham, 2011). Instead of basing the interpretation of battle-axes on just their presence in burial deposits, Needham used several elements of battle-axes contexts in his interpretation, including their typology, distribution and cultural context. In doing so, he was able to look at battle-axes in relation to other funerary artefacts from the EBA, such as daggers; he considers battle-axes as part of a broader group of identity-related items used in EBA society. This chapter demonstrates the variability of battle-axe burial assemblages and determines that artefacts were chosen from a larger pool of objects used in the EBA for expressing specific outcomes and meanings in the funerary process. The relational links between people and objects, created through the itinerary of these objects, were being drawn upon.

A recent example is Sheridan who described them as 'prestigious possessions – symbols of power as much as functional weapons' (Sheridan, 2007, 110). An assessment of function as well as the meaning and the different roles these objects played can only be made when thinking about their functionality through the assessment of use context, as well as their symbology and meaning through their petrological, typological, chronological, stratigraphic, spatial, and cultural contexts. By carrying out archaeological scientific techniques such as wear analysis and experimental tests, and proper understanding of their use-life was combined with an understanding of their contexts to allow for a more accurate interpretation of the object. Chapter 8 discusses the use context in relation to the other six contexts to understand the type of significance and its level of prestige and the function of these implements accurately.

5.2 Typological context: Battle-axes

The typologies for perforated stone implements were first outlined by Sir John Evans in his 1897 monograph *The Ancient Stone Implements, Weapons and Ornaments of Great Britain.* The term battle-axe was used to describe both axe-hammers and battle-axes. Many years later, in his 1960s publication, Paul Ashbee concluded there were five types of battle-axe, Types I to V, depending on the expansion of the blade, Type I was not expanded at all, and Type V was fully expanded (Ashbee, 1960). However, it was Fiona Roe's significant contribution that was the first to distinguish axe-hammers from battle-axes by presenting them as distinctive artefact types (Roe, 1966; cf. Roe 1967; 1968; 1979). She classified a typological system for battle-axes based on their morphology. This typology has been used widely since the 1960s and has been adopted for this research project. Based on chronology, established by association, the battle-axes were also placed into three groups, Early, Intermediate, and Developed. Within these three groups, the battle-axes were then split into stages depending on the expansion of the blade, and the length and width to best represent the different morphology, Stages I through to V. The shape of the butt was also given a category, A through to E (table 5.1 & 5.4). Decoration in the form of incised lines or moulded lines along the sides of the battle-axe is occasionally found on Stages III-V, D, being rarer with the earlier Stages I and II.

Table 5.1: Key for Butt shapes		
Name	Symbol	Morphology
A	▲	Crescentic
B	●	Rounded
C	■	Truncated
D	⬢	Shaped, Angular
E	◬	Semi-circular

Roe noted that battle-axes do not split into obvious groups and should thus be seen more like a continuous series. However, 'for comparison and nomenclature' Roe further divided the battle-axes into nine groups based on nine areas of scatter diagrams which showed reference to various battle-axe shapes (table 5.2) (Roe, 1966, 205). In essence, she grouped battle-axes of a specific Stage and Butt Group, e.g. Stage 1, B, which were the most similar in form and named them after well-known sites associated with a battle-axe of that group. Through this process, Roe was able to identify variants in form that are dependent upon locations, such as the Northern and Southern Variants belonging to the Intermediate/Developed battle-axe morphologies. Roe identified several associations with battle-axes which correlate with the chronological framework she suggested (table 5.3) (Roe, 1966). With regards to Roe's research as presented in table 5.3, the battle-axes from Northern Britain and the Isle of Man are not found associated with Beakers or items of jet, although daggers are found on occasion. Food Vessels and Collared Urns are commonly associated with all typologies, as too are Accessory Vessels. Wessex I and II associations are only present for battle-axes in southern Britain. Figure 5.5 presents all of the battle-axes from Northern Britain and the Isle of Man with a spatial and stratigraphic context. The associated artefacts correlate with those Roe suggested in table 5.3. However, it is clear that there was a broader variety. The spatial and stratigraphic section later in this chapter will discuss this further.

Table 5.2: Breakdown of Battle-axe Groups				
Group Name	Chronology	Stage	Butt Shape/s	Variant
Woodhenge	Early	I	A, B, C, D	None
Calais Wold	Intermediate	II-V	A	None
Wilsford	Intermediate	II-IV	B	None
Herd Howe	Intermediate	II-V	C	None
Codford St Peter	Intermediate	II-V	D	None
Loose Howe	Intermediate/Developed	III-V	D	Southern
Scotsburn	Intermediate/Developed	II-V	D	Northern
Snowshill	Intermediate/Developed	V	E	Southern
Critchie	Intermediate/Developed	III-V	E	Northern

Table 5.3: A breakdown of Roe's 1966 chronological associations		
Stage	Chronological Group	Associations
I & II A, B, C, E	Early and Intermediate	Long-necked beakers Daggers Jet
I – V A, B, C, D, E	Early and Intermediate	Food Vessels
III-V A, B, C, D, E	Intermediate	Food Vessels Collared Urns Cordoned Urns Wessex II
Southern Variants	Intermediate/ Developed	Wessex II
Northern Variants	Intermediate/ Developed	Food Vessels Collared Urns Cordoned Urns

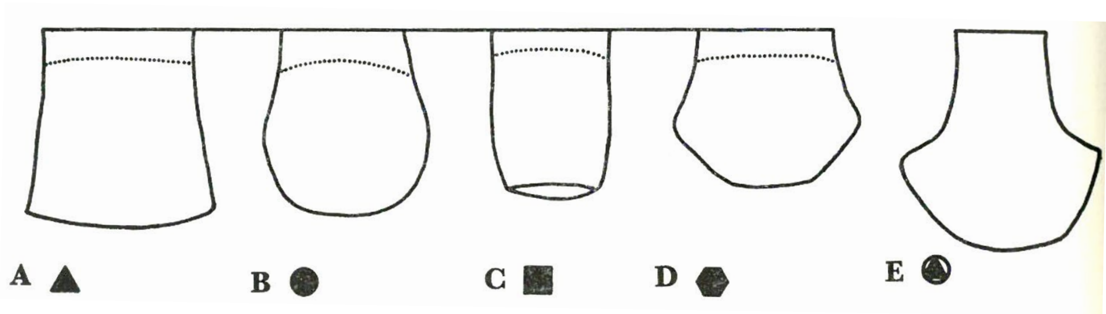
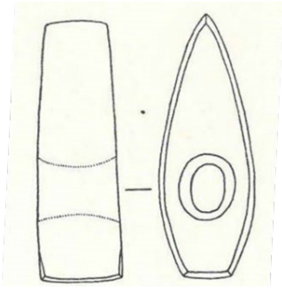
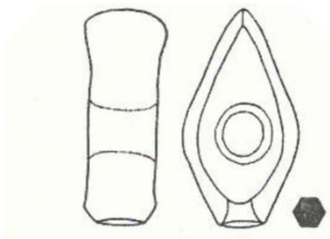
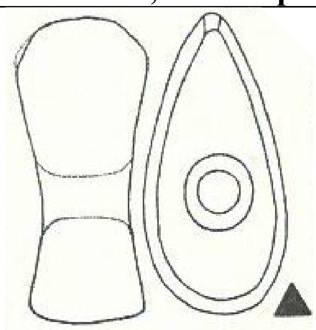
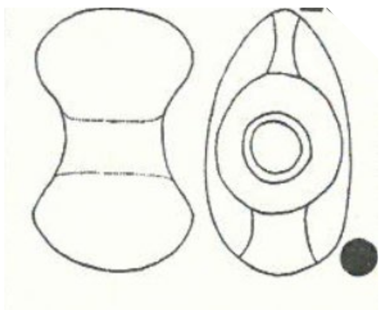
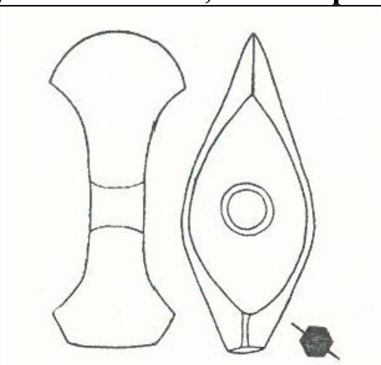
Table 5.4: Illustrations demonstrating battle-axe types and butt shapes (Roe, 1966)	
	
	
A Stage I battle-axe, butt shape C	A Stage II battle-axe, butt shape D
	
A Stage III battle-axe, butt shape A	A Stage IV battle-axe, butt shape B
	
A Stage V battle-axe, butt shape E	

Table 5.5: A table showing the battle-axe associations from the spatial and stratigraphic contexts from northern Britain and the Isle of Man.

ID	Acc. No.	County	Locality	Stage	Butt Shape	Feature	Cremation	Inhumation	Urn, unknown type	Collared Urn	Cordoned Urn	Food Vessel	Accessory vessel	Worked flint	Arrowhead	Flint dagger	Bronze Chisel	Bronze Knife/dagger	Bronze Pin	Copper dagger	Bone pin	Bone toggle	Bone belt hook	Earrings	Whetstone	Razor	Jet	Stone ball
244	?	Y	Flixton/Elf Howe	?	?	Barrow																						
242	NMS EQ 916	FIF	Barns Farm	I	a	Barrow	x	x				x																
153	NMS AH 142	ANG	Burnside Mill	I	c	Cist																						
622	Kelv ?	AYR	Carwinning	I	D	Cairn				x							x?											
73	NMS AH 116	MLT	Cranstown	I	b	Cremation																						
25	NMS AH 106	PER	Grantully	I	c	Stone circle/Cist																						
1	NMS EQ 322	BRW	Hagg Wood, Foulden	I	a	Cairn	x					x		x														
5	MNH 1954-0593	IOM	Knockaloe	I	c	Cist								x														
188	NMS AH 44	PER	Mugdrum Island	I	c	River																						
578	NMS HD 1026	SHE	Ness of Gruting	I	c	House site																						
11	NMS HD 1025	SHE	Ness of Gruting	I	c	House site																						
234	NMS AH 244	ROX	River Kale	I	d	River																						
105	BM 76 4-10 3	Y	Danby North Moor	II	a	Barrow	x																					
227	BM 79 12-9 107	Y	Ganton	II	a	Barrow	x							x														
143	Hull 26.7.426	Y	Garton Slack	II	c	Barrow		x					x			x											x	
623	BM 88 9-1 1	Y	Huggate Pasture	II	a	Barrow		x	x																			
624	NMS HD 1024	SHE	Ness of Gruting	II	a	House site																						
231	NMS AH 239	SUT	River Fleet	II	b	River																						
565	BM 79 12-9 1062	Y	Rudston	II	c	Barrow		x										x										
564	BM Sturge 470	NOR	Seghill	II	b	Cist		x																				
233	ShM J.93.9	Y	11m E of Pickering	III	d	Barrow	x		x					x														
144	NMS AH 109	CAT	Breckigo	III	a	Cairn							x															x
22	Stranraer 2008.24.5	WIG	Cairnderry	III	d	Cairn	x						x															
235	BM 79 12-9 605	Y	Cowlam	III	a	Barrow		x						x													x	
229	NMS EQ 610	PER	Doune	III	a	Cist		x				x																
625	BM 76 4-10 46-47	Y	Herd Howe	III	c	Barrow	x			x																		
236	NMS AH 35	ARG	Island of Coll	III	e	Shell Midden								x														
9	Bradford Museum	Y	Stanbury	III	?	Pit	x			x			x								x		x	x				
79	NMS AH 36	ORK	Whitehall, Stronsay	III	e	Cist		x																	x			
217	ShM J.93.22	Y	2m N of Pickering	IV	d	Barrow																						
145	?	WIG	Bargrennan	IV	e	Cairn	x			x													x					
165	GAGM 13-49f	LAN	Glasgow Victoria Park	IV	e	Cremation	x			x																		
166	BM 79 12-9 1175	Y	Goodmanham	IV	d	Barrow	x														x						x	
164	BM 82 2-23 23	Y	Hambleton Moor	IV	b	Barrow																						
12	Kelv 55-96	REN	High Lawfield	IV	b	Cairn	x																					
596	NMS EQ 251-2	ARG	Oban Mckelvi Hospital	IV	a	Cremation	x				x																	
106	BM 76 4-10 35	Y	Western Howes	IV	d	Barrow	x			x			x								x	x						
169	NMS EP 2	ABN	Broomend of Crichie	IV	e	Stone circle/Cist	x								x													
157	NMS EQ 65	AYR	Chapleton Farm	IV	d	Cremation	x		x																			
74	NMS EP 57	AYR	Nith Lodge	IV	d	Cist	x			x			x															
230	NMS EQ 64	MLT	Pentland	IV	d	Cist																						
189	NMS AH 57	FIF	River Tay, Newburgh	IV	a	River																						
118	NMS EQ 486	WIG	Sandmill Farm	IV	d	Pit	x			x											x				x	x		
552	NMS AH 221	ROS	Balnagown	V	d	Cairn																						
228	?	EL	Eweford West	V	d	Pit	x															x						
135	BM 2010, 8035.20	Y	Loose Howe	V	d	Barrow	x			x			x						x	x								
26	NMS AH 175	CAT	Wick	V	e	River																						
		? For unknown information																										

5.3 Petrological context: Battle-axes

Petrological context is used as an additional context alongside Hodder's five contexts because there was a wide range of rocks available for manufacture, which is a geological and geographical context which is drawn on selectively to produce artefacts. Fiona Roe identified several petrological stone groups that were being used to produce battle-axes (Roe, 1979, 23). Her assessment was based on the known petrological determinations for a number of battle-axes and was based mainly on Southern English examples. Early battle-axes came from a variety of petrological groups in various quantities: XII; XIII; XIV; XVIII; XXIII. Group XII battle-axes were noted to be large in size while Group XIV produced crude examples and was little used. Group XVIII was seen by Roe to be characteristic of the Early battle-axes and was the most numerous of the petrologically sampled battle-axes. Group XVIII continued to be used for the Intermediate and Developed battle-axes, but to a lesser extent. Group XII was used widely for the later battle-axes, Group XXIII also continued to be used, as did Group XIV although only one example was known for this petrology. Little information was known at the time about battle-axe petrologies in northern England and Scotland.

In 1984 Malcolm Fenton published his analysis of the sources used to create Scottish battle-axes and axe-hammers (Fenton, 1984). He also undertook experiments in order to understand their process of manufacture. Fenton concluded there is evidence that many battle-axes and axe-hammers were made from the haphazard exploitation of cobble deposits which outnumber scree deposits in Scotland (Fenton, 1984, 241). His experiments found that cobbles were, in fact, a better source for battle-axe and axe-hammer blanks than scree and outcrop sources. He also confirmed that the petrology of both implements is diverse. In Scotland, this can be explained by the sheer abundance of rock types suited to pecking and grinding (Fenton, 1984, 241). Fenton noted the relative proportions for rocks types used to manufacture battle-axes in Scotland were as follows: 12.2% greywacke; 61% basic and intermediate igneous rocks; 13.4% metabasites; 13.4% other rock types (Fenton, 1984, 217).

The Implement Petrology Group have since compiled a database of petrologies of various stone implements in Britain which was used in the 1988 publication of *Stone Axe Studies vol.2*. This dataset further demonstrates the variability of petrologies used in the manufacture of battle-axes (figure 5.2 & table 5.6). A total of 117 different petrologies were recorded for all battle-axes from northern Britain and the Isle of Man. Some of the petrologies used were identified as belonging to petrological rock groups used for the manufacture of stone artefacts in prehistory (Clough & Cummings, 1979; Clough & Cummings, 1988). Six petrological groups stood out with higher numbers of use for the manufacture of battle-axes: 41 Group XII, pictrite; 41 Group XVII, quartz dolerite; 24 dolerite; 13 Group XXVII, greywacke; 12 Group XV, micaceous sub-greywacke; and 10 Group XIV, camptonite (Clough & Cummings, 1988). No further petrological tests have been carried out on either battle-axes or axe-hammers since these results. The known sources for battle-axe petrologies can only be attributed to those with petrological groups seen in table 5.6 (for a map of the petrological sources, see figure 5.1).

Table 5.6: The petrological groups battle-axes were made from and their sources (Clough & Cummins, 1998, 7-10).

Group	Source
XII	Near Hussington, Shropshire and from Montgomeryshire, Powys.
XVII	Near Austin, Cornwall
XXVII	Southern uplands of Scotland and the sill of northern England
XXVIII	Various sources in Scotland and Northern England
XV	Southern Lake District
XIV	Near Nunaton, Warwickshire
XXIX	Central Ayreshire
XXXI	Possibly Orkney

Group XVII was used mainly for axes and some perforated implements, but the remaining Groups were used exclusively for perforated implements. The use of stone petrologies sourced from southern England indicates the potential for movement of the stone and these objects over their lifetime (Clough & Cummins, 1988, 7-10). Considering the haphazard exploitation of stone sources that were indicated by Fenton, it is also possible that more local sources for these petrologies were also used and are yet to be discovered (Fenton, 1984). Indeed, the use of glacial erratics is also a possibility.

A vast quantity of battle-axes has not been attributed to a petrological group and may represent those stones haphazardly exploited from scree slopes and river beds. They may also be further sources from the North which could have been overlooked. The following known sources were exploited for the manufacture of other stone tool types in Northern Britain and the Isle of Man:

- XXVI, carbonate mudstone, Lias of North Yorkshire;
- XXX, hornblende lamprophyre, sourced from Northern Scotland has been used exclusively for axe-hammers and is rare;
- XXXII, epidiorite or altered dolerite and XXXIII, biotite-sillimanite-quartz-schist, were sourced from Northern Scotland and were used exclusively for axes;
- XXXIV, leucogabbro sourced from Carrock Fell, Cumbria, was used for axes and axe-hammers and is very rare.

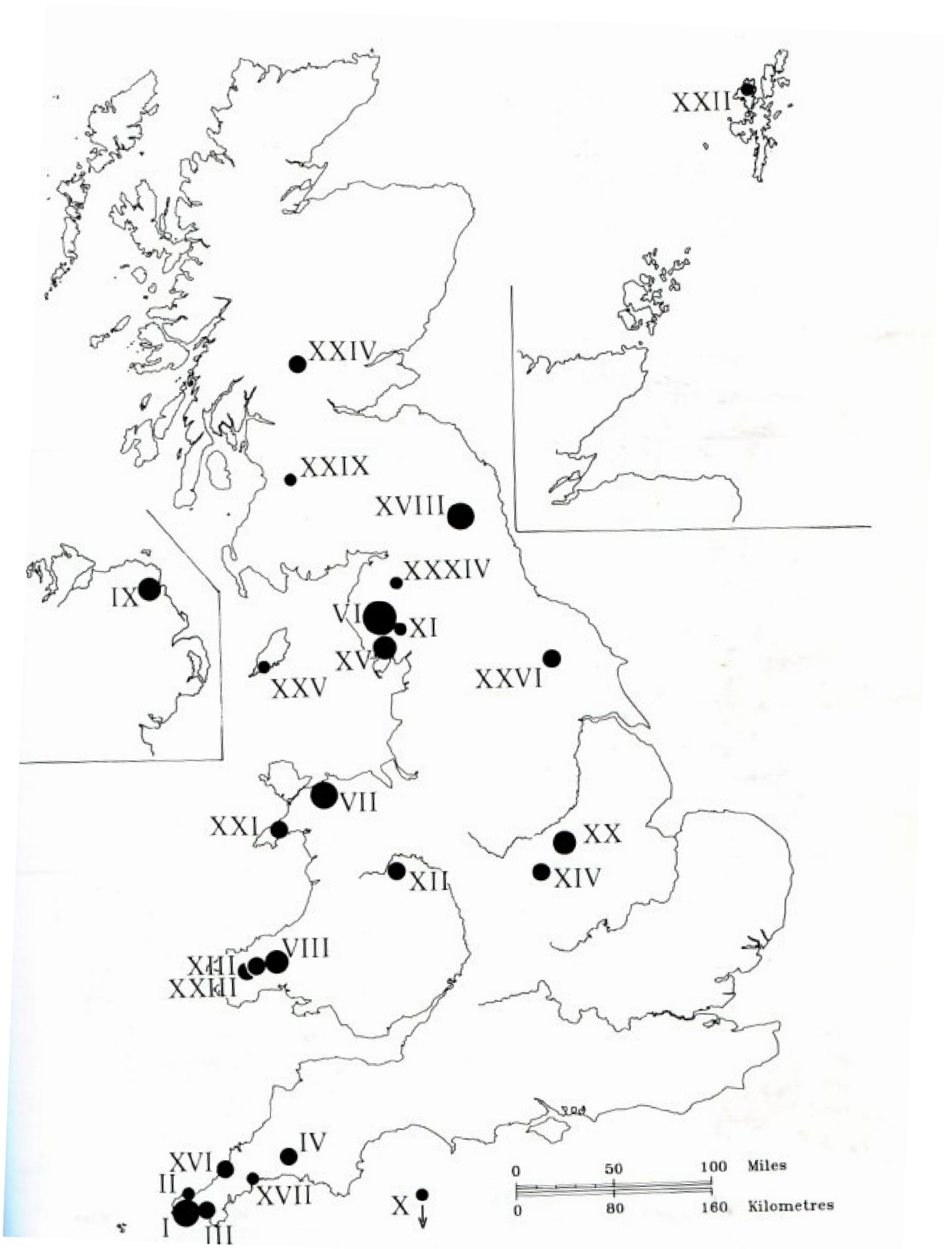


Figure 5.1: The location of the sources of axe groups in Great Britain (Clough & Cummins, 1988, 265)

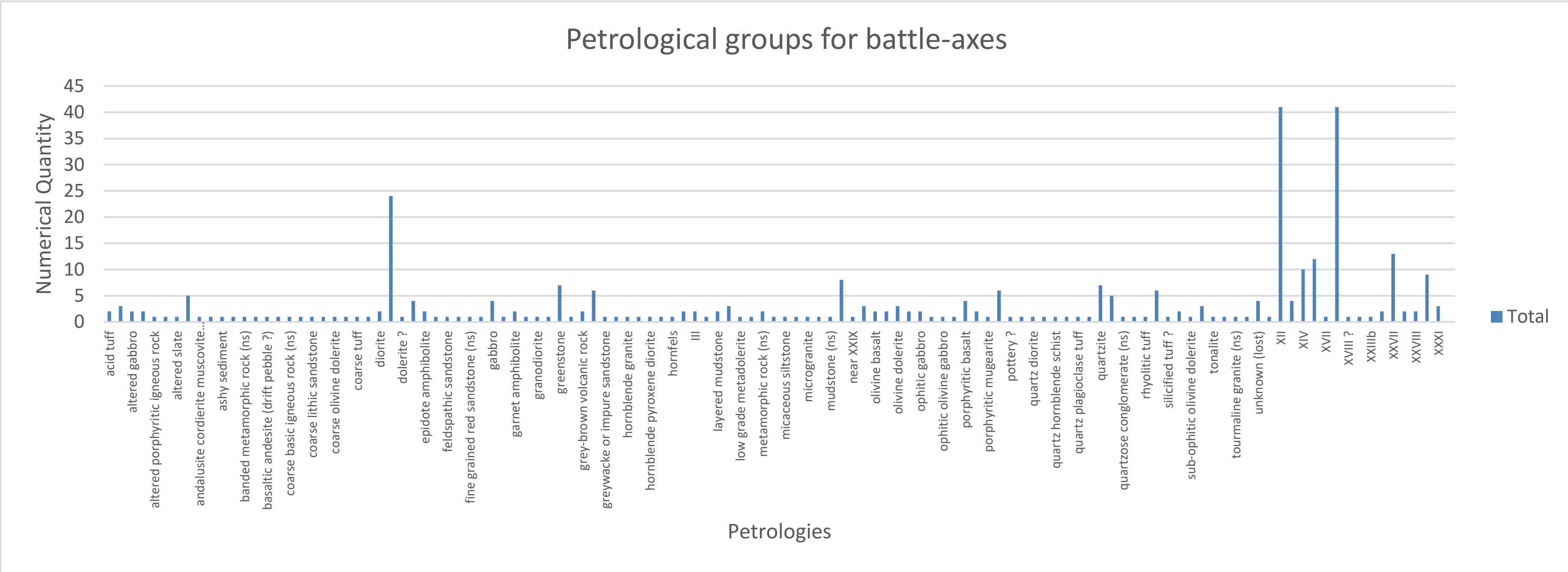


Figure 5.2: A graph demonstrating the varied petrological groups used in the manufacture of battle-axes (Clough & Cumming, 1988)

5.4 Chronological context: Battle-axes

Recent dating projects have confirmed the accuracy of Roe's chronological system, most notably *The National Museum of Scotland's Dating Cremated Bones Project*. The objects associated with battle-axes are known to have been in use during the Early Bronze Age suggesting battle-axes were also in use during this period. Most of EBA chronology has been calculated using pottery when direct dates were not available. The dates of many EBA pottery styles have been confirmed through the dating of associated cremated remains. Pottery urns, commonly deposited with battle-axes, have radiocarbon dates which can be used to infer the dates of battle-axes. For instance, Collared Urns were in circulation in Britain from the EBA when the cremation burial rite became more dominant (Longworth, 1984). Radiocarbon dates of cremated remains directly associated with Collared Urns in Scotland indicated they were used between 2000/1950 BC and 1600/1550 BC, which is also correct for Collared Urns across Britain (Sheridan, 2007, 162).

Cordoned Urns, an adaptation of Collared Urns which exist in northern Britain and Ireland, began being used during the use-life of Food Vessel and ceased thereafter. They are thought to have been current from the 19th/18th century until 16th century BC; early dates from cremated remains associated with an example from a pit at Seggiecrook, Aberdeenshire are 1880-1740 cal BC and 1940-1680 cal BC. The latest date related to a Cordoned Urn in Scotland 1600-1430 cal BC and 1680-1410 cal BC from charcoal from a cremation deposit at Benderloch, Argyll and Bute (Callander, 1905; Banks et al. 2018; Sheridan, 2007, 259).

A re-assessment of the rich Wessex Grave dates as c.1950-1450 BC has established that Food Vessels were likely in use before the emergence of this specific grave series (Garwood & Barclay, 1999, 285; Needham, 2000; Sheridan, 2007, 242). Date ranges for Scottish Food Vessels range from the earliest and latest dates of 2140-1970 cal BC and 1860-1620 cal BC at 1σ. Dates of c.2280-1980 cal BC and c.2280-1670 cal BC obtained from unburnt bone samples associated with the Food Vessel type Yorkshire Vase from the West Heslerton, Yorkshire, demonstrate their use during the Early Bronze Age in Northern England (Sheridan, 2004, 249 & 255). Accessory Vessels, which often accompany urns, such as the Collared variety, were in use during a similar period of the Early Bronze Age in northern England and Scotland. Indeed, there is a large degree of overlap in dates for all pottery vessels associated with battle-axes. Figure 5.3 demonstrates the chronology of use of battle-axes and axe-hammers in relations to other EBA artefacts and burial modes.

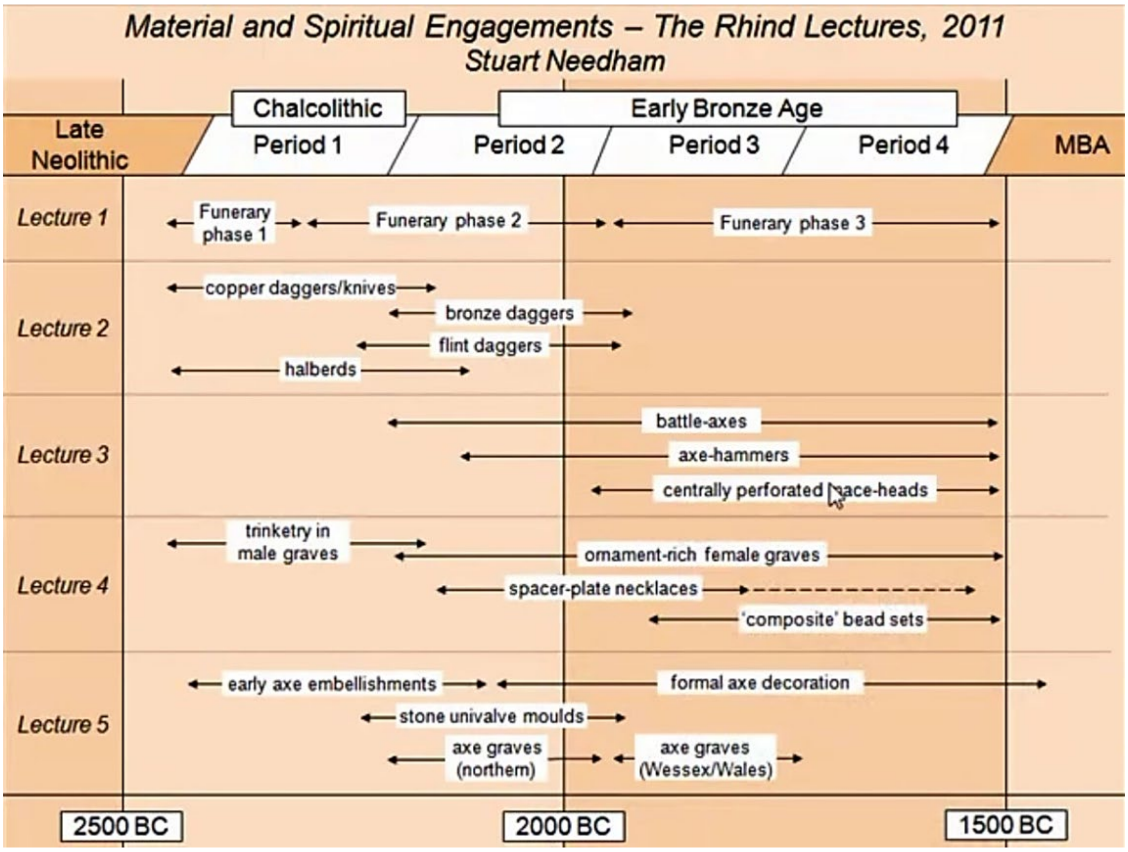


Figure 5.3: Needham's chronological timeline of EBA funerary objects (Needham, 2011)

The National Museum of Scotland's Dating Cremated Bones Project has dated several battle-axes with direct associations with cremated remains which further confirms Roe's classification chronologically. It has confirmed that Intermediate-Developed battle-axes were used within a date bracket of 1900-1600 BC: the Early Bronze Age (Sheridan, 2007, 109). Similarly, the dates related to the battle-axe found during the recent excavation of the Stanbury Pit also fit within the Early Bronze Age.

Table 5.7 and figure 5.4 show the calibrated dates of battle-axes. Table 5.8 demonstrates the calibrated dates of battle-axes and their associated artefacts. It is clear that apart from the Stage I battle-axe from Barns Farm and the Stage III battle-axe from Stanbury, which are earlier in date, the remaining dated implements are grouped with a date range between the late-1800 to the early to mid-1600's Cal BC. This group comprises of Stages III, IV and V battle-axes which appear to have been in use in close proximity chronologically, and so they may have been in use at the same time. The two earliest dates are Stage I and III; this shows the later stages, at least up until Stage III, were being manufactured at the same time as the

Stage I battle-axes. The cremation rite is dominant with these dated examples; however, this will be shown by the result of the dating of cremated remains.

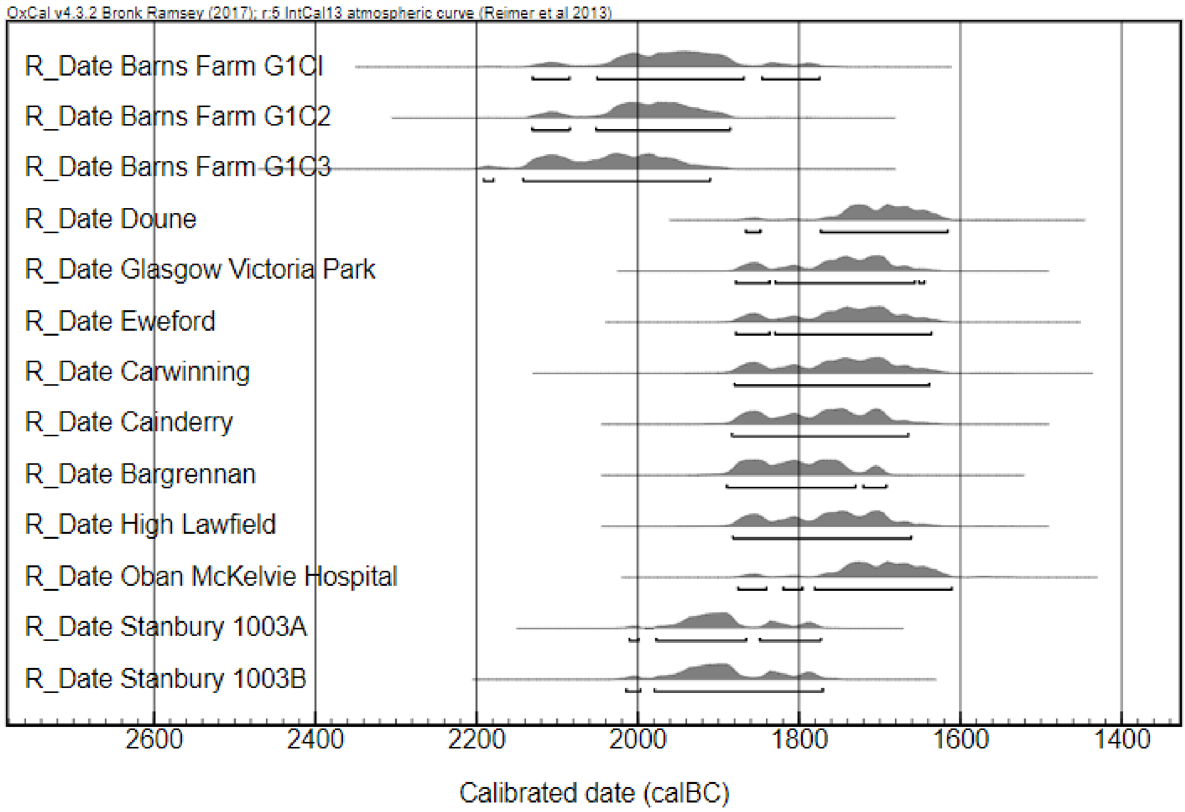


Figure 5.4: The calibrated dates of battle-axes with known dated stratigraphic and spatial associations – Those sites that have more than one date are represented more than once.

Table 5.7: A table showing the different petrological rock types and groups used for the manufacture of the battle-axes analysed

ID	Implement	County	Accession	Locality	Petrology
1	B-A	ABN	NMS EP 2	Broomend of Crichie	XXVII
2	B-A	ABN	NMS AH 202	Mid Clova	XXVIII c
3	B-A	ABN	NMS AH 225	Thistley Crook Farm	porphyrite (ns)
5	B-A	ANG	NMS AH 142	Burnside Mill	XXVII
11	B-A	AYR	NMS EQ 65	Chapleton Farm	plagioclase orthopyroxene amphibole quartz granulite
12	B-A	AYR	NMS EP 57	Nith Lodge	Unknown
21	B-A	BNF	NMS AH 104	Unknown	quartz syenite
22	B-A	BRW	NMS EQ 322	Hagg Wood, Foulden	XXIX
24	B-A	BRW	NMS AH 151	Lauder	XXVII
26	B-A	CAT	NMS AH 175	Wick	unknown
27	B-A	LAN	Manchester 1990.2	Failsworth	unknown
40	B-A	CUM	Carlisle 16.1953	Solway Moss	epidiorite
41	B-A	CUM	Carlisle 41.1932	Stanger Farm, Embleton	ash
68	B-A	EL	NMS AH 108	Longniddry	garnet amphibolite
72	B-A	FIF	NMS AH 230	Cluny Muir, Thornton	unknown
73	B-A	FIF	NMS EQ 916	Barns Farm	porphyritic olivine basalt
74	B-A	FIF	NMS AH 57	Ballinbreich, Newburgh	XXVII
75	B-A	FIF	NMS AH 185	Barlass, Newport	XXVII
79	B-A	IOM	MNH 1954-0593	Knockaloe	unknown
80	B-A	IOM	MNH 1954-0617	Foxdale	Unknown
82	B-A	IOM	MNH 1954-2801	Jurby	Unknown
84	B-A	IOM	MNH 1971-0201	Cronk Y Voddy, Ballageeil	Unknown
85	B-A	IOM	MNH 1980-0406	Ballakilley	fine grained grey sandstone
102	B-A	LNK	NMS AH 136	Westside Wood	XXXI
104	B-A	MLT	NMS AH 93	Cobbinshaw Lock	XXVIII
105	B-A	MLT	NMS AH 116	Cranstown	mudstone (ns)
106	B-A	MLT	NMS EQ 64	Pentland	unidentified (ns)
114	B-A	MRY	NMS AH 60	Elgin	XXVII
118	B-A	NOR	BM Sturge 470	Seghill	quartzite (ns)
119	B-A	NOR	Newcastle 1932.14.3	Rothbury	unknown
132	B-A	NOR	BM Sturge 471	Holystone	XVIII
133	B-A	NOR	Newcastle 1904.6	Newcastle, Barras Bridge	unknown
135	B-A	ORK	NMS AH 36	Whitehall, Stronsay	porphyritic olivine basalt
137	B-A	ORK	NMS AH 133	Stromness, Sandwick	XXVII
140	B-A	PBL	NMS AH 137	Ladyurd	tholeiite
143	B-A	PER	NMS EQ 610	Doune	altered porphyritic igneous rock
144	B-A	PER	NMS AH 106	Grantully	Unknown
145	B-A	PER	NMS AH 44	Mugdrum Island	quartzite (ns)
153	B-A	ROS	NMS AH 221	Balnagown	XXVII
164	B-A	SHE	NMS HD 1024	Ness of Gruting	banded metamorphic rock
165	B-A	SHE	NMS HD 1025	Ness of Gruting	banded metamorphic rock (ns)
166	B-A	SHE	NMS HD 1026	Ness of Gruting	fine grained red sandstone (ns)
169	B-A	SUT	NMS AH 239	River Fleet	XXVII
188	B-A	WIG	Stranraer 2008.24.5	Cairnderry	Granite
189	B-A	WIG	NMS EQ 486	Sandmill Farm	XXVIII (XVIII)
190	B-A	WIG	NMS AH 45	Portpatrick	near XXVIII
217	B-A	Y	BM 2010,8035.20	Loose Howe	unknown
228	B-A	Y	BM 76 4-10 34	Western Howes	unknown
229	B-A	Y	BM 76 4-10 46-47	Herd Howe	unknown
230	B-A	Y	BM 79 12-9 1062	Rudston	XV
231	B-A	Y	BM 79 12-9 107	Ganton	dolerite
233	B-A	Y	BM 79 12-9 1175	Goodmanham	lithic sandstone
234	B-A	Y	BM 79 12-9 605	Cowlam	dolerite
235	B-A	Y	BM 82 3-23 23	Hambleton Moor	unknown
240	B-A	Y	ShM J.1923.38	Blackburn Brook, Sheffield	unknown
241	B-A	Y	ShM J.93.10	nr Scarborough	XVIII
244	B-A	Y	ShM J.93.9	11m E of Pickering	dolerite
253	B-A	Y	Yks Mus 1022.1948	York	Unknown
258	B-A	Y	Yks Mus 1030.1948	Duggleby	Unknown
280	B-A	Y	Yks Mus 1048.1948	Unknown	Unknown
301	B-A	Y	Yks Mus 1090.1948	Cawthorn, Stackyard	Unknown
308	B-A	Y	Yks Mus 4824.2000	Ravensworth	Unknown

Table 5.8: A table to demonstrate the stratigraphic and spatial associations with calibrated dates of battle-axes

ID	Acc. No.	County	Locality	Stage	Butt Shape	Feature	Cremation	Inhumation	Urn, unknown type	Collared Urn	Cordoned Urn	Food Vessel	Accessory vessel	Worked flint	Arrowhead	Flint dagger	Bronze Chisel	Bronze Knife/dagger	Bronze Pin	Copper dagger	Bone pin	Bone toggle	Bone belt hook	Earrings	Whetstone	Razor	Jet	Stone ball	Radiocarbon date - Oxcal 4.3 1∑ (*averages taken for multiple **Bradley, 2011)
622	?	WIG	Bargrennan	IV	e	Cairn	x			x													x						1890-1693 CAL BC
73	NMS EQ 916	FIF	Barns Farm	I	a	Barrow	x	x				x																	2151-1857 CAL BC*
1	NMS EP 2	ABN	Broomend of Crichie	IV	e	Stone circle/Cist	x								x														1850-1650 BC**
188	Stranraer 2008.24.5	WIG	Cairnderry	III	d	Cairn	x						x																1884-1665 CAL BC
578	Kelv ?	AYR	Carwinning	?	?	Cairn				x							x?												1881-1639 CAL BC
143	NMS EQ 610	PER	Doune	III	a	Cist		x				x																	1867-1616 CAL BC
623	?	EL	Eweford West	V	d	Pit	x															x							1879-1637 CAL BC
565	Hull 26.7.426	Y	Garton Slack	II	c	Barrow		x					x			x											x		1879-1645 CAL BC
625	Kelv 55-96	REN	High Lawfield	IV	b	Cairn	x																						1883-1662 CAL BC
596	NMS EQ 251-2	ARG	Oban Mckelvi Hospital	IV	a	Cremation	x				x																		1876-1611 CAL BC
552	Bradford Museum	Y	Stanbury	III	?	Pit	x			x			x								x		x	x					1960-1780 CAL BC*

5.5 Typological Context: Axe-hammers

Roe classified axe-hammers as stone implements with a perforation, a length of over 190mm and a breadth of over 80mm (Roe, 1966; 1967; 1968; 1979). She divided them into two groups, Class I for those with a convex profile or with parallel upper and lower surfaces; and Class II for those that are concave in profile. Their shapes reflect the shapes of Early battle-axes, particularly the dished surfaces and un-expanded butt and blade, although the position of the perforation is most often towards the butt, whereas it is more often central with battle-axes. Frequently, they are very crudely shaped and are occasionally weathered, but finer examples that retain a smooth surface also exist. A small number are decorated with fluted grooves running their length. This an attribute of the Class I Axe-hammer and is more common in south-west Scotland and relatively rare elsewhere (Roe, 1967, 69; Fenton, 1988, 115). Axe-hammers exist in much larger numbers than battle-axes, with a considerable amount in Scotland. They often occur in nuclei, such as those in south-west Scotland, which suggests regional preferences were at play (Fenton, 1984, 217; Needham, 2011).

The typological and chronological sequences for axe-hammers are less well understood than those of battle-axes. The reason for this lies mostly in the lack of spatial and stratigraphical contexts. Axe-hammers are most often stray finds, mostly discovered by farmers. Due to this, and their lack of associated objects radiocarbon dates,chronological sequences are difficult to generate (see table 5.9).

Table 5.9: A table showing the axe-hammer associations from the spatial and stratigraphic contexts from northern Britain and the Isle of Man.

Acc. No.	County	Locality	Stage	Butt Shape	Feature	Cremation	Inhumation	Urn, unknown type	Collared Urn	Cordoned Urn	Food Vessel	Accessory vessel	Worked flint	Arrowhead	Flint knife/dagger	Bronze Chisel	Bronze Knife/dagger	Bronze Pin	Copper dagger	Bone pin	Bone toggle	Bone belt hook	Earrings	Whetstone	Razor	Jet	Stone ball
Dmfs 1965-360	DMF	Whitehall Farm	2	n/a	Cairn																						
Dmfs 1965-367	DMF	Chanlockfoot (penpont)	1	n/a	Cairn																						
Dmfs 1965-368	DMF	Auldgirth	1	n/a	Cairn																						
unknown	AYR	Kirk Michael	1	n/a	Cairn										x												x
unknown	ARG	North Fumerary	1	n/a	Cairn																						
Rochdale 9010204/2711	LAN	Milnrowe, Rochdale	1	n/a	Barrow	x			x																		
unknown	ABN	The Blue Cairn of Ruthven	1	n/a	Cairn																						
unknown	ARG	Dumbarton Shore	1	n/a	River																						
Kirk 5249	KRK	River Cree	1	n/a	River																						
Lancaster LM 286	LAN	Dolphinholme, River Wyre	1	n/a	River																						
Bolton 38	LAN	River Lune	1	n/a	River																						
Hawick	ROX	River Hawich, Denholm hill	1	n/a	River																						
NMS AH 140	DMF	Douglas Farm	1	n/a	River																						
NMS AH 73	REN	Mearns	1	n/a	River																						
Manchester 1998.353	CH	Dickens Wood	1	n/a	Mine Spoil Heap																						
NMS AH 224	KRK	Grange Farm, Urr	1	n/a	River																						
NMS AH 52	FIF	River Tay, nr Newburgh	1	n/a	River																						
NMS AH 238	AYR	Lugar Water, Lugar	1	n/a	River																						
unknown	LAN	Cliviger Law House	?	n/a	Cairn	x		x																			

5.6 Petrological context: Axe-hammers

The petrological identification of axe-hammers is very similar to that of battle-axes. Roes' 1979 article in *Stone Axe Studies* identified a total of eight petrological groups used to manufacture southern English axe-hammers. They are as follows: Group I, uralitized gabbro; XII, picrite; XIII, spotted dolerite; XIV, camptonite; XV, micaceous sub-greywacke; XVIII, quartz dolerite; XIX, greywacke; XXIII; graphic pyroxene granodiorite/quartz dolerite. She noted groups XII and XV axe-hammers occurred in the west while XVIII axe-hammers were found in eastern England. Although her findings were limited to southern England, Roe did suggest that it is likely the use of several groups in the manufacture of axe-hammers also extended to the north of the country, in particular groups XV and XVIII (Roe, 1970, 30).

As mentioned previously, Fenton's work on the source and manufacture of battle-axes and axe-hammers concluded that cobbles were, in fact, better sources for battle-axe and axe-hammer blanks than scree and outcrop sources (Fenton, 1984, 241). The diverse nature of the rock types used for the manufacture of axe-hammers in Scotland was also demonstrated. The relative proportions of rock type were noted as follows: 66.8% greywacke; 22.7% basic and intermediate igneous rocks; 0.5% metabasites; 10% other rock types (Fenton, 1984, 217).

The Implement Petrology Group database further demonstrates the variability of rock types used in the manufacture of axe-hammer across Britain. Of the 709 axe-hammers from northern Britain and the Isle of Man, 157 different rock petrologies were used in their manufacture (for the petrologies of analysed axe-hammers, see table 5.10). The most numerous rock petrologies and petrological groups used are as follows: 137 Group XXVII, greywacke; 26 greywacke from other sources; 116 Group XV, micaceous sub-greywacke; 86 Group XVIII, quartz dolerite; 52 Group XII, picrite; 22 dolerite; and 20 sandstone (Clough & Cummings, 1988). Figure 5.5 shows the areas where particular petrological groups were used for the manufacture of axe-hammers.

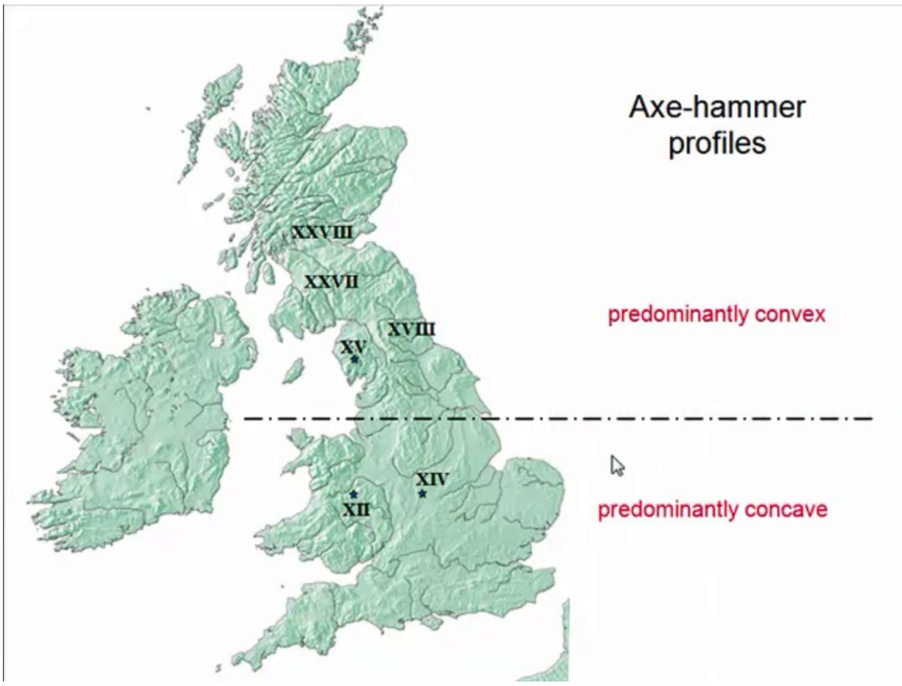


Figure 5.5: A map indicating areas with preferred petrological groups used for axe-hammer manufacture (Needham, 2011)

Table 5.10: A table showing the different petrological rock types and groups used for the manufacture of the axe-hammers analysed

ID	Implement	County	Accession	Locality	Petrology
4	A-H	ABN	NMS AH 191	Turriff	XXVII
7	A-H	ANG	NMS AH 98	Tannadice, Forfar	XXVII
15	A-H	AYR	NMS AH 14	Preston, Colmonell	porphyritic olivine basalt
16	A-H	AYR	NMS AH 147	Colmonell	XXVII
37	A-H	CH	Manchester 1998.353	Dickens Wood	unknown
38	A-H	CH	Manchester 25939	Chelford	XV
42	A-H	CUM	Carlisle 118.1977.2	no provenance	unidentified (ns)
43	A-H	CUM	Carlisle 119.1961	Brougham	sandstone
44	A-H	CUM	Carlisle 1916.37	nr Silloth	greywacke
45	A-H	CUM	Carlisle 2015.76.7 EF3667	Woodend	unknown
46	A-H	CUM	Carlisle 27.1926 331	Kirkbride	greywacke
47	A-H	CUM	Carlisle 69.1950	?Wolsty Bank	grit
48	A-H	CUM	Carlisle 83.1962	Gilgarran	VI
49	A-H	CUM	Carlisle A 11 210	Grinsdale	XV
50	A-H	CUM	Carlisle L43	Skelsmergh	XV
51	A-H	CUM	Carlisle R.1.	nr Wigton	XV
52	A-H	CUM	Carlisle R.2	Ireby	picrite
53	A-H	CUM	Carlisle R.41	Aspatria	XV
54	A-H	CUM	Carlisle RF 28	Ulveston	unknown
58	A-H	DMF	NMS AH 1	Westhills Farm	quartzite (ns)
59	A-H	DMF	NMS AH 11	Lochmaben	Unknown
65	A-H	DMF	Dmfs 1965-360	Whitehall Farm	XXVII
66	A-H	DMF	Dmfs 1965-367	Chanlockfoot (penpont)	near XXVII
67	A-H	DMF	Dmfs 1965-368	Auldgirth	XXVII
70	A-H	EL	NMS AH 215	Athelstaneford	XXVII (XV)
71	A-H	FIF	BM 562,9-5,1	Balmerino	porphyritic olivine basalt
83	A-H	IOM	MNH 1954-6684	Bishop's Demesne	unknown
88	A-H	KRK	NMS AH 171	Minnigaff	XXVIII (XVIII)
91	A-H	KRK	NMS AH 224	Grange Farm, Urr	sandstone
97	A-H	LAN	Manchester 25927	Upper Pike Lane/Hill, Rawtenstall	unknown
98	A-H	LAN	Manchester 38351	Heaton Chapel (Great Manchester)	XV
103	A-H	LNK	NMS AH 50	Aikbrae	metagreywacke
108	A-H	MLT	NMS AH 16	Leith, Edinburgh	porphyritic basalt
116	A-H	NOR	Newcastle 1891.3	Edgewell, Prudhoe	XVIII
117	A-H	NOR	Newcastle 1899.2	Whaggs Estate	XVIII
120	A-H	NOR	Newcastle 1933.38	Ingleton and Headlam - between Scot's Dyke	unknown
121	A-H	NOR	Newcastle 1938.18	Felling	unknown
122	A-H	NOR	Newcastle 1939.10	Alnwick, North Charlton	unknown
123	A-H	NOR	Newcastle 1942.10	Gunnerton qy, Barrasford	unknown
124	A-H	NOR	Newcastle 1945.1	Sunderland	greywacke
126	A-H	NOR	Newcastle 1973.3	Blackhall Mill	unknown
129	A-H	NOR	Newcastle 1981.5	Corbridge	unknown
131	A-H	NOR	Newcastle 1992.4	Felton	unknown
149	A-H	PER	NMS AH 237	near Perth	gabbroic troctolite
154	A-H	ROS	NMS AH 249	Ballavullin	metamorphic rock (ns)
161	A-H	ROX	NMS AH 212	Nisbet Hill Moor	porphyritic olivine basalt
181	A-H	WIG	NMS AH 21	Machermore	diorite
182	A-H	WIG	NMS AH 22	High Clone	XXVIII c
183	A-H	WIG	NMS AH 226	Whithorn	Unknown
185	A-H	WIG	NMS AH 26	Cunningham Farm	XXVII
206	A-H	WIG	Stranraer 1945.01	Culmore	coarse greywacke
207	A-H	WIG	Stranraer 2002.15	Blairbuy	Sandstone (greywacke)
238	A-H	Y	BM Sturge 460	Kirklington	unknown
243	A-H	Y	ShM J.93.3	Sherburn	near XVIII
268	A-H	Y	Yks Mus 1036.1948	Hutton Cranswick	Unknown
270	A-H	Y	Yks Mus 1037.1948	Strensall	Unknown
281	A-H	Y	Yks Mus 1051.1948	Fimber	Unknown
293	A-H	Y	Yks Mus 1063.1948	Grosmont	Unknown

5.7 Chronological context: Axe-hammers

An axe-hammer chronological sequence has not yet been attempted due to the lack of dating and contextual information. It has been suggested that they are contemporary with battle-axes and their form is, of course, very similar to early battle-axes. Smith suggested a date range from c.1650 to c.1250 bc (1447-1476 CAL BC OX 1σ) while Needham stated that their form suggests they were used for much of the Early Bronze Age up until his Period 4 (figure 5.6) (Smith, 1979, 16; Leahy, 1986, 146; Needham, 2011). An axe-hammer from Cleethorpes, South Humberside, was found with the remains of its wooden haft in the peat deposit associated with a submerged forest. Radiocarbon dates from the wooden haft gave two dates, 1941-1452 CAL BC (OX 1σ) from the alkali and acid resistant material in the haft and 1882-1422 CAL BC (OX 1σ) from the humic acid in the haft, placing it within the EBA, although it is thought to have been incorporated into an earlier peat deposit (Leahy, 1986, 143 & 146).

There is also a small number of dates relating to axe-hammers in southern Britain which suggest their use extended from the end of the EBA and ceased in the Middle Bronze Age (MBA). At Barmstone 'crannog', a Bronze and Iron Age lake-dwelling in North Humberside, three broken axe-hammers were found in a group beside a bank of gravel and were, like the rest of the occupation debris, lying on a bed of shells linked to the initial occupation of the site in the MBA. Radiocarbon dates taken from two structural timbers in the dwelling date it to 1530-810 Cal BC, but it is impossible to be sure the axe-hammers were related to these dates (Varley, 1968, 12-24).

An axe-hammer was found associated with another settlement site at Billingborough, Lincolnshire, where it was found lying on a gravel subsoil outside two enclosures. Radiocarbon dates sourced from the settlement enclosure ditch were between 1530-1260 Cal BC and 800-370 Cal BC (Chowie, Fitzpatrick & Andrews, 2001, 5). The date also places the axe-hammer at the end of the EBA and start of the MBA. However, these dates are not securely associated with the axe-hammer (Leahy, 1986, 146). The latest date came from the tip of an axe-hammer found at the base of an ard furrow in a MBA field system at Gwithian, Cornwall. 1300-1100 Cal BC, was given for the layer the tip was within (Thomas, 1970, 13). Unfortunately, the tip no longer exists, so it is impossible to confirm if it was the tip of an axe-hammer used as an ard point or the tip of a regular ard point. No other examples of axe-hammers used as ard points exist. It is possible an axe-hammer was used for this purpose; it may have been an earlier implement re-used in the MBA.

While there is limited dating evidence for axe-hammers, due to their single deposition with no other associated items, their similarity in form to battle-axes is generally accepted they are dated to the EBA (Needham, 2011). It is possible that some axe-hammers were re-used in later periods long after their production ceased. The Cleethorpes example dates to the beginning of the MBA which may also demonstrate the production and use of these implements extended into the start of the MBA. However, it should also be noted that these MBA dates are in the most part indirectly associated and therefore cannot be taken as secure dating evidence.

Additionally, a small number of axe-hammers (n=7) are directly associated with burial deposits. Their treatment and associations during the burial process are similar to the treatment and associations of the battle-axe deposits in burials during the EBA. Common EBA burial modes were used for the deposition of these implements. They were deposited into cairns on six occasions and within a barrow on one. One axe-hammer was found associated with a stone ball and a flint knife (Smith, 1895, 183), which are objects used in burial practice during the EBA. The radiocarbon dates and associations place the use of axe-hammers in the EBA, although they may have been re-used in the MBA. The re-use of stone implements in later periods is similarly evident with Neolithic polished stone axes. They are also often found on many Bronze and Iron Age sites, such as in ditches, pits and post-holes of buildings. Bradley has interpreted them as relics, used to evoke connections with the mythical or ancestral past (Bradley, 2012, 150).

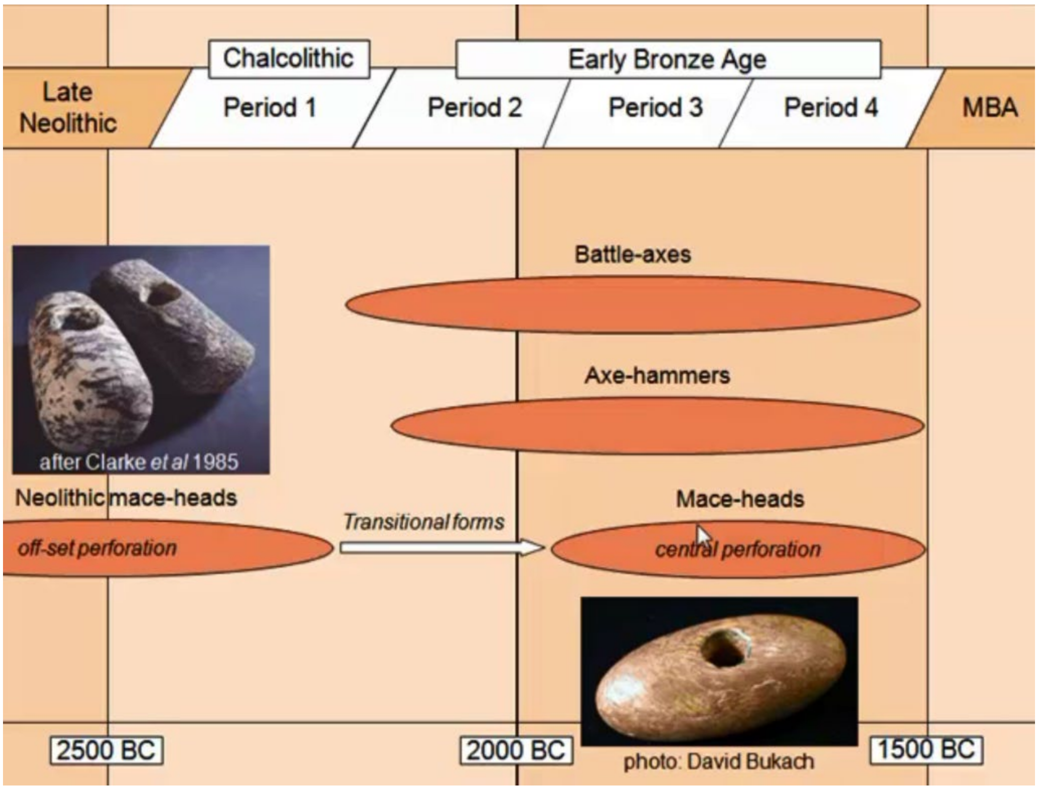


Figure 5.6: Needham's timeline for the use of battle-axes, axe-hammer and mace-heads (Needham, 2011) - note that dates for Neolithic mace-heads are now likely to be much earlier, beginning in the Middle Neolithic (Jones et al., 2017).

5.8 Spatial and stratigraphic context: Battle-axes

The spatial and stratigraphic context signifies the associations the implement was related to within and outside the depositional context. This includes the depositional unit, such as a pit or burial; the associated items of the depositional unit; the area of activity; the site; and finally, the region (Hodder & Hutson, 2003, 173).

The following section will focus on the spatial and stratigraphic context by the typology of battle-axes. The battle-axes of each typology will then be grouped into feature type, such as cist, barrow, river and so on. Only those with depositional information are included. Summaries of the context, including feature type, associated burial practices and artefacts, and finally regional variation will follow to demonstrate similarities and differences between the battle-axe stages.

5.8.1 Stage I

Nine battle-axes of Stage I type have depositional information, eight of these were found in Scotland. The ninth was discovered on the Isle of Man. One Stage Ic battle-axe was either dredged or fished out of a river, NMS AH 224; ID 91, from the River Kales. This implement is not directly associated with other items. However, three Late Bronze Swords were also dredged from the River Tay close to Mugrdum Island (PSAS, 1969, 201-2; Evans, 1897, 193-4; Anderson, 1886, 173, 315-16). Their discovery suggests that these may be part of a hoard or votive deposit, although it is also possible river finds were once deposited in land and have since fallen into the river from erosion processes and the changing course of rivers.

Figure 5.7: Stage I battle-axe NMS AH 142 from Burnside Mill, ID 5 (Image: author)

Three further battle-axes of Stage Ic were deposited in cists, NMS AH 106; ID 144, from Grantully, NMS AH 142; ID 5, from Burnside Mill, and MNH 1954-0593; ID 79, from Knockaloe. The former is said to have come from a mound containing several cists and was associated with a stone circle, although no further information was recorded. No further information was recorded for the Burnside Mill battle-axe either (figure 5.7) (PSAS, 1893, 70; Stuart, 1967, 197; PSAS, 1914, 16). The third battle-axe came from a short cist that was discovered at Knockaloe, Parish of Patrick in the Isle of Man. The cist was made up of stone, floored with four rough stone slabs and covered by a stone slab. It measured 1070mm x 300-

560mm x 460mm high. Two worked flints, and a Stage Ic battle-axe laid upon the cist flour. No sign of bone or pottery remained but it is likely a burial was deposited and has since disintegrated (Woodcock, 2001, 298-8; 398). Due to the size of the cist is it probable that it contained an inhumation deposit.

A Stage Ia battle-axe from Hagg Wood, ID 22, was discovered beneath a cairn which contained three cists (Craw, 1914). The excavation report shows the battle-axe was related to the first phase of the construction of the cairn. It lay on the original ground surface which makes a contemporaneous placement with two primary cists, A and B. Cist A contained the cremated remains of an adult, a Food Vessel, two flint knives, and two flint scrapers. Cist B contained a Food Vessel and two flint scrapers, but no human remains. Nothing was found in the third cist which had been disturbed (Craw, 1914).

Three battle-axes come from more unique depositional contexts. The Stage 1a battle-axe from Barns Farm, Fife, NMS EQ 916; ID 73, was recovered from a grave in a 'complex cemetery'. According to Wilkin these often take the form of cairns, kerbed cairns and barrows which are part of the changes in burial associated with late Beakers and the introduction of Food Vessels into Northern England and Eastern Scotland (Wilkin, 2013, 132-150). Such cemeteries are comprised of more than one burial tradition and frequently different forms of burial; for instance, inhumation and cremation deposits, and burials in cists, pits and graves. Activity on the site began with a phase during the Neolithic, evident from a scattering of pottery and a pit containing marine shells with the Neolithic dated to 3431-3378 cal BC. The later phase of the site saw a diverse Early Bronze Age cemetery made up of six cists, three earthen graves, two hearths and several pits, once enclosed under a barrow. Several of the cists contained a floor of cobbled white pebbles found to be covered by an animal hide which the body rested on. Cist six contained the cremated remains of two individuals accompanied by a bronze awl, while jet pendants and shale beads accompanied the burials in cist four, and cist five contained two jet spacer beads from a four-stranded lunulate necklace (Wilkin, 2013). Men, women and children were present in the cists and pits, and those deposited in pits were cremated. The excavation report describes three graves containing inhumations and one or more cremation deposits within wooden coffins that were arranged amongst the cists (Watkins, 1982). They are contemporary. Grave three also contained a plano-convex knife, a slug knife and a copper dagger and Grave two contained a Food Vessel. The battle-axe was found in Grave One close to face of the adolescent (possibly male) inhumation, with the blade facing upwards. Its haft was visible from the darker soil which ran a few centimetres down the wooden coffin, over a cremation deposit, and towards hands of the inhumed body. A further two cremations and a tripartite lugged Food Vessel were present in the grave, thought to be a single-phase deposit (figure 5.8). All deposits were placed within the same stratigraphic layer and are thus all spatially associated and were dates to 1870-1530 CAL BC (Watkins, 1982; Sheridan, 2003). Examples of other complex cemeteries include Hasting Hill, County Durham, Alwinton 202, Northumberland, and Millfield North henge, Northumberland.

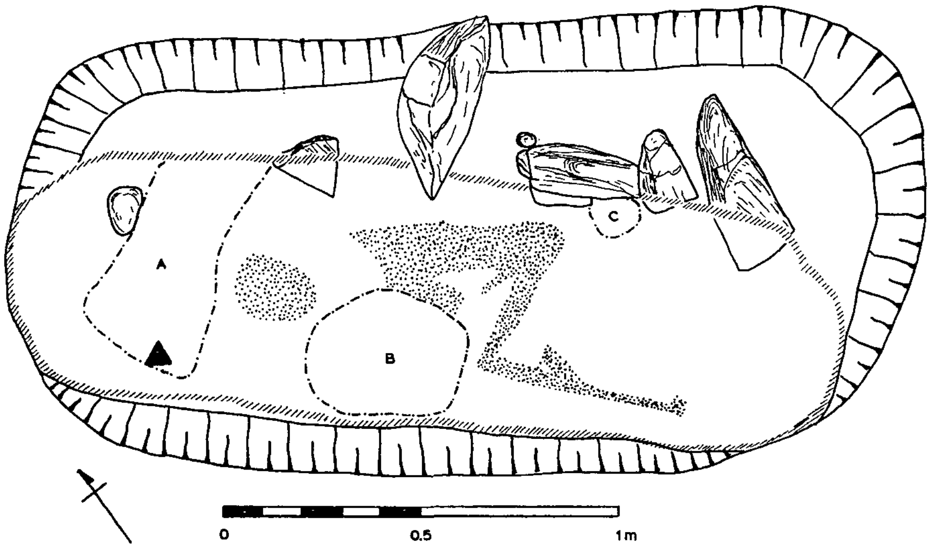


FIG 9 Grave 1. Plan. The three cremation deposits are labelled: A = Cremation 3; B = Cremation 2; C = Cremation 1. Cf pl 7

Figure 5.8: An illustration of Grave One, Barns Farm, ID 73. A = cremation 3; B = cremation 2; C = cremation 1; the battle-axe was found in front of the face, between A and B (Watkins, 1982, 71)

The other unique contexts are the two battle-axes from the Ness of Gruting house site 1, Shetland, half of a miniature Stage Ic battle-axe, NMS HD 1025; ID 165, and a finished Stage Ic battle-axe, HD 1026; ID 166. The former was found between the heart of the building and the opening of the apse while the later was found within peat ash in the western arc of the building. Also found in the building, indirectly associated, were several grinding stones, a miniature Stage IIb battle-axe, a mace-head, polished stone axes, two stone balls, two Bronze Knives, and a spear (Calder, 1958, 373-375).

5.8.2 Stage II

Eight Stage II battle-axes have depositional information. Six are from barrows, one from Northumberland and five from Yorkshire. A Stage IIa battle-axe from Seghill, Northumberland, BM Sturge 470; ID118, was found within a cist which also contained an inhumation of unknown sex or age (figure 5.9) (Evans, 1872, 186). Those from Yorkshire are as follows. A Stage IIb battle-axe, ID 227, was found associated with a cremated burial in a barrow on Danby North Moor, North Yorkshire; no other information is known (Evans, 1972, 189; Smith, 1925, 99; Elgee, 1930, 96). Two Stage IIa battle-axes came from barrows at Ganton, North Yorkshire; ID 231, and Huggate Pasture, East Yorkshire; ID 236. Barrow 18, part of the Ganton group of barrows, contained a central grave placed upon and covered with a number of large flints. The grave fill was made up of a quantity of chalk rubble amongst which inhumation fragments were recovered as well as fragments of two unknown vessels and a worked flint flake. Beneath the fill lay the cremated remains of an adult and a Stage IIa battle-axe placed on the south-west side of the burial. A flint end scraper and knife were found in the mound material, indirectly associated with the battle-axe (Greenwell, 1877, 158; Kinnes & Longworth, 1985, 36-7). The battle-axe from the barrow at Huggate Pasture was found associated with a fragmented urn of an unknown type. An adult inhumation and a piece of red deer antler showing signs of working were found close to this deposit and are thought to be from the same burial deposit (Mortimer, 1905, 312).

Figure 5.9 Stage II battle-axe from Seghill BM Sturge 470, ID 118 (Image: author)

The two final battle-axes from Yorkshire are Stage IIc. The example from Cranswick II barrow at Rudston, East Yorkshire, BM 79,12-9,2062; ID 217, was found in indirect association with two connecting graves below ground level. The grave was the third and final extension of the initial oval cut grave which contained the inhumated remains of a male on his left side. Several associated objects were found between the knees and the skull of the individual. These include a bronze flat riveted dagger with an ox-horn handle located close to the skull; a schist sponge finger; an engraved jet ring; two jet buttons, one plain and another engraved; and a flint and worn piece of pyrite which Greenwell described as a 'flint and steel' strike-a-light (i.e. fire starting kit). An extension to this grave to the south-west formed the second grave of the barrow. A male inhumation was found here contracted on his left side surrounded by associated grave goods. These also included jet buttons beneath the back of the skeleton and a strike-a-light. A final grave extension existed towards the north of the previous grave described. It contained the inhumated remains of an older male laid upon his left side. A bronze razor knife with an ox-horn handle was placed in front of the face, with the blade pointing away from, and the Stage IIc battle-axe was behind the shoulders (Kinnes & Longworth, 1985, 76-7). A total of ten interments were placed in the barrow, they seem to be non-contemporaneous due to their placement in different stratigraphic layers.

The other Stage IIc battle-axe came from Garton Slack long barrow, Yorkshire; ID 565. The deposit accompanied an inhumation deposit, a jet button and an Accessory Vessel with a flint dagger leaning against it. In total, the mound contained fourteen crouched inhumations and one cremation deposit (Mortimer, 1905, 209). Other finds included a Food Vessel accompanying a central inhumation; another inhumation was accompanied by worked flint, a stone pounder, and the lower left jaw of ox or deer near the left shoulder. The cremation was deposited within a Food Vessel with a bone pin (Mortimer, 1905, 210).

In Shetland the miniature Stage IIa battle-axe with a partial perforation, NMS HD 1024; ID 164, was found on the paving inside the wall face on the SE end at the Ness of Gruting, indirectly associated with the other two Stage I battle-axes also found at house site 1 (Calder, 1958, 373-375). Moreover, a Stage IIa, NMS AH 239; ID 169, battle-axe was dredged or fished from the River Fleet near Murray town, Sutherland.

5.8.3 Stage III

A similar number of battle-axes with depositional information exist in Stage III (figure 5.10). Nine battle-axes are spread across Scotland with a few also in Yorkshire. Those from Yorkshire are all from barrows, bar one from a pit, while the others come from two cists, two cairns, and a shell midden. Those from barrows are as follows:

A Stage IIIc battle-axe from Herd Howe, North Yorkshire, BM 76.4-10,46-47; ID 229, was found within the mouth of a Collared Urn. Nothing more is known regarding the sex or age of the cremated remains, nor is the stratigraphical position of this burial within the mound known. However, it is spatially, and most probably also temporally (due to the accompanying grave goods correlating with the use of Collared Urns and battle-axes) associated with several other interments within the stone mound. Seventeen vessels were uncovered overall, including Food Vessels, Collared Urns, and a Beaker, as well as three bone needles/pins all placing the burial firmly within the Early Bronze Age (Atkinson, 1864a; Atkinson 1864b).

The Stage IIIa battle-axe from Cowlam, East Yorkshire; ID 234, came from a barrow mound made up of earth and chalk rubble which contained several worked flints such as cores, scrapers and a leaf-shaped arrowhead (Greenwell, 1877, 222-224). A total of seven burials were present within the mound of both inhumation and cremation burial rites. Two graves were located just above the natural ground surface, connected by an opening 0.6 metres wide. The first contained two burials, the disturbed remains of an inhumation accompanied by three pot sherds and a conical jet button were amongst the earth within the grave. The secondary deposit of a male inhumation between the age of 18 and 24 years had been placed towards the south-east end of the grave. A Stage IIIa battle-axe was in front of the face, with its tip touching it. The hands were described as also being in front of the face, so it is possible the individual was buried holding the battle-axe up to his face. Two flint scrapers, a flint flake, and three pieces of jet were also found behind the head of the individual. The connected grave to the immediate north was a female (probably) inhumation lain upon a wooden floor. She had been wearing a pair of bronze earrings, similar in shape to basket-shaped earrings since the temporal areas were stained red; two pieces of jet were also located behind the head. It is unknown which burial was interred first but the location of the first burial may have been known and possibly is the reason for the location of the subsequent internment thus creating a direct association between the two interments and their associated grave goods.

The final Stage III battle-axe, ShM. J.93.9; ID 244, from a Yorkshire barrow, is from '11 miles east of Pickering', North Yorkshire; the exact location is no longer known. A cinerary urn containing cremated remains was found in the mound, nearby another urn and six worked flints. A further two cremation deposits were found within the mound. The battle-axe was located near to the surface along with a fragment of an urn; they are thought to have been disturbed by a plough (Bateman, 1961, 226-7; Evans, 1872, 176).

Figure 5.10: Stage III battle-axe from 11m East of Pickering ShM. J.93.9, ID 244 (Image: author)

The two Stage III battle-axes from chambered cairns came from Breckigo, Caithness, NMS AH 109; ID 25, and Cairnderry, Wigtownshire, Stranraer 2008.24.5; ID 188. Little is known about the Breckigo cairn in which the battle-axe was found along with a stone cup and ball, their association to one another is not known as the stratigraphical location is missing (Rhind, 1984, 107-8). On the other hand, at Cairnderry cairn a lot more information is known due to excavations in the early 2000s by Vicky Cummings and Chris Fowler (Cummings & Fowler, 2007). The monument consists of three chambers, and a passage set within a round cairn (figure 5.11). The earliest activity on the site was during the Neolithic, evident from disturbed clusters of early Neolithic potsherds in the topsoil. As well as fragments of early Neolithic Carinated Bowl to the north-west of the southern chamber, where the cairn had been previously robbed, there were a number of flints and one piece of Arran pitchstone from below the paving slab of the southern chamber. The construction of the monument is thought to have taken place in a single phase between the Early Neolithic and Early Bronze Age, completed before 1900-1700 cal BC, and is not seen as being contemporary or directly after the Early Neolithic activity. The stone cairn sits on a natural mound, with three stone chambers to the north-east, north-west, and south and a passage from the stone kerb surrounding the south-east end.

Figure 5.11: A plan of Cairnderry Cairn showing the location of pit one where the battle-axe was found, ID 188 (Cummings & Fowler, 2007)

Excavations revealed the re-use of the monument in the middle of the Early Bronze Age, c.1900-1700 cal BC, which saw the creation of a series of five pits containing the human remains of both adults and children around the southern side of the kerb. It is likely this is an area of importance which resulted in its re-use. Indeed, this area would have been highlighted by the rising sun in midwinter and solar movements are known to have held a degree of significance. Pit one was located directly outside the passage leading to the southern chamber and contained a Collared Urn containing the cremated remains of one or more adults. A Stage IIIc intermediate battle-axe was found to the east of the urn, with the shaft-hole running vertically so that the haft had stood up within the pit (figure 5.12) (Cummings & Fowler, 2007, 20). An Accessory Vessel was placed on the primary layer of charcoal and bone fragments beneath the battle-axe. A date for the pit was taken from the lowest context of bone, 1890-1660 cal BC. Samples taken from cremated remains in the other pits present similar dates, as do the associated material culture such as Collared Urns and the battle-axe, thus placing the construction of the pits firmly within the Early Bronze Age. The excavations also revealed the re-use of the site during the Middle Bronze Age. Cremated bone fragments found beneath the paving slabs of the southern chamber gave a date of 1440-1250 cal BC. Since there has been a degree of robbing in this area this context lacks security, nevertheless it does attest to activity on the site during this period.

Figure 5.12: An image of the Cairnderry battle-axe in Pit One, ID 188 (Image: Dr Chris Fowler)

Another Stage III battle-axe deposited in a pit is that from Stanbury, West Yorkshire, ID 552, and is the most recently known excavated example of a battle-axe in northern England. The 2007 excavation uncovered a large Collared Urn, inverted over its contents. The urn contained the cremated remains of a young male; a stone battle-axe; a bone belt-hook; a bone pin, Atkinson's skewer-pin type; an Accessory Vessel; and a pair of bronze ornaments, called 'basket-shaped earrings', but this is unclear due to their shrivelled and melted state. The burial was accompanied by two further Collared Urns (figure 5.13) (Richardson & Vyner, 2011). It appears this was a single depositional event dating to 1960-1780 CAL BC, which places the objects within the same spatial and temporal dimension. Indication of burning is present on all the burial goods found accompanying the cremation, Richardson and Vyner propose this is the result of their inclusion on the cremation pyre. It is not uncommon for

Accessory Vessels to be placed upon the cremation pyre, perhaps unfired, and the part-smelted metal of the earrings suggests they too accompanied the body on the cremation pyre. As for the battle-axe, it appears to have a brown colour suggesting it had been in contact with heat. Despite this, the lack of cracks and fractures, which are seen on the example from Bargrennan, Dumfries and Galloway, leads one to believe it was not placed upon the pyre but instead this effect may be from its placement within the urn containing the hot cremation. The urn also shows signs of heat alteration. It is possible the pit was part of a larger monument, perhaps a burial mound whose appearance among the Pennines and Yorkshire Moors was not uncommon in the Early Bronze Age. Another possibility is the association with a stone setting.

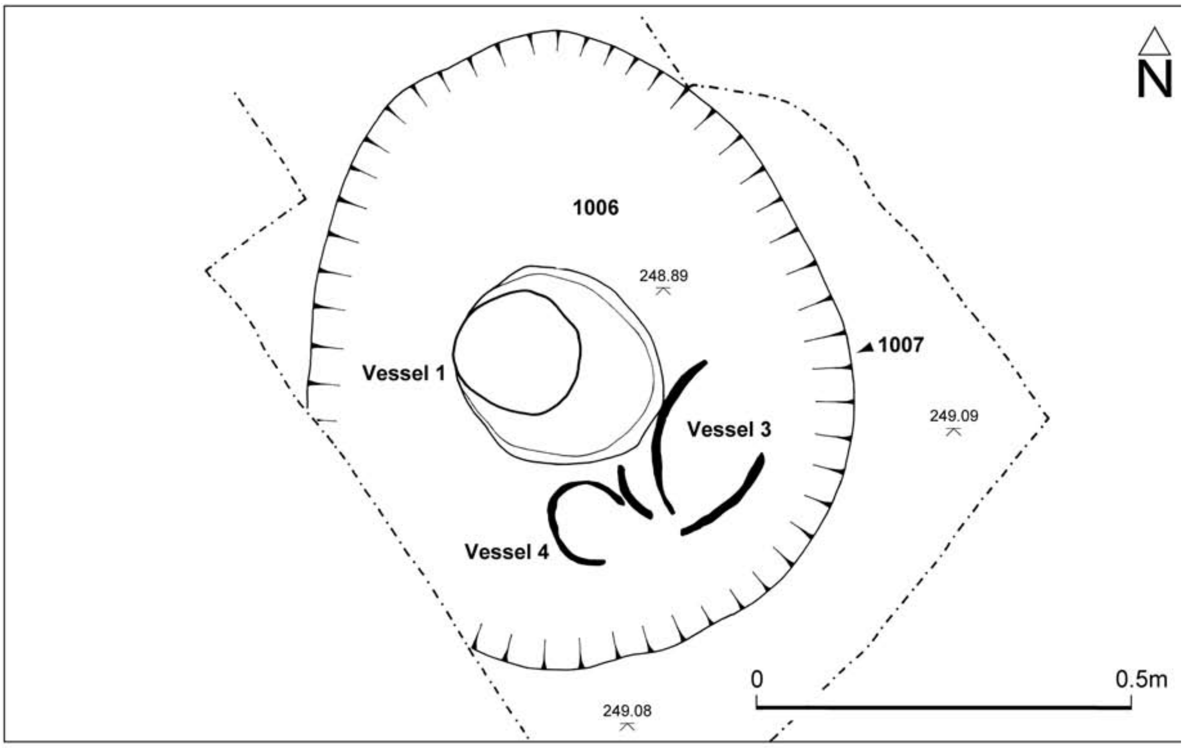


Figure 5.13: A plan of the pit and the three Collared Urns at Stanbury, ID 552 (Richardson & Vyner, 2011, 52)

The two Stage III battle-axes also come from cists. In March 1964 a Stage IIIe unfinished battle-axe, NMS AH 36; ID 135, from Whitehall, Stronsay, Orkney, was found next to a cist within which was an adult inhumation and a possible broken whetstone (Petrie, 1870, 136). It is thought that the cist was once covered by a barrow. Nothing else is known regarding the find. The Stage IIIa miniature battle-axe was in a cist at Doune, Perthshire. It was excavated during a rescue excavation which took place in 1954 at a quarry site approximately 137 metres north of the old railway station by J.R.C. Hamilton after the remains of a stone cist was uncovered during quarrying. Unfortunately, the southern portion of the cist was lost having fallen down the quarry face. The remaining cist had been placed within a specially cut pit, within which were the inhumated remains of a child, aged between five and eight years; only fragments and the skull and upper jaw were present. A small Food Vessel, a Beaker/Food Vessel hybrid, and fragments of a larger Food Vessel are thought to have been placed by the head of the child close to the miniature battle-axe which was also next to the head of the child.

Finally, the only example of a battle-axe found associated with a shell midden is the Stage IIId, NMS AH 35; ID 9, an unfinished example from the Island of Coll, Argyll and Bute, the Inner Hebrides. Several shell mounds or middens occupy the west coast of Coll, partly among the sand hills and partly on the level sand between the hills and the sea. They are made up of vast quantities of shells, mixed with sand, as well as peat, ashes, fragments of pottery and flint. A Stage IIId battle-axe was found within one, as were flint arrowheads (Clarke, 1970). It is not clear whether all these items came from one single mound or several. The date of these mounds is also uncertain.

5.8.4 Stage IV

The Stage IV battle-axes with depositional information number the largest group at fourteen implements. Their depositional features include barrows, cremation deposits, stone circles, a cist, a cairn and a river. As with the other stages, all those found within barrows are from Yorkshire. They are as follows:

The Stage IVd battle-axe from Western Howes, BM 76. 4-10, 35; ID 228, was from the central and largest barrow of a group of three on the Westerdale Moors, North Yorkshire. The barrow was found to contain two adjacent Collared Urns approximately 2.5 metres from its centre. One contained an amount of cremated remains as well as two burnt bone pins which may have been placed upon the funeral pyre. The Stage IVd battle-axe was found within the second Collared Urn which contained a small amount of cremated remains associated with an Accessory Vessel, a bone toggle, and fragments of four bone pins (Smith, 1925, 99; Longworth, 1984, 257; Historic England, 2017).

Another Stage IVd battle-axe was discovered at Goodmanham barrow 89, East Yorkshire, BM 79. 12-9, 1175; ID 233, accompanying the cremated remains of a person 18 years of age placed within a hollow in the ground surface (figure 5.14). A single piece of cremated pig bone and a fragment of a bone pin were found amongst the human bone. This burial appears to have been the second interment within the barrow. The initial burial in the burial mound was within an oblong grave containing two inhumed bodies, a "probably male" 17-year-old and a boy between the ages of 8 and 10 (Greenwell, 1877, 299), lying extended on their backs were within the grave placed head to foot – but the ages are not definitely known and have not been confirmed by modern analysis. A flint scraper, a bone pin and a nodule of burnt sandstone accompanied these bodies. The subsequent burials included both cremation and inhumation deposits. Accompanying material included Accessory Vessels and calcinated flint with several cremation burials, and a cinerary urn and jet pendant with an inhumation burial. Children, young persons, adults and elderly individuals are present among the inhumation deposits (Greenwell, 1977, 294-300).

Another Stage IVd battle-axe is the blade half of an example from a barrow noted to be two miles north of Pickering, North Yorkshire, ShM.93.22; ID 242. Little is known regarding this example. Bateman notes it was found in a field in which there is a barrow (Bateman, 1861, 237). The final Stage IV battle-axe is from a Yorkshire barrow is noted as being at Hambleton Moor, North Yorkshire, BM 82. 3-23, 23; ID 235, but no such place names are known. It has been assumed by the British Museum that it could be Hambleton Hills and therefore it is perhaps related to a barrow (British Museum, 2018). This context is insecure.

Figure 5.14: Stage IV battle-axe from Goodmanham, BM 79. 12-9, 1175, ID 233 (Image: author)

Two examples of Stage IV battle-axes have been found in association with stone circles, the Stage IVe battle-axe from Broomend of Critchie, Aberdeenshire, NMS EP 2; ID 1, and the

Stage IVd battle-axe from Nith Lodge, NMS EP 57; ID 12. Both examples are from more complex sites, each with a variety of features.

The Broomend of Crichie site was excavated by Dalrymple in 1884, and more recently by Richard Bradley. There is consequently a large amount of information known about this site, especially in comparison with the sites of other battle-axes. To understand the association the battle-axe has with the site the development of the site will be demonstrated.

The earliest phase of site activity was during the Neolithic, followed by intermittent grazing until 2400 BC. An avenue was later positioned across the site within which a series of portal stones were placed thereby monumentalising the site. The avenue changed direction at the position of the central shaft grave, which Bradley has considered to either be contemporary with the rows of monoliths or placed in an already significant location, taken into consideration during the construction of the avenue. The position of the monoliths and avenue were later adopted by a henge, enclosing the shaft grave at the point where the avenue changed direction. The earliest possible date the construction of the henge bank is 2410-1900 BC. The seven monoliths within the earthwork enclosure were then relocated, with one placed at the centre above the central shaft grave. The monoliths now consist of an arc or 'cove' surrounding the shaft grave (Bradley, 2011). An effort seems to have been made to emphasise the position of the central grave, perhaps to signify an area of significance for those with specific ancestral links, or from specific lineages to practice rituals of remembrance and commemoration. For example, during the Early Bronze Age, a series of cremated remains were placed in pits close to the monoliths. The cremated remains of both adults and children were uncovered, mostly associated with cinerary urns, in particular, Collared Urns, although a Vase urn was also present. Dates suggest an interval of at least a century between the building of the circle and the last use of the site, 1650-1500 BC, presenting a long period of intermittent activity at Broomend.

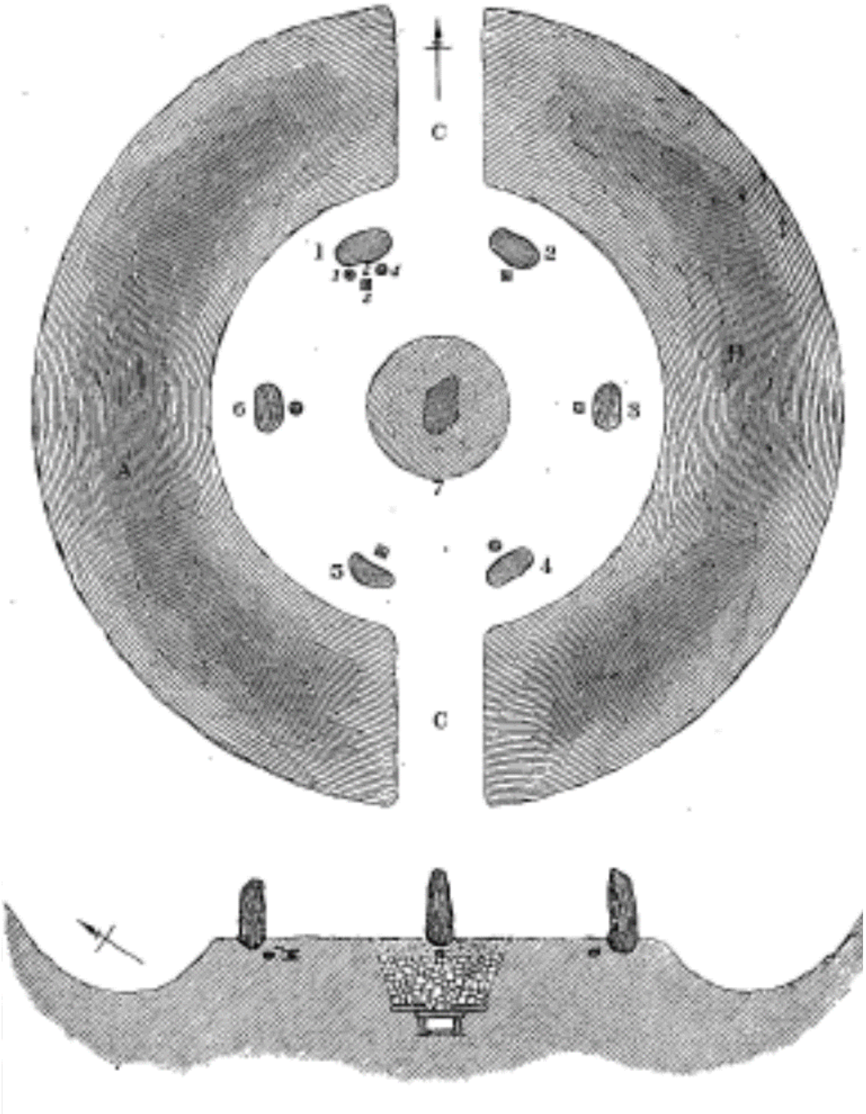


Figure 5.15: A plan of the Broomend of Critchie henge and stone circle. The battle-axe was discovered in front of stone 2, ID 1 (Dalrymple, 1884, 320)

The Stage IVe battle-axe from Broomend was discovered by Dalrymple near to a small circular cist containing a cremation, close to the northern portal stone (figure 5.15). Two other burials surrounding this monolith were also found during the initial excavation by Dalrymple in 1884 (Dalrymple, 1884, 321-2). Bradley's excavations discovered an amount of burnt bone, consisting of an adult and a child when excavating Dalrymple's spoil from his excavation of this feature. A burnt flint arrowhead was also recovered, thought to have accompanied the body/s on the cremation pyre. Bradley was uncertain this recent find came for the same deposit. His estimated date, 1850-1650 BC, from a series of radiocarbon dates associated with the battle-axe deposition, places it in a phase contemporary with the beginning of the building of a timber circle outside the henge.

The battle-axe from Nith Lodge cairn, Ayrshire, was excavated by Alexander Mcloud in 1937. This example presents a slightly different site to the other cairn deposits due to the presence of a stone circle. It is thought to have fifteen stones, forming the shape of an irregular ellipse (Mcloud, 1937). The bounded space enclosed part of a granite outcrop which rose to the surface towards the north-western kerb, and is thought to have been covered in a low cairn. A total of eight pits containing cremated remains were uncovered during excavation. Three of the pits contained pottery associated with cremated remains; Accessory Vessels were present in pits *a* and *b*, while pit *c* contained a Collared Urn placing the deposit firmly within the Early Bronze Age. An intermediate Stage IVd battle-axe was discovered lying near the edge of the granite outcrop in-between pits *a* and *b*, at point *d* on the plan (figure 5.16). The battle-axe is not directly associated with any of the pits, and despite its proximity to two of them this implement was shallower (Mcloud, 1937; Craw, 1913). Another Cairn exists within the same field which was also excavated by Mcloud. It consisted of a small stone circle within which an empty cist lay and covered by a cairn (Mcloud, 1937, 246).

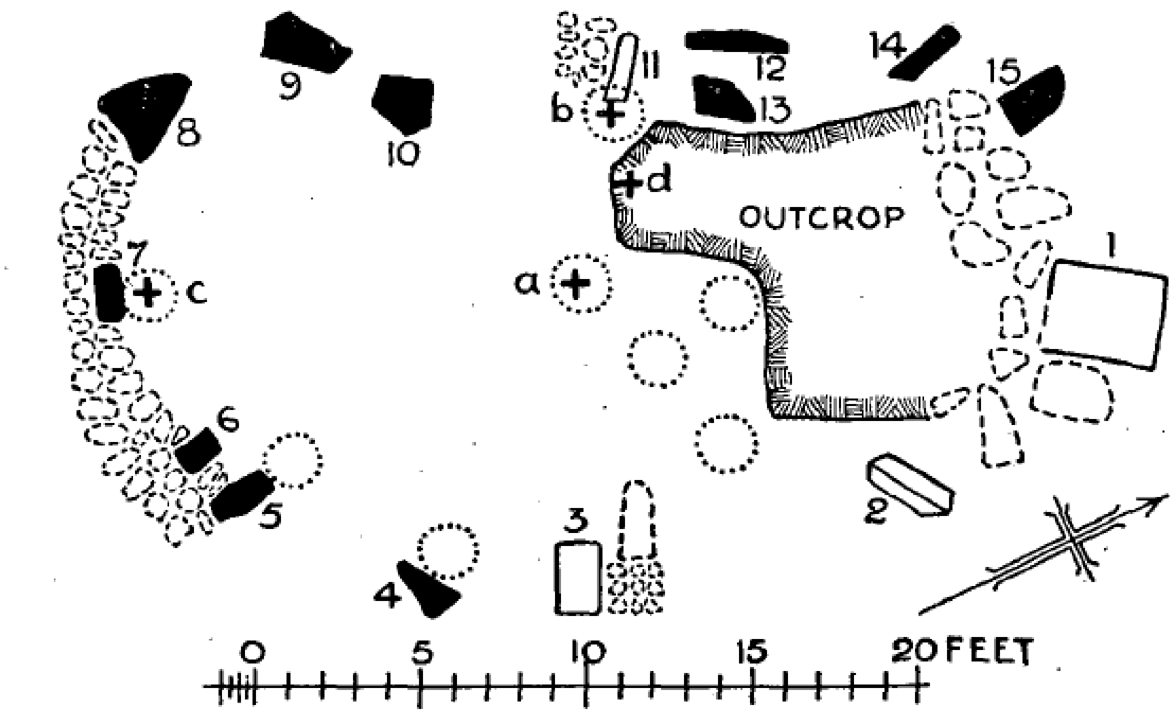


Figure 5.16: A plan of Nith Lodge, battle-axe located at point d, ID 12 (Mcloud, 1937)

Three Stage IV battle-axes were associated with cairns. The most recently excavated example is a Stage IVe example from Bargrennan White Cairn, ID 622. The excavation was initially carried out by Piggott and Powel in 1949 and then more recently by Drs Vicky Cummings and Chris Fowler during the same project that excavated Cairnderry (Cummings & Fowler, 2007). It consists of a passage leading to a central chamber covered by a stone cairn which was surrounded by a stone kerb. Like Broomend and Cairnderry, this monument has multiple phases of activity, with the passage and cairn being built in a single phase. Mesolithic flints indicate the earliest activity at the site, subsequent Early Neolithic activity is evidenced from a single radiocarbon date, 3770-3640 cal BC, which is thought to date the ground surface beneath the cairn. However, this does not date the construction of the cairn. A date for the later construction of the cairn is not known, although excavation revealed significant evidence for Early Bronze Age activity and re-use of the site focused around the entrance of the monument. A series of pit deposits were placed outside the entrance of the tomb, either side of the end passage stones. As well as a pit within the cairn itself, Pit 4, Pit 1 contained a large concentration of cremated bone dated to the Early Bronze age. Pit 2 contained a Collared Urn within which a Stage IVe battle-axe and a bone belt hook were lying in situ amongst a quantity of cremated remains; it dates to 1890-1693 CAL BC (figure 5.17). Pit 3 had possibly been disturbed. Burnt plant remains, and sherds of Early Bronze Age pottery vessels were recovered from the feature, some of which had been subjected to high temperatures.

Figure 5.17: Cremated bone in situ with a portion of the battle-axe in Pit 2 at Bargrennan, ID 622 (Cumming and Fowler, 2005, 25)

Less information is known regarding the Stage IVb battle-axe from High Lawfield Cairn, ID 625. The implement was found with a cremation deposit in what has been described as a cavity close to the location of a Collared Urn and cremation previously discovery. It dates to 1883-1662 CAL BC. It is possible the cavity was a pit dug into the ground surface (Mann, 1923, 104-105; Morrison, 1968, 120-120; Roe, 1966, 243; Roe, 1967, 78).

A further two battle-axes, both Stage IVd, are described as coming from cremation burial deposits. A battle-axe, NMS EQ 65; ID 11, was discovered along with two urns containing cremated remains, the smaller being a Cordoned Urn, while ploughing at Chapleton Farm, Ayrshire (Morrison, 1968, 105; Roe, 1967). One of the urns was inverted over the battle-axe and cremated remains although it is unclear which of the two urns this is. The battle-axe from Sandmill farm, Wigtownshire, NMS EQ 486; ID 189, was also discovered while ploughing. The subsequent excavation revealed a pit containing a Collared Urn inverted over the cremated remains of an adult as well as a bronze razor dating to the Middle Bronze Age, three whetstones, a fragment of a bone pin and a Stage IVd battle-axe. The contents of the urn filled only a quarter of the space, so it is likely the cremated remains represent only part of the cremated individual (Anderson, 1942, 79-83). It was common practice during the Bronze Age to bury only part of the body, the rest perhaps being buried elsewhere or kept in the possession of specific people within the kin group, as ancestral relics or tokens (Brück, 2006, 77-84; Woodward, 2000, 58). A total of three worked flints were found at the site but it was not certain whether they were associated with the urn (Anderson, 1942). Two more Stage IV battle-axes are also associated with cairn features. A Stage IVa battle-axe from Oban, Argyll, ID 596, and another Stage IVe from Glasgow Victoria Park, Lanarkshire, ID 165, are the final battle-axes of this stage coming from cairns. The Oban implement was found during construction work next to a Cordoned Urn, a more unusual urn to be associated with this dataset, containing a cremation deposit. The cremated remains date to 1876-1611 CAL BC. A further two cinerary urns of an unknown type also containing cremated remains were found close, it is probable their deposition as associated. The Stage IVe battle-axe was also found associated with a cinerary urn, this time a Collared Urn containing a cremation deposit which dates to 1879-1645 CAL BC. The implement, and also a Beaker and two Food Vessels, were discovered during a quarrying work. Their association is unknown. Battle-axes associated with cremation deposits are most commonly found with a cinerary urn, no matter what the battle-axe type.

Two final Stage IV battle-axes have limited depositional information and no associated objects. The Stage IVd battle-axe from Pentland, Midlothian, NMS EQ 64; ID 106, was discovered in a cist and is thought to be a foreign import (PSAS, 186, 127; Roe, 1966, 229). The other battle-axe, Stage IVa, NMS AH 57; 74, was dredged from the River Tay near Ballinbreich, Fife (Anderson, 1886, 312-3).

5.8.5 Stage V

Three Stage IV battle-axes have depositional information. Two Stage Vd battle-axes are from a barrow and a cairn, and a Stage Ve battle-axe is from a river.

The battle-axe with the most information is that from the Loose Howe barrow, North Yorkshire, BM 2010.8035,20; ID 217, excavated in 1937 by Elgee and Elgee (figure 5.19) (Elgee & Elgee, 1949). The barrow was surrounded by a shallow ditch and a kerb of upright stones; it contained two interments, a primary and a secondary. The primary interment was buried within a wooden coffin made of oak enclosed with a lid, both parts of the coffin were argued to be dugout canoes. It contained an inhumation which, due to waterlogging, the remains of clothing were still present. The body appeared to have been fully clothed in linen and laid on a bed of rushes, reeds or straw. Three pieces of worked flint and a bronze dagger accompanied the burial. More recently a reassessment of the evidence has concluded both canoes, in fact, formed a dug-out coffin which was two parts of a tree in which was disturbed by interment of the secondary burial (Jones, 2018). The secondary burial was situated immediately below the surface (figure 5.18). A deposit of cremated remains was accompanied by a fragmented Collared Urn, an Accessory Vessel, a riveted copper alloy dagger, a tri-fold bronze pin, and a Stage Vd battle-axe placing the burial firmly within the Early Bronze Age, possibly towards the end. Unfortunately, the burial had been disturbed, so the original arrangement of associated objects is unknown.

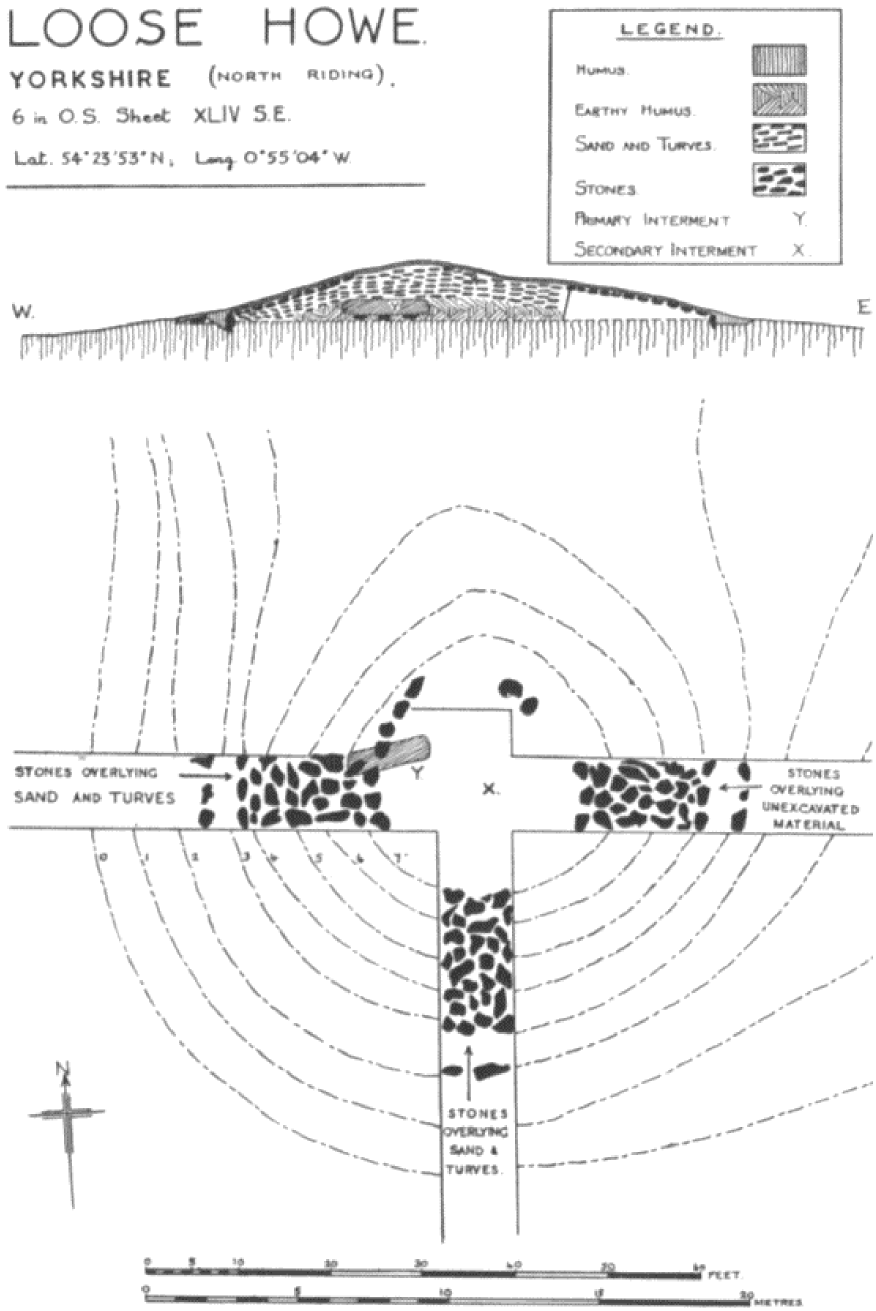


Figure 5.18: A plan section of Loose Howe, point x marks the location of the second interment, ID 217 (Elgee & Elgee, 1949, 89)

Figure 5.19: Stage V battle-axe from Loose Howe BM 2010.8035,20, ID 217 (Image: author)

The Cairn at Balnagown, otherwise known as Scotsburn, has considerably less information known about its depositional context. It is said to have been found in a small cairn of stones (PSAS, 1953, 84). Nothing further is known. The final battle-axe was discovered in the mouth of the River Wick, Caithness, it has been suggested it was discovered by a trawler (PSAS, 1894, 65).

5.8.6 Summary by context type

Nine different context types are represented across the thirty-eight battle-axes with depositional information from Northern England and Scotland. A variety of burial rites were used across this sample, including cremation burials in pits, barrows, cairns and cists; inhumation burials in barrows, graves, and cists; multiple burials, such as the three cremation deposits buried with an inhumation at Barns Farm, Fife; and unique deposits including a shell midden. Each feature type will be discussed to show the similarities and variability within each type. Following this, various themes will be discussed, including complex sites, indirect associations, and the use of sites in multiple periods. To begin with, the barrow contexts will be discussed.

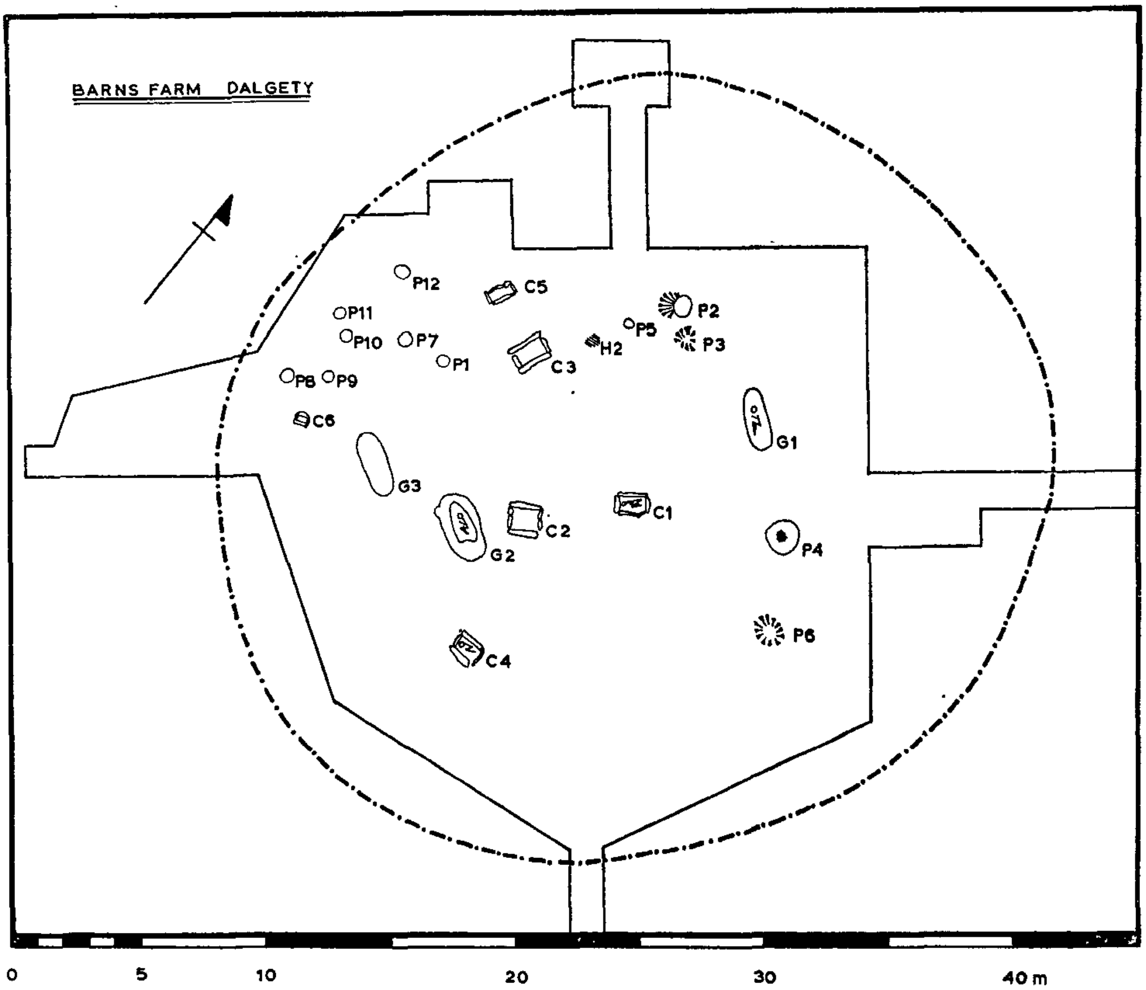
Bar one, all battle-axes that have been found in barrows are from Yorkshire (table 5.11, below). Likewise, bar one, all battle-axes from Yorkshire were found in barrows. Those exceptions are Barns Farm, Fife, Scotland, whose complex cemetery is said to have been covered by a barrow, and the Stanbury Pit, Yorkshire. The latter shows no evidence of a mound, however many barrows in Yorkshire have been removed from years of farming, so it is possible this example was once associated with an earthen monument. The landscape across Yorkshire is littered with barrow sites, often found in groups or clusters. Many of these groups were described by Mortimer in his 1905 publication. Those contained battle-axes are spread across North and East Yorkshire, with seven in North Yorkshire, and four in East.

East Yorkshire is known for the rich assemblages found in graves from the Early Bronze Age, which are often used in parallel and comparison, to those of Wessex. The numerous Early Bronze Age earthworks and barrows together form a monumental landscape and many Yorkshire barrows are positioned with panoramic views of it. For example, Herd Howe is situated on the crest of Gerrick Bank, at a height which commands extensive views of this monumental landscape on all sides, for example. Many barrows in Yorkshire also occupy prominent natural ridges in the landscape, such Robin Hood's Butt, which is part of another group of barrows and said to have contained cremated remains, a cinerary urn, and a bronze dagger or arrowhead (Fortey, 1884-5). As Vyner has demonstrated, the artificially constructed earthen cross-ridge boundaries that appear in this area mark the ritual places or boundaries between the extensively distributed Early Bronze Age burial mounds that typify this area (Vyner, 1994, 37). The Yorkshire barrows, like Herd Howe, are placed in a prominent position amongst, spatially and temporally related, to the EBA monumental and ritual landscape.

The groups of Yorkshire barrows associated with battle-axe depositions contain multiple burials, often of varying ages such as children, young adults, adults and the elderly. All individuals found with battle-axes in Yorkshire barrows (four) that were aged were adult, two being young adults. The gender of many burials is unknown due to the difficulty sexing created remains. However, three of the burials were sexed as male, the age of one was unknown, and the other two were aged at 18, and between 18 and 24. The burial rite also varied between inhumation and cremation, and they have varying combinations of associated grave goods. Worked flint is commonly found with interments and within the mound material, Food Vessels and Collared Urns are commonly found in the same barrow, although not directly associated with one another, and Accessory Vessel occasionally accompanies burials, often with a cinerary urn. Other associated grave goods found within the barrows include jet and bone beads and toggles, bone pins, bronze earrings and bronze daggers. Often the barrows consist of an initial interment placed in a grave cut into the ground surface. Later interments are added at various levels throughout the mound, such as placed on the ground surface or within the mound material. In some cases, interments were buried simultaneously within a mound, such as the two cremation deposits on the ground surface of the Rudston barrow. Grave *a* in the Rudston barrow also has had two extensions added to place a secondary interment into a barrow (Kinnes & Longworth, 1985, 76-77).

Two barrows containing battle-axes are different from the majority, Loose Howe in North Yorkshire, and Barns Farm in Fife (Elgee & Elgee, 1949). Firstly, Loose Howe contains fewer interments compared to the majority of Yorkshire barrows where interments contain as many as eleven battle-axes. However, it is the use of a coffin and lid made from a hollowed-out tree trunk that makes this example unusual. Other barrows have interments places upon wooden planks, such as within two barrows in the Cowlam barrow group, including one containing a battle-axe. However, the Loose Howe coffin envelops the interment, being two parts of the same tree trunk that, when closed, reforms the trunk and closes the coffin (Jones et al. in press). The secondary interment which included a battle-axe was placed in close association to this primary burial and was the only other burial included within the barrow.

Secondly, the Barns Farm barrow is geographically removed from the Yorkshire barrow clusters as it is located in Fife, East Scotland, and is not itself part of a cluster of barrows. It also has multiple cremation and inhumation interments of adults and children, and these have been said to have once lain beneath the barrow mound. However, unlike the Yorkshire barrows, these interments were all contemporary, being in the same Early Bronze Age stratigraphical layer (Watkins, 1982). The diverse nature of this cemetery, including cremation deposits with an inhumation in grave one, was named complex by Wilkin, also sets it apart from the Yorkshire barrows (Wilkin, 2013, 132-150). When looking at the cemetery site as a whole it appears to be diverse, but the style of multiple burial and choice of grave goods is also paralleled with other barrow deposits of the period making this site a little less unique (figure 5.20). For example, a parallel can be found between the battle-axe and Food Vessel from Grave one and those also from Calais Wold, Yorkshire (Mortimer, 1905, 154). This early type battle-axe has also been found more locally in the Forth and Tay regions, for instance from Cairn I at Foulden, Berwickshire, a Woodhenge battle-axe was found at the base of the cairn also associated with several Food Vessels from the first phase of activity. The Foulden Cairn I also provides an equivalent with its paved stone floors in the cists (Craw, 1914, 1913-14).



Barns Farm, Dalgety. Site plan. C=Cist; G=Grave; H=Hearth; P=Pit

Figure 5.20: A plan of Barns Farm complex cemetery, ID 73 (Watkins, 1982, 55)

Table 5.11: Battle-axes from Barrows			
Feature	**County**	**Location**	**Type**
Barrow	FIF	Barns Farm	Id
Barrow	Y	Garton Slack	Ia
Barrow	Y	Ganton	IIa
Barrow	Y	Huggate Pasture	IIa
Barrow	Y	Danby North Moor	IIb
Barrow	Y	Rudston	IIc
Barrow	Y	Cowlam	IIIa
Barrow	Y	Herd Howe	IIIc
Barrow	Y	11m E of Pickering	IIId
Barrow	Y	Hambleton Moor	IVb
Barrow	Y	2m N of Pickering	IVd
Barrow	Y	Goodmanham	IVd
Barrow	Y	Western Howes	IVd
Barrow	Y	Loose Howe	Vd
Barrow	Y	Flixton/Elf Howe	unknown

Moving onto the battle-axe deposits found in cairns (Table 5.12). These are only found in Scotland and, unlike barrows, are not located in any specific area of the country.Little is known regarding the Breckigo and Balnagown cairns. Both have been called chambered cairns so one can assume each had a stone cairn covering one or more chambers, although Balnagown is noted as being small and so is not likely to have had several chambers.

Carwinning Hill, High Lawfield, Hagg Wood, Cairnderry and Bargrennan have all been excavated, the latter quite recently. The last three have multiple phases of construction and interments. However, Hagg Wood is different as it is the only cairn associated with a battle-axe which is not a chambered cairn. Instead, a stone cairn covers three cists and two pits. Food Vessels were found to be associated with the two primary cists and a cremation.

In contrast, the remaining battle-axes from cairns were each found in association with a Collared Urn, apart from at High Lawfield which was found with a Cordoned Urn. Cairnderry and Bargrennan both have EBA pit deposits which signify a continued use of the sites into the EBA. they are part of two different tomb groups, Cairnderry is a Bargrennan type tomb, while Bargrennan is a Clyde cairn, hence their formation is slightly different. Also, the battle-axe deposition contexts differ slightly with the Bargrennan battle-axe placed within a Collared Urn with cremated remains and the Cairnderry implement next to a Collared Urn with a belt buckle. However, the phase relating to the deposit of the battle-axe in both tombs separates them from the other cairns containing battle-axes. Excavation revealed significant evidence for Early Bronze Age activity and re-use of both sites focused around the entrance of the monuments. A series of pits were dug, five at Cairnderry and four at Bargrennan, several containing cremated remains.

The re-use of sites was frequent during the Early Bronze Age. It demonstrates the continued significance of such sites and the importance of maintaining specific memories or links with the area/ancestral lineages/kin groups. For instance, the Broomend of Critchie stone circle and henge is another monument where a battle-axe is associated with the Early Bronze Age phase of activity within a much longer, intermittent use of the site. The proximity of Cairnderry and Bargrennan may be of importance. They are within a largely monumental landscape. Bargrennan White Cairn is part of the Clyde monument group in Dumfries and Galloway characterised by multiple chambers set within a long cairn with a stone façade. There are seven in total, four of which have been excavated showing construction took place in several discrete phases, much like Bargrennan (Cummings & Fowler, 2007, 1; Henshall, 1972; Corcoran, 1969). The Cairnderry tomb is of the Bargrennan monument group also common in the area. They all consist of a passage leading to a small chamber or chambers set within a cairn (Cummings & Fowler, 2007; Cummings, 2011). On top of this, the closeness between the radiocarbon dates associated with the battle-axes at each monument, 1890-1960 cal BC for Bargrennan and 1890-1660 cal BC for Cairnderry, implies the implements may have been in use at the same time.

Table 5.12: Battle-axes from cairns			
Feature	**County**	**Location**	**Type**
Cairn	BRW	Hagg Wood	Ia
Cairn	CAT	Breckigo	IIIa
Cairn	WIG	Cairnderry	IIId
Cairn	REN	High Lawfield	IVb
Cairn	WIG	Bargrennan	IVe
Cairn	ROS	Balnagown	Vd
Cairn	AYR	Carwinning Hill	unknown

Again, there does not appear to be a clustering of cist features associated with battle-axe deposition. For several battle-axes found in a cist, there is little information (table 5.13). Those from Burnside Mill, Seghill, and Pentland merely state they were found in a cist. The battle-axe from Knockalow, Isle of Man, had no associated burial but was accompanied by two worked flints. The burial rite associated with cists is not fixed to either inhumation or cremation and it is likely these examples contained a burial deposit of one of the two burial rites; the Knockaloe cist is big enough for an inhumation deposit, for instance. Inhumation deposits were found associated with the battle-axes at the Doune and Whitehall cists, both of which are Stage III typology, although the Doune example is miniature. The similarities between the two deposits stop there. The Doune cist contained the inhumation of a child with a Food Vessel and a fragment of a Food Vessel whereas the Whitehall example was associated with an inhumation of unknown age and a whetstone.

Table 5.13: Battle-axes from cists			
Feature	**County**	**Location**	**Type**
Cist	IOM	Knockaloe	Ic
Cist	ANG	Burnside Mill	Ic
Cist	NOR	Seghill	IIb
Cist	PER	Doune	IIIa (miniature)
Cist	ORK	Whitehall, Stronsay	IIIe
Cist	MLT	Pentland	IIIId

Three battle-axes were found in association with stone circle settings and cists (table 5.14). The similarities between them are few. Little is known about the Grantully axe deposition although it was associated with a cist just as the other two are. The Nith Lodge example was found to be associated with two cists, containing cremations and Accessory Vessels, but was placed on the ground surface between them, contemporary with the cists. The Broomend of Critchie battle-axe was found within a cist with a cremation deposit and the site is further differentiated by its long, intermittent period which far surpasses that of the other two stone circle sites. As such, the significance of the site persists over a longer time.

Table 5.14: Battle-axes from a stone circle and a cist

Feature	**County**	**Location**	**Type**
Stone Circle/cist	PER	Grantully	Ic
Stone Circle/cist	AYR	Nith Lodge	IVd
Stone Circle/cist	ABN	Broomend of Crichie	IVe

Three battle-axes were found at one House site, the Ness of Gruting on the Isle of Shetland (table 5.15). Spanning the Neolithic and Bronze Age, the house has been interpreted as a stone-working workshop. This depositional context is unlike all others; the three battle-axes are likely to be related to stone-working, especially since two are unfinished. Although they are closely associated with one another, the only contextual similarities exist in typological comparisons with other Stage I and II battle-axes. The occurrence of battle-axes in association with a domestic setting during the Early Bronze Age is unique, and these are the only examples known in the British Isles.

The deposition of a battle-axe in a Shell Midden is also an unusual context whose only parallels exist in the form of the unfinished battle-axe (table 5.16).

Table 5.15: Battle-axes from a house site

Feature	**County**	**Location**	**Type**
House Site	SHE	Ness of Gruting	Ic
House Site	SHE	Ness of Gruting	Ic
House Site	SHE	Ness of Gruting	IIa

Table 5.16: A battle-axe from a shell midden			
Feature	**County**	**Location**	**Type**
Shell Midden	ARG	Island of Coll	IIIa

Several battle-axes have been dredged or fished out of Scottish Rivers (table 5.17). Often the depositions of artefacts in water contexts are interpreted as deliberate. The deposition of objects in water contexts in prehistoric Britain and Europe was a common practice, removing the item from circulation and thus ending their use-life. For example, many valuable bronze items were systematically deposited in marshy lands or large bodies of water. The depositions of metalwork are thought of as an expression of the cultural and social meaning attached to the objects deposited. Their deposition removed the identity and personhood involved with their use, ownership and exchange (Brück and Fontijn, 2013; Needham, 2010). However, it is uncertain that the battle-axes found in watery contexts were originally deposited there or if they were deposited in the ground nearby and were later eroded into the river. Indeed, rivers change course over time, but there have been no noted changes to the river courses in the last few centuries. However, information regarding the course of these rivers does not extend beyond the 18th/19th centuries and so it is unclear whether these battle-axes were deposited in watery contexts or nearby.

Table 5.17: Battle-axes from rivers			
Feature	**County**	**Location**	**Type**
River	PER	Mugdrum Island	Ic
River	ROX	River Kale	Id
River	SUT	River Fleet	IIb
River	FIF	River Tay, Newburgh	IVa
River	CAT	Wick	Ve

Several battle-axes were directly associated with cremation deposits within features, such as barrows or cairns. Four examples, however, have not been recorded as associated with any feature (tale 5.18). The battle-axe from Chapleton farm is recorded to have been found associated with a cremation deposit and an inverted Collared Urn, presumably over the cremated remains. It is likely that the deposit was placed within a feature such as a pit or a cist, or part of an earthen feature which could have gone unnoticed or regarded as not important during the recovery of the deposit. Two battle-axes deposited in pits are also associated with cremated remains within a Collared Urn, so it is probable that the Chapleton farm example was deposited in a pit. Likewise, the Stage IVa battle-axe from Oban is also likely to have come from a feature since another burial deposit was found nearby. This example differs, though, in that a Cordoned Urn was used rather than a Collared Urn. The Glasgow Victoria Park battle-axe is the final Stage IV implement associated with a cremation deposit. This example was also associated with a Collared Urn. The typological outlier in the cremation group is the Stage I battle-axe from Cranstown, about which no further information is known.

Table 5.18: Battle-axes from cremation deposits and no known feature

Feature	**County**	**Location**	**Type**
Cremation	MLT	Cranstown	Ib
Cremation	ARG	Oban	IVa
Cremation	AYR	Chapleton Farm	IVd
Cremation	LNK	Glasgow Victoria Park	IVe

The two pit deposits are similar; both include Collared Urns containing cremated remains, although the Sandmill urn was inverted, and a bone pin was found in each (table 5.19). The size of these deposits is vast, having multiple associated items. Sandmill Farm has eight deposited items included the cremation deposit, and Stanbury has nine. The Sandmill Farm deposit is, however, dated to the Middle Bronze Age due to the presence of a razor contemporary with that period. Whereas, radiocarbon dating has placed the Stanbury deposit firmly within the Early Bronze Age, 1960-1780 cal BC (Richardson & Vyner, 2011).

Table 5.19: battle-axes from a pit			
Feature	**County**	**Location**	**Type**
Pit	Y	Stanbury	III
Pit	WIG	Sandmill Farm	IVd

Several battle-axes are associated with sites that have intermittent use over a long period time and multiple interments or structural additions over time. Battle-axes at these sites are mostly found associated with later phases of activity. For example, there all battle-axes from barrows are associated with later deposits, rather than the primary burial. Other battle-axes are associated with the later use of Neolithic sites, such as the Cairnderry and Bargrennan Cairns, while the Broomend of Critchie battle-axe is associated with the increased activity at the site during the Early Bronze Age. Activity and depositions continued at these sites after the battle-axe depositions demonstrating the continued significance of the sites. Later interments also suggest the continued importance of maintaining certain memories and/or links with the area/ancestral lineages/kin groups.

5.8.7 Summary of associated burial practices and artefacts

Thirty-one battle-axes have associated burial practices. Out of this group, there are 27 different combinations of associated artefacts found with battle-axes, thus exemplifying the variation I will demonstrate in this section. When looking at the assemblages by battle-axe stage, this variation increases stage by stage until Stage 4 where it is at its highest with ten different deposits found with battle-axes. Stage I had two deposits, both different; Stage II had six, again all different; Stage III had eight deposits, all different; Stage IV had ten, and Stage V just had one battle-axe deposited with associated artefacts. It is clear from this that the number of battle-axes placed with associated grave goods increases between the typological Stages. Variation is therefore also seen to increase; however, it must be pointed out that there is no example of any two deposits with a specific battle-axe Stage being the same. As such, this increase in the number of deposits is the reason for the increase in variability if we assume battle-axes of a specific Stage are not deposited with the same array of associated objects more than once. It is, however, apparent that by Stage IV the numbers of associated artefacts deposited with battle-axes is at its highest.

Stage IV has the largest quantity of battle-axes found with cremated remains, with a total of ten. No Inhumation deposits are associated with Stage IV battle-axes. The singular Stage V battle-axe with associated artefact was also found with a cremation deposit. Consequently, it appears the inhumation burial rite was not favoured for the deposition of these later types of battle-axe.

Cremated remains are associated with battle-axes on nineteen occasions, over double that of those with inhumations, which are eight in number. In all, six examples of cremated remains have been found associated with a cinerary urn of some form. Collared Urns are the most common, appearing eight times, while Food Vessel appears twice with cremated remains, Cordoned Urns appear once, and unknown cinerary urns appear twice. Of the six examples of battle-axes and cremation deposits not associated with a cinerary urn, two have no other associated artefacts, being Stage II and IV. The other four, Stages II, III and IV, are varied. Bar one, all of this group have two artefacts associated with a battle-axe, including the cremated remains; a flint arrowhead; worked flint; and an Accessory Vessel. The exception is a Stage IV battle-axe from Goodmanham which is associated with cremated remains, a bone pin and jet.

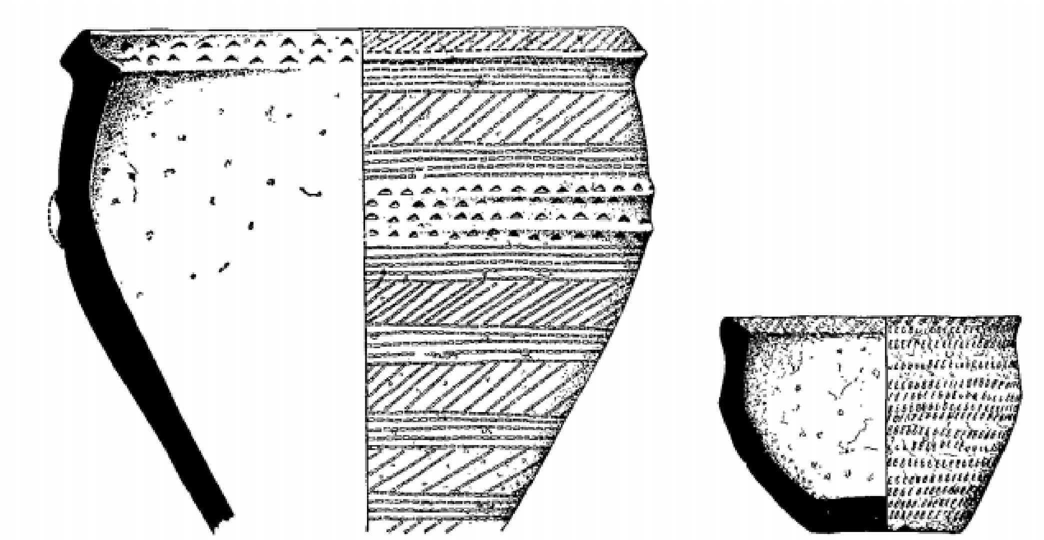


Figure 5.21: An illustration of the Food Vessels found with the miniature battle-axe from Doune, the larger vessel was reconstructed from fragments (Hamilton, 1956, 233).

Food Vessels only appear twice with cremated remains and battle-axes, both Stage I, although the Barns Farm battle-axe also accompanies an inhumation which is the main burial deposit (see figure 5.21 for an example). A Cordoned Urn only appears once, also associated with a cremation deposit and a Stage IV battle-axe. Another pottery form is also found associated with battle-axes, Accessory Vessels (n = 7). Accessory Vessels are not classed as cinerary urns. However, the co-occurrence of cremated remains, a battle-axe, Collared Urn and Accessory Vessel appear common (n = 5). On occasion, other artefacts are included in addition to this combination (n = 3), suggesting a funerary kit which may be added to where relevant. For instance, within the Western Howes Barrow items made of bone in the forms of a pin and toggle were added to the kit. Indeed, Accessory Vessels and battle-axes have been found without a Collared Urn associated on two occasions: the Ganton Wold battle-axe found with an inhumation, Accessory Vessel, flint dagger and jet; and the Breckigo battle-axe found with just an Accessory Vessel, and no burial deposit. These further demonstrate the variation of associated artefacts buried with battle-axes.

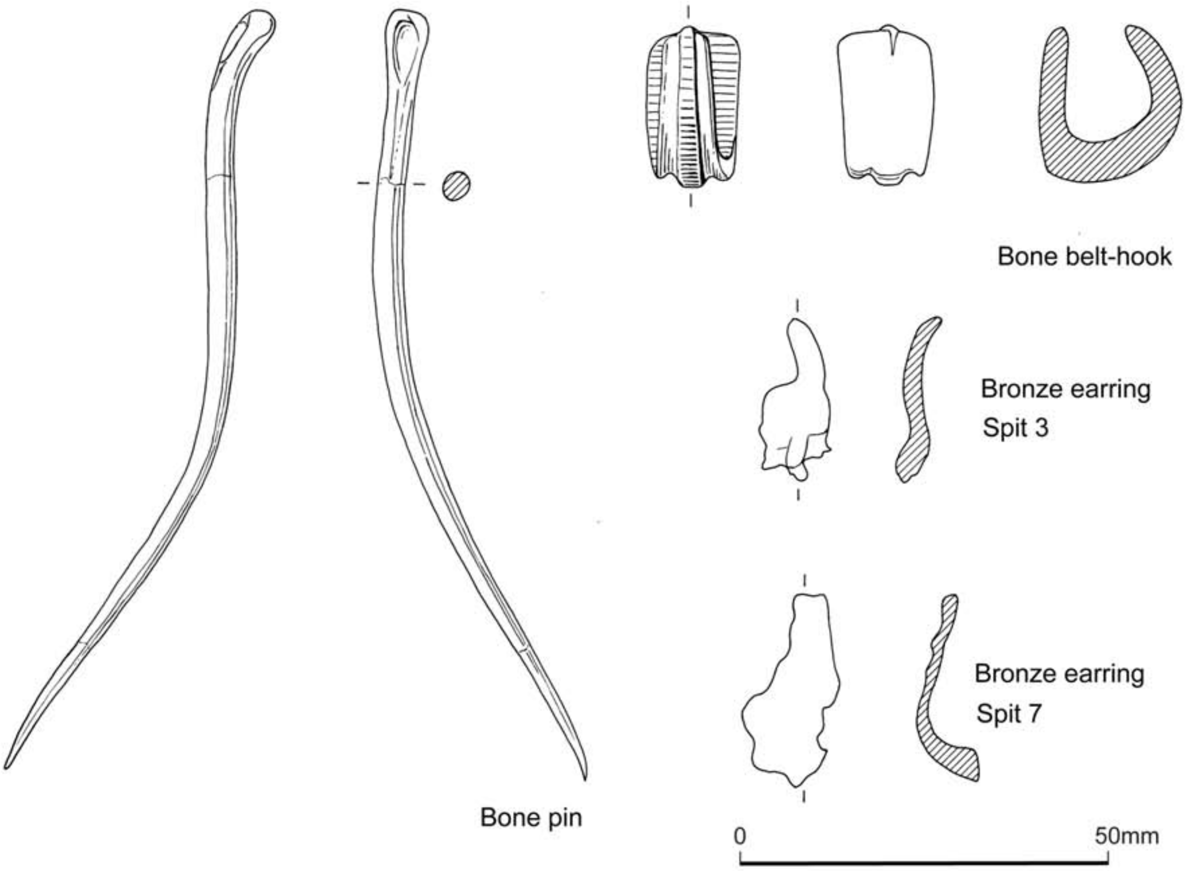


Figure 5.22: Illustrations of the bone pin, bone belt hook and bronze ornaments (earrings) found with the battle-axe at Stanbury (Richardson & Vyner, 2011, 59)

The Stanbury and Sandmill Farm pits contained a very similar funerary kit. However, in this case, an Accessory Vessel was not present in either pit whereas other, more unusual items, were. A whetstone and a bronze razor were found in the pit at Sandmill Farm while at

Stanbury a pair of bronze ornaments, interpreted as basket-shaped earrings, were added to the funerary kit (figure 5.22). These deposits are unique; they are the only examples of a razor and basket-shaped earrings associated with battle-axes. Battle-axes are found within a pit in only two other occasions outside the Bargrennan and Cairnderry tombs (where they represent the later use of both sites in the Early Bronze Age and a continued significance of the sites). The Cairnderry Pit deposit correlates with the battle-axe, Collared Urn, and Accessory Vessel cremation funerary kit, whereas the Bargrennan battle-axe was found within a Collared Urn accompanying a cremation and bone belt hook.

A bone belt hook has only been found associated with a battle-axe on one other occasion; within the Stanbury Pit (figure 5.23). Perhaps the inclusion of a bone belt hook was an addition to the funerary kit with the purpose of better representing the identity of the individual. It is not known what bone belt hooks were used for. However, it is thought they may have been attached to a belt and used to fasten clothing, or perhaps to attach an item to clothing, such as a battle-axe. All bone belt hooks have only been found in funerary contexts in Britain and Ireland. Alison Sheridan argues they are a prestige item used within a repertoire or funerary kit to represent high status. She notes that these items are always found with male burials; the Bargrennan example is possibly male (Sheridan, 2007, 112). Bone objects and battle-axes are always found with cremations accompanied by a Collared Urn. On occasion, other objects were also included, such as an Accessory Vessel at the Western Howes Barrow; this is part of the same funerary kit mentioned above. It appears rules change within this funerary kit probably depending on the individual interred and those interring them.

Battle-axes buried with inhumated remains appear to be part of a different funerary kit. They appear together a total of eight times: once with a Stage I battle-axe; four times with a Stage II; and three times with a Stage III battle-axe. They outnumber the cremation deposits only with Stage II battle-axes (n = 4:2) and are not present with Stage IV and V when the cremation rite became dominant with battle-axe deposits. It must be noted, however, that dates for Stage IV and V battle-axes are within a very similar date bracket to some Stage III battle-axes. There is no apparent chronological movement. Battle-axes with inhumation deposits are not found with Collared Urns but instead accompany Food Vessels on all occasions where a cinerary urn was present (n = 3), bar one where the urn type is unknown. On these instances, no other objects accompanied the burial. The examples of battle-axes and inhumation deposits which are not associated with a cinerary urn have other accompanying objects. For instance, the battle-axe from the Rudston Barrow accompanied an inhumation and a bronze razor knife (figure 7.36), while the Cowlam Barrow contained a battle-axe associated with three pieces of jet, two flint scrapers and a flint flake. There is one occasion, at Seghill, where only the battle-axe accompanied an inhumation. The battle-axe from Garton Slack is a further differentiated as it is the only inhumation and battle-axe deposit which is accompanied by an Accessory Vessel as well as jet and a flint dagger. This may represent a third funerary kit or rule associated with battle-axes whereby an object which best represents the buried individual, either in life or death, is placed with a battle-axe to accompany an inhumation burial. An extension of this rule, or a combination of the two previous rules, is present at Barns Farm where an inhumation is accompanied by a battle-axe, a Food Vessel and three cremation deposits. These three cremation deposits could be token deposits, mainly due to their small size. Such deposits frequently occur during the Early Bronze Age; cremated remains are commonly far too light to contain the remains of an entire skeleton (Brück, 2006, 80; Allen et al. 1987, 211; Lynch, 1984, 29-30). It is probably a ‘complex cemetery’ (*qua* Wilkin 2013), in which this burial was interred, which influenced the inclusion of grave goods and interred bodies. Such cemeteries comprise of more than one burial tradition and frequently different forms of burial.

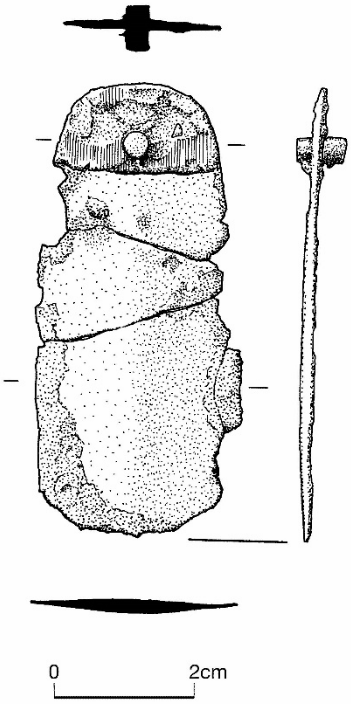


Figure 5.23: A Bronze razor knife found with a battle-axe at Rudston (© Trustees of the British Museum)

Items of bone found with battle-axes are only associated with the cremation burial rite (n = 5). In four cases Collared Urns are also associated; in the fifth case, no urn is accompanying. These deposits are some of the larger examples found with a battle-axe, having up to six associated artefacts. An example is the Stanbury pit which contains a cremation deposit, Collared Urn, a bone pin, bone belt hook, and bonze earrings. Bone pins are present in all four deposits, but in two of these cases, a bone belt hook was also accompanying the Stanbury (figure 5.23) and Bargrennan pits.

Items of bronze associated with battle-axes are few. On four occasions bronze objects have been found associated, three times as additional items accompanying a cremation and pottery vessel and once accompanying an inhumation. In only one occasion a copper artefact was associated. They all represent items commonly found in burial contexts during the Early Bronze Age, such as knives, daggers and earrings. A Camerton-Snowshill type copper dagger accompanied the Loose Howe deposit along with a trefoil-headed bronze pin. A bronze razor dagger was with the Rudston burial while bronze earrings were found in the Stanbury pit. A bronze razor with an ox-horn handle and a possible bronze chisel were also found on one occasion each. It is likely more bronze, and copper artefacts were placed with cremation deposits but did not survive the cremation process.

Jet was found with three battle-axes, all from Yorkshire and Pennine barrows. Like bronze and copper, this material is generally seen as exotic. The type of jet object is unknown for two of these burial deposits, but the third from Goodmanham barrow was a jet button. On two occasions jet was associated with inhumation deposits, and on one occasion with a cremation deposit. The Garton Slack jet was of unknown form and was deposited with an Accessory Vessel, a flint dagger and an inhumation deposit. The Cowlam and Googmanham battle-axe burials were not associated with pottery. The first was associated with worked flint and an inhumation, and the second with cremated remains and a bone pin. These are artefacts commonly found in British EBA burial deposits.

Several battle-axes have also been found with no burial deposit (n = 19). These include a deposit at Carwinning cairn which included a Collared Urn and a possible bronze chisel. It is probable that a burial deposit was once associated with those deposits which have other associated artefacts such as Carwinning cairn. Often bone does not survive after burial. Excavation reports are also lacking, so any identification of a decomposed bone deposit has not been recorded. Most of this group, however, have no associated artefacts (n = 16). Four of these come from rivers and three from the house site at Ness of Brodgar. The others are from cairns, cists and barrows all of which have minimal information regarding the deposition context. Often the only information available notifies us that the battle-axe was found in a particular feature, such as a cairn, cist or barrow. It is most probable that associated artefacts were placed with the battle-axe deposits, but the information no longer exists.

Variation in the assemblage is obvious. An interpretation is the use of specific funerary kits or compilations of artefacts. These could each be related to a battle-axe as the central artefact of the funeral kit. However, it is probable this variation is not specific to battle-axes, but rather that battle-axes are additions to other burials deposits. Therefore, they may have been used in specific, varied funerary kits as one of the additional artefacts. Indeed, the artefact types deposited with battle-axes were otherwise included in commonplace burial practice during the Early Bronze Age. It is apparent that the variation in grave goods within the funerary assemblage's were in keeping with the characteristics of Needham's Phases Two and Three when there were more, and more varied grave goods after 2150 BC – after Needham's fission horizon c. 2250-2150 cal BC (Needham, 2011; 2014). The chronology of battle-axes and axe-hammers places them within these phases. The variety demonstrates that the treatment of battle-axes and axe-hammers in funerary depositions is consistent with that which occurs across EBA Britain.

The data in *Ritual and Early Bronze Age Grave Goods* (Woodward & Hunter, 2005) demonstrates the usual artefacts interred with burials from Wessex, The Peak District, and East Yorkshire. The object types found in battle-axe burial deposits are amongst the most commonly deposited objects in this data. Figure 5.24 demonstrates the presence of dagger/knives, bone points, Accessory Vessels, Collared Urns and Food Vessels, all of which are found in varying combinations and numbers in battle-axe burials, in grave assemblages across the three regions. The most common artefact is the dagger or knife made of bronze or copper; but this occurs in just one battle-axe deposit. However, Needham has suggested that placing battle-axes with daggers was a limited act to support status burials which had nearly died out by his period three. He argues that battle-axes were not high status enough to maintain a role next to daggers in ‘high-status burial trappings’ (Needham, 2011). Bone points or pins are also numerous; they appear in four battle-axe burial deposits. The artefacts most commonly found with battle-axes are Collared Urns, followed closely by Accessory Vessels and then Food Vessels. All three appear in reasonably high numbers in the burial record and so their high presence in battle-axe burials is not surprising and must reflect specific rules for engagement concerning burial in Britain during Early Bronze Age. The table also illustrates several artefacts not found with battle-axe burials which indicates that such rules for engagement include a greater variety of artefacts. Some of these artefacts are never found with battle-axes from northern Britain and the Isle of Man, including awls, teeth, tweezers and perforated stone.

Given the variation of battle-axe funerary assemblages, made up of artefacts commonly used in EBA burial practice across Britain, it is no surprise that they have been associated with high status (Sheridan, 2007). Indeed, some of the artefacts also found in these funerary assemblages are associated with high-status, such as daggers, gold and jet items (Needham, 2011; Woodward & Hunter, 2005). Needham's (2011) argument that daggers were more high status than battle-axes suggests that not all objects placed in EBA burials assemblages had the same status. However, the variation in battle-axe funerary assemblages also suggests that there were different reasons for the inclusion of these artefacts, which means that if they were of high status, this might not have been the only reason for their inclusion. Section 5.10 discusses the meanings and reasons behind deposition in funerary and non-funerary contexts further.

Table 11.37. Selected Early Bronze Age object types from all inhumation or cremation contexts, by number of sites.

Object type	**Composition**	**Number**			**Total**
		E. Yorks graves (125)	Peak graves (60)	Wessex graves (227)	**(412)**
Dagger/knife	Copper/bronze	14	9	92	**115**
Point	Bone	44	24	35	**103**
Necklace	All types	11	10	63	**84**
Awl	Copper/bronze	18	7	49	**74**
Accessory cup	Pottery	8	3	37	**48**
Collared Urn	Pottery	11	15	20	**46**
Food Vessel	Pottery	25	3	5	**33**
Individual bead	All types	4	4	23	**31**
Tusk/tooth	Tusk/tooth	8	4	4	**16**
Dress pin	All types	4	0	10	**14**
Battle-axe	Stone	7	3	4	**14**
Tweezers	Bone	0	2	12	**14**
Perforated stone	Stone	0	0	11	**11**
V-perforated button	All types	5	1	5	**11**
Misc. gold	Gold	0	0	7	**7**

Figure 5.24: Selected Early Bronze Age objects types form inhumation or cremation contexts, by number of sites (Woodward & Hunter, 2005, 531)

5.8.8 Summary of Regional Variation

Like the associated burial practices and artefacts, the location of battle-axes from specific features or with specific associations is also varied. There is no specific burial rite or group of associated artefacts linked with a typological stage or a specific locality; in other words, there is variation within regions as well as between them. However, variation between regions can be found with feature type. Excepting the Barns Farm example, battle-axes deposited in barrows are only found in Yorkshire. It is within this region that the most variety in the assemblage is also present. Though, this is also due to the more substantial information known about sites in this region since there has been a high degree of attention and excavation of Yorkshire sites since the 19th century. As for cairns, they are not found clustered in a specific region, but they do only appear with battle-axes in Scotland. Both cairns and barrows are round mounds being used in the same way. All have multiple stages of development, such as later insertions into the mounds. The Cairnderry and Bargrennan cairns are the only round mounds that have later insertions outside of the mound in pits. Those later insertions in Yorkshire add to the mound itself. Those deposited in rivers, and at stone circles also only appear in Scotland.

5.9 Spatial and stratigraphic context: Axe-hammers

The following section will focus on the spatial and stratigraphic context of axe-hammers. The axe-hammers of each type, Class I and II, with a spatial and stratigraphic will be described before being grouped into feature type, such as barrow, cairn, or river (for which, see table 5.20 for a breakdown). Only those with depositional information are included. Summaries of the context, including feature type, associated burial practices and artefacts, and finally of regional variation will follow to demonstrate similarities and differences for between the axe-hammers.

In comparison to the overall number of axe-hammers, there is only a small number that come from a spatial and stratigraphic context (n=18). Four Southern examples have been dated to the MBA. However, several of these dates are insecure as they are not directly associated with the axe-hammer depositions. The axe-hammer from Billingborough, for example, came from a layer outside two enclosures while the radiocarbon date was taken from within the enclosure (Leahy, 1986, 146). There are a handful of examples with spatial and stratigraphic information from Northern Britain and the Isle of Man also. Although none can be radiocarbon dated, their contexts and associations indicate an EBA date.

Table 5.20: A table to demonstrate the axe-hammers from known spatial and stratigraphic contexts

Acc. No.	County	Locality	Stage	Butt Shape	Feature	Cremation	Inhumation	Urn, unknown type	Collared Urn	Cordoned Urn	Food Vessel	Accessory vessel	Worked flint	Arrowhead	Flint knife/dagger	Bronze Chisel	Bronze Knife/dagger	Bronze Pin	Copper dagger	Bone pin	Bone toggle	Bone belt hook	Earrings	Whetstone	Razor	Jet	Stone ball
Dmfs 1965-360	DMF	Whitehall Farm	2	n/a	Cairn																						
Dmfs 1965-367	DMF	Chanlockfoot (penpont)	1	n/a	Cairn																						
Dmfs 1965-368	DMF	Auldgirth	1	n/a	Cairn																						
unknown	AYR	Kirk Michael	1	n/a	Cairn										x												x
unknown	ARG	North Fumerary	1	n/a	Cairn																						
Rochdale 9010204/2711	LAN	Milnrowe, Rochdale	1	n/a	Barrow	x			x																		
unknown	ABN	The Blue Cairn of Ruthven	1	n/a	Cairn																						
unknown	ARG	Dumbarton Shore	1	n/a	River																						
Kirk 5249	KRK	River Cree	1	n/a	River																						
Lancaster LM 286	LAN	Dolphinholme, River Wyre	1	n/a	River																						
Bolton 38	LAN	River Lune	1	n/a	River																						
Hawick	ROX	River Hawich, Denholm hill	1	n/a	River																						
NMS AH 140	DMF	Douglas Farm	1	n/a	River																						
NMS AH 73	REN	Mearns	1	n/a	River																						
Manchester 1998.353	CH	Dickens Wood	1	n/a	Mine Spoil Heap																						
NMS AH 224	KRK	Grange Farm, Urr	1	n/a	River																						
NMS AH 52	FIF	River Tay, nr Newburgh	1	n/a	River																						
NMS AH 238	AYR	Lugar Water, Lugar	1	n/a	River																						
unknown	LAN	Cliviger Law House	?	n/a	Cairn	x		x																			

5.9.1 Class I

Seventeen out of the nineteen axe-hammers with a spatial and stratigraphic context are Class I (see figure 5.25). Five Class I axe-hammers were found in cairns, all of which are from the south-west of Scotland. Unfortunately, the records for these examples are limited. For four out the five axe-hammers from cairns, the information only states they were found in a cairn (Chanlockfoot, Auldgirth, Kirk Michael, North Fumerary, The Blue Cairn of Ruthven). No further information is known regarding the cairns themselves or other artefacts interred within them (Roe, 1967; Gibson, 1864; Anderson & Black, 1888; Smith, 1895; Ogston, 1931). The Class I axe-hammer from Kirk Michael, Ayrshire, ID 20, was discovered in a cairn with a stone ball and a flint knife (Smith, 1895, 183). This implement is the only axe-hammer from a cairn with information regarding the associated artefacts. However, no spatial information is known regarding these finds. Due to the limited information, it is not known if these axe-hammers were interred into the cairns with a burial. Cairns were commonly used in the Bronze Age for the burial of the deceased along with a variety of associated artefacts, including cinerary urns, items of copper, bronze, flint and stone, much like those found with battle-axe burial deposits. It is probable that a burial was associated with the axe-hammers deposited within the cairns.

Figure 5.25: Image of Class I axe-hammer

An axe-hammer from Cliviger Low House, Lancashire, ID 621, is the only one known from a cairn in the north of England. It was found associated with a cinerary urn of an unknown type, containing cremated remains (Barnes, 1982; Booth, 1899). Information is lost with regards to the form of this implement, so it is not known what type it is, nor is it even certain whether this axe-hammer is an axe-hammer. A distinction between battle-axes and axe-hammers as two different types of perforated object was yet to me made in the late nineteenth century when the description of this finding was made. Many battle-axes are referred to as axe-hammers or hammer-axes in sources published at a similar time. No further axe-hammers have been found associated with cairns in Lancashire. However, a single Class I axe-hammer was discovered in a barrow at Milnrow, Rochdale, ID 506. It is described to have been found close to a Collared Urn with a cremation deposit (Leahy, 1984). Again, no further information is known.

The axe-hammer from Dickens Wood, Cheshire, ID 37, came from a more unusual context as it was found amongst a stone spoil heap from the mine. It is likely to be modern and demonstrates the re-use of an axe-hammer in modern mining activities (Manchester Museum, 2017).

The remaining ten axe-hammers were found in river contexts. As with those battle-axes found in the same feature type, axe-hammers may have been deposited in rivers intentionally. Such a practice in the Neolithic and Bronze Age across Europe is thought to remove objects from circulation, using the act as an expression of their cultural and social meaning, and/or to remove the identity and personhood related to that object (Brück and Fontijn, 2013; Needham, 2010). Another potential reason for their discovery in a river context is the eroding of river banks and changing course of rivers. This may erode areas of land containing archaeological deposits into the river.

5.9.2 Class II

Figure 5.26: A Class II axe-hammer

A single axe-hammer Class II axe-hammer from Whitehall, Dumfriesshire, ID 65, is known from a spatial and stratigraphic context, albeit insecure (for an example of a Class II axe-hammer, see figure 5.26). This implement was found lying on a stone dyke in an area where a cairn had previously been removed (Gibson, 1864, 48; Black, 1894, 110; Williams, 1965, 18). It is assumed that this implement came from the cairn; however, without further information, this remains unclear. However, if the axe-hammers in areas of north-west

England and south-west Scotland are being deposited in similar ways as battle-axes, such as in cairns and barrows, an association with a barrow burial cannot be ruled out.

5.9.3 Summary of context, associated burial practices and artefacts

Seven out of the nineteen axe-hammers with spatial and stratigraphic information are associated with cairn deposits (table 5.21). They occur in the north west of England and Southwest of Scotland only. Little is known regarding these finds, apart from their association with a cairn. The axe-hammer from Kirk Michael, Ayrshire, is known to have been found with a stone ball and a flint knife which suggests that the others may have been associated with artefacts. Class I axe-hammers dominate the cairn deposits, with just one implement being Class II.

Table 5.21: Axe-hammers from cairns			
Feature	**County**	**Location**	**Type**
Cairn	DUM	Auldgirth Bridge	I
Cairn	DUM	Whitehall	II
Cairn	DUM	Penmont, Chanlockfoot	I
Carin	AYR	Kirk Michael	I
Cairn	ARG	North Fumerar	unknown
Carin	LAN	Clivigier Low House	I

Only one axe-hammer has been found associated with a barrow, at Milnrow, Rochdale, Lancashire (table 5.22). This implement was found close to a Collared Urn along with a cremation deposit. It is the only example of an axe-hammer in direct association with a burial. However, it remains uncertain whether this implement is an axe-hammer or a battle-axe.

Table 5.22: An axe-hammers from a barrow			
Feature	**County**	**Location**	**Type**
Barrow	LAN	Milnrow, Rochdale	I

Ten out of the nineteen axe-hammers are from rivers (table 5.23). All are Class I axe-hammers, and each are from a different river. They have mostly been found in Scotland, in the south and south-west, although two were also discovered in rivers in Lancashire.

Table 5.23: Axe-hammers from rivers			
Feature	**County**	**Location**	**Type**
River	ARG	Dumbarton Shore	I
River	KRK	River Cree	I
River	LAN	Dolphinholme, River Wyre	I
River	LAN	River Lune	I
River	ROX	River Hawich, Denholm Hill	I
River	DMF	Douglas Farm	I
River	REN	Mearns	I
River	KRK	Grange Farm, Urr	I
River	FIF	River Tay, Newburgh	I
River	AYR	Lugar Water, Lugar	I

A single axe-hammer was found in a mine spoil heap in Cheshire (Table 5.24). This context is not paralleled with any other axe-hammers from Northern Britain and the Isle of Man

Table 5.24: An axe-hammer from a mine spoil heap			
Feature	**County**	**Location**	**Type**
Mine spoil heap	CH	Dickens Wood	I

The associated artefacts for axe-hammers are few. There are just two axe-hammers found associated with another object. Both are different. The Class I axe-hammer from Kirk Michael was found with a stone ball and a flint knife, and the Class I axe-hammer from Milnrow, Rochdale, was found close to a Collared Urn with cremated remains. It is possible that the Kirk Michael implements were placed with a burial due to the frequent use of flint knives in burial contexts during the EBA (Smith, 1895). Likewise, the remaining axe-hammers from burial feature, cairn and barrow, were most probably associated with a burial deposit, either cremation or inhumation. The presence of axe-hammers in EBA burial features correlates with the occurrence of battle-axes in the same type of burial features. The association between the depositional context can be used to suggest the similar treatment of both types of perforated implement. The majority of axe-hammers, however, are in single deposits with no deposition associations or known features.

5.9.4 Summary of regional variation

Since most axe-hammers were singular deposits, there is little variation regarding spatial and stratigraphic context. However, the presence of a small number of axe-hammers in the south west of Scotland, branching into the north-west of England, is an evident variation and signifies that a different way of treating axe-hammers was at play in this area. Regional variation also presents itself with the deposition of specific types in specific regions. Malcolm Fenton and Stuart Needham have both demonstrated the regional preferences at play when it comes to the choice of using either an axe-hammers or a battle-axe (Fenton, 1984, 217; Needham, 2011). There is a nucleus of axe-hammers in South-West Scotland, an area which has much fewer battle-axes. This correlates with the location of axe-hammers from cairns and the areas where fluted axe-hammers were found. Figure 5.27 demonstrates the distribution of both implement type showing the areas of foci for battle-axes and axe-hammers. Needham has interpreted these axe-hammer foci as signs that regional reactions to battle-axes and axe-hammers were extremely varied; he also interpreted the origin of axe-hammers as coming from a deep symbolical meaning (Needham, 2011). So, perhaps the symbolic meaning of axe-hammers determined the preference or acceptance of either axe-hammers or battle-axes, which would have been varied within and between regions.

It is possible that both implement types were used in similar ways or fulfilled similar roles in the areas where one type is more prevalent. The similar treatment of the axe-hammers in south-west Scotland, being found in burial deposits and high frequencies in areas were battle-axes were few, suggests that they had the same type of significance or meaning as battle-axes in other areas. If this is the case, it would be unnecessary to utilise both axe-hammers and battle-axes in the same area. This may only be the case in areas with high axe-hammer numbers, and low battle-axe numbers. Chapter 8 discusses the difference and similarities between battle-axes and axe-hammers further and the reason behind them.

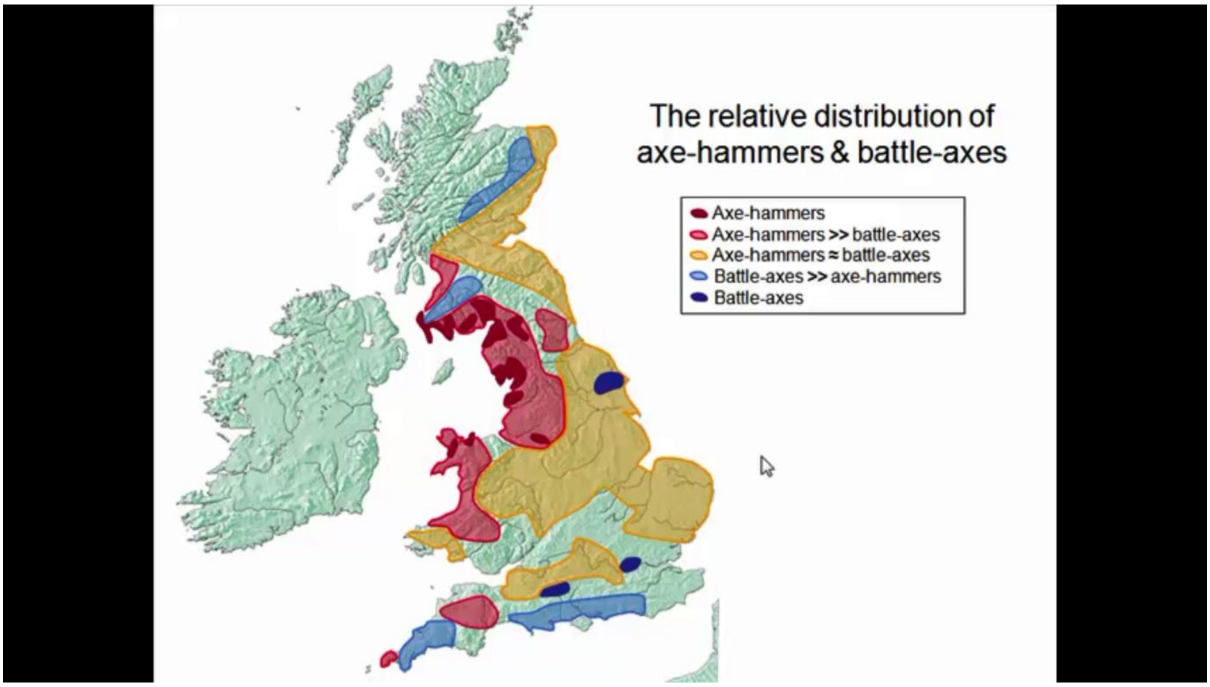


Figure 5.27: The relative distribution of axe-hammers and battle-axes (Needham, 2011)

5.10 Cultural Context: Battle-axes

By assessing the assemblages that battle-axes are associated with, the differing relationships are apparent. These are demonstrated through the degree of variability found in the contextual, typological, petrological, spatial and stratigraphic information of battle-axes in Northern Britain and the Isle of Man. In particular the associated features, artefacts and burial rites, all of which create multiple, consecutive and overlapping assemblages through the successive acts of creation, deposition, process and events. I argue that the choice of a specific compilation of artefacts and burial rite in a specific feature – the funerary kit – were made according to specific rules for engagement. These were formed according to the deceased, those burying the deceased, and the society in which the deceased and the buriers belonged, for instance the social group they belonged to and all others connected through trade and marriage agreements. The associated artefacts found with battle-axes all represent items commonly found in burial contexts during the Early Bronze Age, such as knives, daggers and earrings and are thus likely to be used to represent a specific meaning or aspect of the individual buried and/or those burying them.

Such notions of the roles and types of assemblage that battle-axes are a part of change with every battle-axe in the dataset. There does not appear to be a specific compilation of objects or a specific funerary rite within a specific feature when a battle-axe is present. Take barrows, for example, the variety of burial rites and objects placed with all deposits in a barrow is similar to deposits with battle-axes. There is a variety of combinations of objects and burial rites within just one barrow. This also appears to be the case for other burial structures containing battle-axes, including cists and cairns. The same type of features which do not contain battle-axes also share this variability, so it is not a characteristic localised to battle-axes alone. It is more likely that the choice of accompanying artefacts was made according to the individual interred, those interring them, and the group of people/kin group/society in which they belonged. As such, the significance of a relationship formed during the itinerary of the artefacts was being drawn upon. Therefore, it is the relationships within that society, involved before and during the creation of the funerary assemblage, that give rise to it and reflect the form of the assemblage (Fowler, 2017, 96; Harris 2014, 88–91; Webmoor & Witmore 2008, 65). The reasons for the choice of funerary assemblage related to the significance and power that each artefact has in demonstrating and acting out a specific outcome intended for the assemblage. This type of significance came from the relational links that were created between people, and between people and objects, through the life history of the artefact. As such, by drawing on such connections, relationships and expressions of identity were demonstrated.

When using typology in an assessment of artefacts a homogenisation of the diversity of artefacts within that type can occur. However, typology can also be useful to assess relational assemblages (Fowler, 2017). Since typology is context and has difference and similarities within it, it can be used to understand relationships between artefact types, and their other contextual associations. The type of battle-axe does not seem to be a dominant feature associated with the variation in the spatial and stratigraphic contexts. Perhaps, the type was not a relevant factor in the choice of artefacts for deposition in funerary contexts.

The favoured burial rite associated with battle-axe deposition was the cremation, which becomes more dominant through the stages from Stage II to V. The inhumation burial rite is present in the earlier stages, but by Stage V it has disappeared entirely. This preference of burial tradition changed from inhumation to the cremation burial rite across British EBA funerary assemblages. The lack of association between type and funerary assemblage continues the theme of variation which is most probably associated with differing rules for engagement for burial practice. Of course, battle-axe burial deposits are not unusual within the Early Bronze Age burial record which also has much variability using similar sets of associated artefacts. Longworth’s assessment of the funerary assemblages that included

Collared Urns demonstrated that the same artefacts were used (Longworth, 1984, 47-71). For instance, the cremation burial rite was also the most common for funerary deposits containing Collared Urns (for an example of Collared Urn pottery see figure 5.28), suggesting that this was the common burial rite for EBA burial deposits overall (Longworth, 1984, 47). It is not a surprise, therefore, to witness the battle-axe burial deposits changing in step with other contemporary 'fashions' in burial practice.

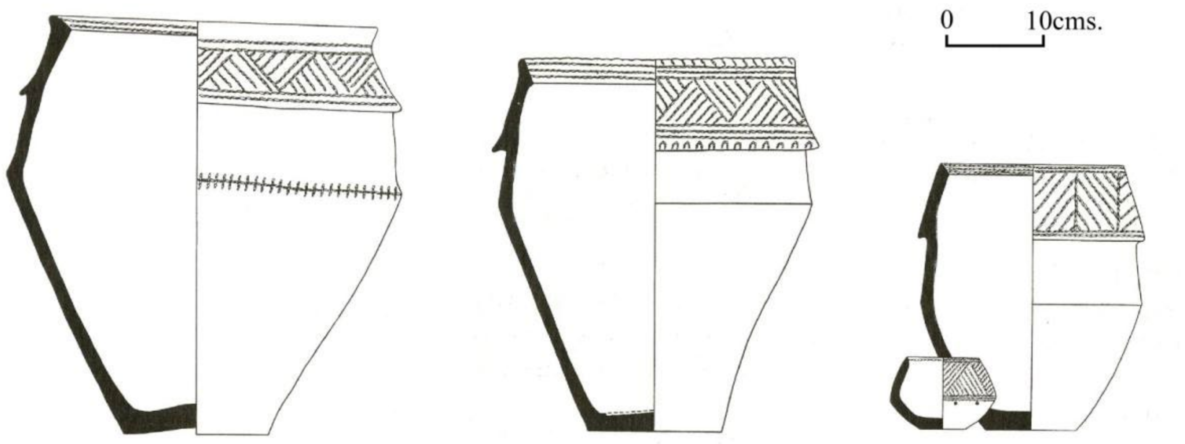


Figure 5.28: Examples of Collared Urns (Wilkin, 2013, 53)

It is not uncommon for specific items to be meant for burial in Britain and Ireland during the Early Bronze Age. For example, ceramics, such as Collared Urns, Food Vessels and Accessory Vessels are commonly found in burial contexts and used to contain food offerings for the deceased or their cremated remains. Indeed, Accessory Vessels were only used for burial. Weapons and tools were also deposited in burials including worked flint, and bronze and copper daggers, the pommels of which are often the only remaining part when cremated. Some of these clearly show use and many of these indicate the longevity of the artefacts use life. The pommels of daggers, for instance, are frequently found heavily worn, and in some cases fragmented (Bukach, 2015, 489). Decorative items were common, such as beads of jet and bone, bone belt hooks and bronze and copper earrings. The continued appearance of such objects in specific formation lends to the idea of specific funerary kits being used within a mortuary tradition (Thomas, 1991).

It was originally thought the presence of weapons and decorative objects such as daggers and earrings, and items made of 'exotic' substances such as gold, signified an elite group of warriors (Evans, 1897; Mortimer, 1905; Elgee, 1933; Greenwell & Rolleston, 1877). In countless remarks by Evans, for instance, battle-axes have been described in such a manner, and Mortimer describes those battle-axes as buried with ‘strong bones of an adult male’ insinuating the strength of a male based on little to no evidence (Evans, 1897; Mortimer, 1905). As mentioned in the introduction, I argue against the idea of a male warrior elite. An assessment of use context in chapters 7 and 8 will assess the likelihood of battle-axes being used as weapons. The male warrior elite identity was assumed according to the analogy and form of the objects as well as the associated artefacts in their spatial and stratigraphic contexts with no attention paid to the use context. Too often have the objects placed with the deceased have been assumed to reflect the identity of the deceased, for instance, a weapon must mean a warrior, an arrow must mean an archer, beads must mean a woman, and exotic artefacts must signify an elite individual. Thomas argues that such stereotypical identities may have ‘little or no connection with reality’ and are instead more likely to be associated with claims of those burying the dead and the society they belonged to rather than to do with a celebration of the acts of the dead during their life (Thomas, 1991, 35-6). Fowler has since explained extensively that the identity of the deceased transformed Early Bronze Age mortuary practice (Fowler, 2013, 511). Identity in life may not be the same as identity in death; it was impermanent and reliant of the recognition of others (Fowler, 2013, 512). Just as identity can change during life, it can also change in death, dependant on the recognition of others and the message they choose to convey. Likewise, an individual may have multiple identities (Goodenough, 1965) which come to the foreground when they are recognised by others in a specific context, therefore changing the identity or focussing on a different part of the identity of the individual in a given segment of time and space. Fowler calls this identity relative to context (Fowler, 2013, 513; Fowler, 2011). Such contexts are diverse, they can be ritual, social, political and material, and could be used to infer, neutralise or hide aspects of society, or could be used to transform the body in preparation for the afterlife (Fowler, 2013, 518). As such, identity is related and dependant on others who may express such agency through action and interaction, such as the varying processes of the mortuary practice. Battle-axes may not have been weapons in life or reflected the identity of the deceased in life, but they may have represented an identity intended by the mourners, such as the strength and power of a warrior. This hypothesis was assessed with wear analysis and functional tests and allowed an assessment of the functional use of battle-axes and axe-hammers as weapons (see chapter 8, section 8.3.3).

The use of specific funerary kits, therefore, reflects the society the deceased belonged in and those burying the deceased. The funerary kit is also thought to have been used alongside the exchange of objects to maintain and forge interpersonal links within society and between societies, thus playing and negotiating power relations and identities (Brück, 2004; 2006 & 2019; Thomas, 1992; Barrett, 1991). Brück (2004; 2019) argued that the presence of artefacts in burials suggests that the concept of self was constructed through interpersonal connections rather than attributes bounded to the individual deceased: 'Objects placed in the grave allowed the mourners to comment metaphorically on the links between the dead and the living, as well as on the changes experienced by a community torn asunder by death…. that identity was a relational attribute; it was people's relationships with others that made them who they were' (Brück, 2004, 307 & 311). In a sense, others are needed for the creation of a person's identity so that they can never purely be independent individuals; identity is relational. The objects placed with the burial include objects used to dig the grave and cook the funerary feast, created and fired on the pyre, and as gifts from mourners – to celebrate, create, maintain, and express identity in life and death. Identities are formed by the continued interaction of people with specific items during specific mortuary practices which objectifies and personifies those involved (Fowler, 2004; 2010). As such, the objects become part of a funerary kit. The relationships drawn upon in the deposition of battle-axes and other artefacts in funerary assemblages reflect the identities of the deceased and the mourners. In this way, the funerary kit creates and maintains the relational interpersonal links involving the deceased and the mourners (Thomas, 1991, 35).

The interpretation that battle-axes as symbols of a male elite have been influenced by the presence of battle-axes in male corded ware burials and burials of the Single Grave Culture or Scandinavian Battle-axe Culture c. 2850-2350 BC. The burials of these 'cultures' are very clearly gendered. Body position reflects sex (males: head to west, lying on right side, facing south. females: head to the east, lying on the left side, facing south). Battle-axes also occur with a specific range of grave goods, including the cord-decorated beaker, flint axes, and beads. Like the northern English and Scottish examples, the sets of grave good accompanying battle-axes in graves are varied (Tilley, 1982, 13). The battle-axes are always found placed by the head of male inhumations. In this context, battle-axes have often been argued to be associated with a warrior elite (Jensen. 1995, 110; Gimbatus, 1953). However, there are other, more accurate interpretations (Roy, 2016/17). Damm has argued the associated status was not from the axes themselves but instead from a status acknowledged through other means, such as through their trade which maintained vast networks (Damn, 1991, 65).

Moreover, both men and women had a kit of grave goods which reflected a gender stereotype, particularly in Corded Ware burials (Bourgeois & Kroon, 2017, Heyd, 2007; Turek & Černy, 2001). This shared burial rite has been interpreted as outcomes of the negotiations between the people who created and participated in the funeral process. In this way, the burial practice is not interpreted as to do the deceased individual alone, but also to do with the mourners and their interpretation of death (Bourgeois & Kroon, 2017).

The battle-axes from Northern Britain and the Isle of Man are not associated with funerary assemblages that have a set gender stereotype due to the variability in funerary assemblage. The sex of the associated burials for most battle-axes is unknown, and just four have been interpreted as male. Moreover, the preference for the cremation burial rite in EBA Britain did not have a gender stereotype. However, despite the difference in the funerary process and assemblage, this interpretation demonstrates the importance of understanding how funerary assemblages are related to the mourners as well as the deceased. Broadly, the use of artefacts drawn from a set pool of objects by mourners in Britain demonstrates a similarity between both areas in how the funerary processes were used to interpret and manipulate the world around them.

Many battle-axes in my dataset do not have any spatial or stratigraphic context. Most often no information is known regarding their finding. Little to nothing can be assessed regarding the spatial and stratigraphic context of these implements. However, their type does not set them apart from those with more contextual information. It is likely that a quantity of these implements came from a feature and perhaps were also associated with a burial and its associated artefacts. Over time these features have been lost due to farming practice, such as being ploughed out. Indeed, there were a number that were discovered alone in a field, often by farmers. A comparison of the wear traces, presented in chapters 7 and 8, assesses if these stray finds are part of a single coherent group, separate to those from funerary contexts.

On the other hand, there is also a possibility some battle-axes were single deposits not associated with other objects or features, although this cannot be known for sure. The meaning of this group of battle-axes may have been different to those interred with burials. If they were intentional single deposits, then perhaps there was a specific reason that they were not chosen to be part of a funerary kit. Perhaps their meaning and agency were not appropriate for the meaning a funerary kit was intended to have. However, these are just suggestions as we do not have the data to known for certain.

Does the same go for those deposited in rivers? This is hard to answer since little is known regarding their deposition. The changing course of the rivers which remove areas of land over time suggests that implements found in rivers today may have once been deposited on land, in a burial feature for instance, but through the changing course of rivers and flooding events such features, and their associated artefacts could have been washed into a river.

If some battle-axes were deposited in rivers intentionally, this might be due to their significance and its level of prestige. However, this can only be a suggestion as the depositional information for these implements is not known. The deposition of objects in water in prehistoric Britain and Europe was a common practice removing the item from circulation and thus ending its use-life. For example, many valuable bronze items were systematically deposited in marshy lands or large bodies of water. The depositions of metalwork are thought of as an expression of the cultural and social meaning attached to the objects deposited. Their deposition and removal dissolved and rendered the identity and personhood involved with their use, ownership and exchange (Brück and Fontijn, 2013; Needham, 2010). It is probable that the deposition of non-metal items within watery contexts were considered in the same way. Indeed, several stone battle-axes and axe-hammers have been found in rivers close to deposits of metal items such as swords. For example, three late Bronze Age swords were recovered from the River Tay, close to Mugdrum Island, where a battle-axe and an axe-hammer were also recovered (canmore.org.uk/site/30082/mugdrum-island, 2018). The significance of stone items being placed in watery contexts is evident numerously. Hoards of Neolithic polished stone axes have been found in bogs in the Netherlands whereby their location ‘played a special role’ within the Funnel Beaker Culture cosmology (Wentik, 2008). Likewise, formal deposits of British Neolithic polished stone axes found in rivers, such as the River Thames have been interpreted as gifts to the gods (Bradley & Edmonds, 1993, 204). Objects belonging to the Early Bronze Age, including several axe-hammers and battle-axes, have also been found in watery contexts. For instance, a barbed and tanged arrowhead was found in the River Thames, and another arrowhead was found in the River Don, Aberdeenshire (Lawrence, 1940, 77; Canmore, 2018). A significance is thus evident for those non-metal items deposited in rivers, despite that their number is far less than metal objects deposited in the same manner. It may even be that the duller appearance of ground stone may be less evident to dredgers, whereas a shiny sword will stand out. However, battle-axes and axe-hammers found in rivers have always been found alone, and their lack of association with concentrations of objects means that it is unlikely that they came from a hoard. Without their depositional information, it remains unclear whether these items were deposited in the river or ended up there through natural processes.

5.11 Cultural Context: Axe-hammers

The cultural context of axe-hammers may appear different to battle-axes in that few appear associated with burial deposits or other artefacts, but most are stray finds much like many battle-axes. In this part of the chapter I argue that axe-hammers are not too dissimilar in life to battle-axes and were part of the same rules for engagement.

The eight axe-hammers from funerary deposits share feature type and associated artefacts with battle-axes including cairn and barrow features and cremated remains, cinerary urns and worked flint. The placement of axe-hammers in similar funerary assemblages to battle-axes makes them contextually associated – this association is also with all object types found in EBA burial assemblages. These similarities suggest that they were part of the same rules for engagement. Indeed, those axe-hammers from funerary deposits are in keeping with funerary deposits across EBA Britain and correlated with the increase of grave goods after Needham's fission horizon c. 2250-2150 cal BC (Needham, 2011; 2014). The same processes for the deposition of battle-axes in funerary deposits described in section 5.10 apply to funerary axe-hammers, including the relational processes of mourner's choice. So, if these two implements were being treated in the same way, then why choose one over the other? The funerary axe-hammers are located in an axe-hammer dominant area where battle-axes are few. Perhaps, as Needham (2011) has argued, the significance of these artefacts interpreted by different communities determined the choice of one or the other.

However, just eight axe-hammers are from funerary contexts. The meaning and role of these may have been the same as battle-axes, but what about those from non-funerary contexts? The same axe-hammer types were found in both funerary and non-funerary contexts which indicates that they were not explicitly associated with their deposition. This is also the case for battle-axes. Most axe-hammers were stray finds. Their lack of depositional information means that only suggestions regarding the processes and meanings of their depositional context can be made. These possible processes share similarities with the suggestions made for stray battle-axe finds. A comparison of use context with all other contexts in chapter 8 discusses how the life histories and depositions of these two artefact types are similar and different.

Like stray battle-axe finds, it is possible axe-hammers once belonged to a burial feature which has since been disturbed and lost, such as though ploughing. A comparison of use context with the depositional context in chapter 8 assesses if the use of these objects can be grouped into funerary and non-funerary deposits and if use could be used to determine if stray finds once belonged to a burial. There is also the possibility that they were intentionally deposited as single deposits. As such, it could be suggested that they were deposited for later recovery, but the lack of multiple objects placed together in these contexts indicates this is unlikely. It is possible that axe-hammers were deposited in areas associated with their use, such as in an agricultural or pastoral area. Most commonly axe-hammers have been found on farmland. Although this is modern, good agricultural or pastoral land today, it may well have also been good in the past. Indeed, those implements from Yorkshire and the Peak District are from areas covered in clearance cairns, some of the earliest signs of agricultural activity. It is also possible that these implements were deposited near objects of relation or importance, such as a particular tree or woodland or on a boundary line. The deposition of short Scandinavian battle-axes, for instance, marked areas to exhibit linear distribution patterns, mark paths and roads along ridges, eskers and waterways. Longer axes are found in hoards and offerings in areas of coastal zones, and along inland paths, marking focal points in the landscape (Lekberg, 2002).

Lekberg's findings demonstrate how perforated stone implements in other areas were being deposited for a specific meaning, having specific roles. It could be suggested that stray axe-hammers and battle-axes were deposited intentionally to express meanings, such as to create, secure and maintain the meaning or claim of that place of deposition, for example a boundary. Depositions may also have occurred as giving thanks to the earth for the life that it gives, through farming the land and the animals which graze it. In this sense, the axe-hammer deposited would be a votive deposit as an act to give back to the land. Bradley has demonstrated that votive deposits did occur on dry land in natural locations imbued with a sacred meaning (Bradley, 2000). He gave the example of caves and rock outcrops, but areas of open fields or domestication were also possible. Natural markers, such as ridgeways, natural boundaries, trees and other plant feature may have been used in such landscapes.

These suggestions are relevant to both axe-hammers and battle-axes, however, with a lack of depositional information, this can only remain a suggestion and differences between stray axe-hammers and battle-axes can only be made when comparing their use-contexts (for which, see chapter 8). Indeed, the relational links between people and objects created through the life of the objects could have been a deciding factor in their deposition. This interpretation of relationships between people and objects is similar to the interpretation that mourner's choice directed the deposition of battle-axe and axe-hammers in funerary contexts. By understanding the use-context, the life histories and itineraries of axe-hammers and battle-axes can be better understood and allows for an understanding of how this might be related to their deposition.

If these artefacts were stray finds, then perhaps they held no special meaning and were discarded when they were no longer needed. However, their absence in middens during the Bronze Age implies they were not merely discarded as rubbish at the end of their use-life, or at least, not in the same way as other rubbish. The discussion of wear analysis in chapter 8 confirms the extent of use on these implements to assess whether they were only deposited at the end of their use-life when they were too damaged for their use to continue.

Axe-hammers have also been found in rivers. I suggest their deposition in these contexts is the same as the battle-axes deposited in rivers. Therefore, if they were deposited, they may have shared similar meanings or reasons for deposition. For instance, they could have been deposited in land and have since been eroded into the water (see Cultural Context: battle-axes). Overall, with a lack of depositional information for most axe-hammers, suggestions of their meaning and the reasons for their depositions can only remain suggestions. An assessment of their use context in chapters 7 and 8 aims to understand this better by looking at the life histories of these objects.

5.12 Problems with interpretation

Since much of the information regarding the context of battle-axes are from antiquarian sources, such as Mortimer, and Evans, it is probable that some information is incorrect, or has been left out altogether. Despite the interpretation that battle-axes are associated with males, few burials have been sexed. Six burial deposits associated with battle-axes have been sexed, four have been designated male and two possibly male. Three that have been sexed as male and one that is possibly male were designated during the nineteenth century when the idea of a male elite was dominant and thus they could represent a biased assumption. During the 19th century the majority of sites were excavated by antiquarian scholars, but it was not common for human remains to be retained for deposit in the museum collections. Those that were retained were often assessed in the first half of the 20th century by scholars who made identifications of sex-based mostly on object associations rather than osteological observations. Despite this, antiquarian sources are still regarded as having fairly reliable gender classifications (Bukach, 2015, 518). The fifth interment that is possibly male was designated in 1973 and the sixth and final deceased designated as a male occurred more recently in 2007. This small number of sexed individuals is a prime example of the difficulty in sexing the deceased in archaeology, particularly those who have been cremated.

Artefacts such as awls which are often found in female burials (Woodward & Hunter, 2015) are not found in battle-axe burials, but this does not mean that battle-axes were never placed with females. For example, a battle-axe was found associated with a female burial outside my study area. The female cremation deposit was found at Stanton Moor T36, Derbyshire, placed within a pit beneath a barrow (Heathcote, 1954, 133). The clear majority of battle-axe burials are cremation deposits which are difficult to sex and so could constitute a mixture of males and females. Re-analysis of the sexed individuals may also reallocate sex to female on those with older interpretations. Future research is needed to reassess the gender of interments in all situations where the remains are still accessible.

In other contexts, sexual differentiation is more apparent. This is strong for Southern English Beaker burials, c.2500-2100 BC, where well-furnished graves were most often males who were accompanied by a broader range of artefacts. For instance, they were buried with daggers, barbed and tanged arrowheads, bracers, spatula, flint daggers, bone points, V-perforated buttons and awls. The majority of beaker burials with gold ornaments were also male. Females, on the other hand, were just buried with awls, and in a few cases, earrings, beads or a bracelet (Bukach, 2015, 525). During the Early Bronze Age bronze daggers and knives (2200-2000 BC) continued to be deposited in male graves. This is particularly noted in Wessex and East Yorkshire, while females also continue to be buried with awls, earrings and beads (Bukach, 2015, 521). Perhaps this means those burial deposits with battle-axes and daggers/knives are male, but we must be careful not to place too much weight on the associations when assessing sex. The funerary assemblages containing battle-axes have different combinations of associated artefacts, and there is no single set of artefacts which stands out. As such, there does not seem to be such a simple division of male and female objects within these assemblages. Therefore, this could mean that either just one gender was present associated with battle-axes, or that both were, but that it was not an important factor in the burial processes.

On the continent, the Scandinavian Battle-axe Culture, known as the single-grave culture in Denmark, and Corded Ware culture in areas of Northern and Eastern Europe, used battle-axes as a key component of burials. This period c. 2850-2350 BC was characterised by single graves buried according to a new set of rules with specific orientation and graves goods. The presence of battle-axes in a position close to the head in such single male inhumations has led many scholars to argue for their significance to that society (Jensen, 1995). The single graves have seemingly prescribed rules of orientation and position, with men lying on their right, and women on their left, in an east-west, orientation. This orientation is a distinguishable male/female division associated with battle-axes (Vander Linden, 2007, 183). Such gender divisions were apparent in Britain before 2100 BC, and patterns of burial orientation have been seen to be shared between British Beaker burials and areas of the Lower Rhine (Shepherd, 2012, 170). However, after 2100 BC the burial orientations and graves assemblages became much more varied in Britain. This change of funerary process has been interpreted as a shift in attitudes towards death and identity during the EBA, as demonstrated in the north east of England and south-east of Scotland (Fowler, 2013; Fowler & Wilkin, 2016). Burial traditions moved towards a nucleation of the deceased, from beaker cemeteries with specific orientations, to burial mounds such as cairns and barrows and to burials in single features or deposits, both of which represent a greater diversity in the treatment of the dead (Fowler, 2013, 10; Wilkin, 2011, 26). Battle-axe burials fit within the last two phases demonstrating that they do not fit in with the burial traditions with prescribed gender differences of the Beaker period. This period of use post-dates (after c.2100 BC) the use of battle-axes in north-western Europe, Denmark and Scandinavian, so, although their form may be linked (Roe, 1966), their use and interpretation in funerary practices were different to that of their European counterparts. As a result, we cannot assume that the placement of battle-axes in male burials in Scandinavia means that the British examples were also deposited with the male deceased.

5.13 Conclusion

This chapter has demonstrated the trends and associations of EBA battle-axes and axe-hammers by assessing the various contextual associations discussed by Hodder to understand the similarities and differences (Hodder & Hutson, 2003, 173). The contexts include their typology, petrology, chronology and spatial and stratigraphic contexts. Trends within these were assessed and discussed to understand the potentials meanings and roles of these objects.

Variability within the assemblages was apparent, particularly those battle-axes and axe-hammers found in burial contexts. This accords with the degree of variation in other EBA burial assemblages in the British Isles. Variation is further demonstrated regionally, whereby regional preferences for implement type, battle-axe or axe-hammer, were at play. In some regions, axe-hammers were deposited in the same ways as battle-axes, despite their morphological differences. Many of both implement type occur as stray finds, a small quantity of each have been found in rivers, and both have implements deposited in burial features, although fewer axe-hammers are found in this context compared to battle-axes. If these two implement types are so similar, then why are so few axe-hammers deposited in funerary contexts? This may be to do with the interpretation of the meaning and significance of battle-axes and axe-hammers by different communities and regions during a period when diversity in funerary interpretation and practice was common (Needham, 2011; Wilkin, 2011).

The choices made regarding the deposition of battle-axes and axe-hammers are related to prescribed rules of engagement – specific actions or ways of interpretation – particularly those in funerary contexts. These were determined by those persons depositing each implement, i.e. the mourners. The itineraries of these implements might have influenced their deposition in a particular funerary assemblage and therefore an understanding of their use-life is essential. Also, by understanding the web of relationships that develop through the life of battle-axes and axe-hammers between people and objects, their roles and meanings can be better understood. The contextual information assessed in this chapter demonstrates that the funerary assemblages are highly variable and reflect the choices of those burying the deceased, rather than the identity of the deceased. This reflects relationships in the itinerary of these objects that might be used to maintain, create and destroy ownership, alliances, boundaries, power, the identity of the individual and society. Such social and political outcomes could have been used to express prestige or high status, but the variability demonstrates that other outcomes are also possible, and we cannot regard the presence of battle-axes or axe-hammers in funerary contexts as indicating high status. For example, these objects might have been used to express the versatility of a person, their strength and ability to functionally use one of these objects. The use context, provided by wear analysis and experimental tests, in chapters 6, 7 and 8, demonstrates the viability of this idea further. It uses the functionality to question the assumptions that battle-axes were *purely* ceremonial and demonstrates that multiple roles for these objects were possible. The use context also questions whether the uses are similar, like the depositional contexts. It is compared with the other contexts discussed in this chapter:

typological; chronological; petrological; spatial; stratigraphic and contextual to understand how these are related and what this means for the roles and meanings of battle-axes and axes-hammers (chapter 8).

Chapter 6 - Experimental Tests

6.1 Introduction

The recreation of archaeological artefacts can be traced to the 1800s with the example of Pitt Rivers' replication of artefacts used to demonstrate his theory of the evolution of technology visually (Bowden, 1991). Experiments during the 19th and 20th centuries subsequently focussed on the efficiency of a tool during a specific task. For example, Evans and Semenov hafted and used replica stone tools to understand their effectiveness (Tringham et al. 1974; Evans, 1897, 162; Semenov, 1964, 103).

Today experimental archaeology is a common and fundamental methodology used by archaeologists to test their hypotheses and understand processes (Dolfini & Collins, 2018, 36). These include the effectiveness of tools and objects at performing specific tasks, the manufacture of materials and artefacts, and processes of construction and farming. The labour investment, organisational requirement and social implications behind a labour force can also be better understood experimentally (Comendador, et al. 2018; Renfrew & Bahn, 2012, 192 & 317-319; Martinón-Torres, M, 2002; Carrell, 1992, 4-5)

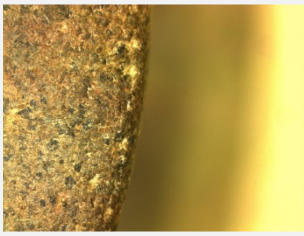
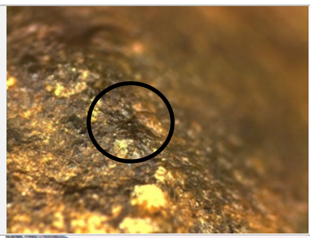
Often wear analysis is coupled with experimental tests to identify the function of objects through the creation of a reference collection of wear traces attributed to specific activities. The analysis of wear traces formed on experimental replicas provides a comparative study for the use traces on artefacts in the archaeological record. This allows for an understanding of how wear traces are formed. Laurence Keeley, Annelou van Gijn, Jenny Adams and Caroline Hamon are among many employing both methodologies to better understand use of stone and flint (Keeley, 1982; van Gijn, 1990; Adams, 1993, 2010 & 2014; Hamon, 2008). Jenny Adams, for example, has carried out numerous experiments with grinding stones to understand the formation of wear over time and the human processes involved in the use of these tools. By doing so, she was able to understand the processes occurring during the interaction of specific materials which aids the understanding of those in the archaeological record (Adams, 2010; Adams, 2014). It is through the understanding of how the wear forms through specific uses, motions, contact materials and durations that these scholars have been able to understand the combinations and amount/development of different types of wear for specific actions and contact materials, thereby creating a reference to follow when analysing artefacts in the archaeological record.

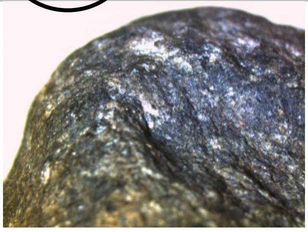
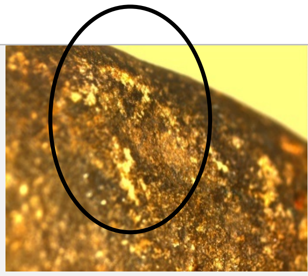
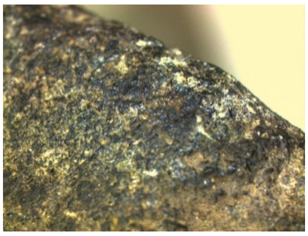
Experimental tests of stone battle-axes and axe-hammers are limited (see section 8.4.1 for reference). However, there have been comprehensive tests of axes which have used analytical approaches to understand the function and role of these objects. Such tests have developed vigorous protocols controlling parameters and minimising variables. During experiments comparing axe-heads of stone, bronze and steel Mathieu and Meyer (1997) ensured that those variables that could not be controlled were considered in order to assess their effect of the experimental test and outcomes. In controlling and understanding the variables and aspects which may change the outcome of an experiment, the experiment will be more effective and the results more accurate.

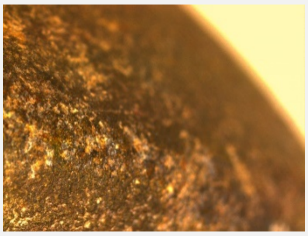
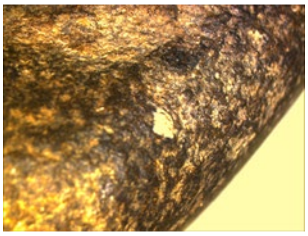
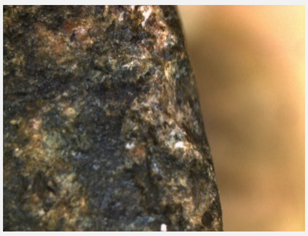
Further accurate methodologies for experiments using copper and bronze axes to chop wood have been used in order to understand the creation of wear marks and the function and efficiency of these objects. Such analytical methodologies have been applied to the study of Bronze Age copper and bronze axes to create comparable results. Kienlin and Ottaway (1998) and Roberts and Ottaway (2003) created analytical protocols in their experiments, which allowed for their result to be compared with one another and with following tests. It is crucial to produce comparable results. By combining this with an attention to the control parameters and an awareness of the variables and their effect, such results are also comparable with material from the archaeological record and allows for more accurate interpretations of function.

Experimental tests using replica battle-axes and axe-hammers are required to assess the wear patterns produced while undertaking specific actions. The development of wear throughout use was assessed to understand better the wear marks seen on those implements in the archaeological record. The effectiveness of these implements during functional use was also noted to evaluate the argument that they were non-functional (Saville & Roe, 1984, 20).

The use that has been hypothesised from the wear on the battle-axes and axe-hammers was used to design the specific experiments. This process ensured that the correct experiments were undertaken in the limited time available. This chapter will introduce and present the experimental tests which informed my understanding of the formation of wear on perforated, ground and polished stone battle-axes and axe-hammers. The experimental results will then be presented, which includes the wear analysed during and after the experiments. The wear generated throughout the experiments will inform me of how it forms during specific actions. My knowledge of wear type and formation was aided by my training at Leiden University where I analysed a large reference collection of stone tools used in a variety of ways. Additionally, my experience analysing stone implements for the duration of my PhD research has given me competent analysis and interpretative skills. A key to understand the wear types explained in this chapter can be found at table 6.1.

Table 6.1: Key to understand wear type		
Mark type	Description	Example Image
Striations	Linear feature(s) that indicate the direction of use	
Grain removal pits	The removal of stone grains from use from contact	
Flake negative (fractures)	Scars from use can indicate the hardness of contact material	
Rounding	The edges of stone grains take on a rounded appearance	
Crushing	Stone grains are deformed due to force and take on a crushed appearance	

Polish	Surface reflects light	
Flake negative and crushing	Indicates a harder contact material	
Grain removal pits & striations	Commonly associated. Indicating contact surface and direction of use	
Limited use	Sparse and small grain removal pits with few associated striations. Rounding may be more present/clear.	
Moderate use	Wear features in close density, form of stone not changed.	
Extensive use	The more prolonged an implement is used, the more dense and agrressive the wear removal becomes. Dense grain removal pits and often	

	associated crushed grains. Fractures may also occur. Form of blade often truncated.	
Medium-Soft hardness contact material	The softeness causes extensive rounding of the high topography and edges of small grain removal pits. Hard enough to removal stone grains. Materials include meat, green plant stems and hide.	
Medium hardness contact material	Some rounding of the high topography and edges of larger grain removal pits. Fractures may also occur. Materials include wood, soaked or soft bone, and plants and cereals.	
Hard hardness contact material	Shapes the surface, such as with multiple fractures and associated crushing and dense grain removal pits, materials include stone, bone and dry antler	

6.2 Methodology

Experimental tests involved the controlled use of replica battle-axes of varying types and replica axe-hammers of the same type. The aim was to test wear formation and development over time during use to ascertain what type of wear marks form at what moments during different types of use. A further aim of the tests was to establish the effectiveness of these implements to understand if their form follows their presumed function, such as being too unwieldy or purely ceremonial (Pegge, 1773; Saville & Roe, 1984, 20). The experimental results will be compared with the wear recorded from the implements in the archaeological record to better understand the use-life of these implements (for which see chapter 7). It was the purpose of these experiments to attempt to replicate such wear patterns using hypotheses drawn from the interpretation of the wear patterns on archaeological objects. The hypotheses are as follows:

- Battle-axes and axe-hammers were used to chop wood and fell trees;
- Battle-axes were used to split wood into small pieces ideal for firewood;
- Axe-hammers were used as wedges to split wood into planks;
- Battle-axes and axe-hammers were used to clear undergrowth and roots;
- Battle-axes and axe-hammers were used to dig through the soil;
- The butts of axe-hammers were used as mallets to hit wood;
- Battle-axes and axe-hammers were used as weapons
- Battle-axes and axe-hammers were used to slaughter animals by delivering blows to the skull

Karsten Wentink's unpublished PhD research includes the only known experiments using stone battle-axes to assess the wear formation relevant to different tasks (Wentink, pers comm). With Wentink's permission, I was given access to the records of these experiments and the experimental objects themselves. The experiments include chopping tree branches; felling a tree; pounding doe, stag and boar skulls; and chopping roots. Many of the battle-axes and axe-hammers in the archaeological record present wear very similar to that produced by Wentink's experiments, although he did not record wear periodically during the experiments, as well as at the end. I have carried out similar experiments, including chopping wood, clearing earth and roots, and striking animal skulls, recording wear periodically to assess the development of wear during repeated use. No other known experimental tests assess the use of axe-hammers in this way. Therefore, all tests carried out with axe-hammers will contribute much-needed information regarding the formation of wear during their use.

6.2.1 List of parameters and variables controlled during the axe experiments

Several parameters (for which, see table 6.2) were controlled for every experiment to allow for a more accurate comparison between each experiment. There are variables which could not be controlled due to the aims of the experiments. For instance, the form of the replica was not controlled as it was the aim to test the functionality of each type. This had little impact on the formation of wear due to the similarity in blade form between battle-axes and axe-hammers. Therefore, it was assumed that the formation of wear recorded during each experiment would be similar for all types of battle-axe and axe-hammers. Several parameters were controlled to eliminate any further variables and create comparable experiments. For example, the sharpness of the replica blades were the same for all replicas before the experiments. Differentiation in sharpness will cause wear to form slightly differently, so it was important that it remained constant while the form of the replicas changed. Overall, the experiments carried out focussed primarily on the formation of wear and secondarily on the performance of the implement where fragility and the ability to be functional was assessed.

Table 6.2: Parameters and variables

Parameter/controls	**Description**
Pauses for analysis	Pauses for analysis of the wear formation were taken at specific points during each experiment. Each pause occurred after a set number of strokes/hits of the replica.
Hafts	All replicas had a haft made of the same hardness of wood by the same person. All hafts for battle-axes were the same size. Likewise the hafts used for the axe-hammers were also the same. The size of the haft will change the force and motion required to use the implement; therefore it was important for it to remain constant.

Analysis	The replicas were analysed at the same points prior, during and after the experiment (table 6.3). The analysis method remained the same throughout.
Petrology	Each replica was made of dolerite stone from the same source.
Sharpness of blade	All replicas were manufactured so that the blades were the same sharpness.
Manufacture	All replicas were manufactured in the same way, using the same tools, to control their condition and form.

Variable	**Description**
Replica	A single replica cannot be used for multiple experiments as old wear will interfere with the newly formed wear, influencing the formation of wear. Therefore, each type was used for a different experiment. A different replica was used in each experiment to test whether certain typologies are too fragile to be used, see above.
Duration	The duration of each experiment varied depending on the length of time needed for wear to develop sufficiently, set at 2000 strikes. It was estimated that each experiment took between 18 and 28 hours.
Strikes	2000 strikes were used for each experiment with the aim to develop the wear sufficiently to that it was moderate to well developed. Due to time constraints, the strikes could not be more numerous.
Experiment	Each experiment carried out a different type of use, including different contact material

	and motion, to test how wear formed under different circumstances and to enable a comparison between use type.

The experiments were undertaken by myself and my father who has experience with wood and carpentry. This allowed for a more accurate replication of the use of these implements. In order to mitigate the effect of fatigue on performance, regular breaks were taken, usually after 50 strikes.

The following method was followed:

Prior to the experiment:

1. Ensure all replicas are kept in a safe environment, i.e. wrapped in bubble wrap and moved minimally to minimise contact and damage;
2. Draw scale images and photograph the replicas;
3. Analyse each replica under a stereomicroscope and record the wear from production;
4. If residue left from production hinders analysis gently clean the replicas with water;
5. Analyse the washed replicas again to ensure all production wear, and pre-test wear is recorded;
6. Record the wear on the same attribute form used for the analysis of implements in the archaeological record to allow for comparison;
7. Take casts using acetate and Provil of the relevant areas;
    a. This enabled a comparison between the two replication materials.
8. Analyse the casts to understand the production wear further;
    a. Analyse each cast using both a stereomicroscope and a metallographic microscope to understand the replication of wear at different levels of microscopy.
9. Record the wear on the same attribute form used for the analysis of casts.

Experiment:

1. The specific experiment plan for each test was followed;
2. At specific points during each experimental test, pauses were taken (table 6.3) to allow for analysis of wear formation. Casts using acetate and President Jet replicative material were taken of the area in contact during the experiment and a description of the experimental test prior to the pause written on a specific experimental form;

a. The implements were washed with soap and water to remove any residue before casting. 10% hydrochloric acid (HCL) was used for residue that could not be removed with soap and water. Dabbing of bluetac was also used to remove wood and bone residue.

3. Macroscopic photographs were taken throughout each experiment and at each pause;
4. The entire experiment was filmed.

Table 6.3: Pause to be taken during experimental tests	
Analysis Stages	Strokes
1	50
2	100
3	200
4	500
5	1000
6	1500
7	2000

6.3 The replicas

The replicas for the experimental tests were made by David Horan using modern tools. This choice was made due to resource and time constraints. The experimental tests were not affected by this choice as the stone was not weakened by the power tools used, and the replicas were analysed microscopically before each experiment to understand the production wear caused by this manufacturing process. Six replicas - four battle-axes and two axe-hammers - were made from dolerite sourced from Poortown Quarry, Peel, Isle of Man. It was essential to create faithful implement replicas so dolerite and greywacke were the two shortlisted petrological stone types chosen to create the replicas. This is because they are the most common stone types used for the manufacture of battle-axes and axe-hammers: Clough and Cummings' database of petrologies of various stone implements across Britain indicated greywacke was used for 279 battle-axes and axe-hammers while dolerite was used for 149 (Clough & Cummings, 1988). The dolerite from Poortown Quarry was used because this is within the study area, and it was challenging to source either of the stone petrologies from other areas of the study areas, i.e. northern England and Scotland. Scale drawings and measurements were followed to create accurate replicas of four battle-axes and two axe-hammers. An angle grinder with a cutting disc was used to cut the stone into shape. A combination of a grinder with sanding discs of various grades and a Dremel, a rotary grinding tool, were used to finish the surface. The perforation was drilled using a pillar drill with a hole corer.

Each replica battle-axe represents a development in the typology so that the expansion of each battle-axe has a more expanded blade and butt. This means the replica battle-axes took the form of battle-axes from stages I through to V (Stage IV is not represented as the shape of the blade is similar to Stage V implements). The reason for this was to test the effectiveness of each shape, i.e. the possibility of their breakage during use, thus reducing their functionality.

Battle-axe 1 is of the Roes' type Stage 1, Woodhenge (Roe, 1966). This type is an early battle-axe; it is defined by a blade depth and butt which are not expanded, thus appearing almost flat on the top and bottom. This replica was based on the example from Hagg Wood, Foulden, Berwickshire, and measures 150 mm in length, 45 mm in width and 40 mm in depth (Craw, 1914; Roe, 1966, 241) (see figure 6.1 for an illustration of the battle-axe prior to being made, and images of the finished replica).

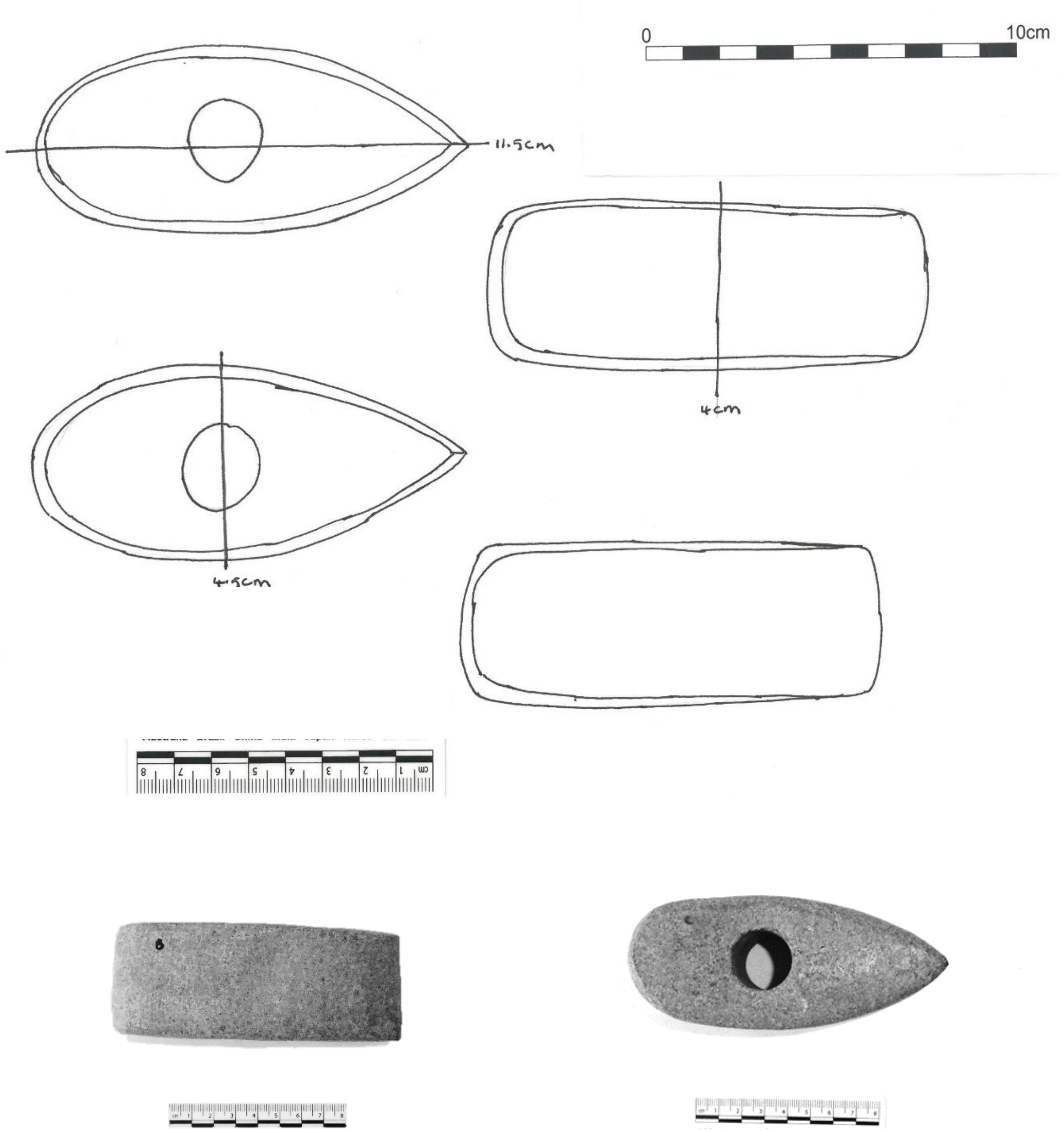


Figure 6.1: Illustration and images of replica 1 (Image: Author)

Battle-axe 2 is of Roe's type Stage II. This battle-axe represents the Herd Howe intermediate type (Roe, 1966). They have truncated butts and are either expanded at both ends or at the blade end only. This example was based on the battle-axe from Rudston, barrow LXVIII, Yorkshire. It measures 60 mm in width, 130 mm in length and 30 mm in depth at the centre of the implement (Kinnes & Longworth, 1985, 76-77) (see figure 6.2 for an illustration of the battle-axe before being made and figure 6.3 for the finished replica).

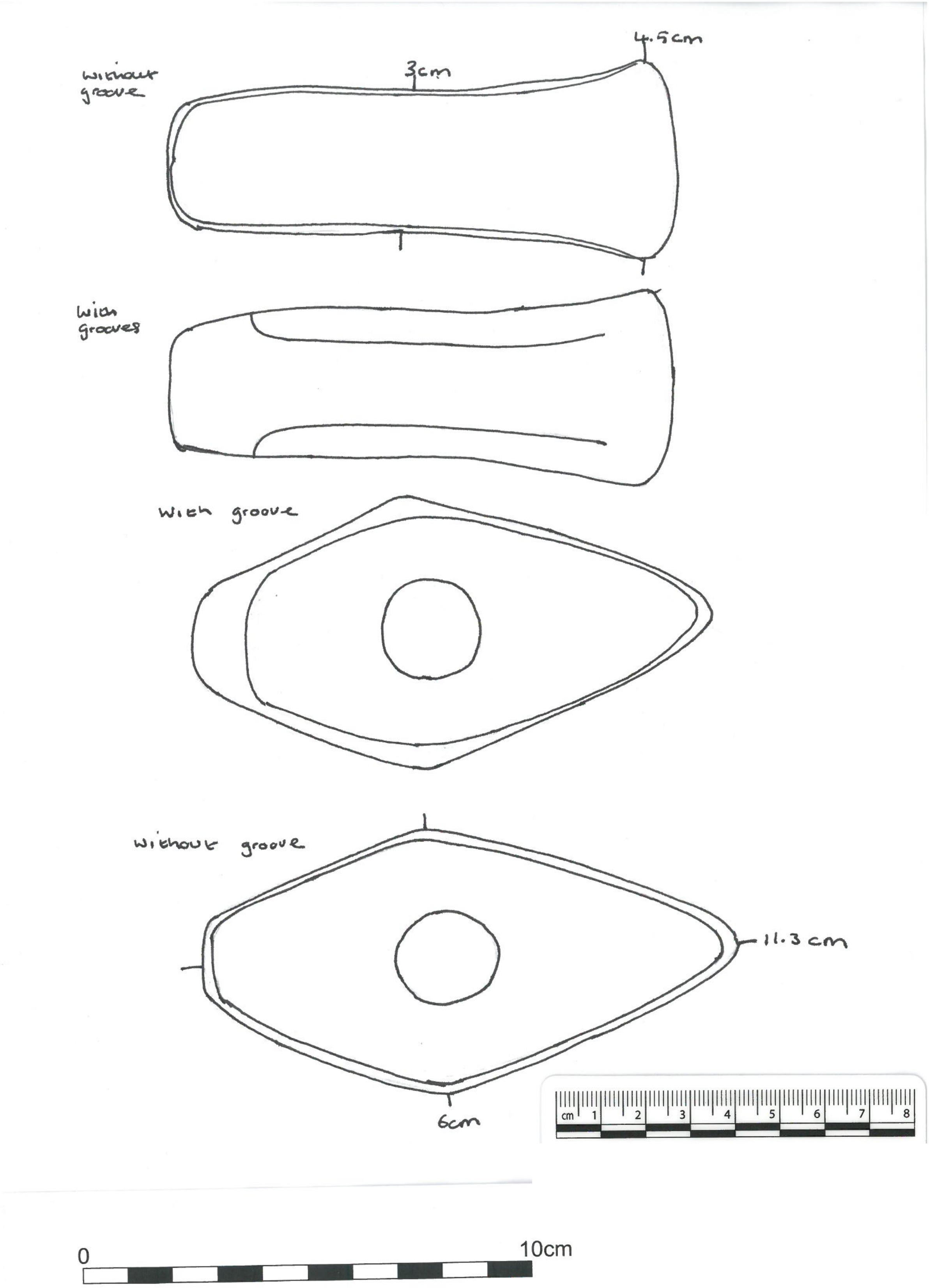


Figure 6.2: Illustration of replica 2

Figure 6.3: Images of replica 2 (Image: Author)

Battle-axe 3 is Roe's Stage III type. This battle-axe represents the Critchie group of Northern Variant battle-axes. This form of battle-axe is shorter in length and larger in depth than the previous stages (Roe, 1966). The morphology and size of this replica were based on a quartzite example from Stronsay Orkney. It measures 95 mm in length, 42 mm in width, the depth of the blade was 70 mm and the depth of the butt was 65 mm (Petrie, 1870, 136) (see figure 6.4 for in illustration of the battle-axe prior to being made, and figure 6.5 for the finished replica).

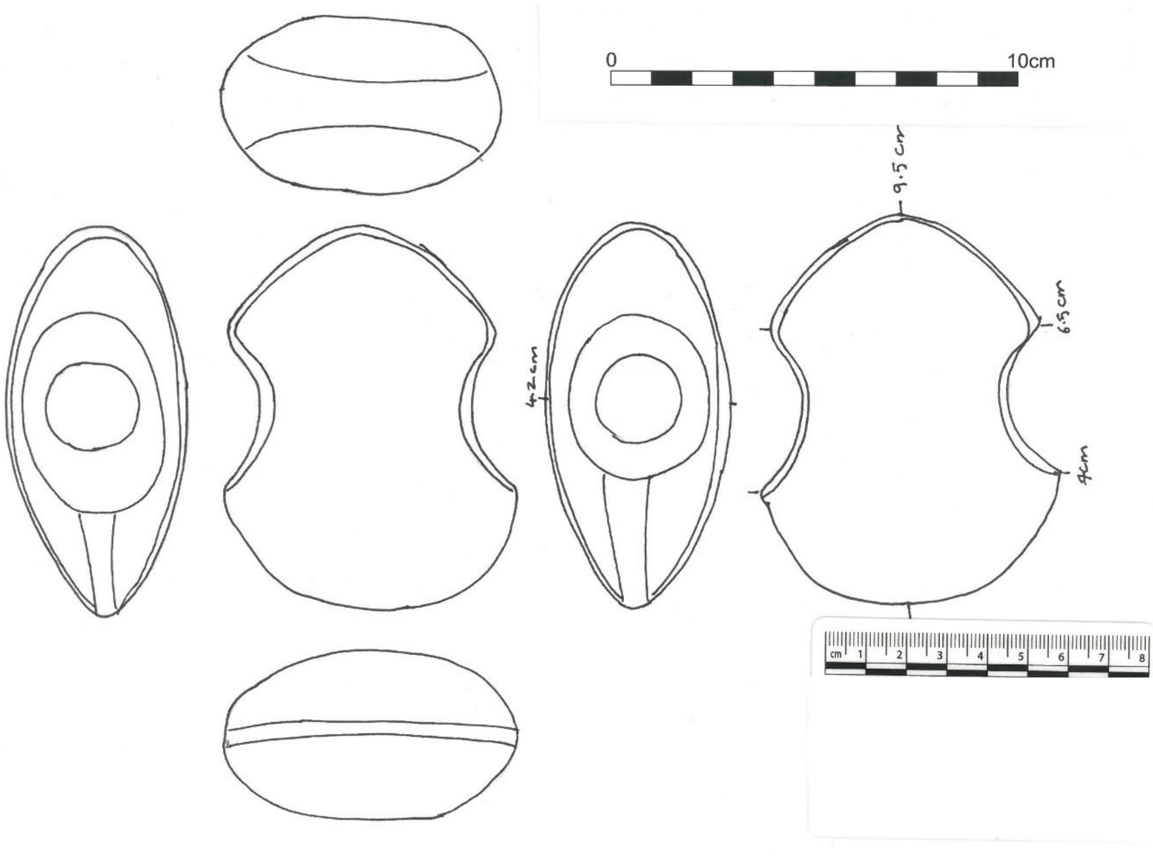


Figure 6.4: Illustration of replica 3

Figure 6.5: Images of replica 3 (Image: Author)

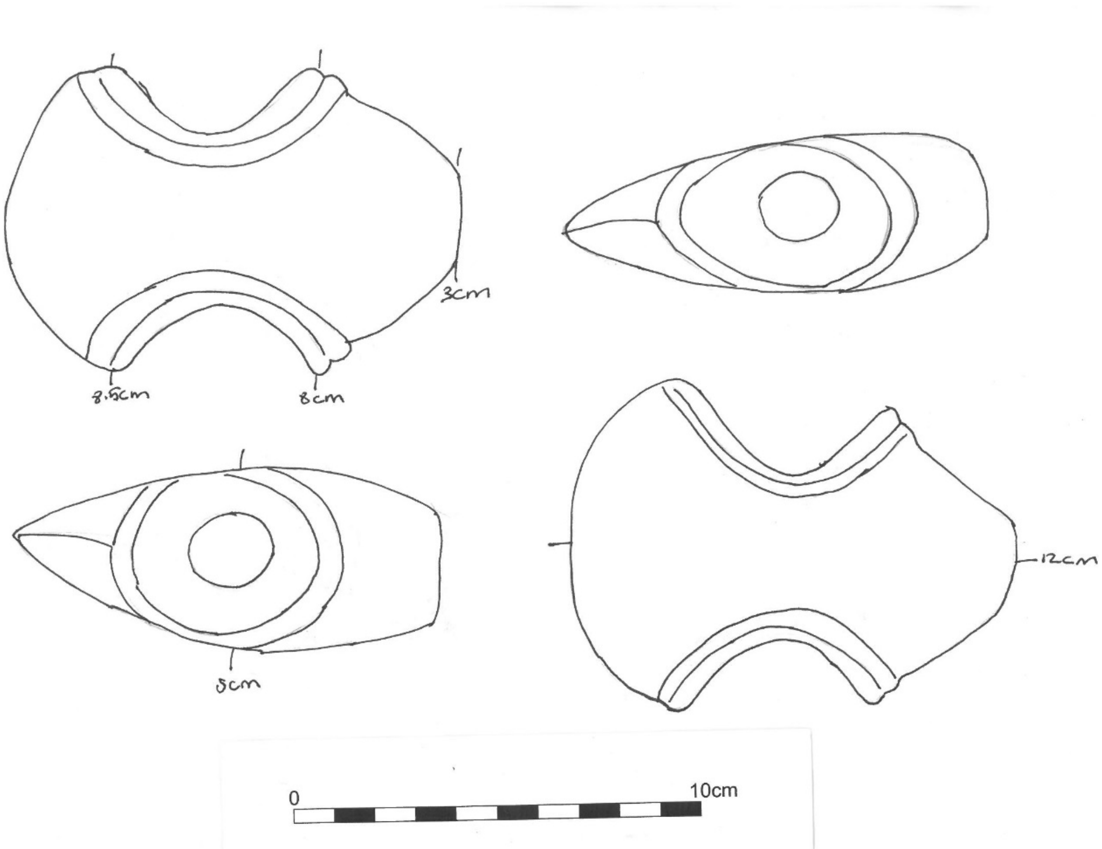


Figure 6.6: Illustration of replica 4

Battle-axe 4 is representative of Roe's Stage V type. This battle-axe was a copy of the Scotsburn typology. This example is short in proportion to its maximum depth, with two expanded ends close together (Roe, 1966). It was based on the Broomend of Critchie battle-axe with the measurements of 120 mm in length, 50 mm in width, 85 mm in depth at the blade and 80 mm in depth at the butt (Dalrymple, 1884, 321-2; Bradley, 2011) (see figure 6.6

for in illustration of the battle-axe prior to being made, and figure 6.7 for the finished replica).

Figure 6.7: Images of replica 4 (Image: Author)

Axe-hammers 1 and 2 represent Roe's class I axe-hammer type (Roe, 1966). Both axe-hammers were based on those in the archaeological record and measure 95 mm in width, 220 mm in length and 70 mm in depth (see figure 6.8 for in illustration of the battle-axe prior to being made, and figures 6.9 and 6.10 for the finished replica).

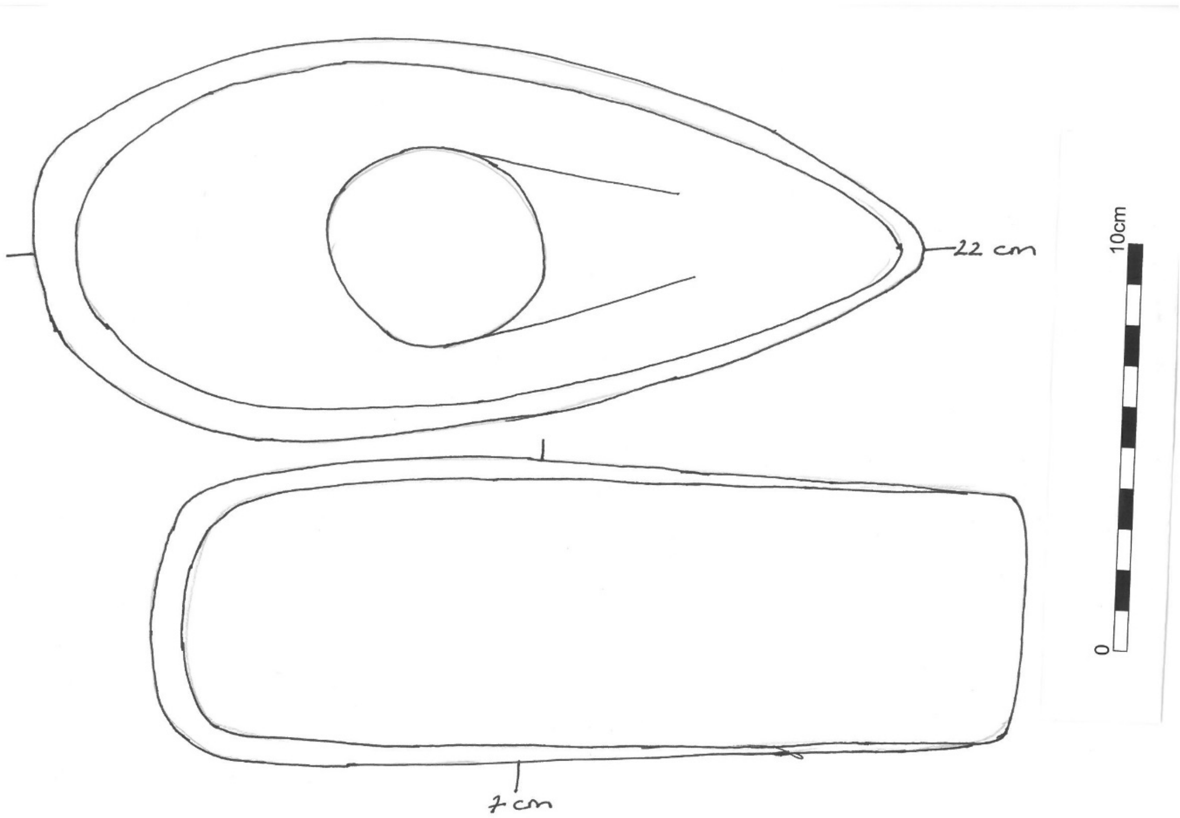


Figure 6.8: Illustration of replicas 5 and 6

Figure 6.9: Images of replica 5 (Image: Author)

Figure 6.10: Images of replica 6 (Image: Author)

Each replica was hafted using freshly cut ash wood with the shape and lengths based on the few examples of axe-hammer and battle-axes found with their hafts remaining (Harding & Young, 1979). A battle-axe haft was 700mm in length (figure 6.11), and an axe-hammer haft was 760mm in length (figure 6.12). The diameters match the diameters of the inside of the perforations. Ash, a tree type present in Early Bronze Age northern Britain (Dumayne-Peaty, 1999, 124; Dark, 2005, 608; Fyfe et al. 2003), was used as it was assessed by Harding and Young in a number of experiments to be the most effective (Harding &Young, 1979). A branch of ash was used to create each haft.

Figure 6.11: Replicas 3 ash hafted with a 700 mm haft

Figure 6.12: Replica 5 ash hafted with a 760 mm haft

Ash was used in five out of six occasions for hafting the replicas. In cases were ash was not available, an alternative wood which was also present during the Bronze Age was used, such as birch, oak, willow, alder, hazel, elm, and pine (Dumayne-Peaty, 1999, 124; Dark, 2005, 608). In this case, pine was used for the chopping wood experiment, this is a soft wood but is not soft enough to cause wear indicative of soft contact materials, and in this case it is a medium hardness contact material.

There are examples of battle-axes with jam hafts, hafts which have been secured using the pressure and expansion of the wood to secure it in place, while there is also evidence for the use of wedges between the implement and the haft to stop the implement wobbling (Keeley, 1982). Both techniques were used during each experiment to secure the haft. Wrappings of hide are also common to secure stone tools to their hafts if the hafted implements needed to be further secured and so it was planned to use a synthetic rope. However, this was not needed.

To recreate the haft lengths as authentically as possible, the axe-hammer hafts were based on an example of a hafted axe-hammer which was found at Cleethorpes, South Humberside. The haft was measured at approximately 760mm long, although it has since been lost and the type of wood is unknown (Leahy, 1986). The battle-axe hafts were based on the one which was discovered still hafted in a bog in at Emmercompascuum, Netherlands. It consists of a 700mm long shaft made of rowan wood (Butler & Fokkens, 2005). Though the hafts for axe-hammers and battle-axes were different sizes, battle-axe hafts were 700mm, and axe-hammers were 760mm, they had a similar shape. The hafts were straight, with a slight bend as demonstrated by the two archaeological examples. They were made from local tree branches with the appropriate shape, cut to the appropriate length.

6.4 Experimental tests

The methods for the experimental tests carried out with replica battle-axe, and axe-hammers are described below. Time and resource restrictions meant that the tests could not be carried twice, such as once with a battle-axe and once with an axe-hammer. However, by focussing on, and not rushing single experiments, the benefit was increased control of parameters and accuracy in understanding the effect of variables.

6.4.1 Felling and Chopping Wood - Stage I battle-axe

Felling and chopping wood would have occurred for several purposes during the Early Bronze Age. For instance, such action would be embarked upon to create planks, beams and posts for the construction of structures, enclosures, and boats. Wood to be used as firewood or for the creation of a variety of wooden objects would also need to be felled and chopped before these processes could begin. There have been numerous experiments felling trees using stone implements (Sehested, 1884; Smith, 1891; Montelius, 1906; Pond 1930; Morris, 1939; Potratz, 1941; Hyenstrand, 1969; Townsend, 1969; Bordaz, 1970; Heider, 1970; Semenov, 1964; Saraydar & Shimada, 1971 & 1973; Kozak, 1972; Coles, 1973 & 1979; Coles, Heal, & Orme, 1978; Carneiro, 1979; Harding & Young, 1979; Steensberg, 1980; Olausson, 1982 & 1983; Orme & Coles, 1983; Coles and Orme, 1985; Jorgensen, 1985; Meier, 1990; Holsten & Martens, 1991; Elberg et al. 2015). Experiments have demonstrated the effectiveness of these implements used to fell trees. One of the most recent experiments used a replica Neolithic stone adze to fell an oak tree, 42 cm in diameter, by cutting notches around the trunk (Elberg et al. 2015). They concluded that it was feasible to use this type of stone implement to fell hardwood trees with large diameters successfully. The recent Horsterwold and Vlaardingen Neolithic house experiments by Annelou van Gijn, Leiden University, used several experimental Neolithic polished stone axes to chop tree branches for the construction of a Neolithic longhouse attributed to the Vlaardingen Culture. They found that stone axes were very effective and fast tools when used to cut trees, although implements of other material were also effective, such as bone and antler axes and adzes (Van Gijn &

Pomstra, 2016; Universiteit Leiden, 2018). The effectiveness of stone axes and adzes, when used to fell and chop trees, is thus well documented. The only known experiments using stone battle-axes to fell trees was carried out by Wentink, who carried out three experiments each felling an American birch tree[2]. The wear formed during Wentink's experiments was analysed after the experiments finished, which means that the development of wear throughout the experiments is not known.

The experiment I proposed to carry out for this research project replicated the chopping motion needed to fell a tree and to chop wood. Both actions would require notches to be made against the grain, perpendicular to the axis of the trunk, around the diameter of the trunk. Since the same motion is used for both felling and chopping wood is likely the wear patterns will be the same. Therefore this experiment replicated both actions. The experiment planned to use a replica battle-axe to chop 2 m long logs, 100 to 300 mm in diameter, into 200 mm lengths, against the grain. The type of wood represented the types present in northern England and Scotland during the Early Bronze Age include ash, birch, oak, willow, alder, hazel, elm, and pine (Dumayne-Peaty, 1999, 124; Dark, 2005, 608). The objective was to strike the logs a maximum of 2000 times, or until developed wear was formed, which was estimated at thirty metres of tree log in 2 m lengths. The proposed action was as follows: a chopping motion using short swings to avoid damage to the perforation; strikes made with the blade angled toward the trunk to create V-shaped notches around the circumference of the log. This experiment was estimated to take approximately 28 hours. The aim was to chop wood using the angled notch approach to assess the development of wear throughout the experiment. The experiment also tested the effectiveness of this implement when carrying out this task. The availability of wood meant that the experiment method used changed to suit chopping branches off a live tree, it used a horizontal chopping action to chop branches off the trunk of a pine tree, section 6.5 describes the method used.

6.4.2 Splitting wood for timber planks – Axe-hammer

Once a tree is felled, the easiest way to transport it is to split it into smaller pieces. Splitting tree trunks creates timber of various sizes that could have been used in the creation of wooden construction materials, such as posts and beams, and objects such as bowls, clubs,

[2] The specific results of Wentink's experimental tests cannot be included in this thesis as I do not have permission by their owner.

and tools. In comparison to chopping wood and felling tree experiments, experiments splitting wood into timber planks are few. One example is the Minsmere experiment by Darrah aimed at splitting wood from a large oak tree for their use in the creation of an early Neolithic timber mortuary structure (Darrah, 2006, 118-128). Wooden wedges were used to split an oak tree trunk into timber planks. Once the initial wedge was hammered into the wood, further wedges were placed in the split it created to slowly force the split to run the length of the trunk. The use of wedges to split wood was concluded to be effective (Darrah, 2006). The use of metal wedges to split wood is known as a method used in medieval carpentry and are in fact still used today.

Wear on several axe-hammers in the archaeological record have presented patterns that suggest their use as a wedge that has been in contact with wood. Evans (1897, 204) suggested previously that these implements were employed as handled wedges to split wood. As such, the experiment plan was to use a replica stone axe-hammer to split lengths of logs into timber planks.

One-metre lengths of the log were planned to be used with a diameter of 100 to 300 mm. For a maximum of 2000 strikes, twenty-three one-metre lengths of logs were estimated. They had to be roughly straight without many knots. The same procedure for picking the wood type used for the experiment chopping wood was also used for this experiment. The experiment hammered the axe-hammer blade into the grain of the wood along the length of the log, using natural splits if they existed. Wear on the butt of axe-hammers in the archaeological record which shows signs of being used as a wedge also have percussive traces showing contact with wood on their butt. Therefore, I planned to use a wooden mallet to hit the axe-hammer into the wood until a split in the wood forms. This was not possible as the wooden mallets available were too soft to survive breakage and so a heavy ash branch was used instead. The method was as follows: remove the bark from the trunk before an axe-hammer is hammered into the wood along the length of the trunk to split it; use the axe-hammer as wedge to split the log along the radii as many times as possible; wooden wedges were on hand if they were needed to hold the split open. This experiment was estimated to take eight hours. This experiment aimed to test the development of wear throughout the course of the experiment. It also tested the effectiveness of using and axe-hammer as a wedge to split wood.

Limited access to fresh wood was considered to be a problem for the application of this experiment. An inadequate quantity of viable wood to split to create the desired amount of wear would mean that the wear may not develop as much as the other experiments. As a result, this experiment tested the development of wear when splitting the available wood, with the aim to assess the progression of wear development until the wood ran out. A restriction on wood would not affect the test of effectiveness, i.e. testing if the implement withstood use. If it was too fragile to be used it is likely that it would break after a short amount of use, rather than through prolonged use. Section 6.6 discusses the outcome of this experiment and how the methodology worked.

6.4.3 Splitting wood for firewood – Stage II battle-axe

The use of fire technology in domestic activities throughout prehistory is well known. Hearths can be found in domestic and mortuary settings. Fire was used for light and heat, for cooking, for kilns and the cremation burial rite. Some would have been collected from wind falls; however the need would have arisen to chop firewood also. In order to transform wood into small enough pieces to burn efficiently, logs of wood were to be split into smaller pieces roughly 8 inches thick, using a technique much the same as a modern day axe. Experiments splitting wood appear to be limited to splitting wood to create planks (Darrah, 2006). Firewood, however, has been used in numerous experiments, such as cookery, furnace, kiln, and cremation experiments although the creation of firewood has never been a parameter which has been tested.

The experiment aimed to split logs 100 to 300 mm in diameter and 200 mm in length. Eight splits per log were estimated. Two strikes with the implement were estimated to create a split; therefore, approximately sixteen strikes could be obtained per log. Overall, 164 logs were estimated to reach the maximum 2000 strikes aimed to create developed wear. It was planned to use the logs created from the chopping experiment in addition to logs obtained elsewhere. The pine branches from the chopping experiment were not used due to inaccessibility, so logs were obtained from local trees recently felled. The same procedure for the wood type used for the previous two experiments was also used for this experiment.

This experiment aimed to assess the efficiency of a battle-axe at splitting wood for firewood. It assessed the development of wear throughout the experiment to understand the progression of wear formation. The experiment was different to experiment 2, splitting wood for planks. It used 200mm long logs placed upon a flat and secure surface and split into smaller pieces. Before splitting the ends of the wooden blocks were squared off, if needed, with a modern saw to stop the battle-axe bouncing off an angled wood surface, instead of splitting it. As such, the battle-axes hit the wood at a roughly 90-degree angle to the wooden surface. Small to medium swings with the axe, held with two hands, were used to split the logs. There is no literature regarding the parameters for this experiment. See section 6.7 for the experiment outcome.

6.4.4 Clearing roots and earth/undergrowth – Stage V Battle-axe

Land clearances during the Early Bronze Age would have occurred for a variety of reasons. For instance, for the creation of enclosures for pastoral and arable farming, domestic spaces or irrigation systems. Likewise, creation of areas for habitation or storage, and transportation routes may have needed to be cleared through undergrowth. In the case of farming, removal of roots and breaking up the soil is a crucial step prior to planting. Later steps in the farming process will have required the digging up of crops, especially root-based foods generally described as tubers. The remains of tubers including the pignut species *Conopodium majus Loret* and *Bunium bulbocastanum L* have been found at a number of Neolithic and Early Bronze Age sites, such as Barrow Hills and Gravely Guy, Oxfordshire where they are suggestive of a food (Moffett, 1991). There are several Bronze Age implements which may have been used for such activities such as animal shoulder blades, while there may also be a plethora of wooden tools which have not survived. The survival of wooden tools at Must Farm, such as a bucket, bowls, bronze socketed axe hafts and possible processing tools, are demonstrable of their varied use during the Bronze Age (Must Farm, 2018).

Similarly, animals may have also been used to clear areas of land. However, there is no reason to think battle-axes and axe-hammers could not have also been used for any of these activities. They may have been used together with other tools to obtain the final result. I hypothesise that battle-axe and axe-hammers can be effectively used to break up and remove soil and roots.

Experiments have previously tested stone-tipped ploughs (Aberg & Bowen, 1960; Sonnenfeld, 1962; Leedham, 2015). In the late 1950s, Aberg and Bowen carried out three short tests using a replica iron-tipped ard based on the Donneruplund ard. They aimed to get the feel of the ard; to discover a suitable means of traction and method of harnessing; and to observe the nature of the furrow cut in a limited set of conditions (Aberg & Bowen, 1960, 144). This experiment tested the plough as an entire object and focussed mostly on how to use the plough effectively. Recently, Robert Leedham carried out experiments with two replica stone ard points. He successfully compared the wear macroscopically to the stone ard points from Orkney in the archaeological record thus demonstrating those in the archaeological record were used in a similar way (Leedham, 2015). The form of these ard points are much larger and dissimilar in shape to stone battle-axes which are comparatively different. The tip of an axe-hammer was discovered, however, in an ard furrow at Gwithian, Cornwall (Thomas, 1970). The tip is no long locatable, and since no illustration exists, it is difficult to confirm the small stone point was once part of an axe-hammers. Despite this, a link to the use of an ard can be made to perforated stone implements, albeit tentatively. There has only been one known experiment by Wentink using a replica battle-axe to cut through and clear earth and the roots of an American birch tree (Wentik, pers. comm).

Wear on several axe-hammers and battle-axes suggest contact with both soil and wood. This contact material was identified when analysing the polish type; the polish form will vary depending on the contact material(s) (for which, see chapter 7 for examples). The experiment assessed the development of wear throughout, which allowed for an understanding of the formation of wear throughout use from undeveloped wear to developed wear. The experiment also aimed to test the effectiveness of using a battle-axe for clearing roots and earth. A battle-axe was used to dig through earth containing roots and stones using a forward and back motion similar to that of using a garden hoe. It was planned to clear an area of land, 1x1m, covered in undergrowth such as bracken to ensure that it would come into contact with roots and soil. A maximum of 2000 strikes was aimed for, which was estimated to take eleven hours. See section 6.8 for the outcomes of the experiment.

6.4.5 Digging/tilling soil with stones– Stage III battle-axe

A parallel experiment to the clearing root and earth experiment was created to test a battle-axe tilling soil. Using it in the same way as the previous experiment, but on soil with stones and a few roots, in order to understand the difference in wear formation between soils heavy with roots and those which are not. This enabled a differentiation in use between land clearance and soil movement, i.e. tilling soil. Moving earth would have occurred for several reasons such as to create features such as pits and troughs, areas for kilns and activities such as cooking or to prepare areas for arable crops. The use of a battle-axe or axe-hammer for these actions is possible although other suitable equipment also exists, such as ploughs and their ard points. Experiments have successfully tested the plausibility and process of using such a tool in prehistory (Aberg & Bowen, 1960; Sonnenfield, 1962; Leedham, 2015). However, it is likely that not one single tool was used for the same activity across the country, therefore, it is appropriate to test the effectiveness of a battle-axe at tilling soil. The experiment also assessed the development of the wear on the replica throughout the test.

The experiment dug an area 1x1m covered by grass by using a hoeing motion whereby the implement is placed in the soil with a small amount of force and dragged back towards the person experimenting, each drag back was categorised as a strike. The plan was to dig to a roughly continual depth of half a metre and extend backwards across the area to remove the small number of roots and break up the soil. To create developed wear, this experiment aimed to use 2000 strikes, which were estimated to take eleven hours. Section 6.9 describes the outcome of the experiment.

6.4.6 Slaughtering cow or pig – Axe-hammer

It is thought that pastoral farming was primarily the most common farming method from the Late Neolithic and into the Early Bronze Age, reverting to cereal agriculture towards the Middle Bronze Age (Stevens & Fuller, 2012; Hey & Robinson 2011, 258). If this is so, it would not be uncommon for the slaughter of livestock to have taken place. Animal remains are not commonly analysed and recorded in detail, so it is uncertain how livestock was slaughtered. There are accounts of the slaughter and sacrifice of animals such as pigs and cattle during the Bronze Age, such as the large quantity of cattle skulls covering Gayhurst round mound (Deighton & Halstead, 2007; Towers et al. 2010). This is an under-researched topic and the vast majority of animal bones are missing because many do not survive and much of those that do were not kept. For instance, Wilkin's review of animal remains from Late Neolithic and Early Bronze Age funerary contexts in Wiltshire, Dorset and Oxfordshire mentioned just 21 findings of cattle, and eleven of pig. They range from fragments to full skeletons (Wilkin, 2011). The method of slaughter is rarely considered. However, Schulting (2008) has used ethnography and the small amount of evidence of trauma in the archaeological record to suggest that such injuries may be a result of methods of drawn-out slaughter may have been used, indicated by unhealed wounds that would not have killed the animal (Schulting, 2008, 101). Perhaps intentionally violent and extreme, having multiple parts, using different methods or acts. These might include repeated blows to the head, cuts, and projectile damage (Schulting, 2008, 100; Bloch, 1985; Hoskins. 1993, 159; Abbink, 2003).

Accounts of fragmentation of cattle skulls are few; some accounts of skulls from EBA barrows in Yorkshire and Silbury indicate peri-mortem injuries at the front of the skulls as a result of several blows to the head (figure 6.13) (Mortimer, 1905, 318). Such fractures could easily have been caused by a large stone implement such as a battle-axe or even an axe-hammer.

The only known experiment using a stone implement on animal skulls is Wentink's experiment striking boar, doe and stag skulls (Wentik, pers, comm). My experiment assessed the wear throughout the experiment using one type of animal skull to maintain the same thickness and hardness of bone throughout the experiment.

Figure 6.13: An ox skull with a frontal bone impact fracture from multiple blows, from barrow 264, Yorkshire (Mortimer, 1905, 318)

Contact with bone is evident on a small number of battle-axes and a more significant number of axe-hammers in the archaeological record. I hypothesised that axe-hammers were effective tools in the slaughter of livestock, whereby their size and weight were utilised to hit the animal on the head hard enough to kill it, much like the modern-day cattle gun. The experiment was to strike the skull of a pig or cow, unskinned, until there were no unbroken parts of the skull to hit. This was to achieve the most amount of hits from each skull. A pig skull was used, as cow skulls were unavailable. One to two hits would probably kill the animal, but it is likely this would not create much wear. Therefore, the experiment used multiple strikes on unbroken parts of the skulls to allow for the wear to develop. Regular pauses were taken to assess how the wear developed from a few strikes to many. It was estimated that a total of twenty animal skulls obtained from a butcher would be used. Due to the logistics of storing large quantities of animal skulls, a total of ten were acquired per day and returned to the butchers for disposal. The experiment used a hafted axe-hammer to strike the animal skulls a maximum of 2000 times to allow for developed wear to form. The plan was to hit each skull in different areas until it was broken and fragmentary, thus allowing for the blade to come into contact with unbroken skull and flesh with every hit. The skulls were placed on flat wooden boards on the ground which the replica did not come into contact. It was estimated that the experiment would take five hours. This experiment aimed to test the effectiveness of the replica at slaughtering livestock by assessing how easy it was to break skull bone. It also assessed the development of wear on the replica throughout the experiment. Section 6.10 describes the outcomes of this experiment.

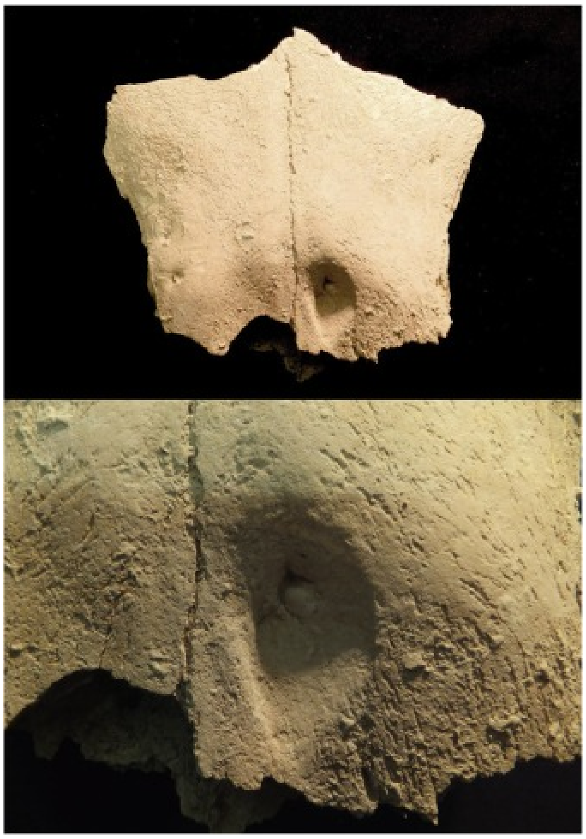


Figure 6.14: Healed depression fracture to left frontal, cattle skull deposit B4, Beckhampton Road long barrow (Banfield et al. 2019, 199).

Cranial trauma on the skulls of livestock has not been recorded in the British Isles. This may be because livestock is rarely intentionally buried. Animal bones can often be found in fragmentary forms in ditches and other rubbish deposits, also often only the species and type of bone is noted in publications. There is limited information, but the blunt force trauma evident on cow skulls in particular EBA barrows suggests pole-axing occurred to some extent. Indeed, the recent paper by Banfield et al. (2019) indicated that pole-axing was present in the Neolithic. They discussed a healed blunt-force impact trauma on the frontal bone a domestic cattle skull from Beckhampton Road Neolithic long barrow, Wiltshire, which they suggest indicates a failed attempt at slaughter through pole-axing (figure 6.14).

In assessing the wear formation and comparing it to those in the archaeological record, it can be argued that axe-hammers came into contact with bone, possibly through animal slaughter. However, other hypothesises could be suggested, such as their use as weapons. O’Flaherty successfully tested the effectiveness of Early Bronze Age halberds as killing weapons by hitting a total of twenty sheep skulls with a replica halberd thus demonstrating their effectiveness at this activity which he connected (O’Flaherty, 2007). A separate experiment would need to be carried out to assess the functionality of battle-axes and axe-hammers during combat. This was not carried out due to the financial and time limits of the project. However, by testing the effectiveness an axe-hammer or battle-axe to slaughter an animal, it can be supposed that these implements would be effective at killing another human if they are effective at slaughtering a pig. This experiment does not inform us about the ease of wielding the weapon, which would need a further experiment.

6.5 Chopping wood experiment results

The chopping wood experiment chopped down four branches of a pine tree. Due to accessibility issues, a tree could not be sourced to fell; however, the same motions were used for chopping branches, 300-400 mm in diameter (figure 6.15). Battle-axe replica 2, with a slightly expanded, straight blade, was used for this experiment. The axe was hafted on a pine haft, 700mm in length, from a fresh branch. Horizontal chopping motions were used to chop through branches to remove them from the tree. The branches were just below shoulder height and therefore were easily accessible. Pauses at 50, 100, 200, 500, 1000, 1500 and 2000 strikes allowed assessment of wear development throughout the experiment. The casts, taken at each pause using President Jet, were analysed under a stereomicroscope as the experiment was carried out in the field with no access to a microscope during the pauses.

Figure 6.15: Image of the experiment chopping pine tree branches with a replica battle-axe

6.5.1 Effectiveness

This battle-axe proved extremely effective at chopping wood. The branches were easily chopped through in around 10 minutes without any excess force. The easy and effective nature of this task for myself to carry out reflects the usefulness of the battle-axe for chopping wood. Suggestions that battle-axes are too weak across the perforation to be functional was clearly disproved.

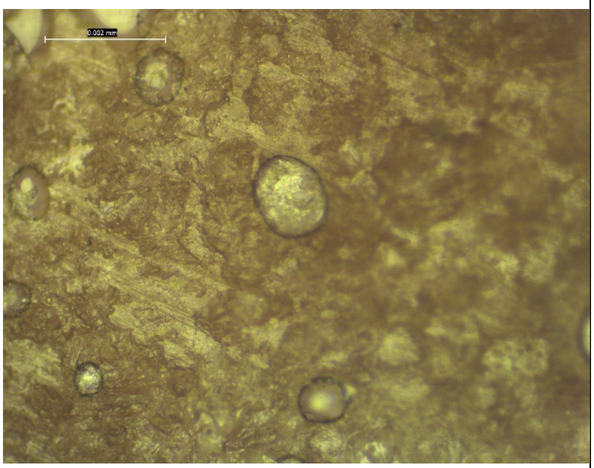
The axe-head was secured to the haft by soaking it in water for two hours, allowing the timber of the haft to swell. This time was too short as the haft shrunk over time, causing the axe-head to spin on the haft very slightly upon impact. Wooden wedges were secured between the haft and inner wall of the perforation to secure the axe-head. On one occasion the wedges fell out during use and the axe-head fell off the haft and struck a stone, causing a small flake removal on the corner of the blade. This was not dissimilar to those seen on the corners of several battle-axe and axe-hammers in the archaeological record. Securing the axe-head with wedges maintained its effectiveness, but the wedges had to be replaced frequently. Following the shrinking of the haft, the axe-head with haft attached was stored in a bucket of water overnight. This maintained the swelling of the timber haft, securing it to the axe-head, allowing the implement to be used efficiently.

6.5.2 Fifty strikes

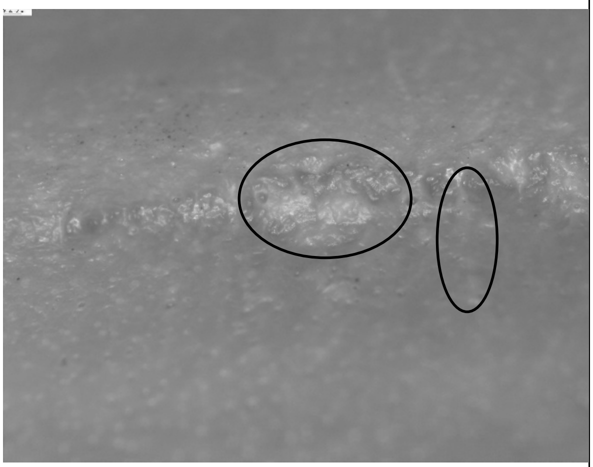
The first pause during the experiment, at 50 strikes, presented very limited wear. Sparse, superficial and narrow grain removal pits were present in small groups on the blade tip. Equally sparse, short striations with a u-shaped profile were associated, running parallel to one another and perpendicular to the blade edge. All wear from use is faint and superficial. It congregates into three groups, one central and one towards either corner. Striations from the production process were still visible.

Analysis of the casts taken at this early stage in the experiment revealed minimally altered production polish. In few areas, this polish appeared slightly rounded at the edges. No use-polish was evident (figure 6.16).

A



B



A. Analysis of an acetate cast of the blade edge using a metallographic microscope: Polish from production still evident. Long, parallel striations over flat, rough patches of polish, X10.
B. Stereoscopic analysis of a President Jet cast of the blade tip, centrally presenting negative wear: The central collection of three bumps are a clump of grain removal pits. A small number of these are spread sparsely across the blade tip. Faint striations can also be seen, X1.5.

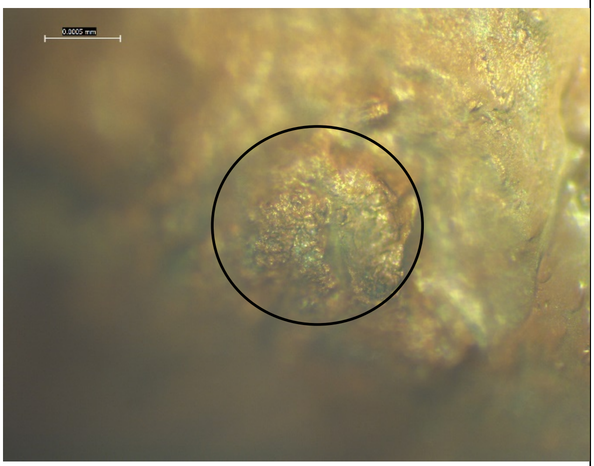
Figure 6.16: Micrographs of wear analysed at 50 strikes chopping wood

6.5.3 One-hundred strikes

One-hundred strikes caused the three groups of pits and associated striations to become more apparent. The pits within the groups had a close density, while the groups were sparsely separated. These pits are developing over the production traces, making them clearly differentiated. The associated bifacial, short striations were slightly greater in number, appearing in groups of 3-4, and have an equally close density. At this stage, rounding of the high topography of the corners of the blade had begun to develop. The wear was still limited and less developed.

Analysis of the casts revealed the development of granular, domed polish in small, sparse patches on the blade tip. The production polish on the blade edges remained with no signs of change (figure 6.17).

A



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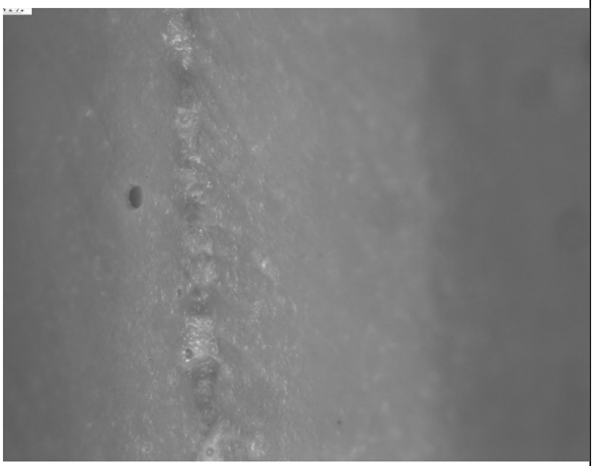


A. Analysis of an acetate cast of the blade tip using a metallographic microscope: granular, domed polish in a small patch, X20.
B. Stereoscopic analysis of a President Jet cast of the blade tip, centrally presenting negative wear: A clump of grain removal pits in the centre of the blade tip, two more exist towards the corners of the blade. Striations can be seen moving away from the pits in a parallel arrangement, X1.5.

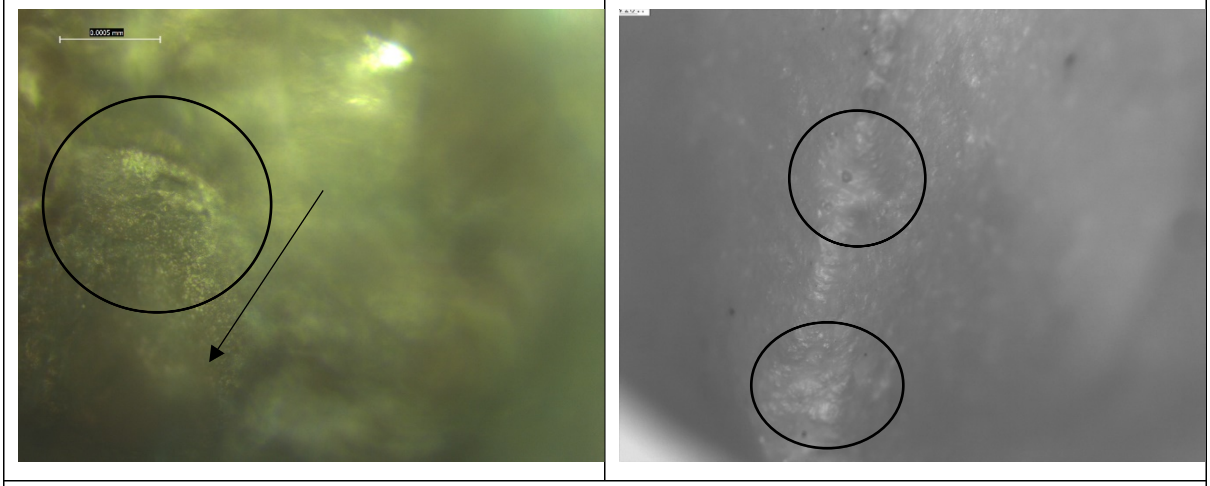
Figure 6.17: Micrographs of wear analysed at 100 strikes chopping wood

6.5.4 Two-hundred strikes

After 200 strikes the wear had sufficiently developed so that it spread onto the blade edge very slightly, approximately 2mm. The grain removal pits had increased in size, several in the centre are large enough to cover the blade tip and edge/s. The increase in size was accompanied by additional pits; these were superficial and narrow like those found at 50 strikes. Pits and associated striations were also found on the corners of the blade, the associated striations were smaller than those on the blade edges and were diagonal, facing towards the blade edges. Rounding of the higher topography of the pits, i.e. the tops of the pits, are present along the blade tip.

Analysis of the casts revealed polish comparable to that of 100 strikes. The tip continued to have sparse patches of domed granular polish. This polish was beginning to show a slight directionality, indicating the direction of use. At this stage, the production traces appeared rougher, although they are still visible (figure 6.18).

A B



A. Analysis of a cast of the blade tip using a metallographic microscope: A patch of granular, domed polish showing directionality indicated by the arrow, X40.
B. Stereoscopic analysis of a President Jet cast of the blade tip, towards one corner, presenting negative wear: A pit on the corner and another close to it on the tip which have increased in size, causing them to cover the tip and blade edges, bifacially, X2.0.

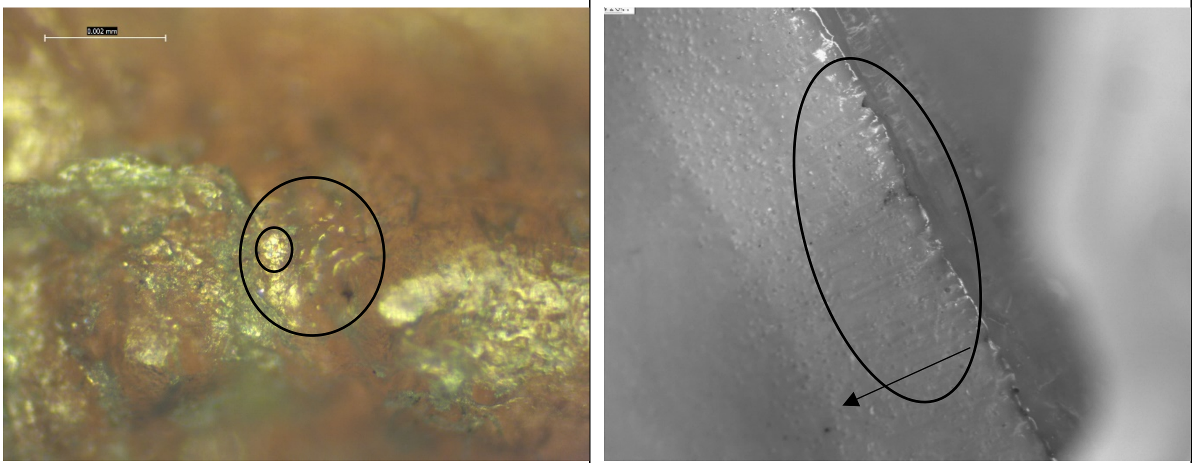
Figure 6.18: Micrographs of wear analysed at 200 strikes chopping wood

6.5.5 Five-hundred strikes

A pause at 500 strikes showed all three groups had increased in size so that they were almost joined. As a result, the wear at the corners of the blade was also closer. At this stage, the pits were larger still, most spread onto the blade edges and smaller pits, much like those at 50 strikes, accompanied them on the edges. The number of striations had increased so that the differentiation between the groups was less clear. They remain with a close density and u-shaped profile. Rounding continued to be present on the high topography of the pits.

Analysis of the casts revealed small patches of domed polish, mostly located on the tip of the axe-head. The polished stone grains were partially connected with the patches, which were sparse and had few parallel striations oriented in the same direction as the directionality of the polish, perpendicular to the blade edge. Production polish remained visible (figure 6.19).

A | B



A. Analysis of an acetate cast of the blade tip using a metallographic microscope: Partially connected small patches of domed polish with short, parallel striations on the patch indicated by the smaller circle, X10.

B. Stereoscopic analysis of a President Jet cast of the blade tip, presenting negative wear: Close density striations running parallel with each other and perpendicular to the blade edge, associated with close grain removal pits on the blade tip, X0.8.

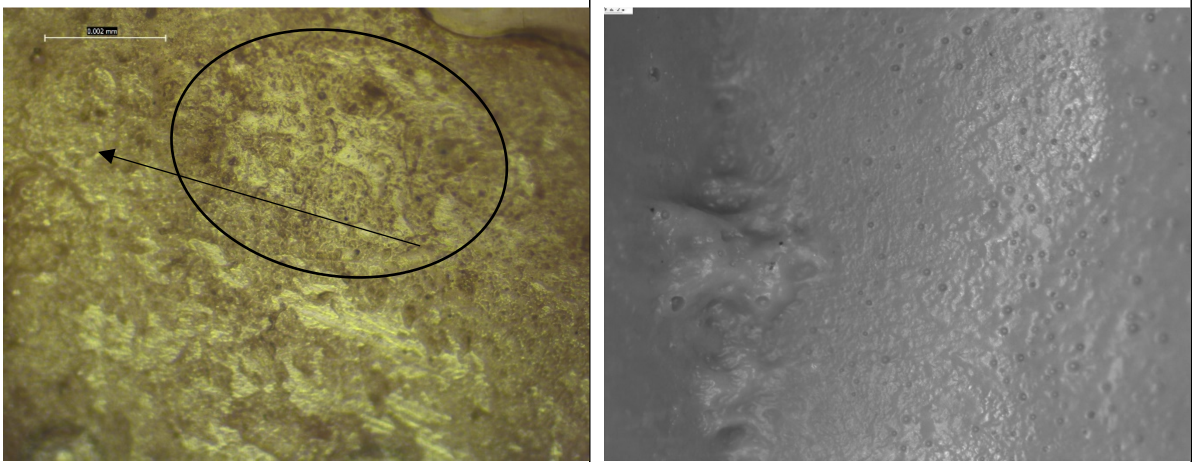
Figure 6.19: Micrographs of wear analysed at 500 strikes chopping wood

6.5.6 One-thousand strikes

Analysis of the wear after 1000 strikes revealed slightly larger grain removal pits which were greater in quantity and spread further onto the blade edges, approximately 5mm. They remained superficial, although they had become wider. The groups of pits and associated striations no longer exist as separate patches as the gaps between them had been filled with pits and striations with similar characteristics. The increase in pits had caused some to join to form larger pits, although this remained relevant for only those directly on the tip. The largest pits were on and closest to the tip, while those further away were smaller since they occurred more recently. At this stage the striations were also greater in number, seeming almost seamlessly to spread along the blade edges with a close density. Some were within the larger pits. They were short, u-shaped in profile and are arranged parallel to one another and perpendicular to the blade edge. Rounding remained the same as the previous pause.

The casts taken at the 1000-strike stage revealed moderately developed wood polish in small patches. They had parallel striations running perpendicular to the blade edge, the same as the directionality, and were surrounded by granular domed polish. This polish is the less developed polish appearing in locations and did not exist at 500 strikes. The patches were sparse to close in density and production polish was still visible in large areas of the blade edges (figure 6.20).

A B



A. Analysis of an acetate cast of the blade edge using a metallographic microscope: production polish (bottom) next to partially connected larger patches of polish, indicated by the circle, directionality indicated by the arrow, X10.

B. Stereoscopic analysis of a President Jet cast of the blade tip, presenting negative wear: Wider pits in the blade tip, moving further onto the blade edges is demonstrate with this patch of grain removal pits associated with the evenly spread striations along the blade edge, X1.5.

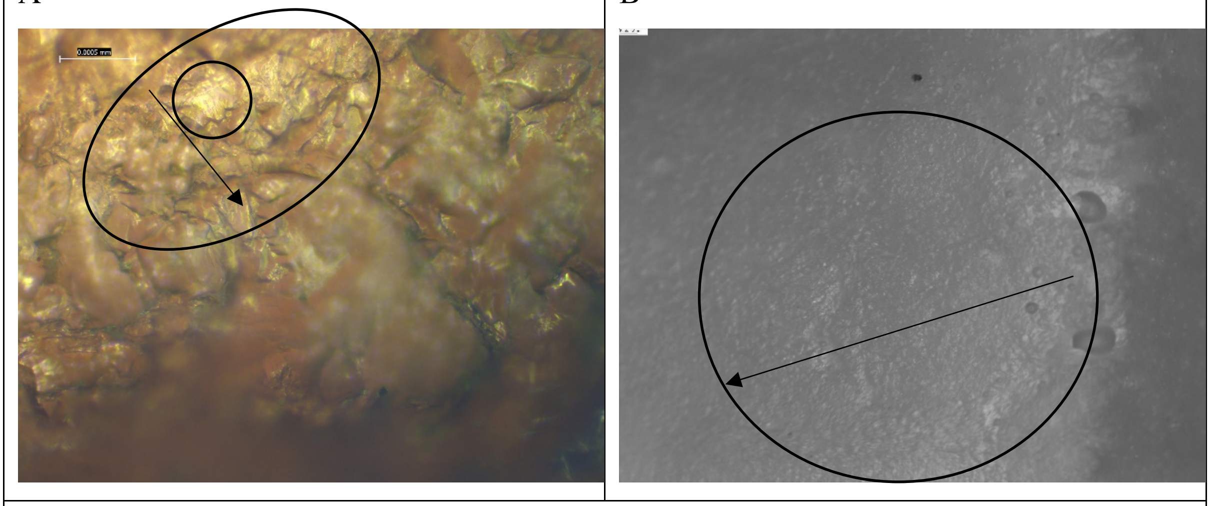
Figure 6.20: Micrographs of wear analysed at 1000 strikes chopping wood

6.5.7 One-thousand-five-hundred strikes

At 1500 strikes the wear appeared continuous across the blade tip and edges. Many more grain removal pits joined together to form larger pits, several of which expanded onto both blade edges. The pits on the blade edges also became larger but did not extend further onto the blade edge than they did at 100 strikes. At this stage, the striations associated with the pits were closer in density, with a close to dense density. Those in the centre of the blade became longer, up to 8mm, and those at the corners of the blade began to overlap one another. All wear was bifacial and rounding continues to exist on the high topography of the tip. A flake negative occurred during this phase of strikes when the axe-head became loose and fell off the haft, hitting a hard stone. A flake from the top corner of the axe-head was removed. Continued use rounded the edges of this flake negative.

Analysis of the casts taken after 1500 strikes showed larger patches of polish from use. The domed polished grains were now starting to be connected, and the density of the patches increased, being close on the blade edge and denser on the tip. The centre of the blade tip had the densest and largest patches of domed polish. On all patches, short parallel striations and directionality indicated the direction of use, perpendicular to the blade edge. The polish is clearly wood polish. In a few places, the production polish was still visible, although it was significantly reduced in size and density (figure 6.21).

A B



A. Analysis of an acetate cast of the blade edge using a metallographic microscope: close to dense patches of domed polish, directionality and direction of striations indicated by the arrow. Short, parallel striations can be seen within the smaller circle, X20.
B. Stereoscopic analysis of a President Jet cast of the blade tip and edge, presenting negative wear: close to dense striations run parallel to one another on the blade edge from the tip, indicated by the arrow. They are faint and extend 8mm onto the blade edges, bifacially, associated with grain removal pits on the tip, X1.5.

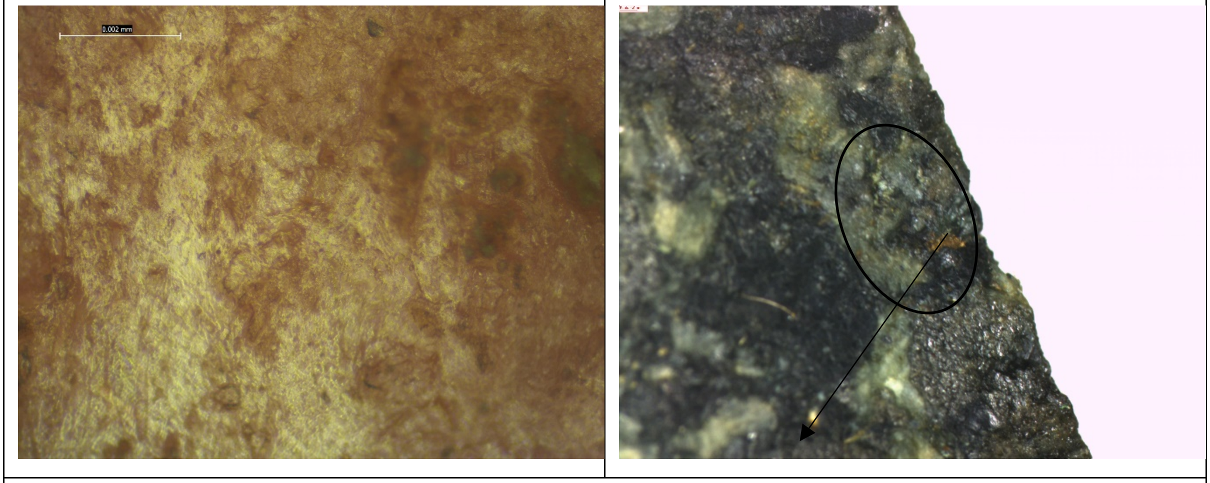
Figure 6.21: Micrographs of wear analysed at 1500 strikes chopping wood

6.5.8 Two-thousand strikes

The final analysis of the axe-head taken after 2000 strikes revealed the dense formation of wear bifacially on both blade edges. Grain removal pits spread continuously along the tip and blade edge, remaining close to the tip and extending 5-10mm onto the blade edge. The pits on the blade edge remained narrow and slightly superficial, while those on the tip were much wider and deeper. The dense formation and larger pits along the tip caused the surface to become rough. A small flake negative was also present on the top corner of the blade, from continued contact. It was rounded, as was the high topography of the large flake negative described at 1500 strikes. Striations running from the pits on the tip and blade edges were dense, running parallel to one another and perpendicular to the blade edge. They were u-shape in profile and were often interrupted by pits. Diagonal striations, pointing towards the centre of the axe-head, cut across these perpendicular striations in the centre and top corner of the blade edges. This wear indicates the movement of the axe-head when meeting the wood at 90 degrees and moving into the wood and leaning in with the bottom corner leaving first, thus leaving the top corner in contact with the wood more often. The wear at 2000 strikes was well developed and dense, but the despite this the blade remained functional and did not need to be re-sharped to maintain this (figure 6.22).

Analysis of the casts and stereoscopic analysis of the blade under a metallographic microscope revealed the domed patches of polish had increased in size to medium and were partially connected with a close density covering the casts. The directionality, perpendicular to the blade edge, was clear with the parallel striations in the same direction. The polish was smooth.

A B



A. Analysis of an acetate cast of the blade edge using a metallographic microscope: Medium sized patches of domed polish, partially connected and covering the cast with a close density and clear directionality, X10.

B. Stereoscopic analysis of the blade edge and tip: dense pits along the tip creating a rough texture, with dense pits next to the tip, within the circle, and striations running from them, all indicated by an arrow, X1.5.

Figure 6.22: Micrographs of wear analysed at 2000 strikes chopping wood

6.6 Wedge-splitting wood experiment results

The experiment carried out to test the formation of wear on an axe-hammer used as a wedge to split wood along the grain was carried out with little success. A one-metre long log was debarked in preparation for it to be split lengthways. A sharp flint was dragged along the surface, along the grain, for the length of the axe-hammer blade to ensure there was a bite for the blade to grip during the percussive action. This experiment involved two people, myself percussively hitting the butt of the axe with a large ash log and another to hold the axe-hammer in place with the haft (figure 6.23). This method was carried out to split the log along the grain, a common technique used with modern tools, such as mauls, today. The log used to hit the butt percussively was chosen due to its weight, it had a 300mm diameter and was 1.5 metres in length. The axe-hammer was hafted to ensure that it did not slip during use.

6.6.1 Effectiveness

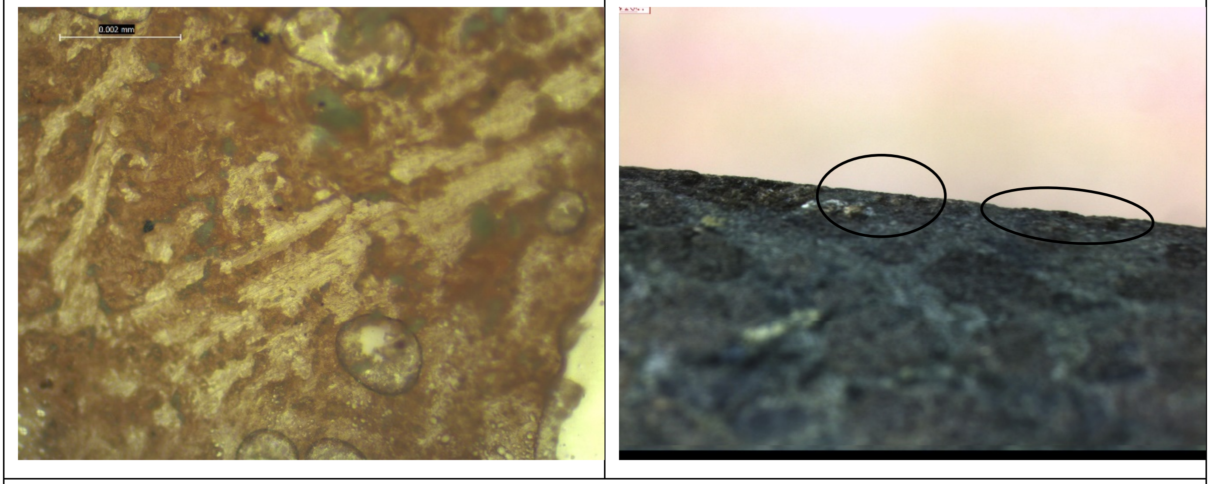
This experiment determined that axe-hammers were not effective tools to be used as wedges to split logs, although repeated experiments are needed to test this further. Over the 2000 strikes the blade slowly created a linear hole but did not split the log. Wear was recorded at the various stopping points regardless of this. I hypothesised that some axe-hammer and battle-axes were used as wedges to split wood into plank type pieces. The negative result from this experiment suggests this hypothesis was incorrect. However, the chance that the experiment was not a faithful reproduction means that repeated tests are needed to re-test the hypothesis. For instance, different types of wood should be used with minimal knots. Likewise, the material used to hit the butt of the axe percussively should be changed. Another axe-hammer could be used to percussively hit the butt of that axe-hammer used as a wedge, with a piece of wood or leather in between to protect the stone. Additionally, a stronger user may prove more effective as they could provide greater force. If further tests are also ineffective, this may be due to the angle of the blade. The angle of modern axes is on average 30-40 degrees at the end, tapering to 15-20 degrees on the body of the axe. The angle of the axe-hammer was 60 degrees at the tip, tapering to 40 degrees.

6.6.2 Fifty strikes

Figure 6.23: Image of experiment used an axe-hammer as a wedge to split wood

The first pause during the experiment occurred after 50 strikes. During this stage, the wood beneath the blade was crushed, but no cracks or splits formed. Macroscopically the blade and butt appeared unchanged. Analysis of the blade and butt under a stereomicroscope revealed minimal patches of small striations on the blade edges associated with superficial and narrow pits in small clumps towards the edges of the blade. More wear was present on one side. Very few traces of wear were present on the butt, just a small patch of close, superficial grain removal pits. Analysis of the casts under a metallographic microscope revealed polish produced during the production process was visible and unchanged (figure 6.24).

A B



A. Analysis of an acetate cast of the butt using a metallographic microscope: Polish from production still evident. Long, parallel striations over flat, rough patches of polish, X10.

B. Stereoscopic analysis of the blade edge: A small clumps of pits on blade tip and edges, sparse, narrow and superficial, indicated by the circles, X1.2.

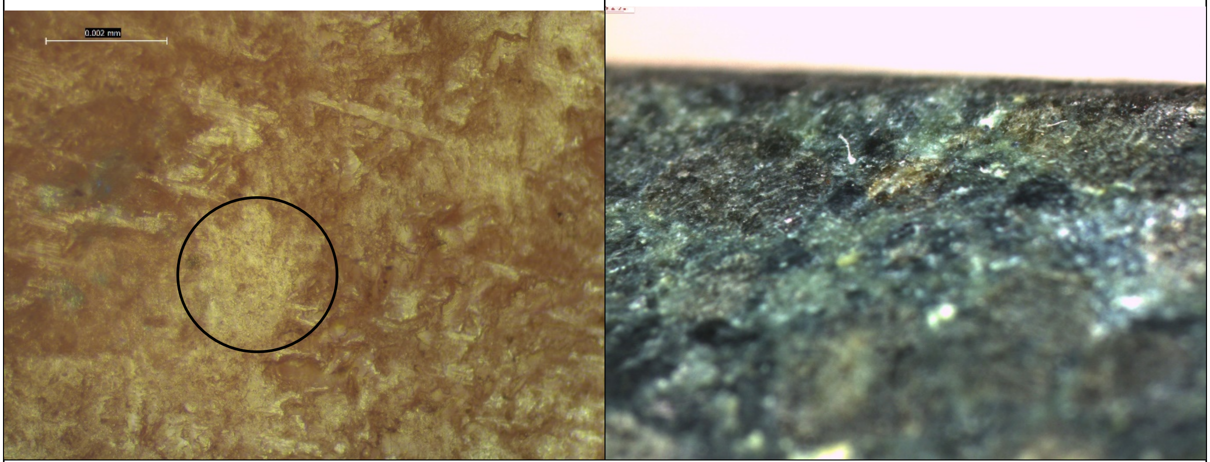
Figure 6.24: Micrographs of wear analysed at 50 strikes of a wedge splitting wood

6.6.3 One-hundred strikes

A pause was taken after 100 strikes during which a small linear hole was created with a V-shaped profile. Grains of wood were crushed and removed during this process. The wood did not split during this stage. When analysing the blade and butt under a stereomicroscope, the wear had visibly increased in quantity, although it remained less developed. The striations were both long and short and a mix of diagonal and perpendicular to the blade edge, in clumps along the blade edges, bifacially. They were associated with larger clumps of grain removal pits extending 10-15mm onto blade edge. The largest quantity existed in the centre of the blade, bifacially. Rounding was first seen in this area. Few sparse pits were present on the butt.

Metallographic analysis of the casts showed altered production polish. In sparse places, this polish was interrupted by a slightly granular polish on the blade edges and butt (figure 6.25).

A B



A. Analysis of an acetate cast of the blade edge using a metallographic microscope: A granular patch indicated by the circle, interrupts the production polish, X10.

B. Stereoscopic analysis of the blade edge: Diagonal and straight striations run from grain removal pit on the tip and blade edge, with a close density, arrows indicate the direction of striations, see circle an example of pits, X1.5.

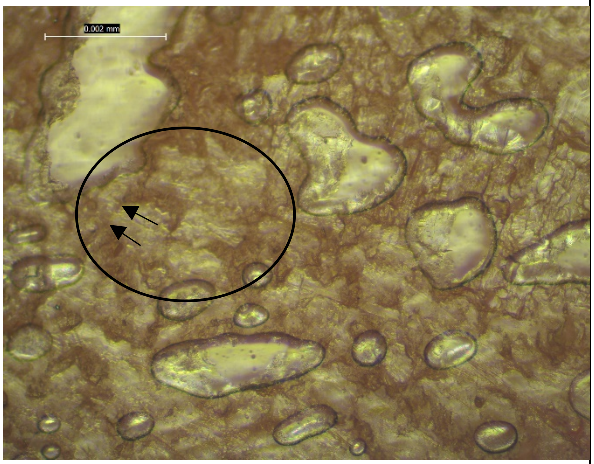
Figure 6.25: Micrographs showing wear analysed at 100 strikes of a wedge splitting wood

6.6.4 Two-hundred strikes

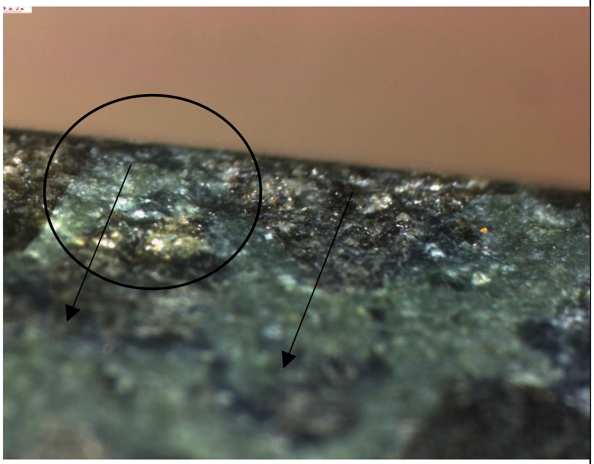
After 200 strikes wear was first visible macroscopically, albeit superficial and sparse. The stereoscopic analysis revealed the wear had developed enough to cover the length of blade edges, bifacially, with a sparse to close density. Grain removal pits extend across this area but remained superficial and narrow. Associated striations remained the same as at 100 strikes, although were greater in number and therefore occasionally overlapped each other. Rounding remains minimal at this stage. This is the first-time crushing was viewed, location at a corner of the blade edge, and related to the clump of grain removal pits present in that area. The corners of the blade had slightly denser wear, and more grains were rounded. The wear analysed on the butt of the axe-hammer after 200 strikes were similarly developed. Greater quantities of grain removal pits, superficial but wider than the previous stage, occurred in small clumps in the centre of the butt.

Metallographic analysis of the casts taken of the blade edges, tip and butt after 200 strikes revealed the development of a use polish visibly different to the production traces still present. Areas of the production polish were rounded from use while patches of domed and slightly granular grains were present in a close density. The patches were sparse and were larger at the corners of the blade where the wear analysed under the stereomicroscope revealed larger patches of denser grain removal pits and rounding (figure 6.26).

A



B



A. Analysis of an acetate cast of the blade edge using a metallographic microscope: Small, minimally connected patches of domed polish, see the circle, with limited parallel striations, their direction indicated by the arrows, X10.

B. Stereoscopic analysis of the blade edge: Superficial and narrow grain removal pits extend onto the blade edge, they are closer in density near the tip, see the circle. Arrows indicate the direction of striations which are associated with the pits, X2.0.

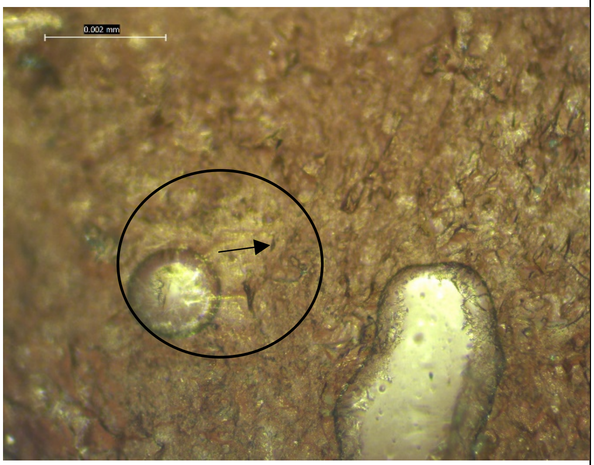
Figure 6.26: Micrographs showing wear analysed at 200 strikes of a wedge splitting wood

6.6.5 Five-hundred strikes

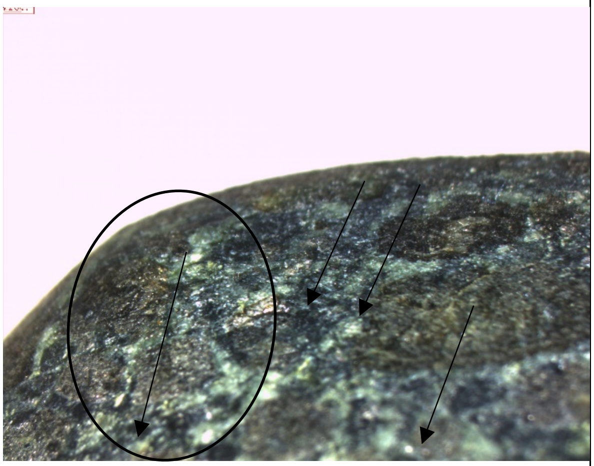
A pause was taken after 500 strikes to assess the development of wear. The percussive action on the butt of the axe-hammer resulted in the larger hole in the log, 100mm in length with crushed wood grains at the bottom of its V-shaped profile. However, a split did not occur. Analysis of the axe-hammer under a stereomicroscope showed the patches of grain removal pits extended further onto the blade edge although remained superficial. Associated striations extended this far also, being intermittent, multi-directional and overlapping. The wear further away from the edge had a sparser density, while that closer to the blade tip is close. Rounding was present on grains on the tip, sparsely. The corners of the blade edges continued to have a greater quantity of pits and striations compared to the remainder of the blade.

The development of polish from use was apparent during the analysis of the casts taken after 500 strikes under a metallographic microscope. The unconnected domed polish was present on the tip of the blade while small patches of slightly connected domed polished grains could be found on the blade edges. They showed clear directionality and had parallel striations in the same direction, perpendicular to the blade edge. The butt also had patches of slightly connected domed polish with a clear directionality across its width, parallel striations occurred in groups of 2-3 and ran in the same direction. These patches were limited to the centre of the butt (figure 6.27).

A



B



A. Analysis of an acetate cast of the butt using a metallographic microscope: Small patched of domed polish, unconnected, with directionality and groups of 2-3 striations in the same directions, as indicated by the circle and arrow, X10.

B. Stereoscopic analysis of the blade edge: The wear is more developed at the corners of the blade where there are more grain removal pits and striations as indicated by the circle and arrows, X1.0.

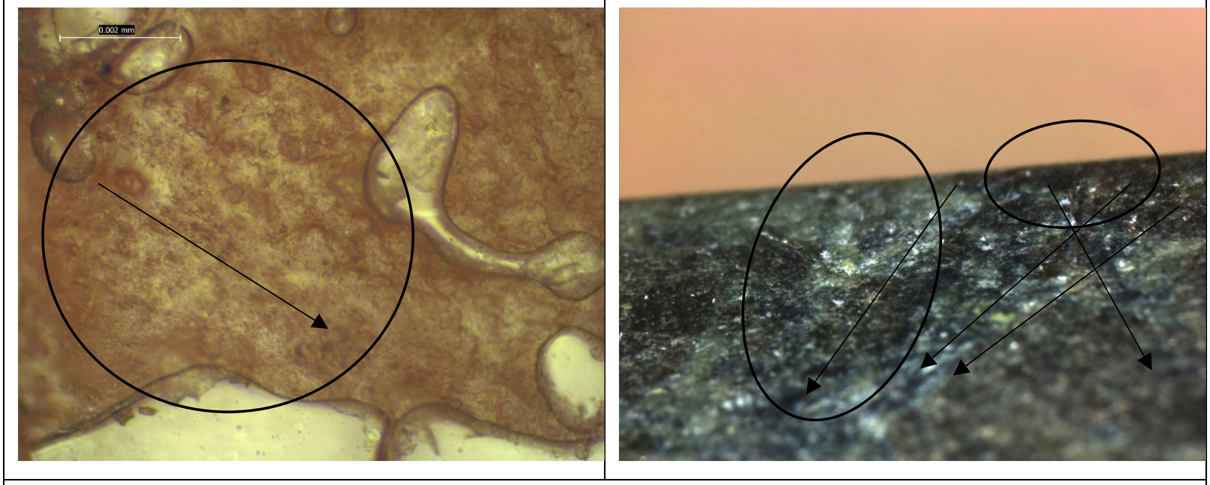
Figure 6.27: Micrographs showing wear analysed at 500 strikes of a wedge splitting wood

6.6.6 One-thousand strikes

A pause was taken after 1000 strikes. Again, the experiment failed to cause a split in the log; it did, however, increase the width and depth of the hole. At this stage, the wear was considerably more developed, being more numerous and close in density. It would be described as moderate use. The striations and pits extended 20mm onto the blade edges, bifacially and were accompanied by grain removal pits. The wear at the corners of the blade edges was close to dense in density and thus remained more developed than on the remaining blade. Rounding of grains was present across the blade tip and corners at this stage. Grain removal pits on the butt were also greater in number and density with some rounding developing on the higher topography. Associated striations were also apparent, occurring in parallel patches in multiple directions, occasionally overlapping. The wear on the butt at 1000 strikes extended across most of the butt.

Metallographic analysis of the casts taken at this pause revealed close patches of domed polish with a clear directionality, some patches were perpendicular, and others are parallel with the blade edge, present on the blade edges and tip. Similar patches of domed polish were also present on the butt, although the striations slightly overlapped which correlated with the striations analysed under the stereomicroscope. This wear was caused by the percussive hits on different areas of the butt and moving a little on contact (figure 6.28).

A B



A. Analysis of an acetate cast of the blade edge using a metallographic microscope: Close patches of domed polish, see the circle, with a clear directionality indicated by the arrow. Striations overlap slightly, X10.
B. Stereoscopic analysis of the blade edge: Striations and pits extend onto blade edge 20mm, indicated by the oval and the arrows showing the direction of the striations. Rounded stone grains on the tip, see the small circle, X1.5.

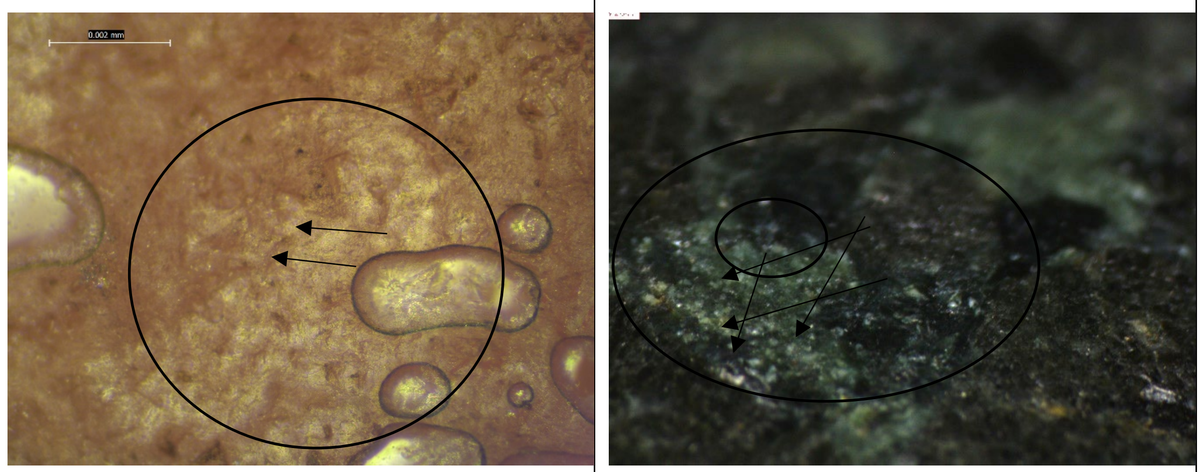
Figure 6.28: Micrographs showing wear analysed at 1000 strikes of a wedge splitting wood

6.6.7 One-thousand-five-hundred strikes

The penultimate pause during the experiment occurred at 1500 strikes. The log was not split, and the hole increased in width and depth slightly. Small pits were visible macroscopically up to 20mm from the tip, and larger pits were visible spread evenly along the tip. Analysis under a stereomicroscope revealed pits on the blade edge were close in density and extended 20-25mm from the blade edge. The further away from the tip the pits were less well developed, being more superficial, narrow and less dense. The more developed pits on the tip were larger and more heavily rounded. The striations at this stage overlapped to a greater extent, with many crossing diagonally over one another. Grain removal pits on the butt were denser and were associated with overlapping parallel striations of equal density. Sparse crushed grains are also present at this stage. Rounding of the higher topography was present on the blade tip and butt.

Metallographic microscopic analysis of the casts revealed larger patches of domed polish covered the casts from the blade tip and edges and the butt, with a close density. Clear directionality and associated striations remained the same as the previous pause (figure 6.29).

A | B



A. Analysis of an acetate cast of the blade edge using a metallographic microscope: Close patches of larger, medium-sized patches of domed polish, see the circle, with a clear directionality and associated striations, indicated by the arrows, X10.
B. Stereoscopic analysis of the butt: Close to dense grain removal pits with sparse crushed grains within the large circle. Associated parallel striations overlap on another as the arrows indicate. The high topography is slightly rounded, see the small circle, X2.5

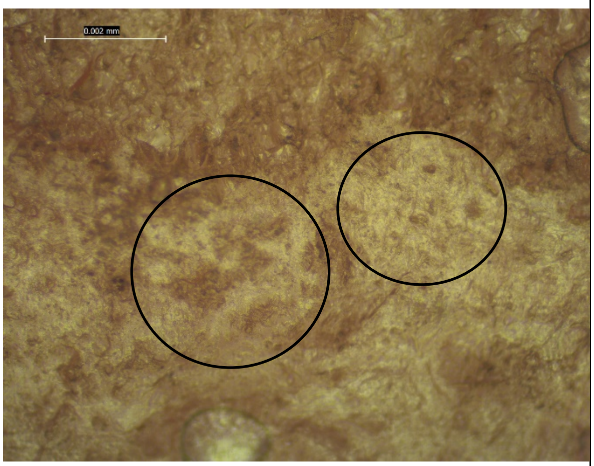
Figure 6.29: Micrographs showing the wear analysed at 1500 strikes of a wedge spitting wood

6.6.8 Two-thousand strikes

The final pause occurred at the end of the experiment at 2000 strikes. A split did not occur at any point during the experiment. By 2000 strikes the hole created in the log was again wider and longer, remaining with a V-shaped profile. It had a depth of 30mm and a length of 100mm. Macroscopically the pits on the blade tip and edge are evident. Analysis of the axe-hammer under a stereomicroscope revealed that the pits extended 30mm from the blade edge and remain small. Larger pits were present on the tip and the blade edge directly next to the tip. In these areas, the pits are close to dense in density. The remaining pits are close with those furthest away from the top being sparse to close in density. The associated overlapping striations also extend um to 30mm form the tip. They are intermediate and range in length from small to medium. The pits and striations are most dense at the cornered of the blade edges were rounding is also most prevalent.

Analysis of the casts under a metallographic microscope revealed patches of domed polish covering the casts with clear directionality. The patches were close to one another, and the domed grains within the patches were partially connected. The patches are smaller than at 1500 strikes due to the increased grain removal interrupting the development of polish. Mixtures of smaller and larger patches of domed polish were present across the cast of the butt. Micro-removals of grains were evident on these patches (figure 6.30).

A



B

A. Analysis of an acetate cast of the blade edge using a metallographic microscope: Close patches of domed polish, see circles. Their shape and size have been interrupted by grain removal causing larger removals and micro-removals, X10.

B. Stereoscopic analysis of the blade edge: Pits and striations extend 30mm into the blade edge, they are close in density further away from the blade tip. The circle indicates the clumps of pits associated with intermittent striations; the arrows indicated their direction, X1.2.

Figure 6.30: Micrographs of the wear analysed at 2000 strikes of a wedge splitting wood

6.7 Splitting wood experiment results

The experiment to split wood used battle-axe replica 1 to split logs of semi-dried birch into smaller pieces ideal for firewood. The logs were cut into 300mm lengths using a modern saw before they were split with a vertical chopping action into four to six pieces, dependant on the diameter of the log (figure 6.31). The diameters ranged between 100 and 250mm. Semi-fresh wood which had been stored outside, uncovered, for two months was used for this experiment due to the difficulties in sourcing a large quantity of fresh wood of the same species. Pauses at 50, 100, 200, 500, 1000, 1500 and 2000 strikes were enacted to assess the development of wear throughout the experiment.

Figure 6.31: Image of experiment splitting wood with a battle-axe

6.7.1 Effectiveness

The effectiveness of using a battle-axe to split wood parallels that of the chopping wood experiment. Over a short period of time, two minutes on average per 50 strikes, the logs were split into smaller pieces ideal for firewood. Smaller logs, approximately 100mm diameter, were split with one to three strikes while those up to 300mm diameter took between fourteen and fifty strikes. The logs with knots required a greater number of strikes. Those with greater strength than myself would easily split the logs if fewer strikes, causing the act of splitting wood to be more effective and quicker. The logs were placed on grass to protect the axe if a strike was missed.

During this experiment, the hafting of the battle-axe was made more effective. Shaping the top of the haft to the same diameter of the perforation and gently forcing the axe onto it followed by soaking the hafting implement in water in between use, ideally overnight, created the maximum possible pressure to hold the battle-axe in place. By doing so, the battle-axe did not spin on the haft during use. Simple physics dictates that when force is applied to a wooden haft by forcing a perforated implement over it, the action will compress the wood and cause friction, thus holding the implement onto the haft. It is important to acknowledge the effect of the hysteresis of wood, which is that when placed under pressure, it will deform and not fully return to its original shape when the pressure is removed. Consequently, over time any friction exerted by compression on the haft will lessen, in addition to shrinkage when the wood further dries. So, placing the hafted implement into water ensures the wood remains fully saturated with water and thus fully expanded and continues to create friction (Foliente 1995).

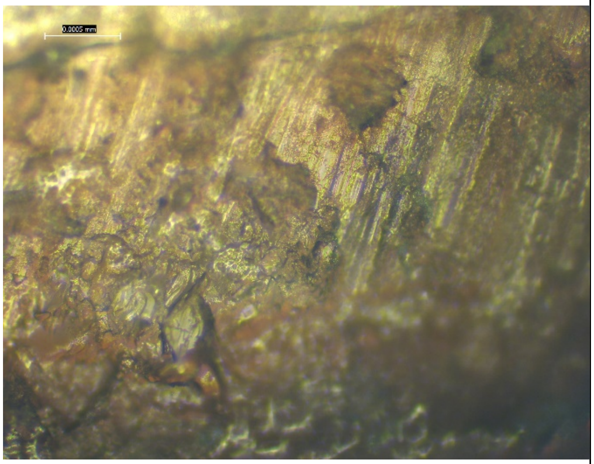
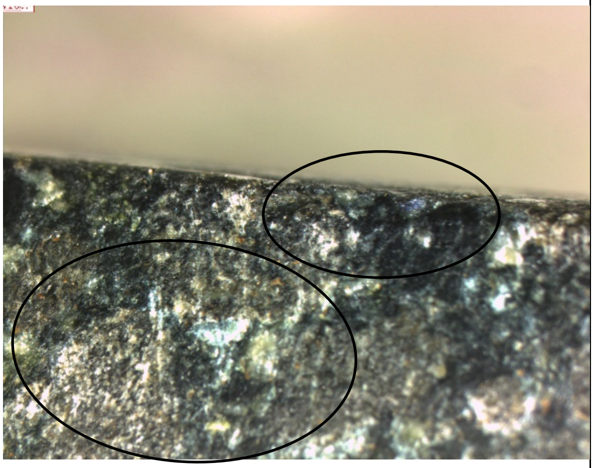
With the correct hafting methods, the performance of this axe-head was impressive; it spilt wood very effectively and easily. It is clear that the implement would have sustained prolonged use, possibly across the user’s lifetime, only needing to be re-sharpened occasionally (figure 6.32).

Figure 6.32: Most securely hafted battle-axe

6.7.2 Fifty strikes

The first 50 strikes created limited wear. However, rounding of the blade tip was beginning to develop on the high topography of the grain removal pits. The grain removal pits were few and sparse. They were located on the tip in three groups, central and towards the blade corners. Very small striations were associated with these pits, running from them. The three groups of striations were present on just one side of the blade and existed in groups of two to three parallel striations running perpendicular to the blade edge. Both the pits and the striations were superficial and narrow. Striations from the manufacturing process remained clearly visible. A flake removal occurred on the top corner of the blade when it was dropped onto a stone, leaving a small flake negative.

Analysis of the casts taken during the 50-strike pause revealed no change the production polish and no additional use-polish developing (figure 6.33).

A	B
	

A. Analysis of an acetate cast of the blade edge using a metallographic microscope: Polish from production still evident. Long, parallel striations over flat, rough patches of polish, X20.

B. Stereoscopic analysis of the blade edge and tip: Striations from production still visible on the blade edge within the large oval; a small group of pits from use next to rounded grains is visible in the smaller oval, X1.2.

Figure 6.33: Micrographs of wear analysed at 50 strikes splitting wood

6.7.3 One-hundred strikes

One-hundred strikes caused little development in wear. Rounding continued to be present with the flake negative becoming slightly rounding on its higher topography. A small number of bifacial striations was added to the small groups of striations.

Analysis of casts taken at this stage revealed sparse, small patches of granular polish in between large patches of production polish. In some areas, the large patches of production polish were reducing in size (figure 6.34).

A	B

A. Analysis of an acetate cast of the blade edge using a metallographic microscope: Granular polish in between production polish, X20.

B. Stereoscopic analysis of the blade edge and tip: Sparse striations on the blade edge associated with grain removal pits in small groups, X1.2.

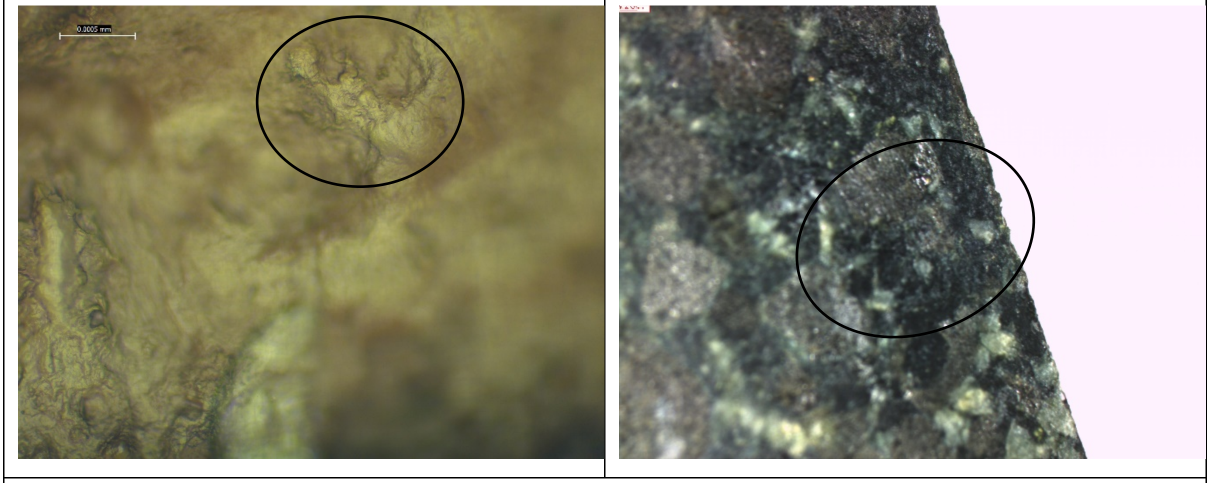
Figure 6.34: Micrographs of wear analysed at 100 strikes splitting wood

6.7.4 Two-hundred strikes

During the next phase of strikes, the groups of narrow, superficial grain removal pits increased in size, although remained small. Bifacial short striations continue to run from the three groups of pits increasing in number by 1-2. They were shallow and u-shaped in profile. The corners of the blade tip had been rounded further (figure 6.35).

Analysis of the casts from 200 strikes revealed patches of partially connected granular polish, the tops of such grains were domed. This wear signifies the early stages of the formation of wood polish known from the reference collection I analysed at Leiden University.

A B



A. Analysis of an acetate cast of the blade edge using a metallographic microscope: Domed grains more apparent, with directionality, X20.

B. Stereoscopic analysis of the blade edge and tip: Small patches of superficial grain removal pits in the centre of the tip with a small patch of shallow striations running from them. This occurs bifacially and in two other groups towards the blade corners, X0.8.

Figure 6.35: Micrographs of wear analysed at 200 strikes splitting wood

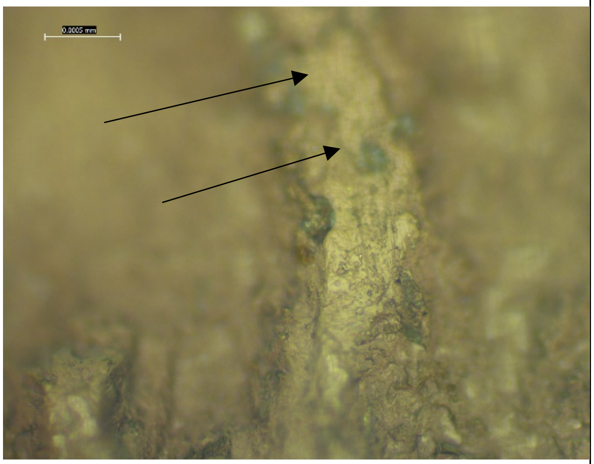
6.7.5 Five-hundred strikes

The next pause was taken at 500-strikes. During the previous 300 strikes it was the aim for the axe-head to contact the wood at a 90-degree angle, however, miss hits often resulted in the axe-head hitting the log at an angle, often slanted to one side.

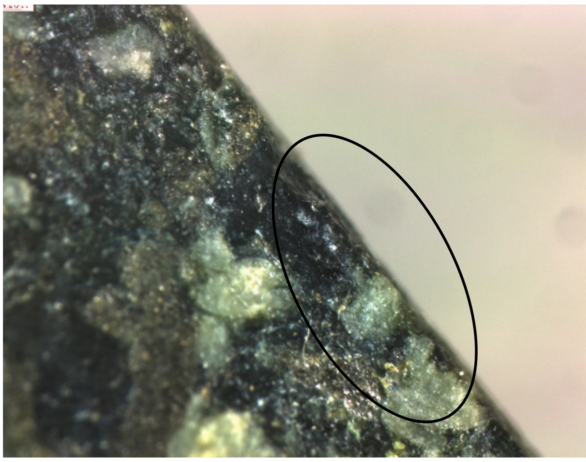
During this phase, the groups of grain removal pits and associated striations developed slightly, becoming greater in number. A total of six groups now existed. The striations were more numerous and continued to be u-shaped in profile, parallel in arrangement and perpendicular in orientation. The grain removal pits remained narrow and superficial, although they were more frequent, remaining directly on the tip in close density within the groups; the groups had a sparse density. The largest quantity of pits and associated striations was in the centre of the blade tip. The high topography of the blade corners remained rounded, particularly evident is the high topography of the flake negative on the top corner.

Analysis of the casts at high magnifications revealed small patches of partially connected domed polish which is a development from the granularity feature of the polish at 200 strikes. The domed patches had small groups of 2-3 striations in a parallel arrangement, oriented similarly to the directionality of the polish. The polish was less to moderately developed wood polish (figure 6.36).

A



B



A. Analysis of an acetate cast of the blade edge using a metallographic microscope: Three patches of domed polish partially connect where the arrows points. Parallel striations run in the same direction as the directionality and perpendicular to the blade edge, X20.

B. Stereoscopic analysis of the blade tip: larger quantity of narrow, superficial grain removal pits in groups, high topography around the pits is rounded and thin striations run from them in parallel groups running perpendicular to the blade edge, X2.0.

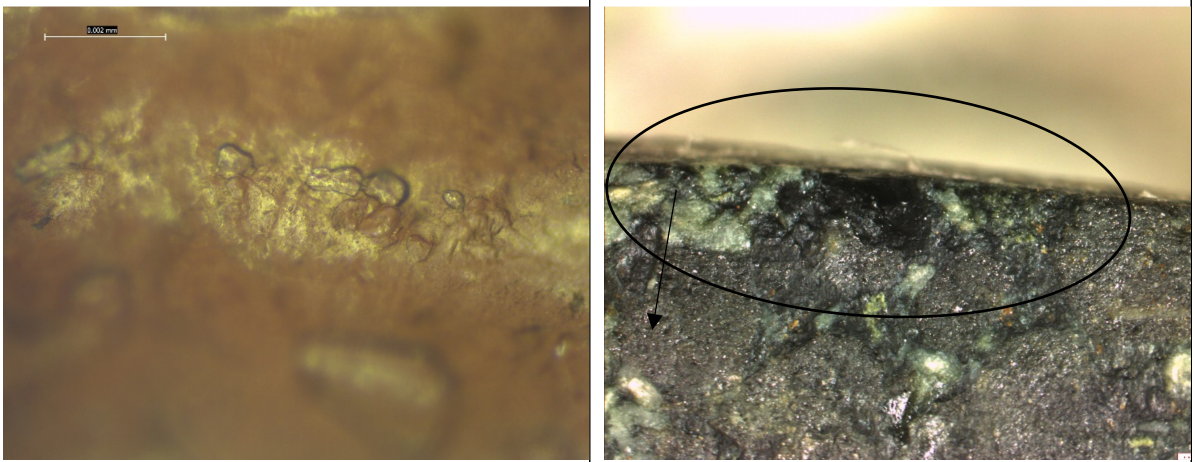
Figure 6.36: Micrographs of wear analysed at 500 strikes splitting wood

6.7.6 One-thousand strikes

At 1000 strikes the bifacial striations had developed enough to be obvious macroscopically, as was a small, shallow dip in the centre of the blade tip, caused by the increased size of a clump of grain remove pits removing enough stone to create a visible difference in the blade shape. The wear at 1000 strikes was significantly developed in comparison to 500 strikes. The groups of pits became denser and appeared on the blade edge as well as the tip. The pits remain narrow and superficial but were dense within the groups of pits; each group is now close in density. The denser pits exist in the centre of the blade, causing the shallow dip visible macroscopically. This density extended a small way towards the top corner of the blade which appeared to come into contact with the wood first, with the most force. The striations in association with the pits were now spread more evenly along the blade edge, although the groups were still vaguely visible since the striations are closer in density in these areas. The striations remain short, parallel and run perpendicular to the blade edge with a u-shaped profile. The rounding of the corners extended to cover more of the corners.

The polish analysed on the casts was more developed wood polish. The patches of domed polish were larger and connected in more locations. Directionality was clear, and the small striations continued to cover the patches in parallel arrangements in a close density (figure 6.37).

A B



A. Analysis of an acetate cast of the blade tip using a metallographic microscope: Patches of domed polish connected in more places with a close density, directionality signalled by an arrow, X10.
B. Stereoscopic analysis of the blade edge and tip: Dense grain removal pits within a group on the blade tip, they extend onto the blade edge and have striations with a close density associated. They run parallel to one another and perpendicular to the blade edge; an arrow signifies their location, X1.0.

Figure 6.37: Micrographs of wear analysed at 1000 strikes splitting wood

6.7.7 One-thousand-five-hundred strikes

The final pause before the end of the experiment, at 1500 strikes, saw the development of some abrasion on the blade edges up to 5mm from the tip. At this stage, the clumps of grain removal pits on the blade tip and edges were visible macroscopically despite their superficial and narrow shape. Microscopically it was clear the density of these pits has increased. The denser areas of pits remain in the areas where the three groups of pits and associated striations developed during the first stages of the experiment. Less dense pits and striations exist between these three areas. At this stage of the experiment, the axe-head manufacture traces were barely visible on the blade. Rounding had developed further and extended onto the blade tip, in sparse clumps around the three groups of dense wear. A greater number of pits extended onto the blade edges bifacially and they were accompanied by close-dense striations which were more numerous. A small number of sparse striations, with a medium length and straight-diagonal orientation, existed on the blade edges starting at 5mm from the blade edge. These were associated with the abraded areas and were most likely caused when the axe-head moved between the log when it was split in two, thus causing both halves to meet the axe-head. Finally, the polish was not evident on the blade corners, associated with the rounding of the higher topography.

At 1500 strikes the polish revealed during cast analysis covered all the casts in small to medium sized patches which were larger than the patches of polish create after 1000 strikes. The patches were close in density, and their directionality signified the direction of use. Some more granular polish with domed grains had developed in between these patches; this was less/limited developed wood polish which will turn into larger patches like those surrounding it with prolonged use (figure 6.38).

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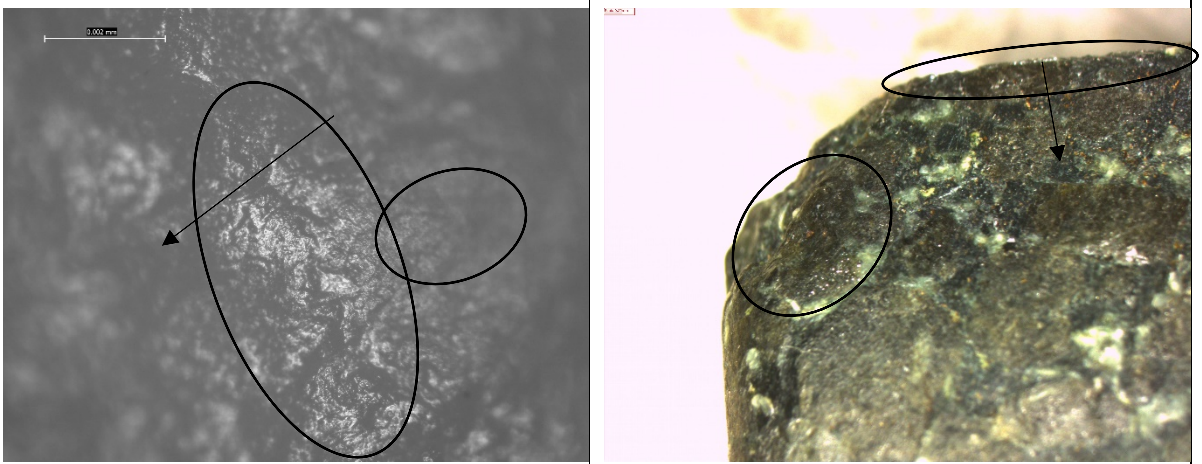

A. Analysis of a President Jet cast of the blade tip using a metallographic microscope: Large patches of domed polish, close in density with noticeable striations running the same direction as the directionality of the polish signified with the arrow. The small oval contains granular, less developed polish, X10.
B. Stereoscopic analysis of the blade corner and tip: Rounding of the flake negative on the corner of the blade; dense pits on the blade tip with associated striations running from them 5-10mm, X0.8.

Figure 6.38: Micrographs of wear analysed at 1500 strikes splitting wood

6.7.8 Two-thousand strikes

The experiment ended at 2000 strikes. The blade remained sharp despite the developed wear created throughout the experiment. It was clear that the axe-head could continue to be used for at least another 2000 strikes, if not more before it would need to be re-sharpened. Grain removal pits extend across the blade tip and edges, bifacially. Those on the tip are dense while those on the blade edge were dense close to the tip and close in density further away from the tip. They extended 10mm back from the tip. The densest pits remained in the three groups described previously. These groups had expanded in size due to the number of pits on the blade and therefore were very close to each other. The pits remained superficial and narrow, although those in the denser areas of pits had increased in size and their edges had become increasingly rounded. Rounding of the high topography and the edges of pits is present along the blade tip and at the corners. The corners were still polished. The striations were dense and evenly spread along the blade edges, bifacially. They were slightly longer and in places appear intermittent. Pits surrounded them. Overall, the wear became dense and well developed.

Analysis of the casts revealed polish comparable to the casts taken at 1500 strikes. The patches of domed polish remained the same size although they were slightly more connected. Also, the parallel striations appeared to be slightly more numerous, facing in the same direction as the directionality signified by the form of the polish. On ending the experiment, wood polish was clear and recognisable with a moderate to developed development (figure 6.39).

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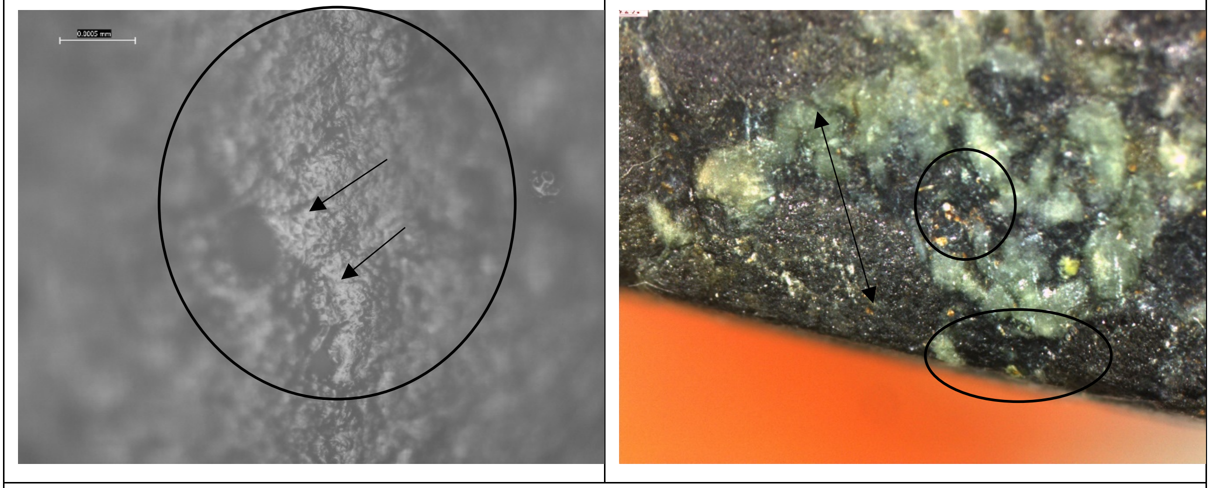


A. Analysis of a President Jet cast of the blade edge using a metallographic microscope: Large patch of domed polish with a greater number of striations, directionality and direction of striations indicated by arrows which they run parallel with, X20.

B. Stereoscopic analysis of the blade edge and tip: Patch of dense pits extending on to blade edge seen within the circles. The arrow indicated the spread of dense, superficial pits running along the blade tip. Striations clearly ran parallel to one another from the blade edge, X1.5.

Figure 6.39: Micrographs of wear analysed at 2000 strikes splitting wood

6.8 Digging/clearing soil and roots experimental results

Digging/clearing soil and roots used battle-axe replica 4 to clear undergrowth around a birch tree. This includes chopping through the roots of the tree as well as clearing the grass and moss undergrowth around it (figure 6.40). The soil was loamy silty soil and contained very sparse, small stones of approximately 2mm diameter. Thin roots from the undergrowth ran through the soil as well as thicker, 50mm diameter, roots from the tree; all were chopped through.

Pauses were enacted at several stages of the experiment in order to assess the development of wear at 50, 100, 200, 500, 1000, 1500 and 2000 strikes. A pause at 1500 strikes was decided upon after the wear presented between 1000 and 2000 strikes during the digging/clearing soil and stone experiment was considerably developed. The original methodology designated 3000 strikes per experiment; however, due to time and resource limitation, this was reduced to 2000 strikes. The casts, taken at each pause using President Jet, were analysed under a stereomicroscope as the experiment was carried out in the field with no access to a microscope during the pauses.

Figure 6.40: Image of the experiment clearing soil and roots using a battle-axe

6.8.1 Effectiveness

The experiment effectively broke apart the roots and soil. The small roots were chopped through instantly while the larger roots required approximately 50-80 strikes. Those stronger than myself would be able to chop through the thicker roots in fewer strikes. It is probable, due to the more active nature of people during the EBA, that they had better ability and strength which would make tasks such as this experiment quicker and easier. Since the experiment was not hard for me to carry out, it was assumed that it would have been a lot easier for those in the past.

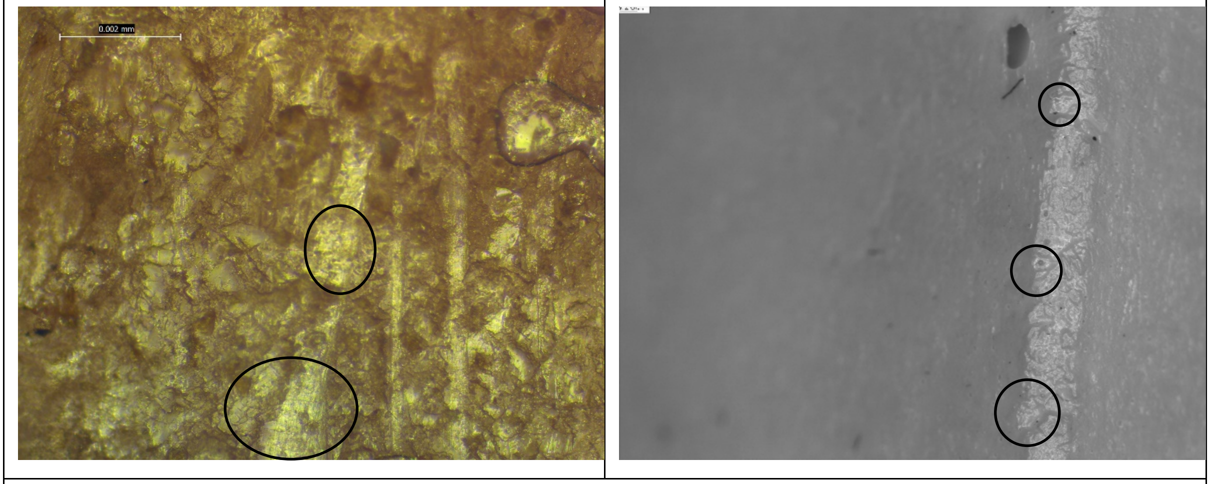
Similar to the digging/tilling soil and stones experiment, this experiment was also less effective at removing soil from the area. Due to the angle of the blade, set at a right angle to the shaft, the axe easily broke up the soil but was less effective at the removal of such soil. The experiment revealed that battle-axes could effectively break apart undergrowth and thick roots which will aid clearing land. Other tools would be required to remove the broken-up soil, such as shovels. It is probable battle-axes were part of a tool kit of various items used together and separately.

6.8.2 Fifty strikes

During the first pause to analyse the development of wear, it was evident the use-wear was minimal. Tiny, superficial, narrow grain removal pits, quite faint, were present on the tip in a sparse distribution. They were focused mostly in the corners of the blade. Even fewer striations existed on the blade edges, associated with the pits. They were very short and occurred in clumps of 1-2, in parallel arrangement perpendicular to the blade edge. Production traces are still visible, although were clearly discernible from the use-wear. The wear was limited and less developed.

Analysis of the casts taken at this stage show production wear remains the most frequent polish. However, it was slightly altered with small, thin striations in multiple directions which was caused by contact with the soil grains (figure 6.41).

A B



A. Analysis of an acetate cast of the blade edge using a metallographic microscope: Production polish visible; thin, multi-directional striation existed on this polish, within the circles, X10.

B. Stereoscopic analysis of a President Jet cast of the blade tip and edge, presenting negative wear; sparse pits along the blade tip signified by the circles, X1.2.

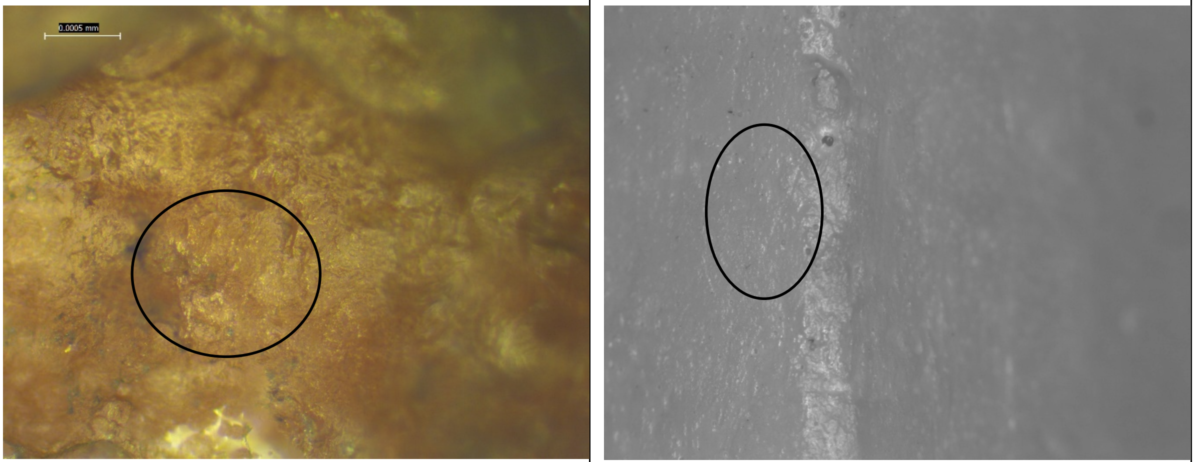
Figure 6.41: Micrographs of wear analysed at 50 strikes digging soil and roots

6.8.3 One-hundred strikes

At 100 strikes the number of pits had increased considerably, covering areas of the tip and blade edges. More pits were in fact on the blade edges compared to the tip. They remained very small and superficial and surrounded by striations on the blade edges. The short striations occur bifacially in 6 groups along the blade edges. They were parallel with one another and ran perpendicular to the blade edge with a sparse to close density. A few, very sparse longer striations occur in the centre, and towards the corners, these were intermittent and overlapped other striations.

Analysis of the casts revealed the reduced quantity of production traces and the development of a granular polish on the blade tip and edges. There was a slight rounding of the edges of these grains. Singular, short, striations were found related to the granular polish with an orientation perpendicular to the blade edges (figure 6.42).

A B



A. Analysis of an acetate cast of the blade edge using a metallographic microscope: Granular polish with slightly domed tops developing in small patches, X20.

B. Stereoscopic analysis of a President Jet cast of the blade tip and edge, presenting negative wear: More pits developed along the blade tip, close in density, but striations are sparse, one is indicated within the circle, X1.5.

Figure 6.42: Micrographs of wear analysed at 100 strikes digging soil and roots

6.8.4 Two-hundred strikes

Analysis of the axe-head after 200 strikes presented more grain removal pits on the blade edges with intermittent, thin striations with a u-shaped profile amongst them. The pits were small, narrow and superficial but became close in density. Those pits closest to the blade tip were wider, although they remain superficial. Smaller, newly developed pits existed between the groups of wear seen at 100 strikes. At 200 strikes rounding of the higher topography in the centre of the blade appeared.

The casts taken after 200 strikes revealed polish with a slight degree of directionality beginning to develop. These small patches of sparse granular polish continued to be present, with a few striations oriented in the same direction as the directionality, perpendicular to the blade edge. Small, sparse to close domed patches were also present. These patches were bigger and closer in the centre of the blade tip where the striations also appeared longer. Slight rounding was present, the same as 100 strikes (figure 6.43).

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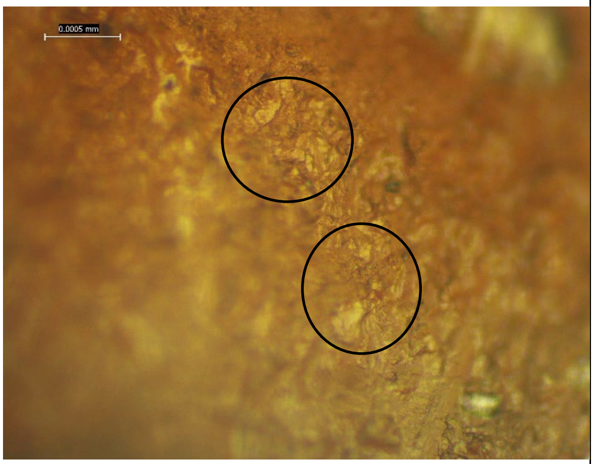

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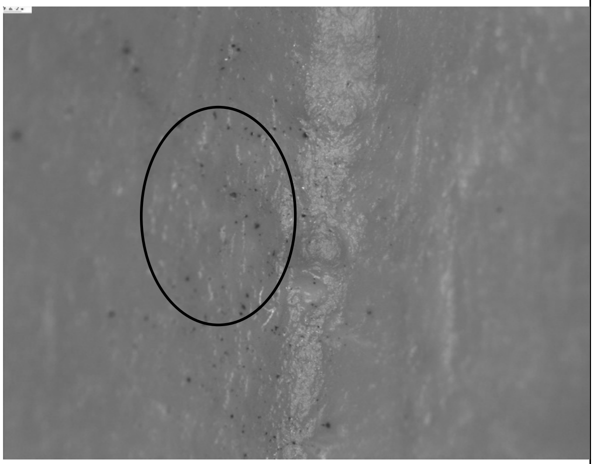

A. Analysis of an acetate cast of the blade edge using a metallographic microscope: Small patches of dome polish develop. Sparse to close, and unconnected. They had a directionality and very small striations, X20.

B. Stereoscopic analysis of a President Jet cast of the blade tip and edge, presenting negative wear: A greater quantity of pits along the blade tip, increasing their density; superficial, narrow pits has also developed on the blade edge in small patches, such within the circle. Faint striations are associated with those on the tip and blade edge, X1.5.

Figure 6.43: Micrographs of wear analysed at 200 strikes digging soil and roots

6.8.5 Five-hundred strikes

By 500 strikes the wear was considerably more developed. Many more intermittent striations spread across the blade edges, extending 10-15mm from the blade edge with a close density. They were accompanied by the small, superficial pits described in the previous pauses, although these too are more numerous. The striations in the centre overlapped, due to their diagonal orientations, while the wear towards the bottom corner of the axe-head was limited, with much few pits and striations. The pits extended 1-2mm from the blade edge, and the striations were equally short. This wear indicates that the area of the axe-head in contact with the contact material most often was the centre and top corner.

Analysis of the casts taken at this stage revealed granular, semi-connected patches of polish. The edges of the grains appear slightly rounded, almost domed and associated striations were more numerous, often overlapping and with multiple directions of orientation. The patches remain small but were close in density. Contact with soil caused the granular polish. However, contact with wood roots resulted in the slight rounded, domed appearance of some grains (figure 6.44).

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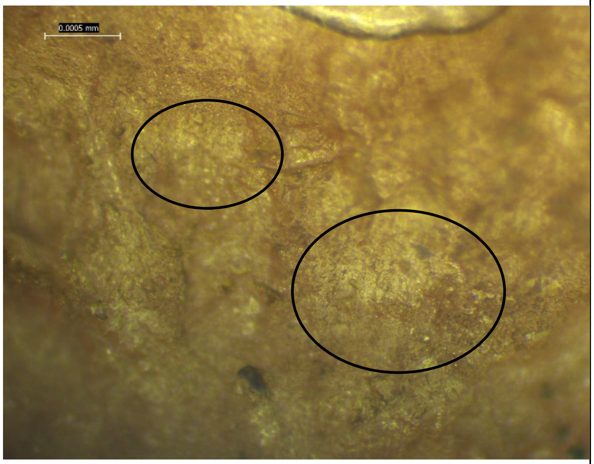

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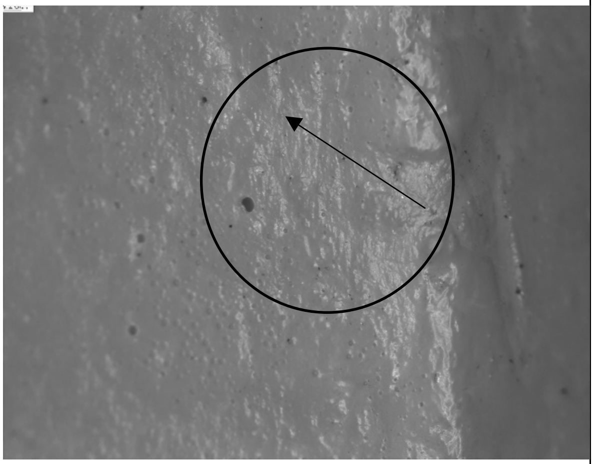

A. Analysis of an acetate cast of the blade edge using a metallographic microscope: Patches of slightly domed granular polish, semi-connected, X20.

B. Stereoscopic analysis of a President Jet cast of the blade tip and edge, presenting negative wear: An increased quantity of pits along the blade tip, increasing their density and their size; superficial, narrow pits have also developed on the blade edge in larger patches, such as within the circle. Striations were also more numerous and are associated with those on the tip and blade edge; an arrow indicated their direction, X1.2.

Figure 6.44: Micrographs of wear analysed at 500 strikes digging soil and roots

6.8.6 One-thousand strikes

At 1000 strikes the extent of the wear extended slightly more evenly across the entire blade. The bottom corner of the blade which, at 500 strikes had limited wear, now had pits that extended further onto the blade edge, with related intermittent striations much like the more developed wear seen at 500 strikes. The remaining centre and top corner of the axe-head had denser wear and the grain removal pits were larger.

Analysis of the casts taken after 1000 strikes revealed close, partially connected patches of domed polish. Striations on the polish were long and often singular in multiple directions. The areas surrounding the patches had less developed granular polish. The domed polish was indicative of contact with wood roots while the striations indicate a more granular contact material, the soil (figure 6.45).

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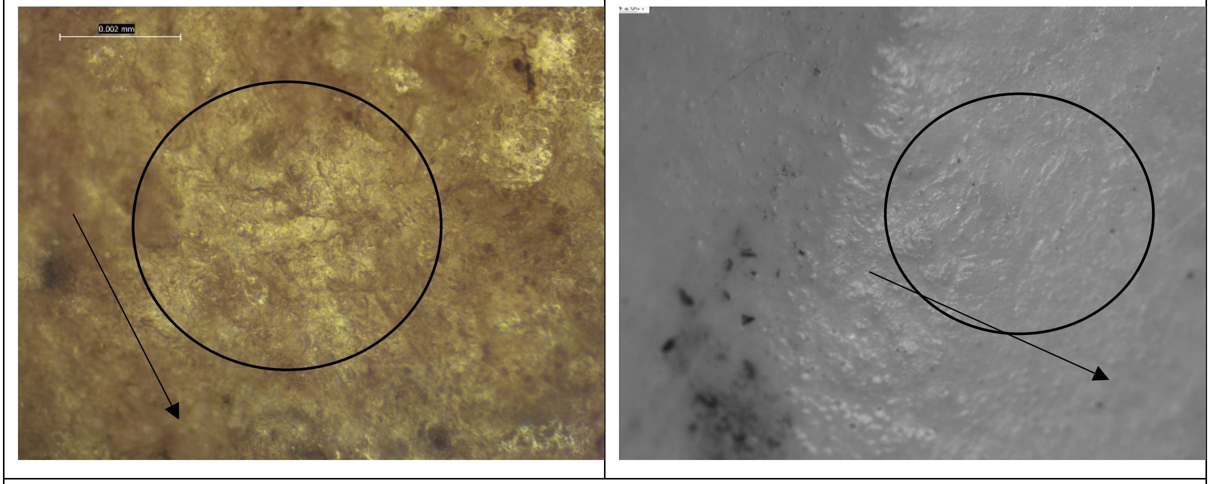


A. Analysis of an acetate cast of the blade edge using a metallographic microscope: Larger patches of slightly domed polish, semi-connected, and less granular with multi-directional striations and a clear directionality indicated with the arrow, X10.

B. Stereoscopic analysis of a President Jet cast of the blade tip and edge, presenting negative wear: An increased quantity of pits along the blade edges, increasing their density and their size, such as within the circle. Striations are also more numerous and are associated with those pits on the tip and blade edge; an arrow indicated their direction, X1.2.

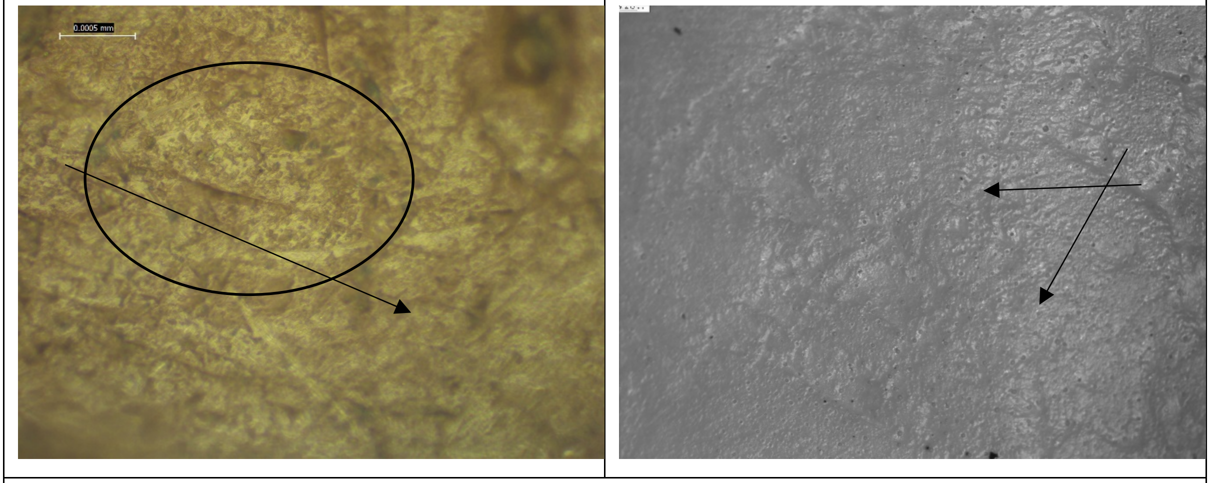
Figure 6.45: Micrographs of wear analysed at 1000 strikes digging soil and roots

6.8.7 One-thousand-five-hundred strikes

At 1500 strikes the grain removal pits were greater in quantity and extended further onto the blade edge, 15-20mm. There were equally more striations associated with the grain removal pits and extended intermittently just as far onto the blade edge, overlapping and facing multiple directions. This wear was caused by this increased contact with granular soil. The pits closest to the tip were larger due to smaller pits combining. The wear on the bottom of the cast was by now almost the same as that in the centre and top of the blade. The difference lay in the size of the smaller pits. The density of the wear across the blade was close.

The casts taken after 1500 strikes revealed large patches of partially connected polish. It was slightly domed, but parts also appeared granular. The polish was accompanied by overlapping, multi-directional striations. A directionality perpendicular to the blade edge was apparent for all patches. This wear was very similar to that at 1000 strikes, but its development resulted in it being more connected and closer in density (figure 6.46).

A B



A. Analysis of an acetate cast of the blade edge using a metallographic microscope: Large patches of partially connected, slightly domed polish, with some granular elements; multi-directional striations and a clear directionality indicated with the arrow, X10.
B. Stereoscopic analysis of a President Jet cast of the blade edge, presenting negative wear: Pits extend further onto the blade edges, increasing their density and their size, such as within the circle. Striations are also more numerous and often overlap, indicated by the arrows, X2.0.

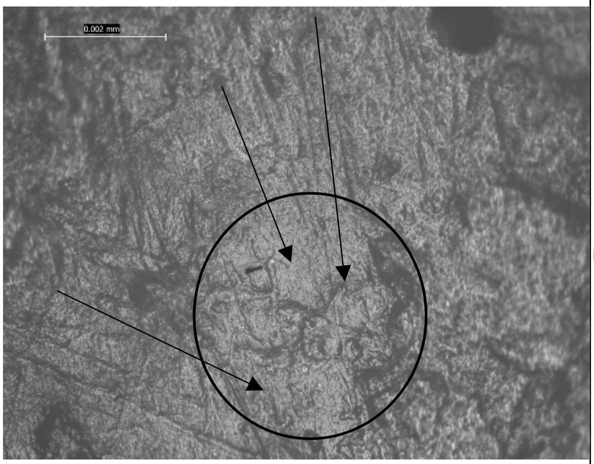
Figure 6.46: Micrographs of wear analysed at 1500 strikes digging soil and roots

6.8.8 Two-thousand strikes

Analysis of the axe-head at the end of the experiment, after 2000 strikes, revealed more developed wear with a close to dense concentration. The thin striations were more numerous and longer, extending up to 20mm, and spread along the entirety of the blade edges bifacially. Small, superficial and narrow pits extend onto the blade edges, running close to the striations. They were dense near to the tip where they were also more numerous. Few pits exist on the tip which was very rounded and smooth. The pits that have developed on the tip were wide and shallow with smaller pits extending from them on the blade edges bifacially. The blade edges were also rounded, reducing the depth of the grain removal pits. The striations were parallel and run perpendicular to the blade edge, however, those more central had diagonal striations overlapping them. In these areas, the grain removal pits were slightly more numerous and denser, showing that this area of the blade was in contact initially and more often with the spoil and roots (figure 6.47).

Analysis of the casts taken after 2000 strikes revealed the patches of domed polish with granular areas had increased in size. Long striations covered the patches and existed in multiple directions, occasionally overlapping. The patches were mostly connected on the blade edges, and small micro-removals indicate removals of grains during use. The domed areas were caused by the contact with the wood roots while the more granular areas and long, multiple-directional striations were created from contact with soil.

A



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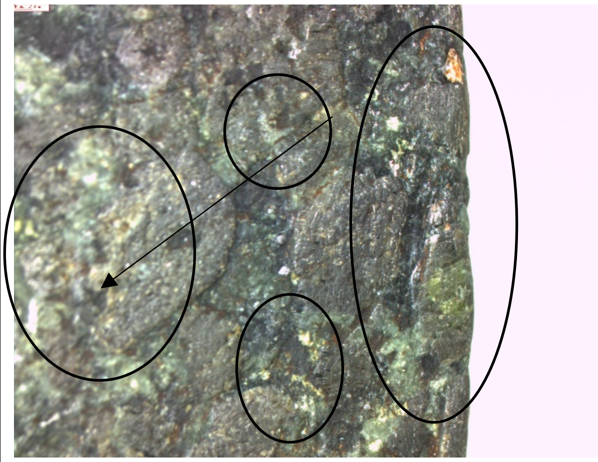


A. Analysis of a President Jet cast of the blade edge using a metallographic microscope: Long striations, in multiple-directions cover a large patch of domed and slightly granular polish, as indicated by the arrows and circle, X10.
B. Stereoscopic analysis of the blade edge: Pits extend further onto the blade edges, such as within the circles. Long striations extend as far as the pits and are also more numerous, indicated by the arrows, X0.8.

Figure 6.47: Micrographs of wear analysed at 2000 strikes digging soil and roots

6.9 Digging/tilling soil with stones experimental results

The experiment dug a hole 1.3 x 0.7 m with a 0.25m depth using replica 3. The implement was hafted on a 700mm haft made from an ash branch. The battle-axe was used to dig through soil containing 15% stones, the stones were small flint pebbles, 20-50mm in diameter, and the soil was loamy with sparse scatterings of large clumps of clay (figure 6.48). Pauses were enacted at several stages of the experiment in order to assess the development of wear, at 50, 100, 200, 500, 1000, 2000 strikes, macroscopically and microscopically. Casts of acetate and dental casting product, President Jet, to analyse under a metallographic microscope. Due to time and resource limitation, the maximum strikes were 2000 strikes

Figure 6.48: Image of the experiment digging/tilling soil with stones using a battle-axe

6.9.1 Effectiveness

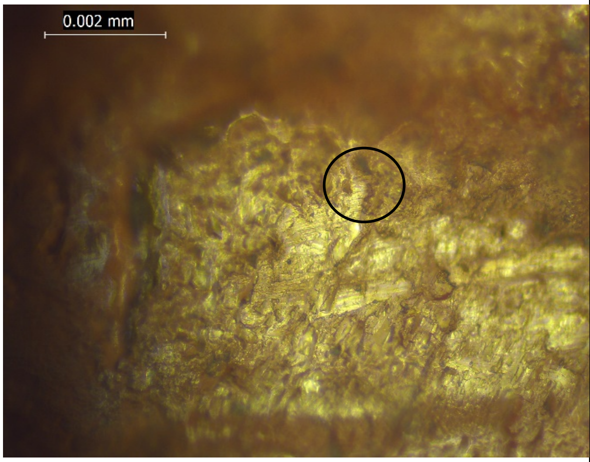
The effectiveness of using a battle-axe to dig through soil containing stones was reduced. The orientation of the blade, set at a right angle to the shaft, cut through the soil easily, breaking it up just as a hoe or ard point would. However, such orientation was impractical for removing the soil which the blade had broken apart. A battle-axe with an expanded blade was used for this experiment, but it is likely straight, un-expanded blades would also fail at digging due to their shared orientation at a right angle to the shaft. As such, rather than a digging role, these implements would be much more effective being used as an ard point to create ard furrows for sowing seeds by tilling the soil. The presence of the tip of an axe-hammer, an implement which shares the same blade orientation, was found within an ard furrow at Gwithian, Cornwall (Thomas, 1970, 13). Thus, based on effectiveness alone, this suggests the action of tilling soil may have been enacted.

6.9.2 Fifty strikes

During the first phase of the experiment, the battle-axe dug an area with limited plant roots with a short swing of from just above hip height. On contact with the earth, the axe-head was dragged back towards the user for between 100 and 200mm, with the blade inserted up to 30mm in the soil. This action was continued for 50 strikes before the axe was cast to replicate the wear and analysed to assess the development of wear up to this stage.

At the 50-strike stage, very limited damage occurred. A few, sparse striations were dotted across the blade edges, bifacially. They were long and were the result of contact with stones in the soil. These stones also created small clumps of grain removal pits in the centre of the blade and smaller clumps towards its corners. Contact with stones in the areas has caused limited crushing within the grain removal pits. Production traces are still clearly visible. Analysis of the casts revealed production polish from the manufacturing process was still visible, but the edges of these traces appeared very slightly rounded in places (figure 6.49).

A



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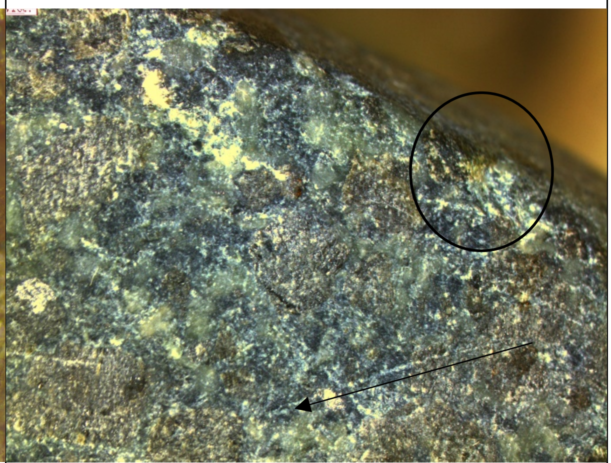


A. Analysis of an acetate cast of the blade edge using a metallographic microscope: Production polish with element slightly rounds, such as within the circle, X10.

B. Stereoscopic analysis of the centre of the blade edge and tip: Clumps of grain removal pits are on the tip; the white areas are crushed grains from contact with stones in the soil. Sparse, diagonal striations can be seen on the blade edge, X0.8.

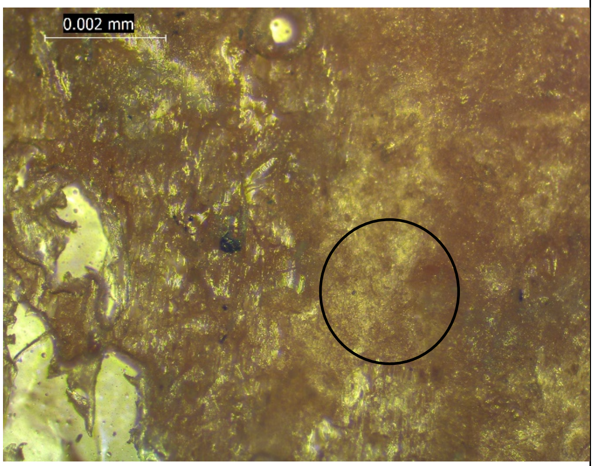
Figure 6.49: Micrographs of wear analysed at 50 strikes digging soil and stones

6.9.3 One-hundred strikes

The following 50 strikes were carried out using the same method. A pause was taken at 100 strikes to assess the development of wear and cast the implement. At the 100-strike phase, more bifacial striations developed across the blade edges, with a greater number on one side than the other caused by the location of stones in the soil. The clumps of grain removal pits seen at the previous phase had grown bigger, and the clumps were more numerous, spread sparsely and evenly along the blade tip. The pits extended slightly onto the blade edge up to 5mm and were associated with clumps of parallel striations with a similar density, running perpendicular to the blade edge. Rounding from contact with the soil were also becoming slightly apparent on the higher topography of the pits.

Analysis of the casts revealed that the production polish was still very clear and that a granular polish was also beginning to develop in separated patches, lessening the extent of the production polish (figure 6.50).

A



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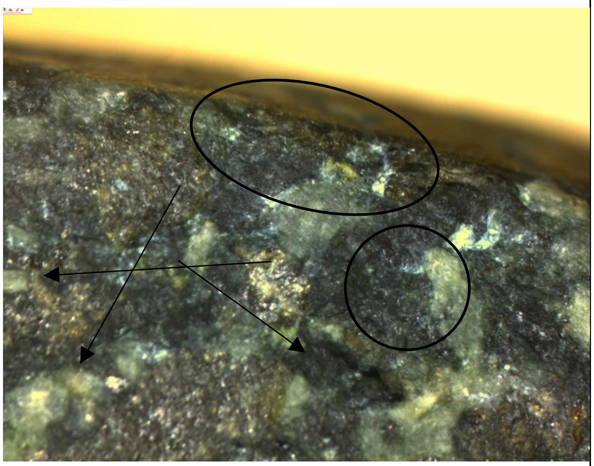


A. Analysis of an acetate cast of the blade edge using a metallographic microscope: Production polish with areas of granular polish nearby, see the circle, X10.

B. Stereoscopic analysis of the centre of the blade edge and tip: Larger clumps of grain removal pits are on the tip with wider pits; the white areas are crushed grains from contact with stones in the soil, circled. Striations perpendicular to the blade edge and diagonal striations can be seen on the blade edge, see arrows, X0.8.

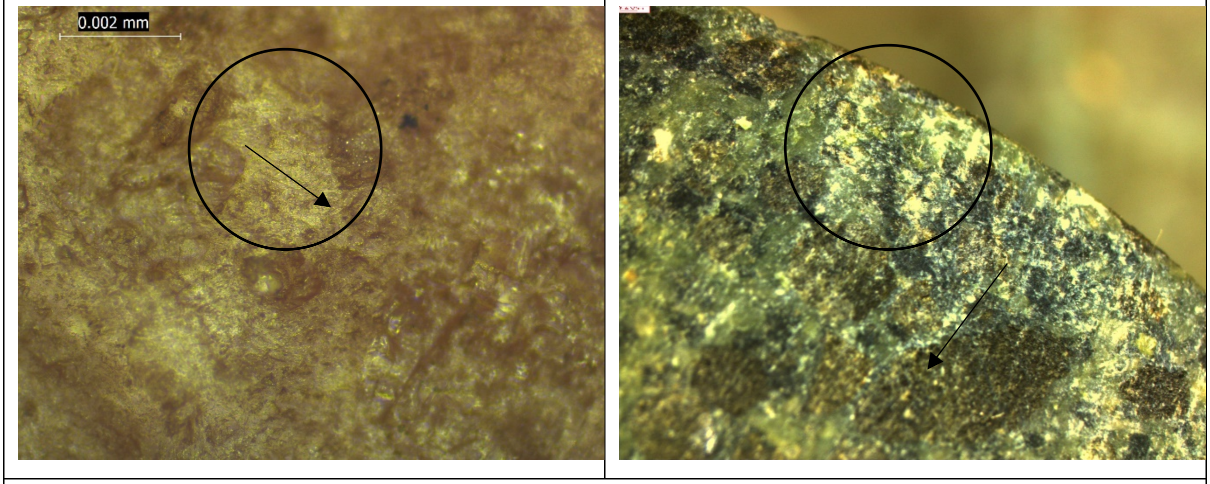
Figure 6.50: Micrographs of wear analysed at 100 strikes digging soil and stones

6.9.4 Two-hundred strikes

Another pause was taken at 200 strikes. During the strikes leading up to this pause, the hole being dug increased in depth and, as a result, the axe-head became more efficient at breaking apart the soil and removing stones. This was most effective when the blade was able to hit the wall of earth head on, like a hoe. The wear at this stage includes slightly more striations in the same formation, spread across the blade edges, in associated with the grain removal pits. Sparse long scratches also appeared on the blade edges from the sharper, broken flint in the soil. these are few. At this phase, the clumps of grain removal pits have increased in size on the blade edges. The pits appear angular and have increased in size within the clumps at the centre and towards the edges of the blade. The clumps were slightly larger than at 100 strikes but were still small. Crushing of grains was more apparent at this phase and exists mostly in the centre of the blade and blade edge in association with the grain removal pits in this location. Rounding from contact with the soil continues to be present on the higher topography.

Analysis of the casts again revealed the continued presence of production polish, but this appeared to have become slightly smoother through use. Small, sparse patches of use polish were granular, with overlapping striations from contact with the soil grains and a lack of directionality (figure 6.51).

A B



A. Analysis of an acetate cast of the blade edge using a metallographic microscope: A patch of granular polish with striations running through it, indicated by the circle and arrow, X10.

B. Stereoscopic analysis of the centre of the blade edge and tip: Close clumps of grain removal pits on blade tip and edge, crushing occurring. Also, some scratches on the blade edge, see the arrow, X0.8.

Figure 6.51: Micrographs of wear analysed at 200 strikes digging soil and stones

6.9.5 Five-hundred strikes

At 500 strikes the fourth pause was taken to assess the development of wear since the previous pause at 200 strikes. During this phase, the axe-head began to spin on its haft, so wooden wedges were hammered into the gaps between the haft and the perforation to secure it. At 500 strikes abrasion became apparent towards the top corner of the blade, the area initially in contact with the contact material. In this area, more numerous grain removal pits, extended 20mm onto the blade edges bifacially, and were related to crushed grains. Pits on the remaining blade extend onto the blade edge approximately 10mm. The clumps along the blade tip were more pronounced due to their larger size. Clear, short striations ran from the pits. They were dense at the centre of the blade and their density decreases to close on the remaining areas of the blade edges. The 500-strike pause saw the first flake negatives occur; very small multiple flake negatives are present centrally on the tip caused by increased contact with stones. Rounding was present on the higher topography and occurs mostly on the bottom corner of the blade.

Analysis of the casts revealed the production polish was noticeably altered, becoming smoother. The polish from use remained granular with a close density, although the grains were sparsely connected. Some small striations, overlapping, exist in patches on the blade tip amongst the granular polish (figure 6.52).

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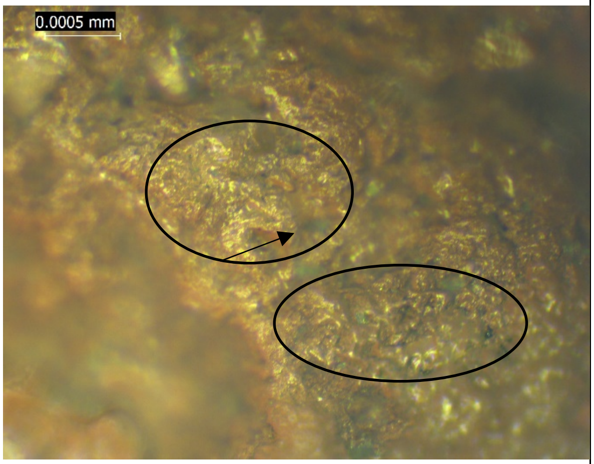

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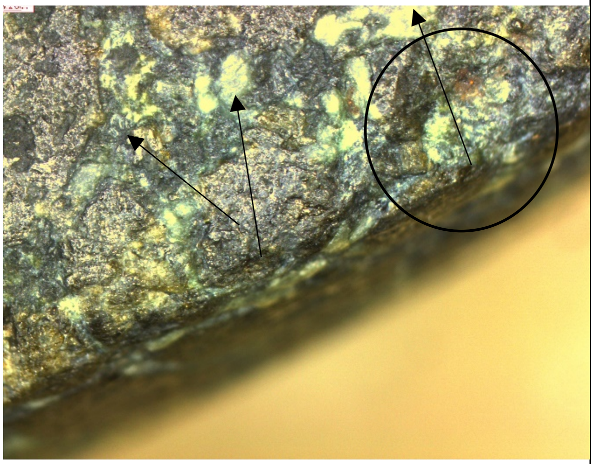


A. Analysis of an acetate cast of the blade edge using a metallographic microscope: A patches of granular polish with striations running through, sparsely connected, indicated by the circles. The arrow shows the direction of striations, X10.

B. Stereoscopic analysis of the centre of the blade edge and tip: Clumps of angular pits increasing is depth and width, some are from removed grains on the blade edges as well, such as inside the circle. Striations are running from all pits with a close density, X1.2.

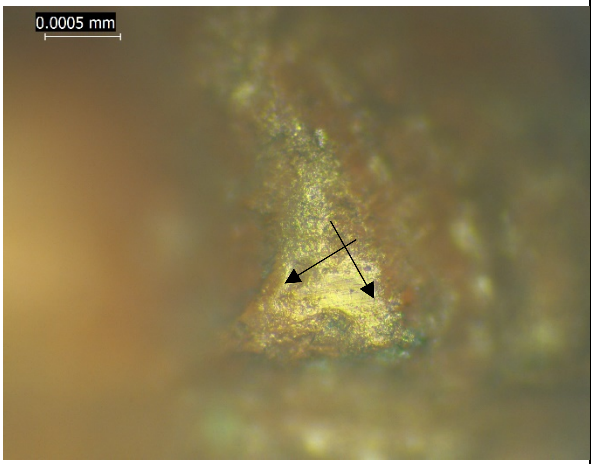
Figure 6.52: Micrographs of wear analysed at 500 strikes digging soil and stones

6.9.6 One-thousand strikes

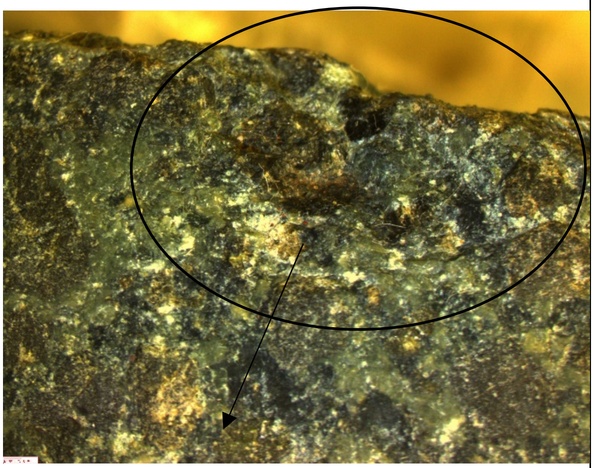
A pause was taken at 1000 strikes. The wear at this phase could be described as developed. Flake negatives were present at the centre and towards the top corner of the blade. These bifacial removals overlapped and had crushed grain on their edges where the topography is higher. Grain removal pits were dense across the blade tip and extend onto the blade edge. They exist in large clumps of overlapping angular pits with crushed grains closely distributed. Short to long parallel striations in a close density run from the pits on the blade tip, associated with them. Striations on the blade edges were also close to dense pits extending up to 20mm. Rounding is limited to the bottom corner of the blade tip. Increased contact with stones, a hard contact material, is aggressively removing grain, including those rounded by the soil.

Analysis of the casts taken after 1000 strikes revealed much more developed polish. The granular polish was partially connected and formed patches, smoother looking. The striations on these patches had a close to dense density. They were thin and overlap. Although production polish was still visible, it was limited in size (figure 6.53).

A



B



A. Analysis of an acetate cast of the blade edge using a metallographic microscope: Smoother patches of polish with dense to close striations overlapping, direction indicated by arrows, X20.

B. Stereoscopic analysis of the centre of the blade edge and tip: A large flake negative on the tip and blade edge can be seen with long striations running from it and patches of crushed grains around it, X0.67.

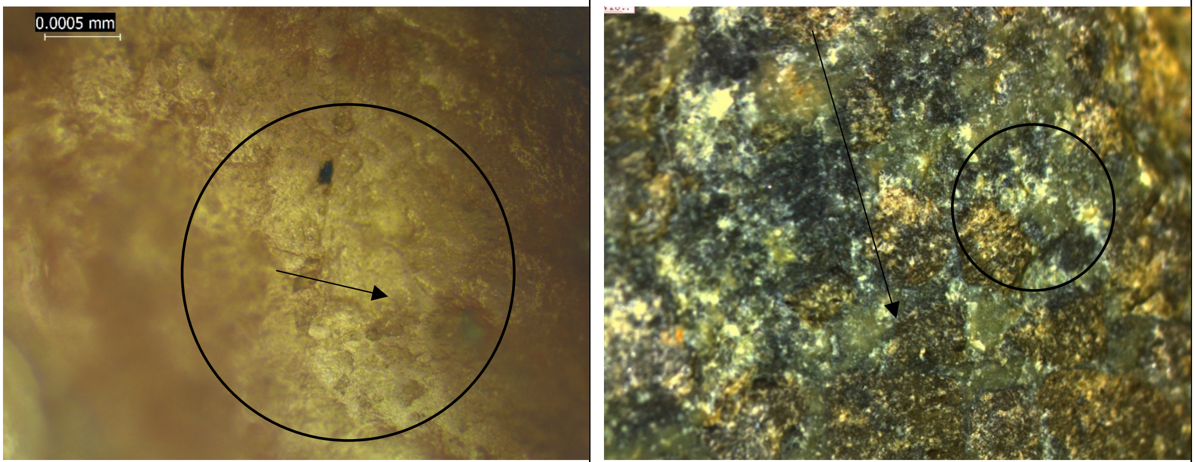
Figure 6.53: Micrographs of wear analysed at 1000 strikes digging soil and stones

6.9.7 Two-thousand strikes

The experiment ended at 2000 strikes when the wear was significantly developed. The blade was truncated in several areas, taking the appearance of a wave. This truncation was caused by the increased quantity and density of grain removal pits, the highest density of which was present in the centre and towards the top of the axe-head which initially met the soil and stones with each strike, thus increasing the development of wear. Flake negatives were amongst the densest pits and were wide and made up of multiple fractures. Crushed grains with a close density were present along the blade and concentrated around the flake negatives. Long striations ran from the pits on the blade tip, they were intermittent and often broken up by pits on the blade edge. Thin striations from contact with soil extend intermittently to the back side of the perforation, approximately 50mm from the blade tip. Rounding and polish were most clear at 2000 strikes. It existed at the corners of the blade and extended back towards the perforation. Areas of the butt close to the perforation were also rounded from contact with soil.

Analysis of the casts revealed a developed polish of patches of granular and smooth polish relating to the types of soil the axe-head came into contact. Polish from contact with clay was noticeable as granular polish. Striations were numerous on the large patches of connected polish (figure 6.54).

A B



A. Analysis of an acetate cast of the blade edge using a metallographic microscope: Large patches of granular and smooth polish with long striations, see circle and arrow, similar to polish formed on the stone when in contact with clay, X20.

B. Stereoscopic analysis of the centre of the blade edge: Long, intermittent striations, see an arrow, run from the blade edge, broken up and surrounded by clumps of grain removal pits and crushed grains, see the circle, X1.0.

Figure 6.54: Micrographs of wear analysed at 2000 strikes digging soil and roots

6.10 Animal slaughter experimental results

The animal slaughter experiment hit pig heads to replicate the modern cattle bolt gun used in abattoirs. Cow heads could not be acquired due to the restrictions in place regarding disease transmission when handling bovine body parts and so the experiment was restricted to pig heads only. Axe-hammer replica five was used to hit 40 pig heads across the skull until they were fragmented. The axe-head only came into contact with the unbroken areas of the skull: i.e. once an area of the skull had been broken, the axe-head was used against another unbroken part (figure 6.55). One pig head was used for every 50 strikes. The skulls were placed on a wooden board to aid the cleaning of the area after the experiment. Pauses at 50, 100, 200, 500, 1000, 1500 and 2000 strikes were enacted to assess the development of wear throughout the experiment.

Figure 6.55: Image of the animal slaughter experiment using an axe-hammer

6.10.1 Effectiveness

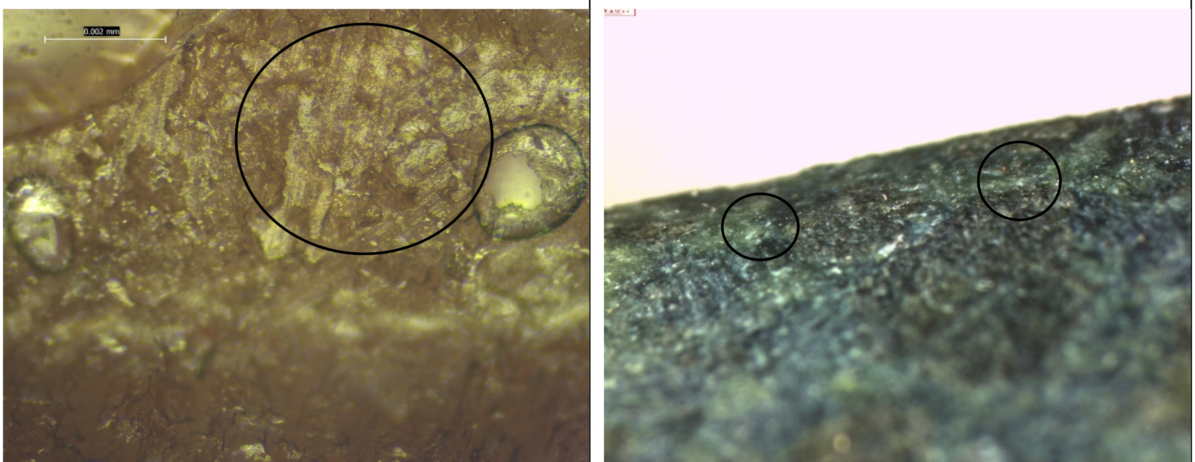
The weight of the axe-hammer was sufficient to crack the skulls on first contact with the implement the majority of the time. On three out of 40 occasions the skulls required 40 strikes for the first crack to be made, although dents were made with the first strike. These examples were bigger pig heads with thicker skulls. An axe-hammer would doubtless be able to stun and knock out a pig on initial contact; in many of these occasions, it would most probably kill the pig. It was, therefore, an effective implement in the slaughter of pigs. Approximately one pig head was used for every 50 strikes. Although the experiment was not able to be tested on a cow head, this experiment attests to the damage that can be inflicted with an axe-hammer. Considering the axe-hammer was able to break apart the larger and thicker pig skulls, it would not be unreasonable to assume it could also cause damage to a cow's head. Multiple strikes are likely to be needed to fracture a cow skull, however. A single blow would be enough to stun the animal, allowing to more safely slaughter the animal.

6.10.2 Fifty strikes

The first pause during this experiment was at 50 strikes. Residue covered the majority of the axe from contact with animal tissues. These were wet and greasy and have contributed to the development of a sheen like polish in small patches along the blade edges and tip at this early stage. Rounding of grains in small patches, along the tip and blade edges were associated with the polish — contact with the skin and flesh covering the skull bone, soft contact materials, cause such wear. Limited, faint striations in two parallel patches running perpendicular to the edge, bifacially, were located towards the top corner of the blade indicate this end of the blade came into contact initially with each strike. The bone underneath the flesh is hard and will cause striations and removals. Superficial, narrow grain removal pits develop in separated, sparse clumps along the blade tip. Towards the corners of the axe-head, they extend slightly on to the blade edges, and occasional pits have crushed grains caused by the hard. They are associated with the striations.

Analysis of the casts under high magnifications revealed no change to the production polish and nor was any use-polish visible at this early stage in the experiment (figure 6.56).

A B



A. Analysis of an acetate cast of the blade edge using a metallographic microscope: Production polish, no use polish visible, such as within the circle, X10.
B. Stereoscopic analysis of the centre of the blade edge and tip: Small, superficial, narrow pits, with a sparse density and surrounded by slightly rounded grains, such as within the circles, X2.0.

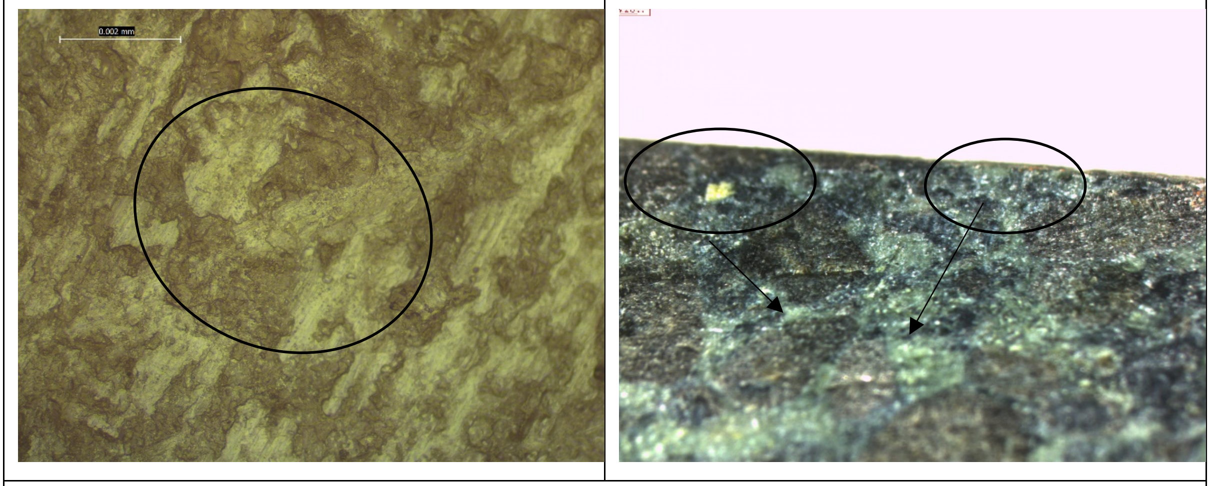
Figure 6.56: Micrographs of wear analysed at 50 strikes hitting animal skulls

6.10.3 One-hundred strikes

After 100 strikes the blade is yet to change shape, and the wear is not visible macroscopically. Rounding and the sheen like polish continued to be present on the high topography along the blade tip and edges. However, it was not as extensive due to the slightly abraded surface and grain removal pits. By 100 strikes the striations had increased in quantity and now extended across the blade edges, mostly bifacially. They were not uniform, and their size and orientation were variable, occasionally being intermittent. Some of the larger striations, closer to the corners, were diagonal and slightly overlapping, while the remaining linear features run perpendicular to the blade edge. The striations were associated with the grain removal puts on the tip and blade edges. They were small, superficial and narrow, and clustered in groups amongst abrasive wear on the blade edge, in particular in the centre of the blade. The wear remained limited and faint.

Analysis of the casts revealed partially altered production polish, which appeared smoother. In other areas, the grains within the higher topography also had a limited smooth polish, unconnected and thus giving it a granular appearance (figure 6.57).

A B



A. Analysis of an acetate cast of the blade edge using a metallographic microscope: Production polish, slightly smoother from use, such as within the circle, X10.
B. Stereoscopic analysis of the centre of the blade edge and tip: Small, superficial, narrow pits, increased in number and surrounded by slightly rounded grains, such as within the circles; striations are now also running from the pits, see the arrows, X1.5.

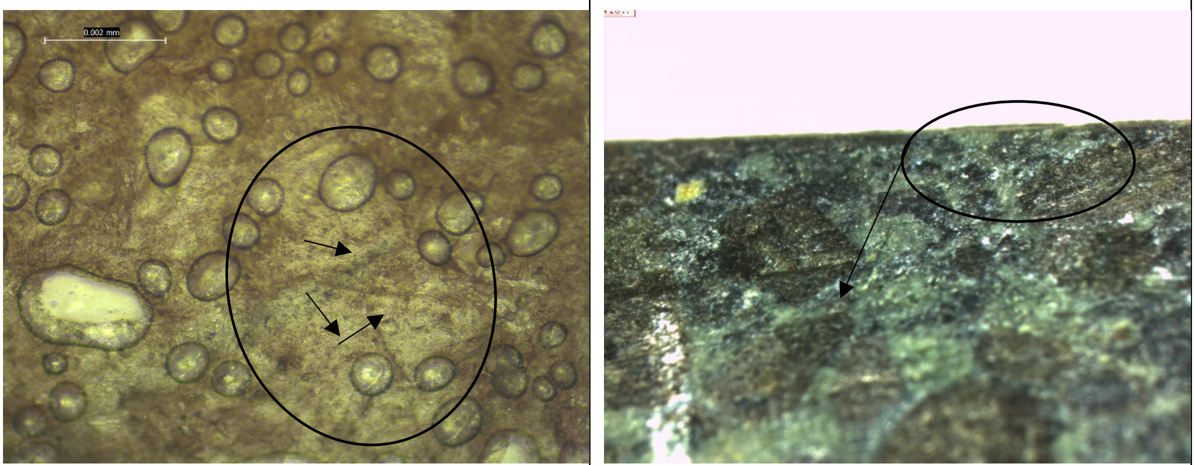
Figure 6.57: Micrographs of wear analysed at 100 strikes hitting animal skulls

6.10.4 Two-hundred strikes

A pause at 200 strikes revealed the development of scratches on the blade edges, 50mm in length approximately. They were caused by direct contact with the skull surface and fractured skull fragments. By this stage there is an increased quantity of grain removal pits on the blade edges, however, they were limited to the tip which was rounded along the entire tip. Groups of superficial, narrow pits were present on the tip, they were very small, and the edges were rounded. The pits on the blade edge were equally small but were less rounded. They extended back 10mm with a close density and were associated with the striations which ran intermittently for the same distance and were greater in quantity in comparison to 100 strikes. Sparse diagonal striations overlapped the straight ones across the blade edges, but with a focus at the corners of the blade edges.

The casts taken after 200 strikes were analysed to reveal to larger patches of smooth polish with a higher quantity of small striations. At this stage, the striations were often overlapping. Some rounding of the edges of the patches and grains, as well as the production polish, was present, most likely from the contact with flesh (figure 6.58).

A B



A. Analysis of an acetate cast of the blade edge using a metallographic microscope: Larger patches of smooth polish from use, such as within the circle, striations face multiple directions as indicated by the arrows, X10.
B. Stereoscopic analysis of the blade edge and tip: Small, superficial, narrow pits, in larger groups on the blade edge, the tip is rounded and has minimal pits in comparison; striations run from the pits as indicated by the arrow, X1.0

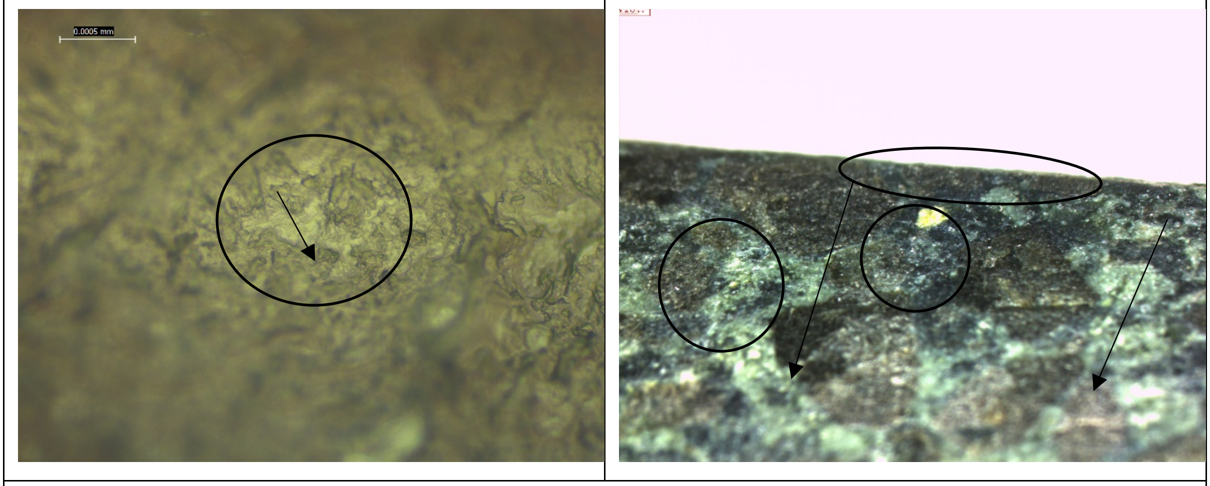
Figure 6.58: Micrographs of wear analysed at 200 strikes hitting animal skulls

6.10.5 Five-hundred strikes

The wear at 500 strikes was much the same as 200 strikes but in higher quantities. The striations were also longer, and the grain removal pits extended further away from the blade edge, 10-20mm, comparable to the striation length. The striations remained thin and faint; they were mostly intermittent and a mixture of straight and diagonal striations, overlapping. Rounding was limited to the blade tip, mainly the corners, and some areas on the centre blade edges. Scratches remained on the body of the axe-head not far from the blade.

Analysis of the casts revealed larger patches of smooth polish which were closer in density and partially connected. At higher magnifications, such as X20, the polish appeared slightly domed. The striations at this stage were clearer and occurred in larger numbers, 5-6, in a parallel arrangement. Some were diagonal and overlapped over other straight and diagonal striations (figure 6.59).

A B



A. Analysis of an acetate cast of the blade edge using a metallographic microscope: Patched of polish becoming slightly domed at higher magnifications such as within the circle, they have close density striations, notified by the arrow, X20.
B. Stereoscopic analysis of the blade edge and tip: Small, superficial, narrow pits in larger groups on the blade edge, which are more numerous, see circles. The tip is rounded and has minimal pits in comparison; striations run from the pits are also more numerous and are indicated by the arrows, X1.0.

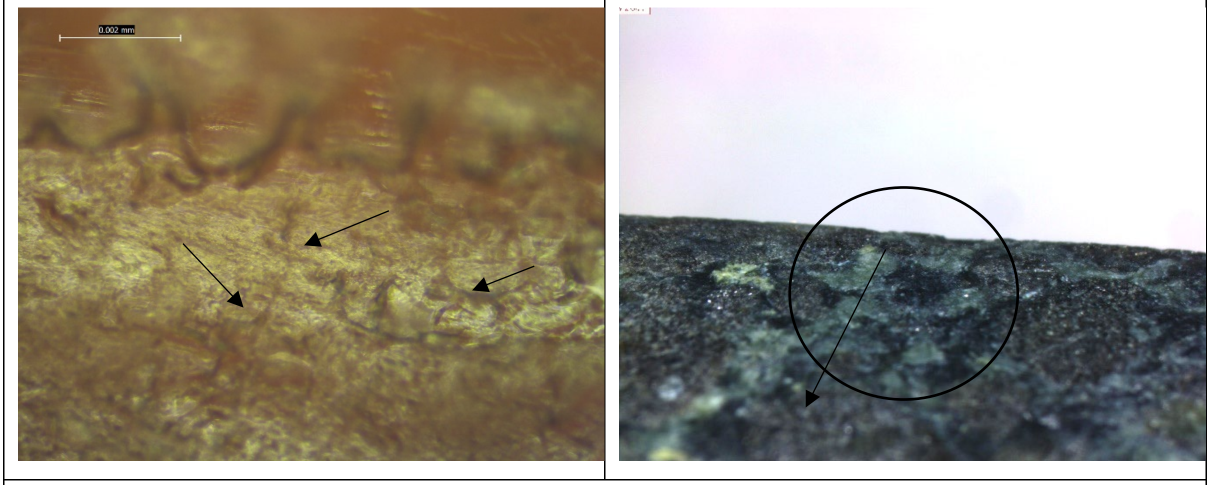
Figure 6.59: Micrographs of wear analysed at 500 strikes hitting animal skulls

6.10.6 One-thousand strikes

At 1000 strikes the development of wear was in line with the previous two pauses. The wear was very similar to 500 strikes but was greater in quantity and size. Rounding was more extensive and spread further onto the blade edge, approximately 5mm. Overlapping, thin, long striations starting 10mm from the blade edge were more numerous and were accompanied by superficial, narrow grain removal pits. Both wear types were close in density. The pits on the tip and blade edge close to the tip were larger in diameter but remained superficial; their edges were rounded (figure 6.60).

The metallographic microscopic analysis revealed that the patches of slightly domed polish have increased in size, with a close density and covered in patches of an increasing number of parallel striations, 5-10. They remained in straight and overlapping positions, often overlapping.

A B



A. Analysis of an acetate cast of the tip using a metallographic microscope: Patch of slightly domed polish, partially connected with multi-directional striations, indicated but the arrows — many micro-removals from impact with bone, X10.
B. Stereoscopic analysis of the blade tip and edge: Rounding of grains which appear smoother extends further onto the blade edges, such as within the circle. Long striations are some very small grain removal pits visible amongst the rounding, indicated by the arrows, X1.2.

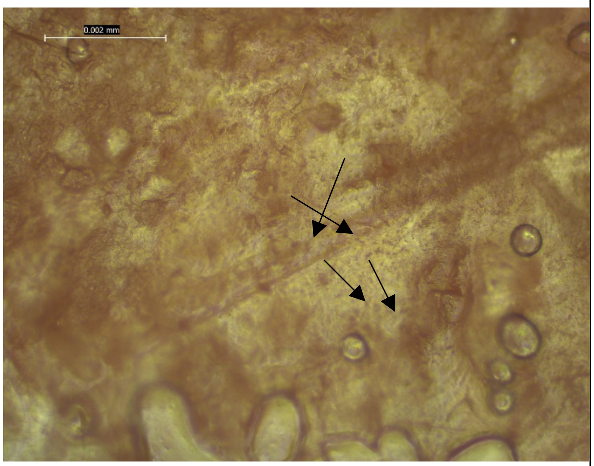
Figure 6.60: Micrographs of wear analysed at 1000 strikes hitting animal skulls

6.10.7 One-thousand-five-hundred strikes

The pause was taken at 1500 strikes. At this stage, there is still no wear visible macroscopically. Wear was not too different to 1000 strikes. Striations and grain removal pits were comparable while the rounding extended 15mm from the blade edge. A few wider striations were present on the blade edge, diagonal and facing towards the centre of the blade at an obtuse angle. They were wider than the thin striations covering the blade edge and are most likely from direct contact with bone. Contact with flesh and skin resulted in the smooth appearance of the surface of the blade edges and tip (figure 6.61).

Analysis of the casts under a metallographic microscope showed larger patches of slightly domed, smooth polish with micro-removals from the removal of grains through use. Close density striations cover the patches of polish, occasionally overlapping. Patches were close in density.

A



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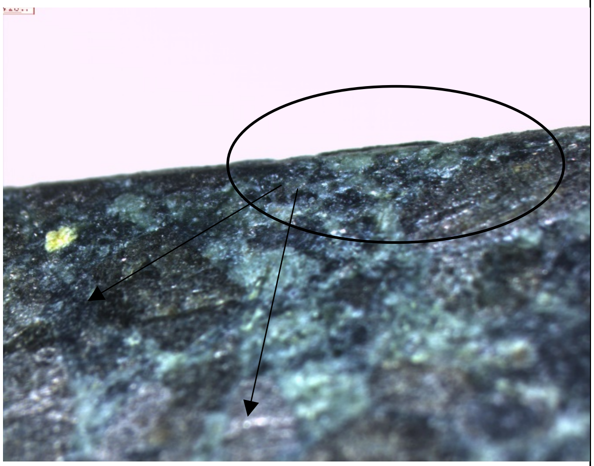


A. Analysis of an acetate cast of the blade edge using a metallographic microscope: Medium sized patches of slightly domed polish, covered in close density striations, their direction indicated by the arrows, X10.

B. Stereoscopic analysis of the blade tip and edge: Close to dense grain removal pits in a patch next to the blade edge which has noticeable rounded high topography; long parallel striations run from them; they are clearer at this stage, X1.0.

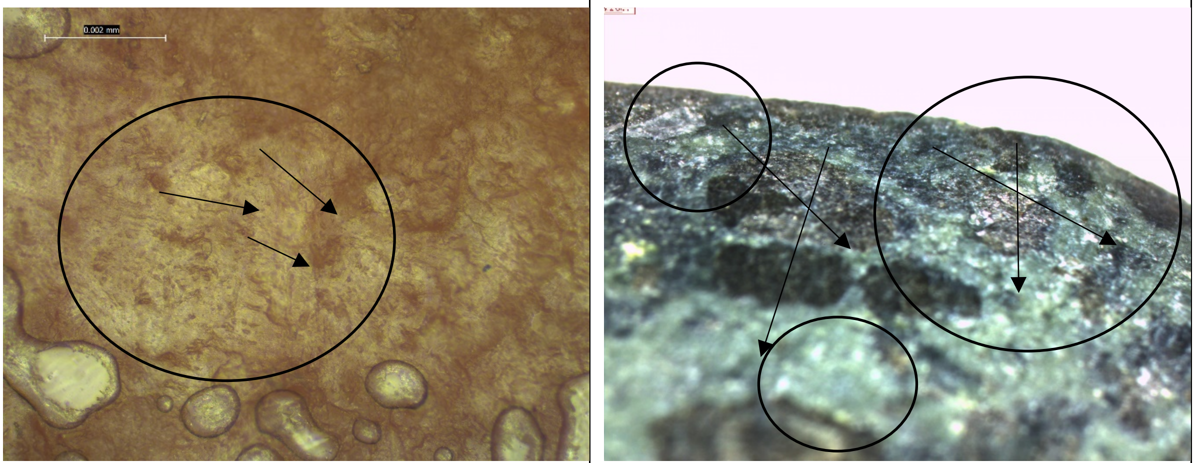
Figure 6.61: Micrographs of wear analysed at 1500 strikes hitting animal skulls

6.10.8 Two-thousand strikes

The experiment ended after 2000 strikes. At this stage, the wear was visible macroscopically as small pits running along the blade tip. Microscopic analysis revealed an increase in the number of pits and striations on the blade edges, running up to 15mm from the blade edge. The striations were a mixture of straight parallel, short striations close to the tip and longer, singular striations with diagonal orientations often overlapping each other as well as the shorter striations. The narrow, superficial pits surrounded the striations in a close density which became more dense closer to the blade tip where they appear in clumps. The pits were less clear on the tip due to the rounded grains from contact with flesh. However, they appeared larger and more spread out along the blade edge. Some large scratches exist on the blade edges, running almost parallel with the blade edge (figure 6.62).

Analysis under a metallographic microscope showed the development of the smooth polish to a density which was close to dense. The patches of polish were large, and they were covered by dense striations in parallel groups. Micro-removals were evident in the patches from the removal of stone grains during use.

A B



A. Analysis of an acetate cast of the blade edge using a metallographic microscope: Large patches of smooth, indicated by the circle, slightly domed polish with dense striations, their direction indicated by the arrows. Small pits in the polish are micro-removals, X10.

B. Stereoscopic analysis of the blade tip and edge: The tip appears slight bumpy which is the rounded appearance of the grain removal pits on the tip. Higher quantities of pits exist on the blade edge in large patches, which are most dense closest to the tip, see circles; Overlapping striations cover the micrograph and are signalled by the arrows. Rounding and smoothing of the blade edge and the tip is still visible, X1.2.

Figure 6.62: Micrographs of wear analysed at 2000 strikes hitting pig skulls

6.11: Conclusion

Experimental tests using replica battle-axes and axe-hammers were created and carried to assess the type of wear produced while undertaking specific actions. The development of wear throughout use was assessed to understand better the wear marks seen on those implements in the archaeological record. The effectiveness of these implements during their use was also assessed to understand if they could be used functionally. The experimental results suggest that both battle-axes and axe-hammers were fully capable of being used functionally for long periods of time. The potential for long periods of use means these objects could have been passed down through generations or kin groups, needing to be re-ground to re-sharpen the blade on occasion to continue their use.

Table 6.3: A comparison of wear from each experiment at 2000 strikes					
Experiment	**Striations**	**Pits**	**Rounding**	**Flake negatives**	**Polish (high mag)**
Chopping wood	Dense, Cover blade edges bifacially, u-shaped in profile, 10mm long and in a parallel arrangement perpendicular to the blade edge. Some at corners are diagonal, pointing towards the centre of the blade. Interrupted by pits on the blade edge.	Dense, cover blade tip and extend onto blade edges bifacially 10mm, narrow and superficial, those closest to tip are wider and deeper.	Along blade tip, at corners and the edges of the pits of the blade top, high topography of the flake negative.	One small, shallow flake negative on one corner, edges and high topography rounded.	Close density, varying sized patches of domed polish with a clear directionality moving away from the blade tip, parallel striations on the polish orientated in the same direction.
Wedge-splitting wood	Close density, parallel, extend up to 30mm onto blade edge, interrupted by pits causing them to become intermittent, length varies from small to long, orientated perpendicular to the blade tip.	Close density, cover blade tip and extend onto edge 30mm, narrow and superficial, surrounds and interrupts the striations on the blade edges.	High topography on corners rounded	None	Close density, patches of domed polished, small to large in size, micro-removals (pits) on the patches, clear directionality, parallel striations on polish orientated in the same direction.
Splitting wood	Dense, u-shaped in profile, extend 10mm	Dense, cover blade tip and edge, extend 10mm	High topography along the blade tip and the top	None	Close density, large patches of domed

	onto blade edges, bifacially, parallel arrangement orientated perpendicular to blade tip.	onto blade edge, narrow and superficial, densest patches occur in three groups the centre and towards the edges of the blade, surround pits.	of the pits on the blade edge, close to the tip, and at the corners.		polish, with a clear directionality moving away from the blade tip, patches covered in dense parallel striations orientated in the same direction.
Digging/clearing soil and roots	Dense, thin striations, u-shaped in profile, in a parallel arrangement, orientated perpendicular to the blade tip, those in centre overlap and are orientated diagonally, extend up to 20mm onto blade edges, bifacially.	Dense, cover blade tip and edge, extend 20mm onto blade edges bifacially, close to striations, pits on the tip are wide, shallow and rounded, pits on the blade edge are superficial and narrow.	High topography and edges of pits on the tip and blade edge directly next to tip, rounded.	None	Close density, large patches of domed and slightly granular polish, covered in long situations, overlapping and orientated in multiple directions, domed parts of the polish have directionality.
Digging/clearing soil and stones	Dense, u-shaped, long, intermittent striations, interrupted by pits, extending 20mm in the centre of the blade edges and 50mm	Dense, angular, superficial and narrow, extend up to 20mm in centre of the blade and 50mm towards the corners to that they	Rounded high topography on the blade corners, extending back towards the perforation.	Wide, multiple fractures along the blade tip and edge associated with the densest patches of pits and crushed stone grains.	Close density, large patches of granular and smooth polish covered in long striations, orientated in multiple

	towards to corners so that they meet the perforation, bifacially.	meet the perforation, bifacially, crushed stone grains within pits.			diagonal direction and overlapping.
Animal slaughter	Dense, cover blade edges, spread up to 15mm onto blade edges, bifacially, parallel arrangement, orientated perpendicular to blade tip, a mixture of short and longer striations, the longer striations are orientated diagonally and overlap, large scratches in multiple directions on blade edges.	Dense, wide pits close to the blade tip, superficial and narrow further from it, spread up to 15 mm onto blade edges, bifacially.	High topography and edge of pits on tip rounded.	None	Close density, large smooth patches, edges slightly rounded giving a domed appearance, dense striations on the patches, slightly overlapping.

The tests revealed that the wear forms across all blades of differing format and size in a very similar manner when used with the same action, against the same contact material. Generally, the wear started with a few patches, pits and striations on the blade tip which became larger and denser throughout use, spreading spread across the tip and blade edges. Therefore, the results from the experiments carried out with a specific type of battle-axe or axe-hammer can be assumed to develop similarly on the types not tested. The less developed wear from uses involving contact with wood starts in the same manner, but is a specific grouping of wear, with three groups of pits and striations, one in the centre and one towards either corner, bifacially. This wear arrangement has been termed the ‘three-group arrangement’ which is discussed further in section 7.3.

Table 6.3 summarises the wear at 2000 strikes for each experiment and demonstrates the type of wear and the combinations of wear to expect to find on a stone blade used for the same action. Each implement at 2000 strikes had similar wear, such as parallel striations, which came from the similarity in motions used. However, each implement also had its own, unique combination of wear specific to the action and contact material it was used against. Some examples of distinguishable wear are as follows: it was clear that contact with a hard contact material, such as stone, caused more distinctive traces as stone against rigid hard stone is more destructive that stone against a medium hardness contact material, like wood; the wear traces from contact with soil were could also be distinguished easily from contact with wood and bone; Soil caused long, overlapping and intermitted striations which were very different from the parallel striations caused by contact with wood which rarely overlaps.

Each contact material created a different distinguishable polish. Contact with wood was the most distinguishable type of polish due to domed appearance, clear directionality and parallel striations on the polish with the same orientation as the directionality. When wood was not a contact material, the polish did not have directionality. The polish from contact with soil created granular and smooth patches of polish, and contact with bone caused large, smooth patches of polish, slightly domed, with dense, slightly overlapping striations. The less distinguishable wear at 2000 strikes was between the chopping wood and splitting wood experiments since both used chopping motions, one vertically and the other horizontally, against wood of the same hardness.

All but one experiment resulted in the effective completion of the function being tested, indicating these implements could be used functionally for tasks including chopping wood, splitting wood for firewood, and slaughtering animals. The exception was using an axe-hammer to split wood as use as a wedge failed to split the wood at all. It is possible that this experiment was not a faithful reproduction of how these tools could have been used as wedges. A repeat of the experiment changing the parameters is needed to test the hypothesis further that battle-axes and axe-hammers were used as wedges to split wood. Changing the percussive tool to another axe-hammer, with wood as an intermediate substance is one parameter that could be changed.

Chapter 7: Analysis of wear results on EBA battle-axes and axe-hammers

7.1 Introduction

This research project aims to apply use-wear analysis to assess the use of 121 perforated ground and polished stone battle-axes and axe-hammers held in the archaeological record. Use-wear analysis provides a scientific method to explore the uses of these implements through the application of direct observation by optical and metallographic microscopy. A new casting methodology using acetate film to replicate the surface of ground and polished stone allowed for the analysis of these implements at both low and high magnifications. The additional experimental tests were used to aid the identification of function through the creation of a reference collection of wear traces attributed to specific activities (for which, see chapter 6).

A selection of such implements from across Northern Britain and the Isle of Man was studied for this purpose. It was not within the means of the project to analyse all implements from the study area. Therefore, the implements were selected to represent different typologies, petrologies and locations. Fragmented implements were not included nor were those which were overly weathered as weathering removes traces of use. Often the extent of weathering was not known until the implement was assessed directly at the museum as photographs of museum online collections are limited. Roe's 1966 publication and the Implement Petrology Group data were used to pick out the most appropriate implements. I ensured that implements from each county in Northern Britain and the Isle of Man was represented, where available and existing. It was impossible to represent all petrologies used for the manufacture of axe-hammers and battle-axes due to the high number; a total of forty out of 68 different petrologies were represented in the sample. I aimed to analysed one to two implements of each typology from each county. This was not always possible as some counties had limited battle-axe and axe-hammer finds (Information on the typology, petrology and location of the battle-axes and axe-hammers can be found in the *Recorded data* spreadsheet in the digital appendix).

Wear analysis was carried out on the chosen dataset held at specific museums: including Edinburgh Museum; Stranraer Museum; Dumfries Museum; The British Museum; York Museum; Tullie House Museum, Carlisle; Manchester Museum; The Great North Museum, Newcastle upon Tyne; Manx Museum, Isle of Man; and Sheffield Museum. The museum online databases and the Implement Petrology Group dataset were used to determine where the implements required for analysis were kept. A stereomicroscope was used to analyse each implement directly using low power microscopy, which allowed for the analysis of wear patterns including striations, grain and flake removal, and the presence of polish. Casts using acetate film were then taken from the relevant areas to replicate the wear. These were analysed under a metallographic microscope in the archaeology laboratory at Newcastle University. This method allowed for the analysis of the type of polish and thus the type of contact material during use (see chapter 4 for the methodological approach). Such a multi-scale approach, using both low and high-power microscopy, allowed for a broader range of results. Such new approaches are complementary because they focus on specific aspects of use-wear (Dubreuil et al. 2015, 124).

The five months training and experience at the Material Culture Laboratory in the Archaeology Faculty of Leiden University, under the guidance of Dr Annelou van Gijn, Dr Christina Tsoraki and Annemeike Verbaas, allowed the interpretation of wear to be carried out accurately. I drew upon the vast collection of experimental implements at Leiden used for a variety of different purposes and on and between different materials, for different lengths of time. My analysis of this collection enabled me to gain a good understanding of wear formation on a variety of different materials, uses, and contact materials. For example, several experimental stones tools have been used as comparisons to aid the recognition of wear formation on my dataset. These include several polished stone axes used for chopping wood, sandstone grinders used to grind wood, bone, stone and cereals, and battle-axes used to chop wood, roots and soil, and animal skulls for Karsten Wentink's PhD research experiments.

My experimental tests have built upon the information gathered through these previous experimental tests to aid the identification of function (for which, see chapter 6). It was imperative to understand how wear formed throughout different tasks. The wear analysed throughout the experimental tests have been compared with the wear on battle-axes and axe-hammers to aid and confirm the interpretation of the motions of the implements and their contact materials. The experimental tests included chopping pine branches, splitting birch wood logs, digging and clearing soil with stones, digging and clearing soil with roots, splitting tree trunks into planks of wood, and animal slaughter. The effectiveness and functionality of battle-axes and axe-hammers were unmissable.

The use of ground and polished stone battle-axes and axe-hammers from the Early Bronze Age have therefore been assessed through the application of wear analysis on a sample of these implements from across northern England and Scotland. These results have been interpreted based on comparisons with traces produced by experiments on replica ground or polished stone objects. The application of the methodology was successful and revealed promising results suggesting that both axe-hammers and battle-axes were functional and possibly hybrid tools. The following sections will demonstrate the type of wear analysed on battle-axes and axe-hammers by drawing upon experimental tests and knowledge of wear formation. Interpretation of the data has determined that wood is the most common contact material, although contact with soil, roots, and bone have also been identified (for which see figure 7.1).

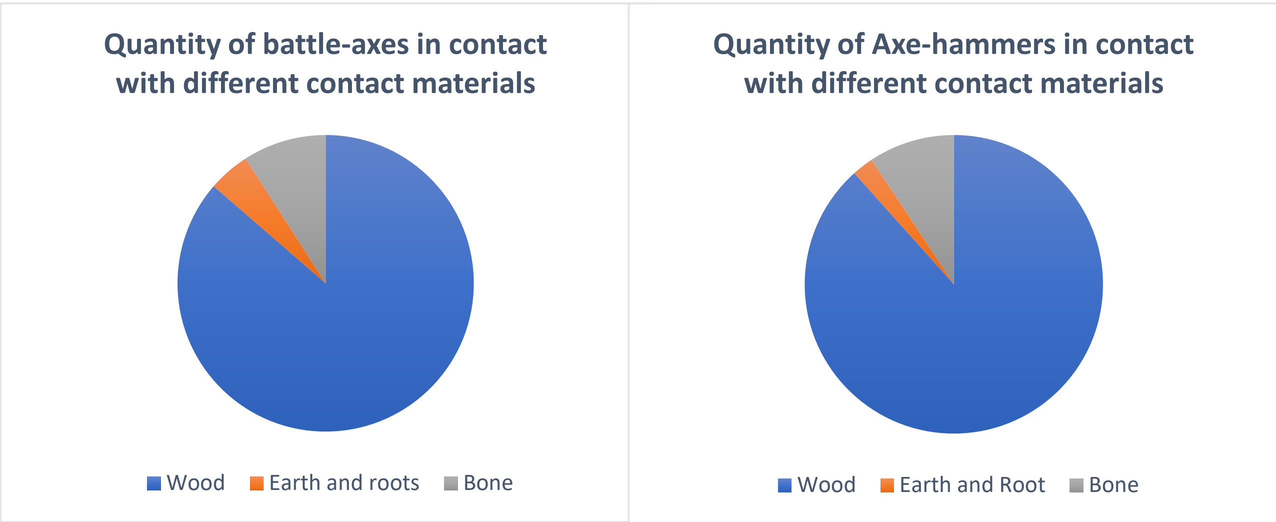


Figure 7.1: Two pie chart to demonstrate the materials in contact with battle-axes and axe-hammers

The following sections will demonstrate the variation in motion and extent of use present in the data set. For a reference of the wear types, see figure 6.1. Most notably, however, is the discovery of the three-group arrangement – an arrangement of three groups of pits on the blade tip and associated bifacial striations on the blade edges, occurring in the centre and towards the blade corners (figure 7.7) – a formation of wear which occurs during the early stages of contact with wood, using a chopping motion. Prior to the experimental tests, this was not known. This wear pattern was found on both battle-axes and axe-hammers in museum collections. By analysing the experimental replicas throughout the experiments, the development of wear was understood a lot more thoroughly.

7.2 Contact with wood: Battle-axes

The most common material to be in contact with battle-axes is wood, with 38 out of the 62 battle-axes analysed exhibiting evidence for such contact. This was assessed by using both low and high-power approaches. Wear analysis of battle-axes in contact with wood showed variability in the wear, in particular the motion and angle of use, the hardness of contact material, and the amount of use. Figure 7.2 demonstrates the variable use motions analysed on battle-axes in contact with wood. This section will be broken down into three sub-sections: those indicating chopping motions and the variability within that group; those indicating a wedge motion; and those with less developed wear, which convey less information regarding use.

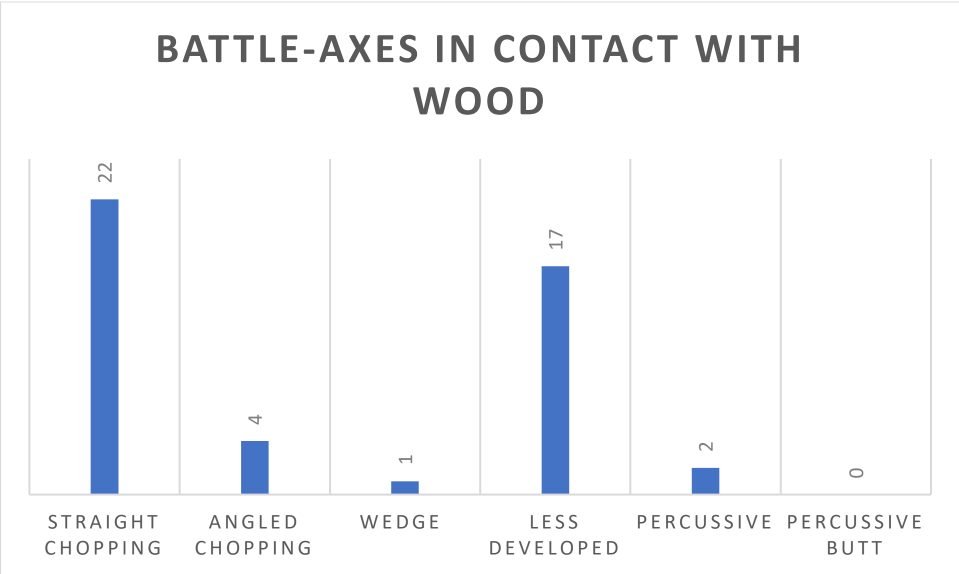


Figure 7.2: A bar graph to demonstrate the different motions of battle-axes used in contact with wood

The identification of contact with wood was made using knowledge of wear formation and a comparison with experimental tools. These tools include grinding stones used to polish wood (see figure 4.3), stone axes used to chop wood, and the experimental tests as part of this project (chapter 6). The characteristics of contact with wood on bladed implements at low power magnification include rounding of grains on areas of the tip and blade edge due to the medium hardness of the contact material. The experimental tests used to chop branches, split logs and split a tree trunk confirmed the process of wear development when in contact with wood. They show that a blade that is in contact with wood will develop grain removal pits along the blade tip and blade edge from repeated contact. These will firstly occur as singular pits, sparsely distributed along the tip. The wear will develop from further use into small groups of pits of the tip with a sparse density, these start as two or three groups, in the centre and towards the blade corners and at this point, they have begun to appear on the blade edges one to two mm from the tip. Continued use creates new groups of pits, closer in density, on the blade tip and edge, resulting eventually in a continuous spread of pits along the tip and edge. Contact with the wood and the movement of the axe-head also causes striations to develop with the pits. They occur on the blade edge. Chopping motions were used for two of the experimental tests which produced bifacial striations that ran perpendicular to the blade tip, in a parallel arrangement. Their quantity and density are related to the creation of grain removal pits; the higher density and quantity of pits is positively related to the density and quantity of striations. Different motions will determine the orientation of the striations. The experiments using an axe-hammer as a wedge to split wood into planks had striations which were straight and diagonal from the movement of the blade against the contact material (see chapter 6 for a description of the experiment). Extensive use of an implement will cause flake removals on the tip and blade edge. The discovery of the three-group arrangement has allowed those implements in the archaeological record with similar wear patterns to be interpreted correctly and more accurately than was possible before.

Contact with wood was also identified by high power analysis of the acetate casts. Wood polish was identifiable by the domed appearance of the stone grains (see figure 7.3 for examples of wood polish analysed on the dataset). The polish will always have a directionality which shows the direction of movement. It will also always have related striations, often with a parallel spatial arrangement. The connectedness of wood polish will depend on its development through use over time. Less developed wood polish may appear granular, but continued use will create larger patches of polish which become more connected as use continues. Experimental tests confirmed the form that polish takes when it is in contact with wood, particularly the granular appearance of less developed wood polish (see chapter 6).

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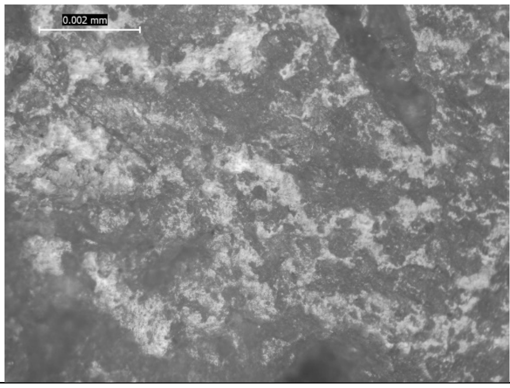

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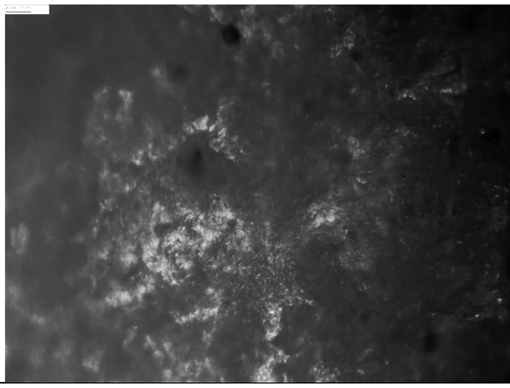

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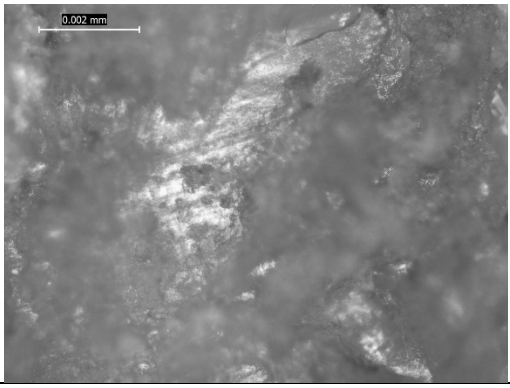

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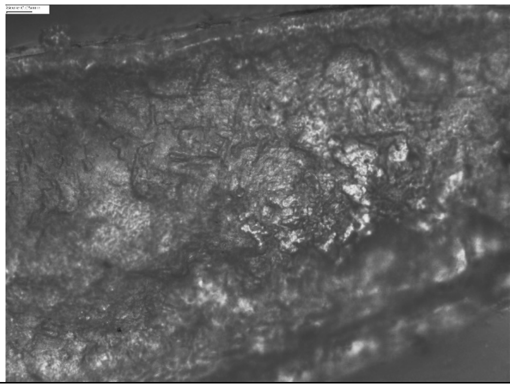

A. ID 82, Blade edge: Well developed domed polish with partially connected grains and a clear directionality and parallel striations orientated in the same direction; wood polish. 10X MET.
B. ID 73, Blade tip: Connected patch of domed polish with clear directionality perpendicular to blade tip. 10X MET.
C. ID 84, Perforation: Developed patch of polish with connected domed grains, directionality moving through the length of the perforation. Parallel striations are very clear and indicate hafting of the implement. 10X MET.
D. ID 240, Blade tip: Small patches of domed wood polish surrounded by less developed wood polish looking more granular. Directionality parallel with blade tip with parallel striations oriented in the same direction. 10X MET.

Figure 7.3 Micrographs of wood polish analysed on battle-axes and axe-hammers in museum collections

7.2.1 Chopping motions

The training at Leiden University and analysis of experimental tools have determined that bladed implements used in chopping motions will cause bifacial striations which are spread along the blade edges. They are parallel in arrangement with an orientation perpendicular to the blade edge. Experiments chopping tree branches and splitting logs have determined that chopping motions cause such striations when the blade contacts the material at a 90 degrees angle. When the angle differs, more diagonal striations will occur. An assessment of the experimental implements throughout their use showed that the longer an implement is used, the greater striations become in quantity and density. This is positively correlated with the creation of grain removal pits along the tip of the blade and on the blade edge, close to the tip (see chapter 6 for the experimental results).

The wear analysed on experimental replicas used with chopping motions in contact with wood are comparable to battle-axes analysed in museum collections. Chopping motions are indicated on 26 battle-axes (nine of which are uncertain motions due to limited wear or weathering) by the presence of bifacial striations perpendicular to the blade tip and extend, evenly spaced, across the entire blade edges and similar lengths. Identical bifacial striations imply chopping motions roughly 90 degrees to the contact material. This is present in 19 battle-axes; however, a number (n=4) have more striations and associated wear on one side of the blade in comparison with the other. This uneven development of wear indicates a more angled position of the implement in relation to the contact material during use. During the experimental tests, the changing of the angle of the blade affected the orientation of the striations. Areas which came into contact with the contact material first also had a greater amount of wear. This indicates that those battle-axes with more wear on one side of the blade were used with this side coming into contact with the contact material first and therefore also more often as a result of changing orientations of the blade through the angle of use and possibly the handedness of the user or users. In this case, multiple users were possible.

On these 19 implements, striations are most commonly short to medium in length, with continuous patterns and are U-shaped in profile. They are associated with grain removal pits spread evenly along the blade pit with narrow and superficial depth and shape. Pits extend onto the blade edge, although they remain close to the tip, on those which have prolonged use and thus have more developed wear. The pits are often superficial and narrow but are with a close density. Polish occurs on the higher topography. Such wear is evident on replica objects at 500 strikes during the chopping wood experimental test.

Battle-axe 21 (for information corresponding to ID numbers, see appendices), from an unknown location in Banffshire, Scotland, is a typical example used to chop wood (see figure 7.4 for micrographs of wear showing chopping motions). The similarities between this battle-axe and experimental stone axes used to chop wood are significant. U-shaped, shallow, close and short striations are evenly spread bifacially along the blade edges. They are associated with grain removal pits also evenly spread along the tip, close in density, and superficial in depth and shape. A collection of small singular flake removal negatives, feather terminations, exist in the centre of the blade tip signifying the prolonged use of the battle-axe. The flake negatives also suggest that the centre of the blade was in contact with the contact material more, perhaps coming into contact with it first with each contact. Rounding of the high topography on this specimen is evident with polish located in similar areas, particularly on the blade corners where contact is less abrasive. Such results during low power analysis indicate a medium hardness contact material. High power analysis revealed clear wood polish.

Bifacial diagonal striations towards the corners are not uncommon on battle-axes used in a chopping motion. The diagonal orientation is also a gentle slope. The diagonal striations are also always orientated towards the closest blade corner, which most probably also indicated a chopping motion with a different orientation or angle of the blade, very similar to the actions causing more extensive wear on one side of the blade. For example, a battle-axe 240, has a mixture of straight and diagonal striations related to the wear on the tip whose highest concentration exists in the centre of the blade. This arrangement of striations indicates the changing motions of the implement during chopping. Changing angle, height, handling and location of the chopped area may affect the location of wear formation. Likewise, multiple users may result in striations being orientated slightly differently. Two battle-axes show a slight deviation in the amount of wear on one side; both examples are from Yorkshire: 229 and 233. A battle-axe from Yorkshire, 253, shows a clear differentiation between the two sides of the blade, one of which presents dense pits with related crushing on a single side.

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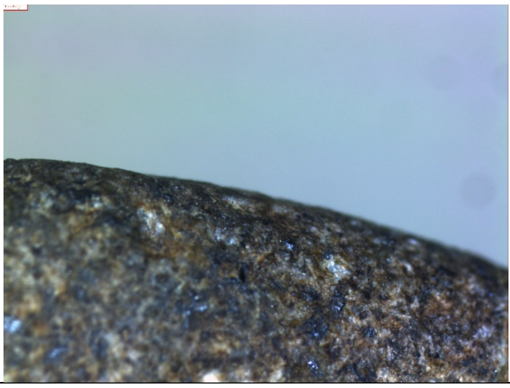

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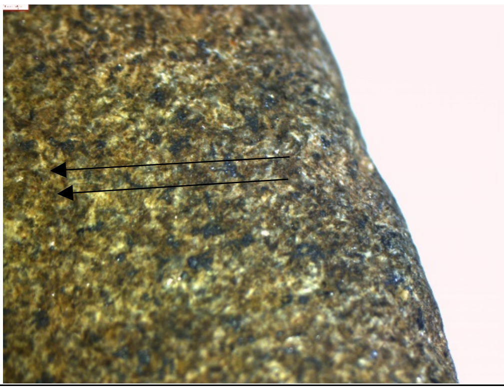

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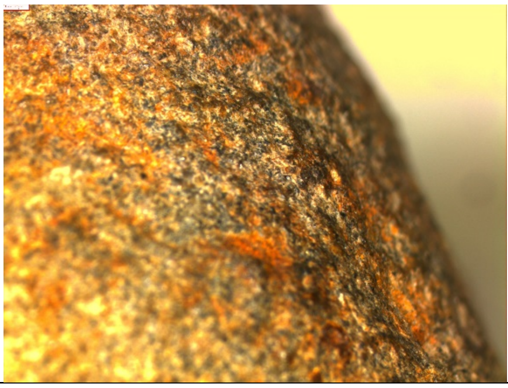

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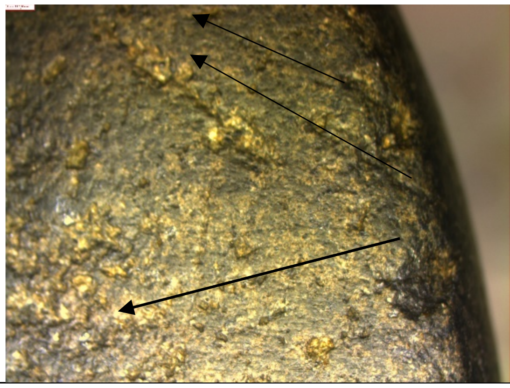


A. ID 68, corner of blade edge and tip. Bifacial short parallel striations spread in patches across blade edges associated with the small, superficial grain removal pits on the blade tip. The pits are close in density and have large pits among them from more extensive use; the high topography surrounding the pits is rounded. 1.5X STE. Chopping wood.

B. ID 68, centre of blade edge and tip. Bifacial short parallel striations spread in patches across blade edges associated with the small, superficial grain removal pits on the blade tip and blade edge. The pits are close to dense in density; the high topography surrounding the pits is rounded. Arrows indicate the direction and location of striations which extend across blade edge. 1.0X STE. Chopping wood.

C. ID 105, blade tip and edge. This implement has less developed wear with limited, superficial grain removal pits in three groups in the centre and towards the blade corners. Associated faint, parallel striations are in similar bifacial patches on the blade edges. Rounding of the higher topography on the blade tip. 1.2X STE. Chopping? Wood.

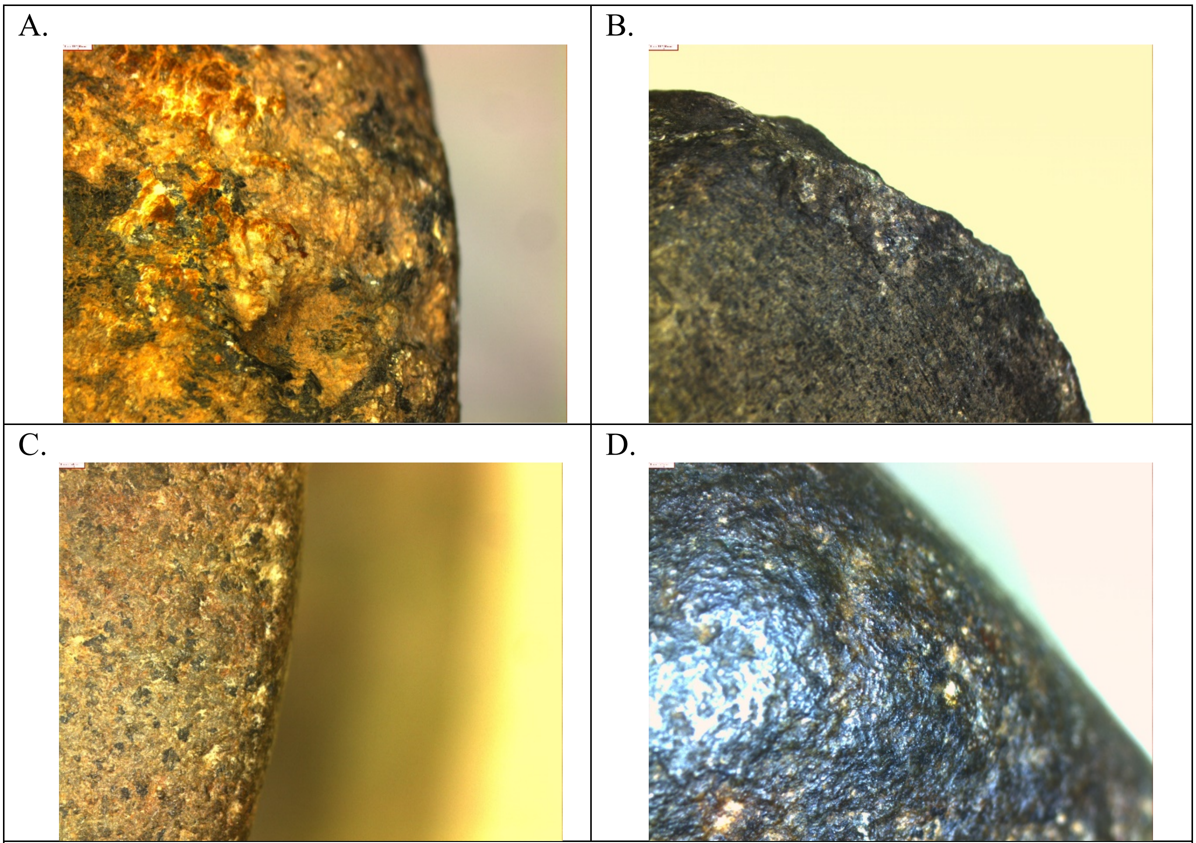
D. ID 240, blade edge and tip. Bifacial striations are present at diagonal angles on the blade edges at a medium length and close in density. They are associated with dense groups are large grain removal pits on the blade tip. This battle-axe also has large scratches caused by plough damage. 0.67X STE. Chopping wood at an angle.

Figure 7.4: Micrographs of battle-axes presenting wear indicative of chopping motions and in contact with wood

Although chopping motions on battle-axes in contact with wood are common, there is a large amount of variation between these implements. This lies in the combinations of wear patterns, such as striations, grain removals and flake removals, which are related to the hardness of the contact material, the stone petrology and the development of wear (figure 7.5). All of these will create slightly different wear patterns.

A harder contact material will cause more abrasive wear. It is likely to cause fractures and flake removals relating to crushed grains as well as more developed grain removal pits which are more numerous and denser. Wood is generally a medium hardness contact material, however a small number of battle-axes show more damaged wear, including fractures and crushing. Battle-axes used for chopping a medium-hard wood have flake negatives with striations running through them from continued use, for instance. Battle-axe 105 shows clear signs of being used with a chopping motion as indicated by the bifacial striations in the blade edges. The crushing present on the blade, coupled with superficial, wide and overlapping flake negatives on the blade tip and edges towards to corners as well as rounding of the high topography indicates a medium-hard contact material. Striations run through the flake negative demonstrating chopping continued after the flakes were removed. High magnification analysis revealed this example had wood polish, thus suggesting that it had been used on a harder wood. Another battle-axe, 253, presents crushed grains at the corners of the blade, and a high density of grain removal pits which may also be a characteristic of a harder contact material – medium-hard wood.

Extensive use of the implement to chop wood will produce more developed wear, which will be more abrasive and denser. The experimental tests have demonstrated that the grain removal pits and related striations will become greater in number and density as use continues. Continued use can also cause larger removals such as flake negatives. More developed wear occurs through the prolonged use of the object (for an example, see the development of wear throughout each experiment in chapter 8). At high magnifications the polish will be more extensive after prolonged use, in this case, wood polish. The patches of domed polish become larger, and more connected, eventually joining and creating a smooth blanket polish (Vaughan, 1985, 30-44). At low magnifications more developed wear will cause more grain removal pits and thus also more related striations, and therefore both wear types will become denser. The increased stress on the surface of the stone will cause a greater number of pits, and the surface is more likely to fracture on impact, thus creating flake negatives.



A. ID 241, blade edge and tip. Dense groups of pits with small step termination fractures from extensive use. Close to dense density striations run from these removals in parallel formations perpendicular to the blade. 0.67X STE. Chopping wood; extensive.

B. ID 253, corner of blade edge and tip. Multiple fractures accompanied by crushed grains a dense grain removal pits within the fractures. Highest topography slightly rounded from contact with wood. 0.67X STE. Chopping wood; medium-hard contact material.

C. ID 233, centre of blade edge and tip. Evenly spread grain removal pits along blade tip and slightly onto blade edge. Close in density, shallow and wide. Associated with shallow, close bifacial striations also spread evenly along blade edges. High topography of blade tip rounded from contact with wood.1.0X STE. Chopping wood; Medium-soft hardness; Moderate use.

D. ID 132, corner of blade tip. Polish and rounding dense and connected. High topography around grain removal pits particularly rounded. Three groups of close density, parallel, bifacial striations run from associated superficial grain removal pits in groups on the blade tip. 1.2X STE. Chopping Wood; medium-soft.

Figure 7.5: Micrographs showing wear on battle-axes from different hardness wood contact materials and from excessvie use.

7.2.2 Wedge motion

Indications of battle-axes used as wedges to split wood are found on three occasions. These examples present a specific combination of wear types and patterns which explicitly indicates a wedge motion in contact with wood. These have been interpreted as wedges used to split wood. This interpretation has been based on training at Leiden University. A wedge is hypothesised from a combination of wear marks and patterns. These include percussive traces on the butt similar to experimental hammerstones, often showing contact with wood from the use of either a wooden hammer or a stone hammer with a wooden subsidiary material; and a heavily flaked and fractured blade with long striations running from it towards the butt. The blades show clear wood polish. These traces are formed from the implement being hammered into the wood, much the same as modern wedging using metal wedges. Examples of battle-axes used as wedges to split wood are distinctive compared to others in contact with wood. In particular, the long striations which often end level with the perforation and that are associated with the fractures in the form of multiple flake negatives on the blade tip, are quite unlike the other implements in contact with wood. The flake negatives are most often overlapping, although step fractures also occur. The development of fractures indicates long periods of use. No signs of the modern re-use of these implements was evident.

Battle-axes which show signs of being used as wedges to split wood all show the possible use of an intermediate material coming into contact with the butt, in doing so the material is protecting the butt when it was hit percussively. The butt of battle-axe 73, for instance, has rounded high topography surrounding the crushed grains and grain removal pits (figure 7.6). The rounding is extensive enough to suggest a medium contact material was protecting the butt. High power analysis has suggested the intermediate material is wood.

Using the butt of battle-axes as a percussive tool is also possible. All battle-axes with percussive traces on their butts also had wear indicative of use as a wedge, such as flake negatives and long striations, which suggests that percussive action used on the butts was related to the use of the blade, rather than being a separate use. An experiment using a replica axe-hammer as a wedge to split wood did not split the wood. As a result, the wear on the blade is not comparable to the battle-axes from museum collections that were interpreted as wedges. This is a consequence of the blade remaining on the surface of the log. Additional tests are required to be carried out to assess this hypothesis further (for further information, see chapter 6). It is assumed that a successful experiment will produce wear marks more similar to those in museum collections.

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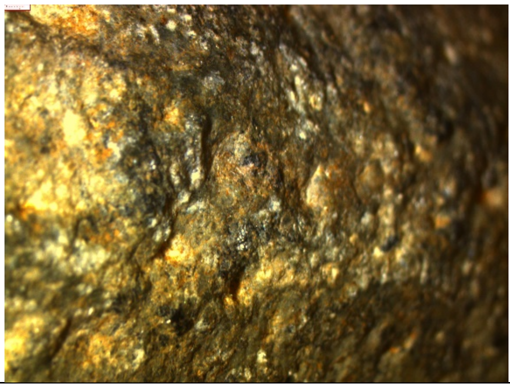

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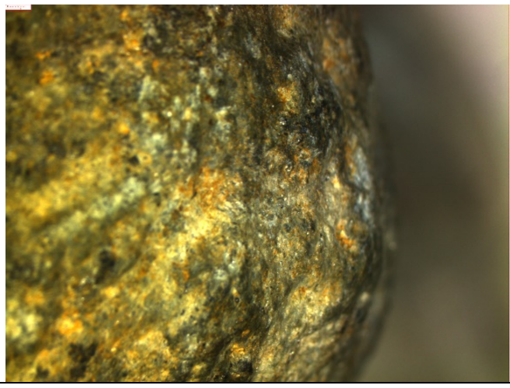

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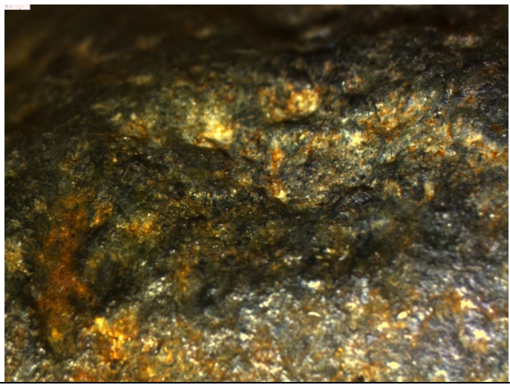

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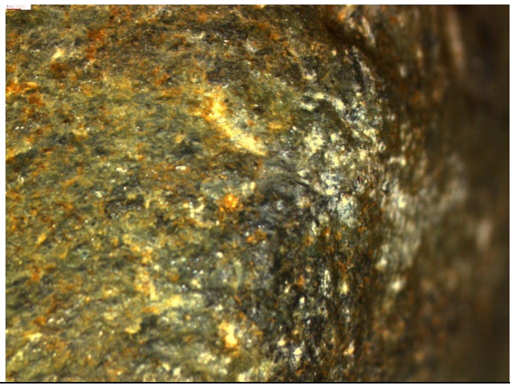

A. ID 73, blade tip. Dense, wide grains removal pits and small fractures. Crushed grains within some pits. Bifacial deep striations on the blade edges are associated with the percussive wear on the tip. Rounding of high topography form contact with wood, separated density. 0.8X STE. Wedge to split wood.
B. ID 73, blade corner and edge. Dense, wide grain removal pits with crush grains associated large linear fractures on blade edge. Rounding of the highest topography present. Percussive traces on the corner. 0.8X STE. Wedge to spit wood.
C. ID 73, butt. Percussive traces on butt evident through large grain removal pits within a wide flake negative and limited crushed grains. High extent of rounding grains and polish indicate intermediate substance used when hitting the butt. 1.2X STE. Contact with wood.
D. ID 73, corner of blade tip. Percussive traces: dense crushed grains, oblong flake negative and patches of small, dense grain removal pits associated with one another. Patched of rounded grains also present. 1.2X STE. Wedge to split wood.

Figure 7.6: Micrographs of a battle-axe used as a wedge

7.2.3 Less developed wear from contact with wood

There are several battle-axes that have less developed wear but show signs of being in contact with wood; this has been identified by the wood polish on their blades (figure 7.8). The wear on the blade of these examples does not extend across the entirety of the blade tip and edge. Instead, it appears in groups, most commonly found centrally on the blade tip with associated wear on the blade edge and further groups towards the corners of the blade. The size of these groups of wear range from one or two separated pits to more dense groups of more numerous of pits. The associated wear consists of bifacial short striations running from the pits and minimal polish of the higher topography, similar to the wear formed when chopping wood.

The density of striations is equivalent to their related pits. Analysis of wear formation during the experimental tests using wood as a contact material determined that limited use, up to 500 strikes, saw wear develop from sparse pits with associated striations to small, sparse groups of wear, often found as three groups. A greater amount of use saw a greater amount of wear, such as pits and striations, which were also denser. The longer and more extensively an implement is used, the more wear will have developed. Prolonged use will result in highly developed wear with clear characteristics of its specific use.

Battle-axe 40 is a good example of a battle-axe with limited wear. High power analysis revealed it had been used in contact with wood. However, low power analysis showed limited wear with very superficial grain removal pits and related bifacial striations in small groups located in the centre and towards the corners of the blade; they are faint, and there is rounding present on much of the blade tip. Abrasive action has not been sustained for a long enough duration to remove grains and limit the rounded areas. This is comparable to the development of wear analysed during the experimental tests.

The discovery of the three-group arrangement of wear, three groups of pits with associated striations on the blade tip, was found on six battle-axes (for micrographs and a diagram of this wear pattern, see figure 7.7). Prior to the experimental tests chopping tree branches and splitting wood for firewood, the motions of these battle-axes were uncertain. However, by assessing the formation of wear throughout the experiments, this wear pattern was discovered as that wear which develops in the earlier stages of use, i.e. up to 500 strikes (see chapter 6). The groups of wear on the six battle-axes are separated, and the density of the pits within the groups was close. They are narrow and superficial in depth and shape. The groups occur roughly in the same locations on all implements with this three-group arrangement. One group, often the largest, is in the centre of the blade, with the other two groups towards the corners of the blade tip. The striations associated run from each group of pits, they are short and with the density separated to close by. The bifacial nature of the striations indicates these implements were used in a chopping motion. High power analysis indicated they all have wood polish. This wear was found on all experimental battle-axes used in contact with wood with chopping motions during the first 500 strikes (see the splitting wood for firewood and chopping tree branches experiments). Therefore, I argue that the battle-axes presenting the three-group arrangement were used infrequently or for a shorter period, in contact with wood, using a chopping motion. The wear patterns are less developed chopping wood patterns.

Wear in a three-group arrangement was analysed on battle-axe 190. The bifacial U-shaped striations are arranged into three groups, in the centre and towards the blade corners. They are associated with small groups of superficial and sparse grain removal pits on the blade tips, in the same areas as the three groups of striations, typical for the three-group arrangement of wear. The edge of each pit is very rounded, although the rounding is not within the lower interstices. High power analysis indicates wood polish on the blade and tip of this battle-axe. The bifacial arrangement of striations associated with small, superficial pits indicates a chopping motion on a medium to medium-soft contact material (the extent of rounding indicates a slightly softer contact material).

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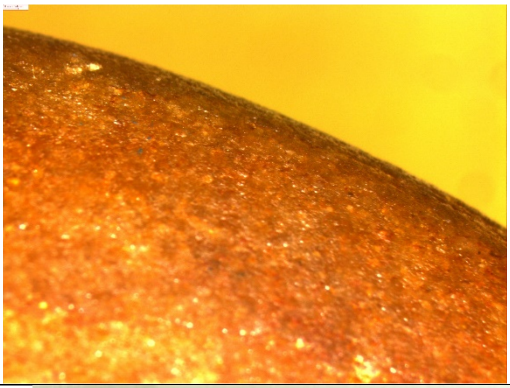

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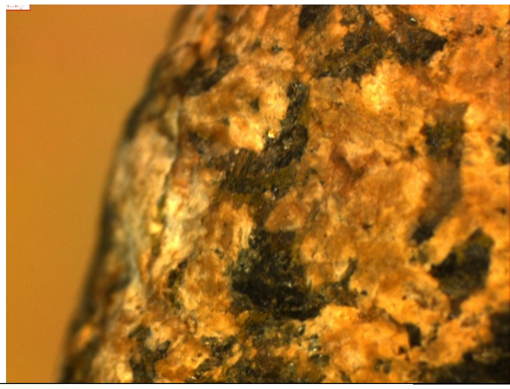

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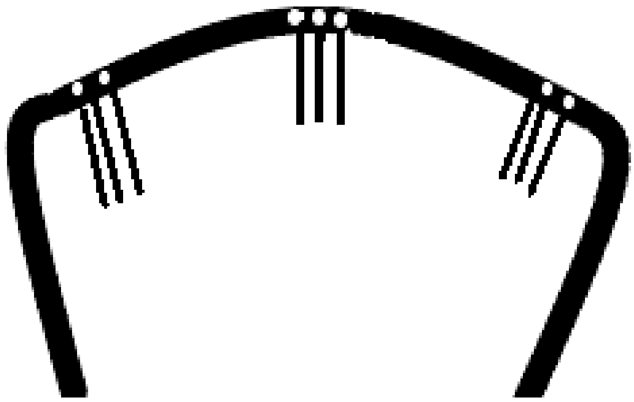


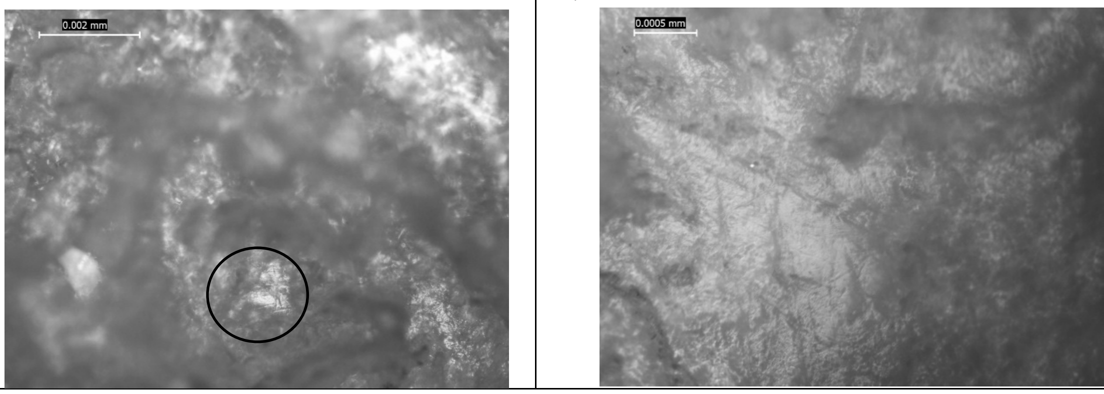
A. ID 118, Blade edge. Limited, undeveloped wear. Sparse pits on blade towards one corner with associated striations, 2-3 in number. X1.0 STE. High magnification analysis shows contact with wood.
B. ID 190, Blade centre. The wear has developed in three groups on the blade edge and tip. This micrograph shows the central group of close grain removal pits with associated striations running from them. The pits are limited to the blade tip. Similar groups of wear are located towards each corner of the blade, bifacially. X1.5 STE. Contact with wood.
C. ID 190, A macroscopic image of a battle-axe with less developed wear forming the three-group arrangement. The circles indicate the area of the blade edge and tip where wear has developed. This included striations, associated with grain removal pits on the blade tip. Grains on the tip in these areas are also slightly rounded from contact with wood.
D. A diagram to clarify the three-group arrangement. The black line indicates the striations on the blade edge, these will be bifacial on both blade edges, and the white dots represent the grain removal pits on the blade tip, associated with the striations.

Figure 7.7: Micrographs and images of less developed wear and the three-group arrangement

7.3 Contact with bone: Battle-axes

Contact with bone is evident on four battle-axes (n=4). This was identified using high power magnification as results of low power analysis are often too similar to wear caused by medium hardness contact materials from that caused explicitly by contact with bone. Contact with bone can cause a sheen through tribochemical wear. High power magnification allows for the assessment of polish type; contact with bone creates a specific polish type. Bone polish is identifiable by the domed grains covered in striations, often in multiple directions. However, bone and wood polish are very similar since contact with both materials causes domed grains (Adams, 1989). Both polish types develop on individual stone grains and follow the shape of the grains. More developed wear for both contact materials also causes the domed grains of the polish to connect to form patches. However, bone polish often has a lot more striations on the domed grains, which may be very faint and in multiple directions, often overlapping. Striations on wood polish, on the other hand, are more often parallel in the arrangement and fewer in number. The interpretation of this polish was based upon training at Leiden University, where experimental tools used in contact with bone were analysed. An experimental test carried out for this project was also used as a comparative study of wear formation (chapter 6). The development of wear analysed during this experimental test showed overlapping striations in multiple directions throughout use, a clear difference from the experimental replicas used in contact with wood. These are similar to those analysed in the museum collections (figure 7.8).

A. B.



A. ID 133, blade tip. Small patches of domed polish with clear striations, indicated in the circle. X10 MET, contact with bone
B. ID 133, blade edge. Large patches of domed polish covered in deep overlapping, multi-directional striations. X20 MET, contact with bone

Figure 7.8: Micrographs showing polish from contact with bone under high magnifications.

7.3.1 Chopping motion

Of the four battle-axes with bone polish, three show indications of being used to chop (figure 7.9), i.e. with a chopping motion which results in bifacial striations evenly spread along the blade edges, short to medium in length (figure 7.10).

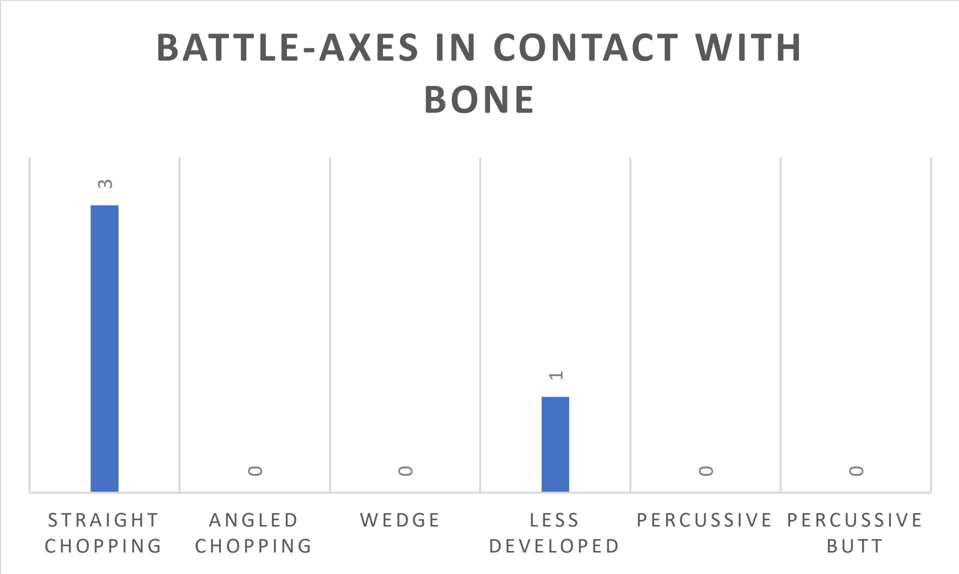
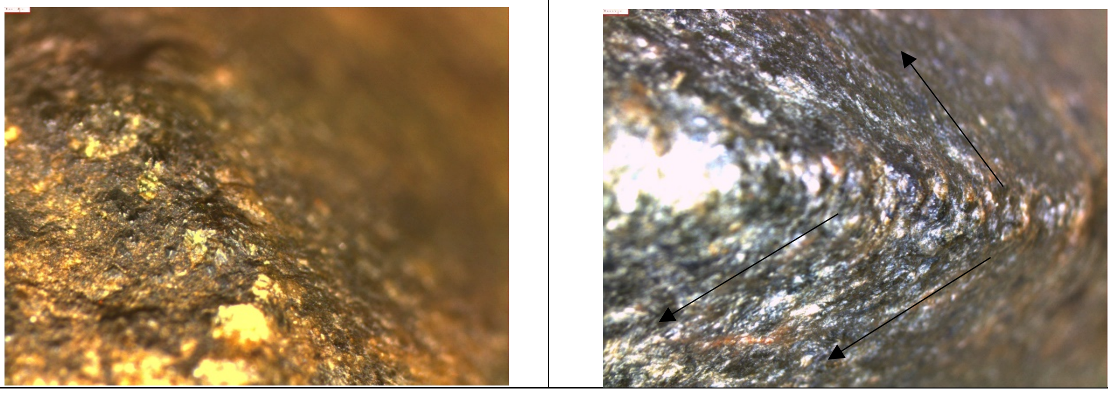


Figure 7.9: A bar graph to demonstrate the motions of battle-axes used in contact with bone

Under high magnification analysis of battle-axe 11 presented clear bone polish. Striations in multiple directions with a close density covered small groups of domed polish, partially connected. Low magnifications revealed faint bifacial striations in small groups and associated pits rounded high topography. The faint striations and the present of polish from grinding amongst the bone polish indicate this implement was possibly reground. A further two battle-axes showed contact with both bone and wood: 133 and 301. Both implements have polish indicative of multiple uses.

A. B.



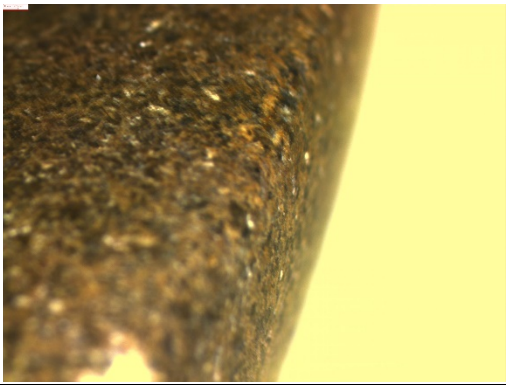
A. ID 301, blade tip and edge. Rounded and polished high topography on the tip of the blade surrounded by grain removal pits from which associated striations run onto the blade edges, bifacially. This indicates a chopping motion and a medium hardness contact material. X2.0 STE, contact with bone and wood.
B. ID 133, blade tip and edge. Close density pits run evenly along the tip of the blade, the high topography is rounded, and striations run from the pits on the blade edges, bifacially. The striations extend along the length of the blade edges, a few of which are indicated by the arrows. X0.8 STE, contact with bone and wood.

Figure 7.10: Micrographs of the wear on battle-axes used in chopping motions in contact with bone.

7.3.2 Less developed wear from contact with bone

The fourth battle-axe, 217, with wear signifying contact with bone has less developed wear (figure 7.11). Less developed wear was seen on the experimental replicas up to 200 strikes. Low magnifications revealed wear similar to the production wear on the rest of the implement, for instance, striations ran parallel to the blade tip, which was likely caused by re-grinding rather than by use. Re-grinding removed any indication of motion during use. Under high magnifications, the wear indicates that this implement came into contact with bone before it was re-ground. Bone polish is visible on limited areas on the blade edge where re-grinding did not remove all of the previous wear. The re-grinding traces bears similarity with the re-ground stone axes used in the Hosterwold and Vlaardingen House building experiments.

A



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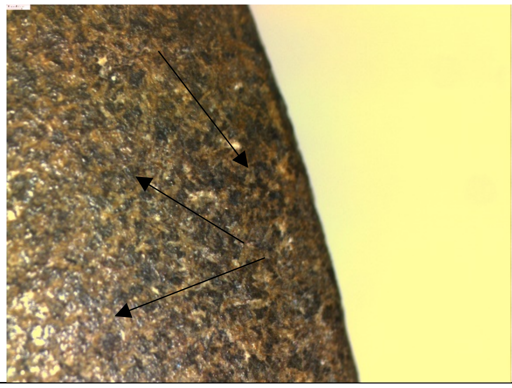


A. ID 217, blade tip and edge. Limited pits, sparsely distributed on blade edge and some on tip. X1.2 STE, contact with bone

B. ID 217, blade edge. Overlapping striations in multiple directions on the blade edge indicate the re-grinding of the blade, a few of which are indicated by arrows. They are not associated with any other wear on the blade edge or tip. X1.5 STE, contact with bone.

Figure 7.11: Micrographs of less developed wear on battle-axes in contact with bone

7.4 Contact with earth and wood/roots: Battle-axes

The final contact material present on two battle-axes is earth and wood, interpreted here as chopping through roots within the earth (figure 7.13). Figure 7.12 demonstrates the motions used for battle-axes in contact with earth and roots. Battle-axes 140 and were 145 in contact with earth and roots. Based on similarities with experimental evidence, these battle-axes may have been used to clear undergrowth including chopping through root systems. They show no signs of modern use or re-use. Information from the analysis of Wentink's experiment using a battle-axe to chop tree roots was used alongside the analysis of the development of wear during this project's chopping and clearing soil and roots experiment as comparative to aid interpretation. The wear analysed on battle-axes 140 and 145 is comparable to these experiments. Predominantly the understanding of how wear developed throughout this project's experiment (see chapter 6) has helped determine the type of contact material on the objects in the museum collections.

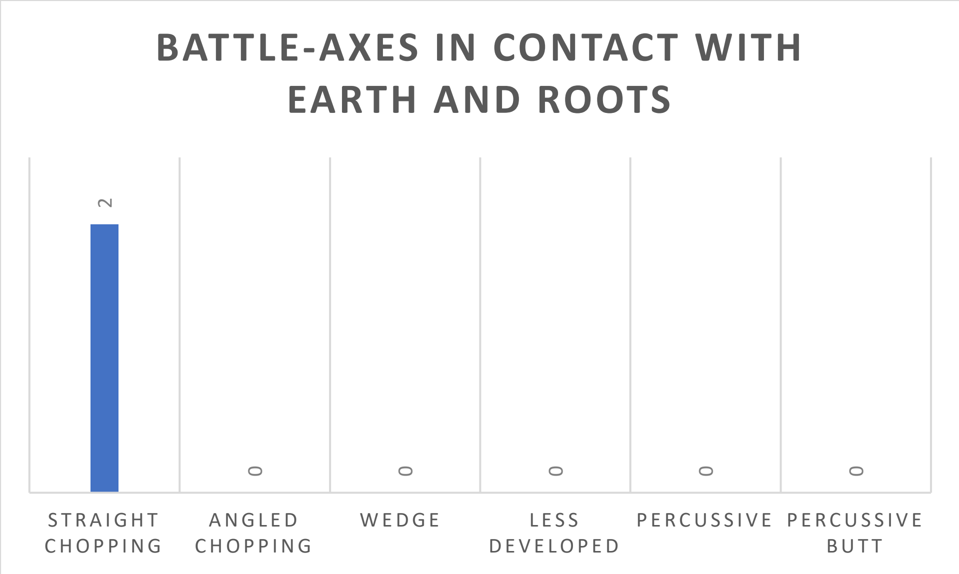
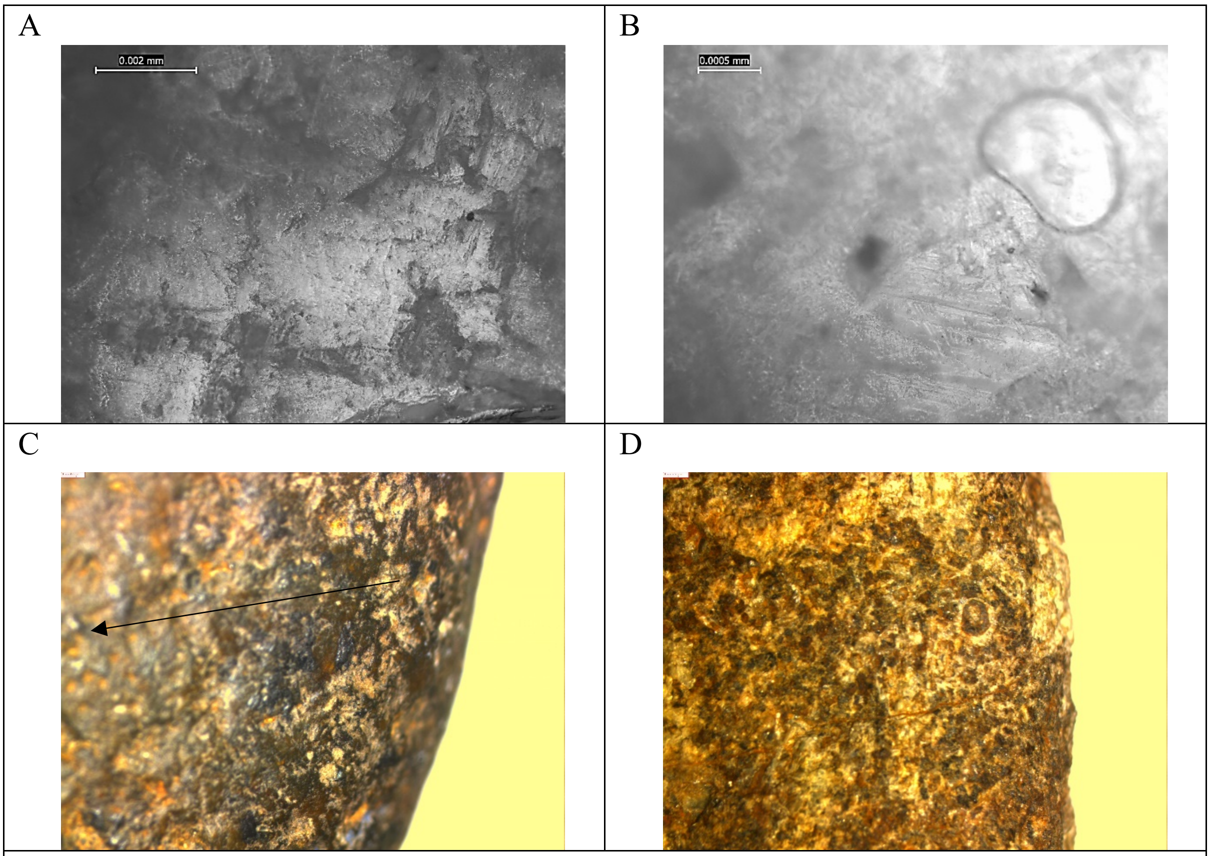


Figure 7.12: A bar graph to demonstrate the motions of battle-axes used in contact with earth and roots

At lower power magnifications the wear analysed signifies chopping motions were used (figure 7.12). Bifacial striations occur on both battle-axes. The two examples are very similar, with long, shallow, parallel striations in groups along the blade tip and edges with a close density and superficial depth. The striations are associated with grain removal pits present on the tip and surrounding the striations on the blade edge. The density of the pits and striations are close to dense, and they are evenly spaced across the blade tip and edges. The continuation of pits onto the blade edges, in combination with long striations, indicates that the implements were immersed into the contact material deeper than the tip. The experiments confirm that clearing roots in the soil would have this effect. Rounding and polish are present along the blade tip and on the corner of the blade. It also extends onto the blade edge, beyond the striations. The polish analysed under high power magnifications is a mixture of wood and granular polish from contact with wooden roots and more granular soil. The striations are greater in number, facing multiple directions, and overlapping in many instances from contact with soil. The grains were connected with the polish arranged in large patches not dissimilar to the experimental examples. The granular and domed polish was also present on the experimental replica.



A. ID 140, blade edge. Well developed, large patches of slightly domed polish, mostly connected. The patches have a granular appearance and are covered in overlapping striations. X10 MET, contact with earth and roots.
B. ID 145, blade edge. A large patch of slightly domed polish with long, striations, overlapping. The edges and surrounding areas are granular from contact with soil. X20 MET, contact with earth and roots.
C. ID 145, blade edge. Grain removal pits extend 10-15mm onto blade edge with a close density. They are wide and shallow and are associated with long striations, one of which is indicated by the arrow. The high topography surrounding the pits is polished X1.5 STE, contact with earth and roots.
D. ID 140, blade edge and tip. Long deep striations run from dense grain removal pits on the tip. Pits extend 20-25mm onto the blade edge and surround the striations. The extend of wear formation indicates prolonged extensive use. X0.8 STE, contact with earth and roots.

Figure 7.13: Micrographs of the wear on battle-axes in contact with earth and roots.

7.5 Multiple use and re-grinding: Battle-axes

Multiple use is not uncommon among battle-axes (figure 7.14). There are nine examples which either present signs of multiple contact materials and motions or of re-use after re-grinding. Re-grinding would have occurred to renew and sharpen the blade to continue its functional use (figure 7.15). Fractures and breakage of the blade were also re-ground to reduce the chance of further breakage during use. It is likely that there are many more which were re-ground and re-used, but the wear from re-use removed any signs of re-grinding and any previous use. Battle-axes may have been re-ground repeatedly to continue their use-life and functionality, a process which removes the wear formation from the previous use or uses. The Hosterwold house experiment at Leiden University has demonstrated the ease and worth of re-grinding to re-sharpen the blade for continued use (J. Wijnen, A. Verbaas & A.Van Gijn, 2018)

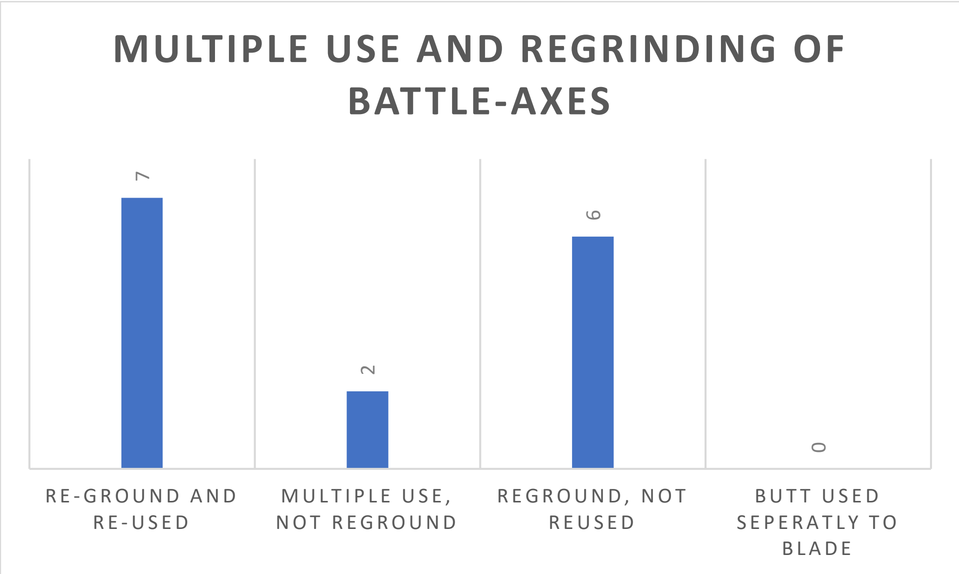


Figure 7.14: A bar graph to demonstrate the re-grinding and multiple use of battle-axes

Of the nine examples, two show no signs of being re-ground. The wear on battle-axe 133 indicates two different contact materials and motions; i.e. two different uses. There were no re-grinding traces on this implement, and the two different uses cannot be distinguished as occurring at two separate events. This indicated that the use against two contact materials with different motions was not consecutive and probably switched between the two uses, without the re-sharpening in between uses. This battle-axe was initially used as a wedge to split wood (percussive traces on both the blade and the butt are visible), followed by contact with bone. Crushing of grains associated with dense grain removal pits, multiple flake negatives, and long striations indicate a wedge motion on both the blade and the butt. The association with striation on the edges of the butt indicates that the butt was stuck into a contact material. Under high magnifications, the butt showed clear wood polish. This battle-axe is the only example where the butt of a battle-axe appears to have been used to split wood. It indicates there may have been multiple ways of using these objects.

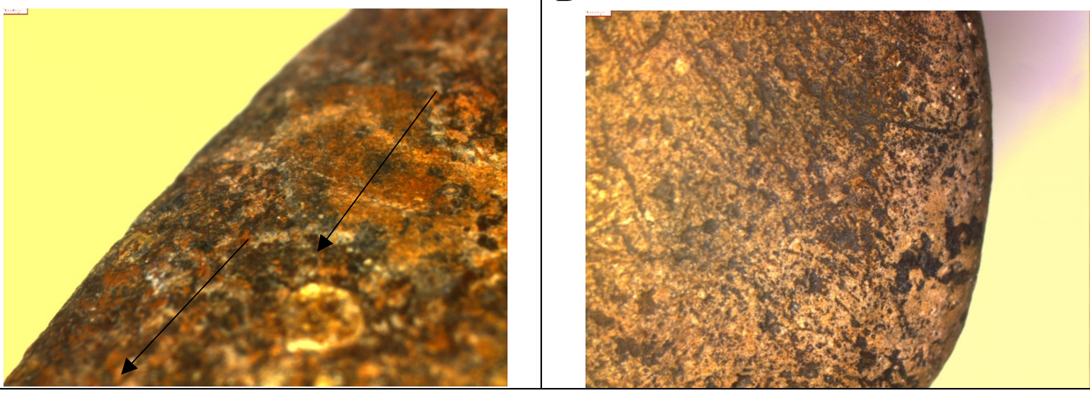
A further seven battle-axes have been re-ground and re-used. This process has removed most of the wear from the previous use so often little information regarding this use can be determined. One example, however, has faint signs of the previous use. Battle-axe 24 has very faint bifacial striations on one blade corner and limited associated pits on the blade tip and a significant degree of rounding. This wear is not associated with the clearer, more developed wear on the blade tip and edges where rounding is less developed. Striations parallel with the blade tip are indicative of re-grinding. The secondary use has a concentration of wear on the corners of the blade, with bifacial striations and dense pits. A singular flake negative exists in the centre of the blade which has complex termination and has less rounding of the high and low topography compared to the remainder of the implement. It is associated with the secondary use-wear.

Five battle-axes present wear indicative of chopping wood as their final use after regrinding: battle-axes 24; 5; 253; 301; 234. High magnification analysis indicates all five have wood polish. Three of these have less developed wear, with patches of parallel striations, perpendicular to the blade tip, and related pits, both of which are sparse. These examples also have re-grinding striations running parallel with the blade tip and appear more pronounced in comparison with the production wear on the body of the implements. Battle-axe 253 also has multiple flake negatives from the previous use, which were re-ground. This action smooths the fractured edges and minimised further breakage.

Within this group of five re-ground axes used again in contact with wood is an example which has multiple motions and contact materials. Battle-axe 301 has both bone and wood polish present on the blade tip and edges, much like battle-axe 133. Wood polish is more prevalent than the bone, which indicates either contact with wood occurred after contact with bone, or both contact may have switched between the two materials. If this is the case, contact with bone occurred more frequently. At low magnifications, this battle-axe presents signs of being used with a chopping motion. For instance, parallel, bifacial striations, perpendicular to the tip are present and associated with evenly spread grain removal pits on the tip. Overlapping flake negatives are present on the centre, and towards one corner of the blade tip, this is a sign of prolonged use rather than a hard contact material due to the rounded high topography and the lack of crushed grains. Percussive traces are also visible on the butt. Dense grain removal pits spread across the butt, are accompanied by crushed grains within many of these pits and a degree of rounding on the high topography. A flake negative is visible close to a dense patch of pits; the edges were also rounded from use. The rounding indicates a medium hardness contact material.

Six battle-axes have been re-ground but lack any signs of re-use: battle-axes 11; 144; 189; 118; 217; and 164. All examples have very limited, faint wear, mostly consisting of sparse striations and superficial and spare grain removal pits. The faintness of wear present on these implements is the result of re-grinding. Striations running parallel with the blade edge and are very clear in comparison to use traces. The use-wear from these examples is too faint and sparse to conclude contact material and motions used under low magnifications. However, under high magnification, the polish of four out of the five was interpreted. Three of the battle-axes, 164, 118 and 189, presented limited wood polish on the blade edges and tips. On the further two, 11 and 217, bone polish was present in small patches on both the blade tips and blade edges.

A B



A. ID 189, blade edge and tip. Striation runs parallel with the blade tip from re-grinding, the arrows indicate the direction. Re-grinding striations cut across sparse striations from use. X1.5 STE.
B. ID 24, blade edge and tip. Clear re-grinding striations covering the blade edge running parallel with the blade tip. Re-use after re-grinding has polished the tip. X0.8 STE, re-ground and re-used in contact with wood.

Figure 7.15: Micrographs of wear on battle-axe from re-grinding.

7.6 Uncertain: Battle-axes

The final type of wear analysed on the battle-axes in the dataset is that which fits under the term unclear. There are several reasons why the wear of an implement can seem uncertain or unclear and can thus not be interpreted. For example, if the implement is too weathered and as a result, the use-wear will have been removed and altered through the weathering process. In some cases, the motion or contact material cannot be ascertained since the wear is either limited, sparse, or unusual. In many of these cases, the hardness of the contact material can be determined. However, further research is needed to assess what specifically caused the use marks. For example, the use as a chisel or to crush bone to release marrow are possible suggestions for further experimental tests.

For a small number of battle-axes (n=7) use traces are not visible. The traces visible on these examples can only be attributed to the manufacture of the implements (figure 7.16) Such production traces are distinguishable from the use marks analysed on the remaining battle-axes. Under low magnifications, the wear marks include either flattened grains with shallow, parallel striations in random arrangements, or more granular grains associated with multi-directional, overlapping, shallow striations in random arrangements. Under high magnifications, the flat polish indicated stone on stone contact, while polish related to the granular grains was not dissimilar to grinding using sand.

A

B

A. ID 143, blade edge. Polish from production, flat with parallel striations indicating stone on stone contact. X10 MET, ground with stone.
B. ID 143, blade edge. Grinding striations are the only visible wear on the blade, they are parallel in arrangement and the orientation varies between perpendicular to the blade edge and parallel with it. X1.0 STE, production traces only.

Figure 7.16: Micrographs of wear from battle-axes with only production traces.

7.7 Contact with wood: Axe-hammers

Wood is also the most frequent contact material indicated on the axe-hammers in the dataset (figure 7.18). Thirty-eight axe-hammers out of the 56 axe-hammers analysed presented wear indicating contact with wood. Despite the difference in form between axe-hammers and battle-axes, the wear patterns are often very similar. Indications of contact with wood on both forms are the same since both axe-hammers and battle-axes are made of stone with a blade parallel with the perforation. The motions indicated on axe-hammers in contact with wood include chopping motions and the use as a wedge to split wood (figure 7.17).

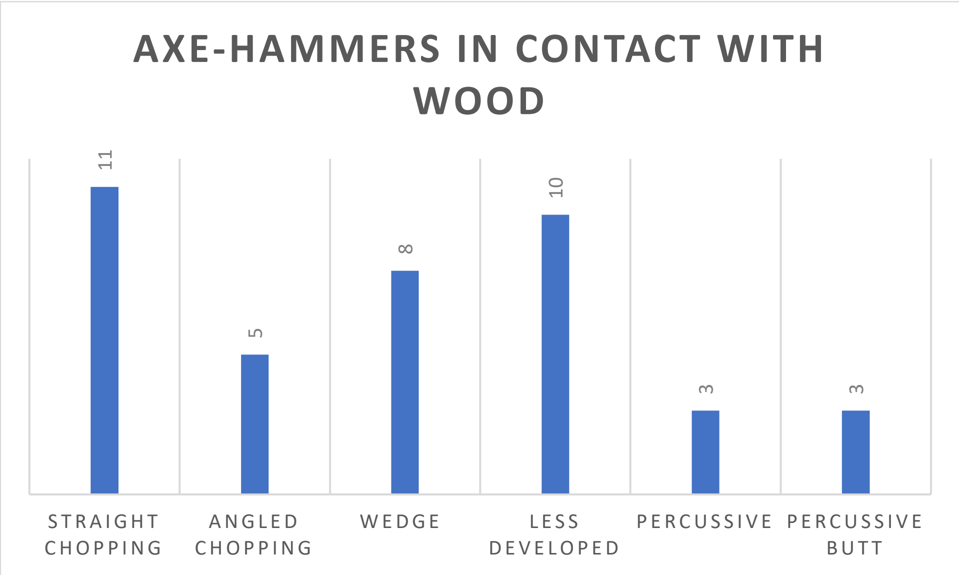
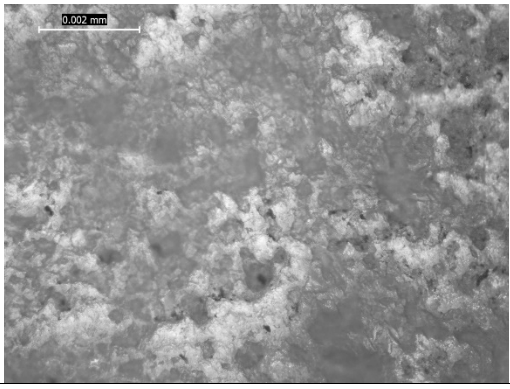


Figure 7.17: A bar graph to demonstrate the different motions of axe-hammers used in contact with wood

Differences between the battle-axes and axe-hammers are mostly situated in the amount of use the implements have been subjected to. Axe-hammers often show signs of being used more extensively than battle-axes, so much so that the blades were truncated in some instances and many more were fractured. This type of wear applies to those axe-hammers also used in contact with other materials, such as bone and earth and roots. The interpretation of wear is based upon wear analysis training and analysis of numerous experimental tools from Leiden University and from the experiments carried out for this project (for which see chapter 6).

A



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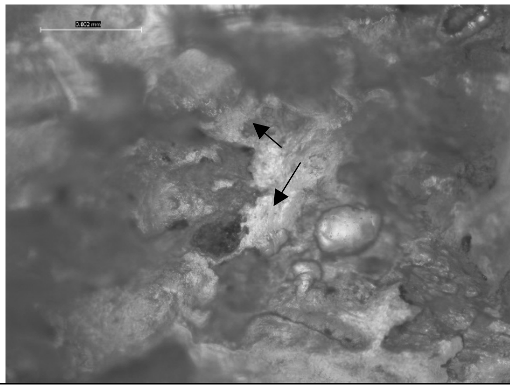

A. ID 43, blade edge. Partially connected domed polish with a directionality perpendicular to the blade edge, sparse parallel striations follow the same directionality. X10 MET, contact with wood.
B. ID 66, blade tip. Small patches of partially connected domed polish with a directionality perpendicular to the blade edge. Striations are parallel and singular and run parallel and perpendicular with the blade edge; some are indicated by the arrows. X10 MET, contact with wood.

Figure 7.18: Micrographs of wear from axe-hammers in contact with wood

7.7.1 Chopping motions

Chopping motions are indicated on twenty-two axe-hammers in contact with wood (figure 7.19). The wear which indicated chopping motions on axe-hammers is the same as that on battle-axes, both at low and high magnifications. Under low power analysis, both motions chopping straight and at an angle are indicated. Straight chopping motions are indicated by bifacial wear, while angled motions are indicated with wear more developed or extensive on one side or part of the blade compared to the rest of the blade. Axe-hammer 120 has close, shallow and u-shaped bifacial striations in a parallel arrangement, perpendicular to the blade tip. They are associated with superficial and narrow grain removal pits arranged with a close density evenly spread along the blade tip and slightly onto the blade edges. This implement lacks crushed grains, although there is a singular flake negative centrally on the blade tip. It is probable that this is related to extended use of the implement. Striations run through the flake negative indicate that use continued after the fracture occurred. The high topography of the pits and flake negative are rounded from contact with the medium hardness material. The wear found on this example, much like many others, is similar to the wear on stone axes used in chopping wood experiments.

Chopping with the blade at an angle (n=7) to the contact material can be demonstrated by axe-hammer 122. Striations are only present on one side of the blade. They are parallel and run perpendicular to the blade tip at a medium length in patches with a close density and u-shape in profile. The striations are related to close grain removal pits on the blade tip which become slightly denser in the centre. A large flake negative on the other side of the blade has grain removal pits within it. The presence of more intrusive wear, the flake negative, as well as pits on the blade edge indicates that this side of the blade was in contact more often. Therefore, chopping may have occurred at an obtuse angle. This motion may have been as a result of the shape of wood that was being chopped, the accuracy of the person chopping or the position of the person.

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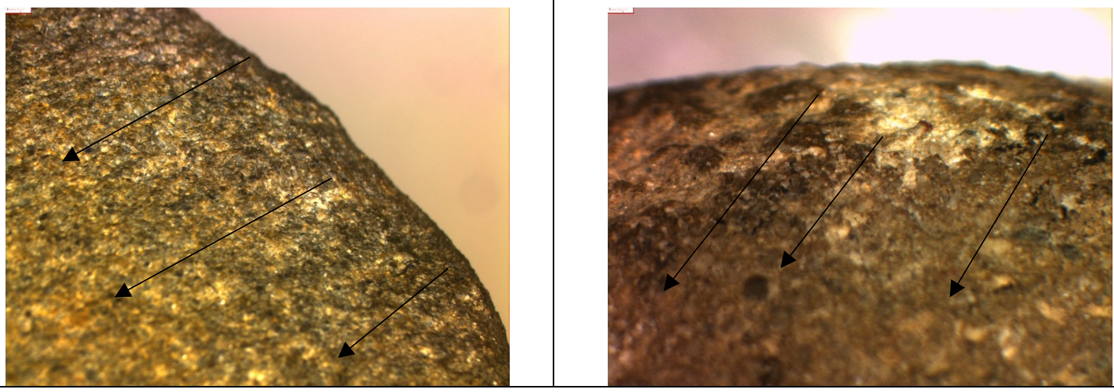


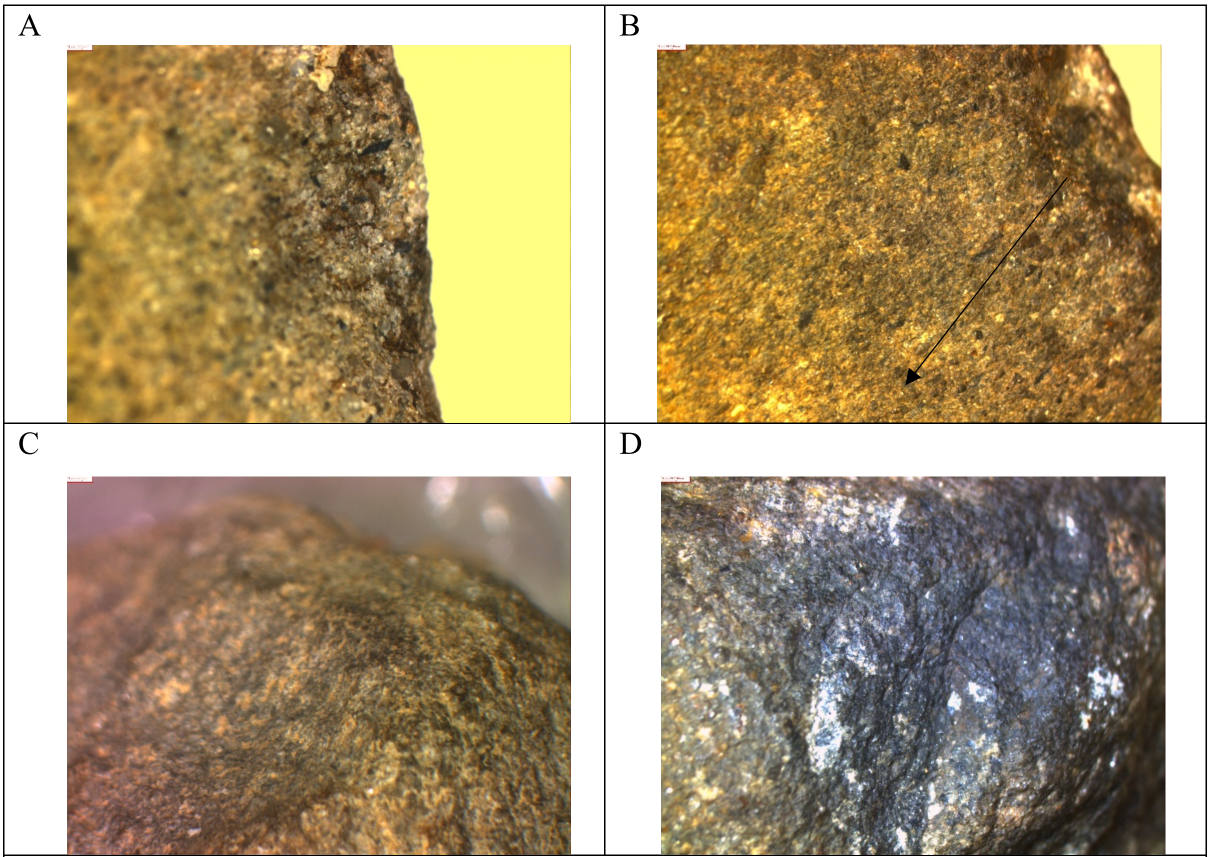
A. ID 120, blade edge and tip. Bifacial, shallow, parallel medium length striations with a u-shaped profile run from the grain removal pits on the blade edges, some striations are indicated by the arrows. X0.8 STE, chopping motion.
B. ID 44, blade edge and tip. Bifacial, shallow, short, parallel striations run with a close density from dense grain removal pits and crushed grains on the blade tip. Arrows follow some of the striations. X0.8 STE, chopping motion, medium-hard contact material.

Figure 7.19: Micrographs of wear on axe-hammers used in chopping motions in contact with wood

Many axe-hammers have been used extensively (n=16). This includes axe-hammers used in a chopping motion against wood. Wear on such examples includes dense striations associated with equally dense pits on the blade tip and edge, often such pits have begun to truncate the blade slightly due to the extensive, prolonged use (figure 7.20). For this reason, flake negatives are often present along the blade tip also. Use wear on axe-hammer 15 presents wear indicative of extensive use. The bifacial striations are shallow, parallel and running perpendicular to the blade edge just as they are for less developed wear. However, these striations are denser, covering a lot more of the blade edges. They are related to grain removal pits on the blade tip, with a similar density. Extensive use is further demonstrated by the singular flake negatives present at the centre and corner of the blade. Grain removal pits are present around and inside of the flake negatives, indicating continued abrasive action. The well-developed rounded grains and polish within the perforation indicate extensive hafting.

Rounding of the high topography, particularly the edges of the pits, as well as the shallow striations and pits, indicates a medium hardness contact material. Analysis of the development of wear throughout this project's experiments determined that the more a stone battle-axes or axe-hammer is used, the greater the density and quantity of wear patterns (chapter 6) — specifically, grain removal pits and striations. Prolonged use abrades the impact surface, which results in fractures such as flake negatives. The wear differs from that produced from contact with a hard contact material as the crushing of grains is less frequent and rounding of grains occurs.

Contact with harder materials, i.e. harder wood types, stone or hardened bone, will create more abrasive wear whereby crushed grains and denser grain removal pits and fractures are common, while rounding is less frequent. The wear on five axe-hammers used to chop wood indicate contact with a harder wood, medium-hard. In all five cases, the grain removal pits and related striations are close in density, but there are concentrations of multiple flake negatives on the blades, often overlapping. Crushing is related to the fractures on a couple of occasions. The concentration of fractures accompanied by crushing as well as the close density of striations and grain removal pits indicates a harder contact material. The continued presence of rounding demonstrates the hardness of the contact material must be medium-hard. Rounding would not occur if the contact material was hard. An axe-hammer 43 presents the wear indicative of such medium-hard contact material. This axe-hammer has large and multiple flake negatives along the blade, truncating it slightly. Crushed grains are found in association with the flake negatives. The bifacial striations remain close in density, while the associated grain removal pits on the blade tip and slightly onto the blade edge are close within groups, each group separated from one another.



A. ID 15, blade edge and tip. A large flake negative in the centre of the blade, unifacial. Prolonged use has removed grains from within the flake negative and striations run through it. X 1.2 STE, contact with wood, extensive use.

B. ID 183, blade edge and tip. Dense striations run from large, dense grain removal pits on the blade tip. Extensive use creates dense wear. X0.8 STE, contact with wood, extensive use.

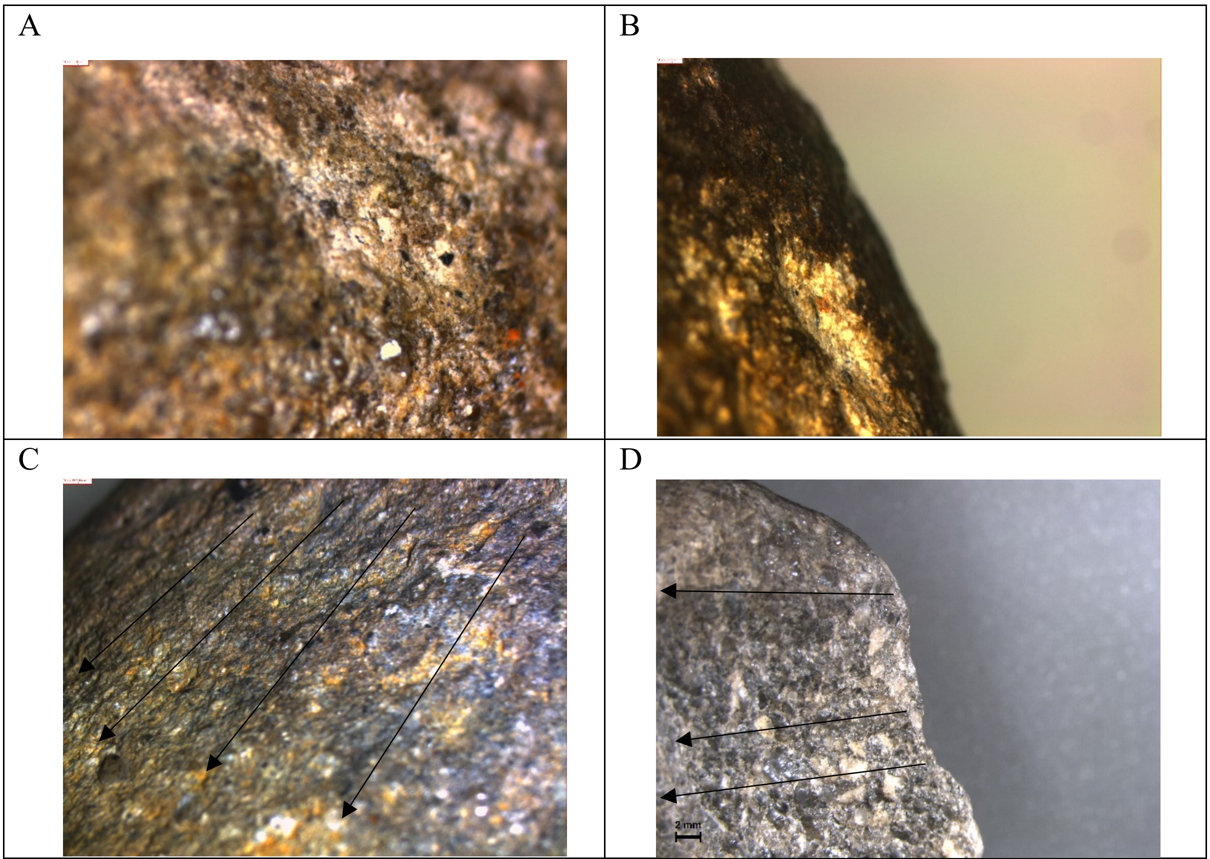
C. ID 53, blade tip. Multiple fractures have begun to truncate the tip. Rounding of the high topography around the fractures indicated a medium-hard contact material. X0.8 STE, contact with wood, medium-hard contact material.

D. ID 149, blade tip. Multiple flake negatives beginning to truncate the tip, patches of crushed grains accompany dense grain removal pits on the high topography. X0.67 STE, contact with wood, medium-hard contact material.

Figure 7.20: Micrographs of wear on axe-hammers from extensive use and contact with harder contact materials

7.7.2 Wedge motion

Like battle-axes, wear on several axe-hammers also indicated their use as wedges to split wood (n=8). The indications of this use remain the same as battle-axes: long striations extending down the blade edge, away from the blade tip, which is truncated by dense pits and multiple, overlapping flake negatives; percussive traces are present on the butt (figure 7.21). Five axe-hammers presents wear indicative of being used as a wedge to split wood. In all cases wood polish was present under high magnification analysis on the blade as well as the butt, demonstrating the butt of the implements were percussively hit with a wooden implement to force the blade into the wood in order to split it. Axe-hammer 7 is one example of such wear. A couple of axe-hammers used as wedges to split wood were used extensively and for more than one use. Details regarding these implements will be touched upon later.



A. ID 129, butt. Patches of dense crushed grains associated with grain removal pits from a percussive action. X2.0 STE, contact with wood, wedge motion, percussive.
B. ID 103, blade tip. Crushing has occurred within wide, dense grain removal pits. The pits are dense enough converge and form larger pits. X1.5 STE, contact with wood, wedge motion.
C. ID 149, blade edge. Long, dense striations in a parallel arrangement run perpendicular to the blade edge, they form the truncated tip of this implement, some are indicated by the arrows. They are surrounded by grain removal pits and crushed grains.
D. ID 4, blade edge and tip. Wide, deep, and overlapping flake negatives on the blade edge. Long striations, indicated by the arrows, run from the tip, through and past the flake negatives. Crushing has occurred on the tip, which is heavily truncated. X0.8, contact with wood, wedge motion.

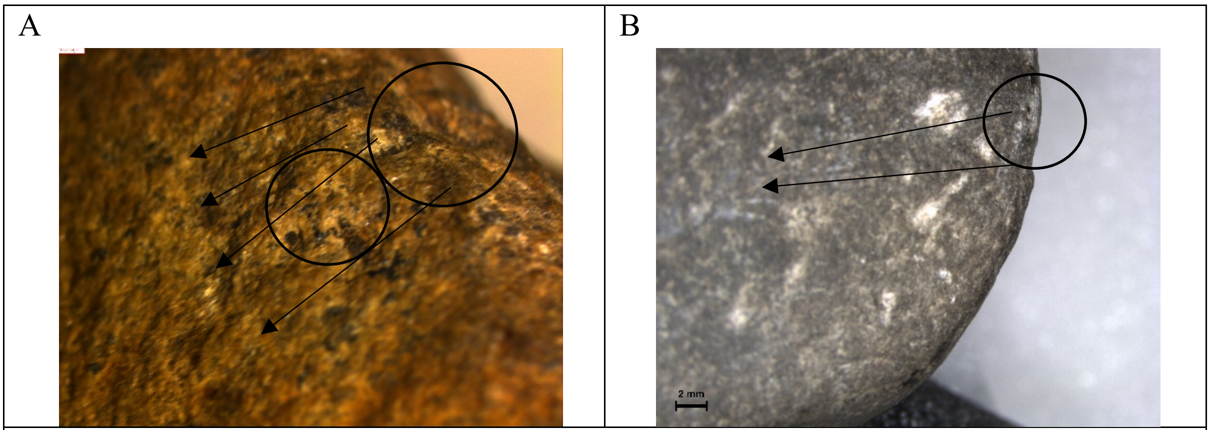
Figure 7.21: Micrographs of wear on axe-hammers used as wedges

The inability during this experimental test to use an axe-hammer as a wedge to split wood may suggest that, like the battle-axes with these wear patterns, axe-hammers may not have been used in this manner. There are axe-hammers with percussive traces on the butt and no distinctive wedge wear patterns on the blade which show that these axe-hammers have been used with different actions and motions on the blade and butt, instead of as a wedge. For instance, the butt may have been used to hammer wooden posts. It could also be thought that those interpreted as wedges were used in this way. However, this does not explain the long striations on the blade edges. So, further tests are required to assess this hypothesis.

7.7.3 Less developed from contact with wood

Several axe-hammers that indicate they had been in contact with wood have less developed wear (n=10), much like the battle-axes in contact with wood. For example, the density of wear on axe-hammer 45 is sparse, particularly sparse striations and pits. However, the limited wear did not remove the possibility of identifying the hardness of the contact material and motions during use. Chopping motions were evident by the bifacial striations, their sparse distribution reflecting the early stages of the chopping tree branches experimental test. The high degree of rounding on the blade means a medium/medium-soft material was in contact. Analysis under high magnifications confirmed this was wood.

The three-group arrangement that develops in the early stages of contact with wood, using chopping motions (see chapter 6), is found on three axe-hammers: 243; 108; 154 (figure 7.22). All have three groups of bifacial striations related to three groups of grain removal pits on the blade tip centrally and towards the corners; the exact positions of each group vary slightly. The striations and pits are close in density and shallow. All show typical wear expected for contact with wood and indicate a medium to medium-hard hardness contact material. The medium-hard contact materials are indicated by the presence of a single flake negative on the blade tip on all examples, as well as rounding of the high topography. The three-group arrangement of wear on axe-hammers is being interpreted as a less developed wood chopping use, the same as with the battle-axes with this type of wear. Experimental tests chopping, and splitting wood confirm this hypothesis.



A. ID 243, blade tip and edge. A group of close pits in the centre of the blade tip and edge are associated with a few striations which run from them. The wear is bifacial and indicated by the arrows and circles. Similar patches of wear are located towards the corners of the blade edges. X1.0, contact with wood, chopping motion, less to moderate development.

B. ID 154, blade corner edge and tip. A small patch of close pits on the tip with three striations running from them as indicated by the circle and the arrows. The large white, crushed areas are modern wear. X0.8, contact with wood, chopping motion, less developed.

Figure 7.22: Micrographs showing less developed wear on axe-hammers

7.8 Contact with bone: Axe-hammers

Contact with bone is evident on four axe-hammers from the bone polish present (n=4). All four axe-hammers were used in a chopping motion indicated by bifacial striations in parallel arrangements running perpendicular to the blade edge (figure 7.24). One example, axe-hammer 131, has wear indicative of an angled chopping motion, i.e. the wear is denser on one side of the blade suggesting the angle of the blade was obtuse when it came into contact with the bone (figure 7.23).

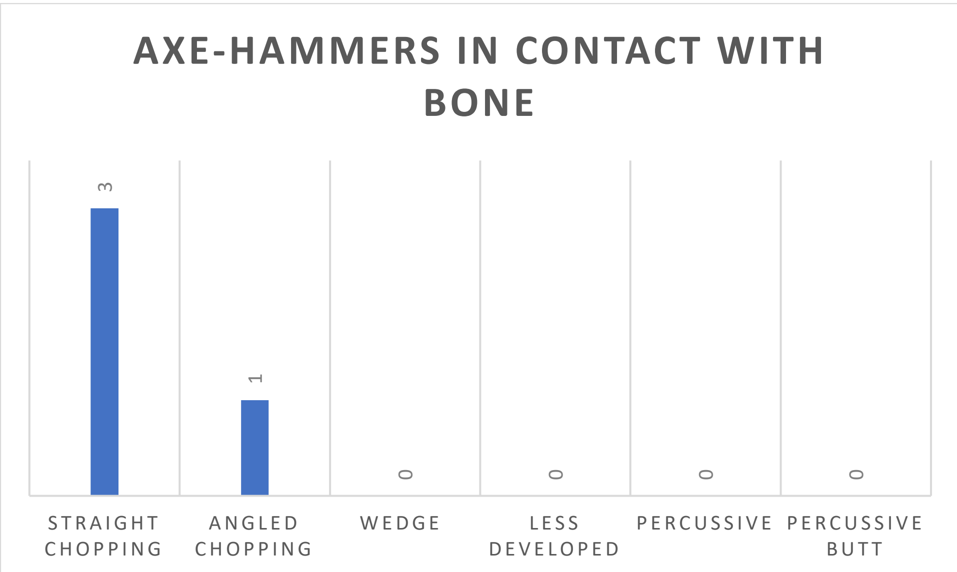
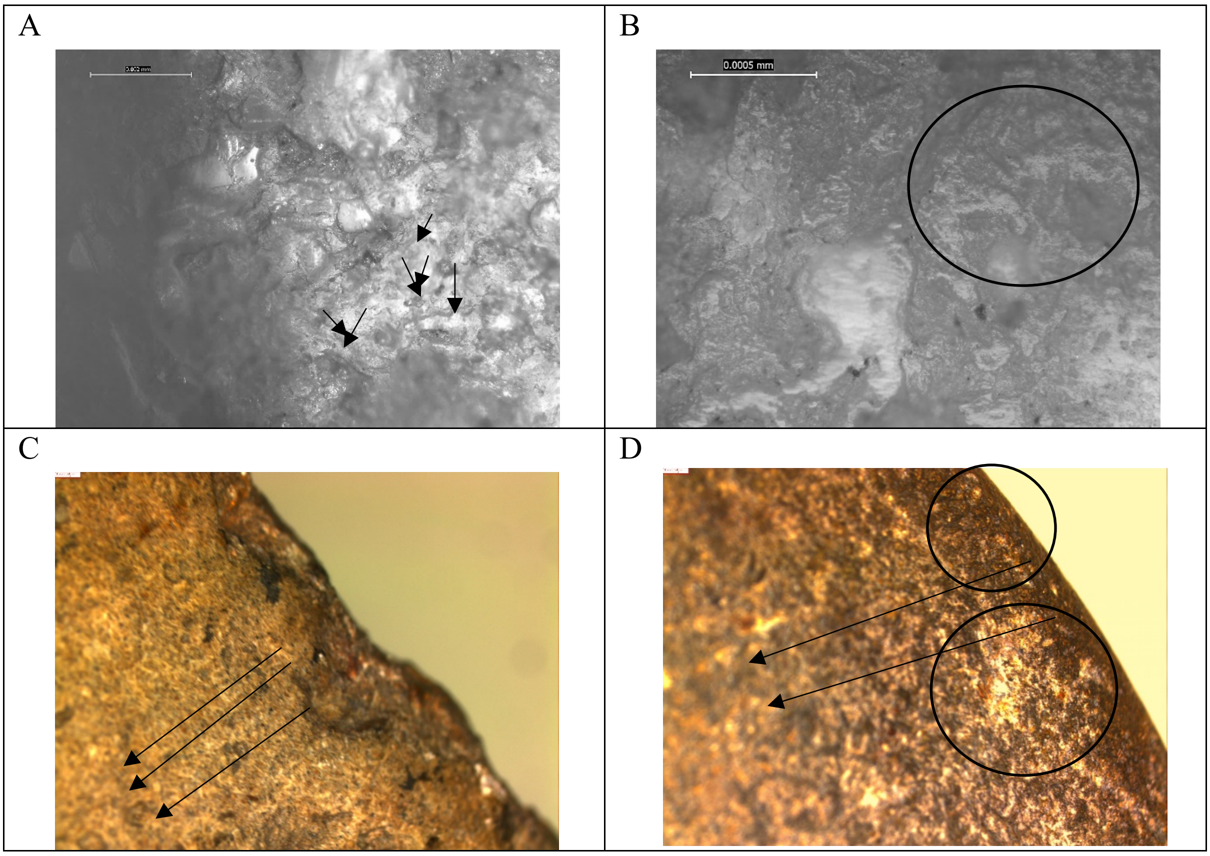
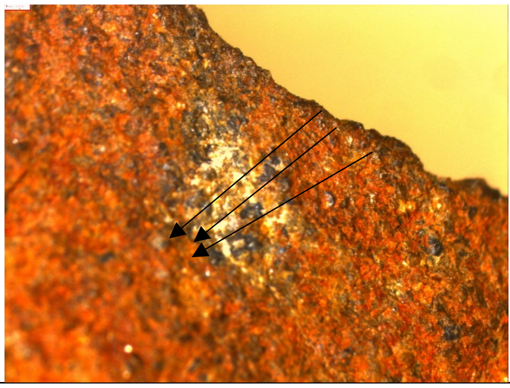


Figure 7.23: A bar graph to demonstrate the motions of battle-axes used in contact with bone

Axe-hammer 71 showed the most developed wear of the four implements. This example had dense, medium length, shallow striations evenly spread along the blade edges and associated with equally dense grain removal pits on the blade tip and moving onto the blade edge approximately 5mm. The grain removal also extended over the blade corners a similar distance. Extensive use is also indicated by the large step and hinge fractures along one side of the blade. Grain removals with related striations are present within the fractures and indicate continued use after breakage. Two of the four axe-hammers in contact with bone indicate the hardness of the contact material was medium-soft, due to the high degree of rounding, particularly of the edges of the grain removal pits. It is possible these examples came into contact with more flesh compared to those with a medium hardness contact material; all four show signs of being in contact with the flesh and bone. The wear is also comparable with this project's experimental test using an axe-hammer to hit a pig skull. It was clear from this that contact with the flesh caused rounding of the blade, especially towards the corners and the high topography of the grain removal pits.



E



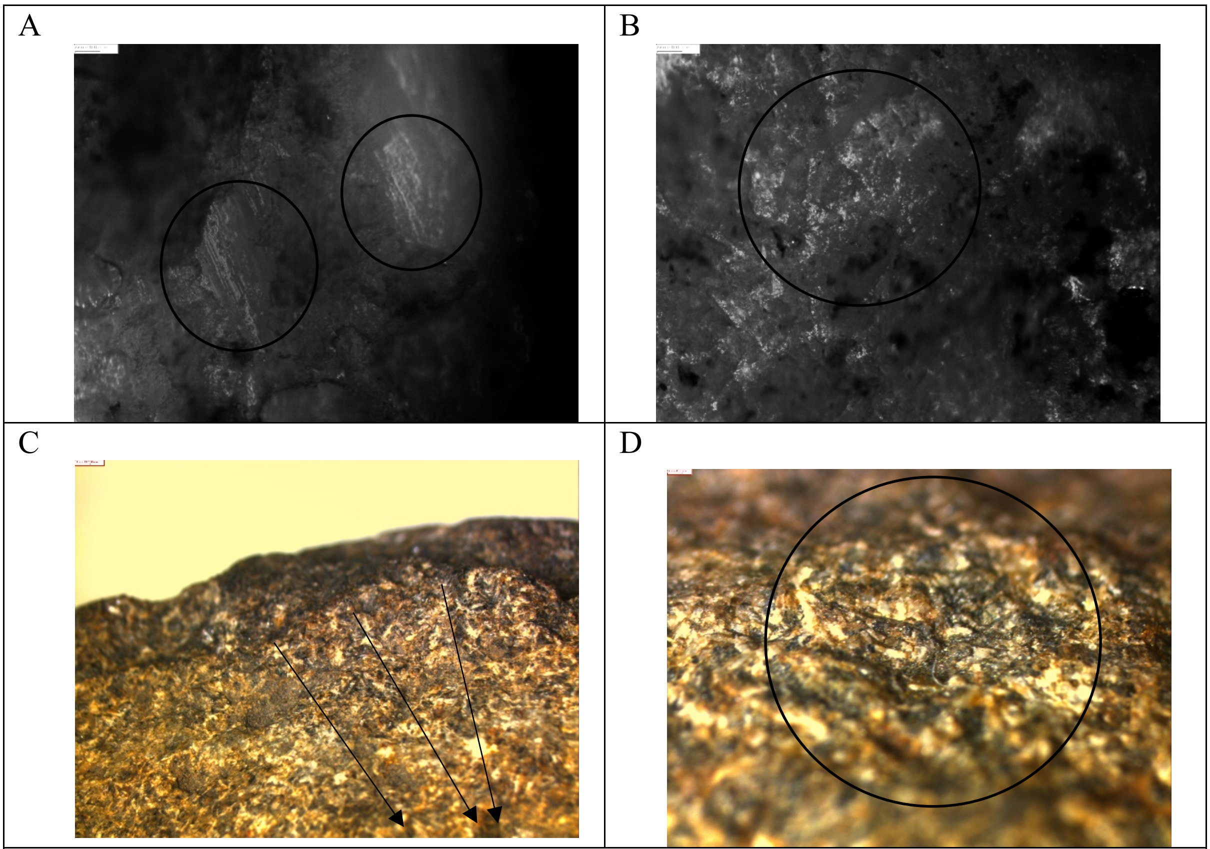
F

A. ID 131, blade edge. Domed patches of polish moderately connected with faint singular striations in multiple directions, occasionally overlapping, some are indicated by the arrows. X10 MET, bone polish.
B. ID 71, blade edge. Partially connected domed polish with small overlapping, multi-directional striations causing the surface to look bumpy. X20 MET, less developed bone polish
C. ID 71, blade edge and tip. Dense grain removal pits and small flake negatives on the blade tip from prolonged use. Parallel, dense striations run from the tip along the blade edges bifacially, as indicated by the arrows. The high topography is rounded. X10 STE, contact with bone, chopping motion.
D. ID 124, blade edge. Grain removal pits extend onto the blade edges as singular pits and as groups as signalled by the circles. Parallel striation run perpendicular to the blade edge from the grain removal pits on the blade tip and from the pit on the blade edge as indicated by the arrows. The tip is polished with some rounded grains, possibly from contact with flesh. X1.0, contact with bone, chopping motions.
E. & F. ID 131, blade edges. Micrograph E has close density striations running from grain removal pits on the tip, which are changing the shape of the blade edge slightly. X1.2 STE. This is different from micrograpgh F which is the other side of the blade. F has sparse striations and grain removal pits on the blade edge indicating that E came into contact with the contact material more often and most probably initially. X0.67 STE, contact with bone, angled chopping.

Figure 7.24: Micrographs of the wear on axe-hammer in contact with bone

7.9 Contact with earth and wood/roots: Axe-hammers

Unlike the battle-axes in contact with earth and wood/roots, such contact material is evident on just one axe-hammer 70 (n=1). Contact with earth and wood/roots is one of two uses indicated on this implement (figure 7.25). This implement was used in contact with earth and roots prior to its use as a wedge to spilt wood. The truncation of the blade and abrasive action on the blade edge caused by its use as a wedge removed much of the previous wear. However, under high magnification analysis, two types of polish wear visible, earth and roots as well as wood. Both polish types have similarities since wood is present in both; however, there was a clear difference in that long, overlapping and often deep striations are present on earth and roots polish which is a mixture of domed and granular polished grains as demonstrated during wear analysis of the clearing and digging earth and roots experimental test (see chapter 6).



A. ID 70, blade edge. Unconnected medium sized patches of polish with a slight dome. Long, deep striations run parallel through the polish with overlapping singular striations towards the edges of the patches, see circles. X20 MET, contact with earth and roots.
B. ID 70, blade edge. Partially connected small patches of domed wood, with faint parallel striations. X10 MET, contact with wood and earth and roots
C. ID 70, blade edge and tip. Multiple grain and flake removals on the tip of the blade have truncated it, rounding of the high topography in this location indicates a medium hardness contact material. The truncation indicates an extensive, well-developed use X0.67 STE, wedge motion.
D. ID 70, butt. Dense, wide grain removal pits cover the butt and are associated with sparse crushed grains. The rounded high topography indicated a medium contact material, potentially used as an intermediate substance between the butt and the hammer X1.5 STE, wedge motion.

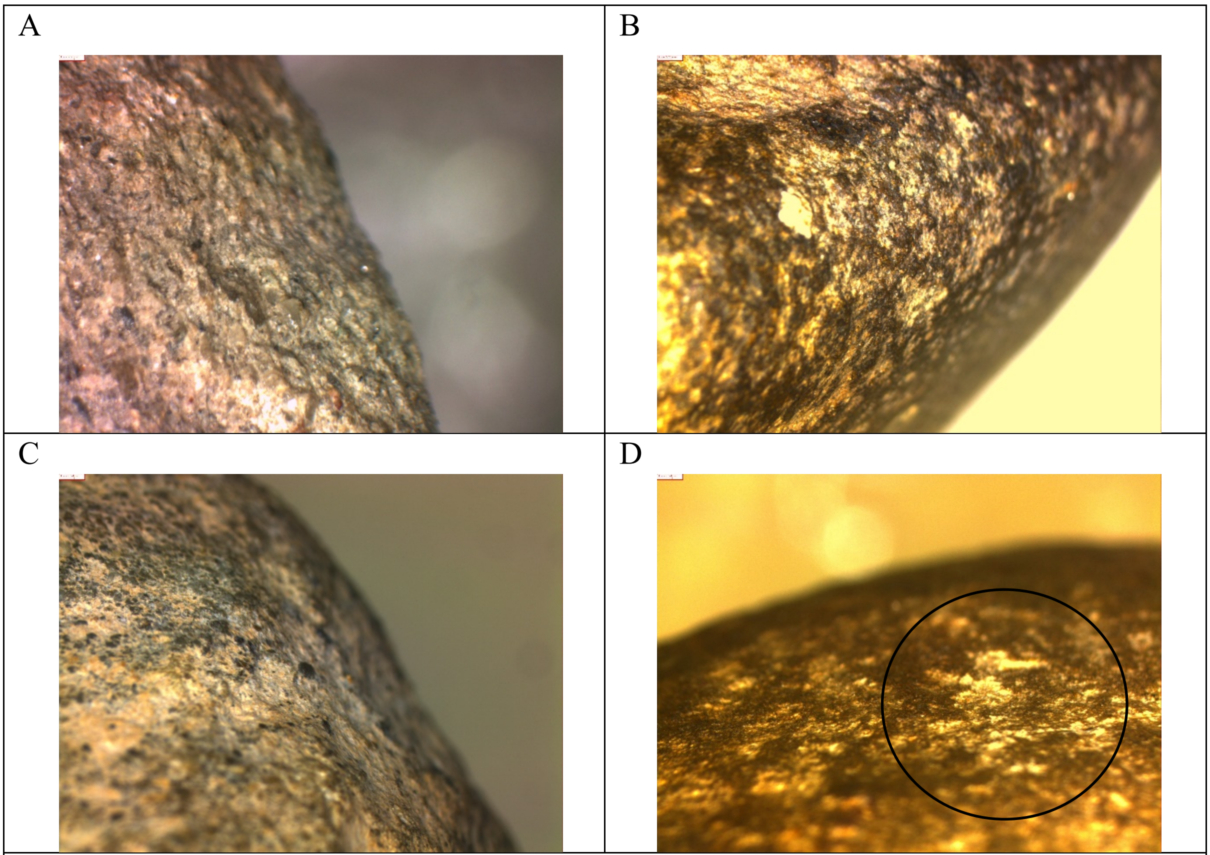
Figure 7.25: Micrographs of wear on axe-hammers in contact with earth and roots.

7.10 Percussive: Axe-hammers

Three axe-hammers indicate their blade has been used percussively (n=3) to strike medium-hard and hard surfaces (figure 7.26). On these axe-hammers the wear traces from percussive action is indicated by groups of dense, large grain removal pits, often associated with flake negatives. Crushed grains are present with a density close to dense across these areas and are directly associated with the grain removal pits and often within the pits. This wear is irregular in arrangement and distribution, which indicates it is from percussive use rather than pecking, which would be more regular. Using the butt to percussively hit a material and percussively hitting the butt with another material will cause the same percussive marks. Analysis of experimental hammerstones used percussively as well as the manufacture traces of ground and polished stone aided the identification of percussive traces.

Axe-hammer 47 has been used so extensively that the contact material was unable to be identified. This is the result of extensive use on a medium-hard contact material which has removed stone grains in which the wear defining contact material can be identified. The prolonged use of this implement caused the tip of the blade to be removed from successive grain and flake removals. Percussive traces are evident on the broken tip area which is covered with dense grain removal pits and crushed grains. The extensive use of this implement against a medium-hard contact material using a percussive motion caused the truncated blade. Axe-hammer 161, on the other hand, has been used less extensively. This example was initially used to chop wood followed by a percussive use, also on wood. The secondary use is not as developed and therefore was not used for the same length of time as the implement was used to chop wood. The percussive wear is concentrated towards the corners of the blade where the grain removal pits are dense and are accompanied by crushed grains, sparse in density and quantity. As a result, the corners of the blade have become slightly truncated, creating a convex blade which indicates that the corners of the blade were coming into contact with the contact material first and most probably most often.

The third implement with percussive traces is more unusual than the other two. As will be described in the following section, this example was used in a modern context percussively, possibly in contact with stone. It is assumed that it was used for mining activities.



A. ID 47, blade tip. Dense, wide grain removal pits in an irregular formation indicate percussive traces on blunted blade tip. X0.8 STE, percussive on blade.
B. ID 161, blade tip. Close, wide and shallow grain removal pits on the corner of the blade tip from the percussive contact with wood. This is partly due to the blunt nature of the blade tip. X0.8 STE, percussive on blade.
C. ID 83, butt. A dense patch of wide, shallow grain removal pits on the butt, irregular in arrangement and thus different to the production wear. Percussive wear is less developed as it has not changed the shape of the butt. X1.0, percussive on butt.
D. ID 98, butt. Sparse, wide and shallow grain removal pits from percussive action. The large pits have crushed grains within them as indicated by the circle. X1.0, percussive on butt.

Figure 7.26: Micrographs of wear on axe-hammers used percussively

Percussive traces are also found on the butts of axe-hammers. Some of these are associated with their use as wedges to split wood. However, there is a small number which has percussive wear on the butt not related to the wear on the blade. These are being treated as axe-hammers with wear indicating multiple use. On three occasions, analysis of the butts of these implements under high magnifications revealed wood polish. It is, therefore, possible they were used as hammers to hammer wooden stakes or posts into the ground. The following section will discuss details concerning the percussive use of the butt of axe-hammers.

7.11 Multiple use: Axe-hammers

There are several axe-hammers which have had multiple uses indicated by different motions and contact materials (n=9). This section will discuss the multiple uses analysed, which is often the last use and that proceeding it (figure 7.27). The uses analysed are not necessarily the only uses for that implement, instead that these are the only uses visible on the object.

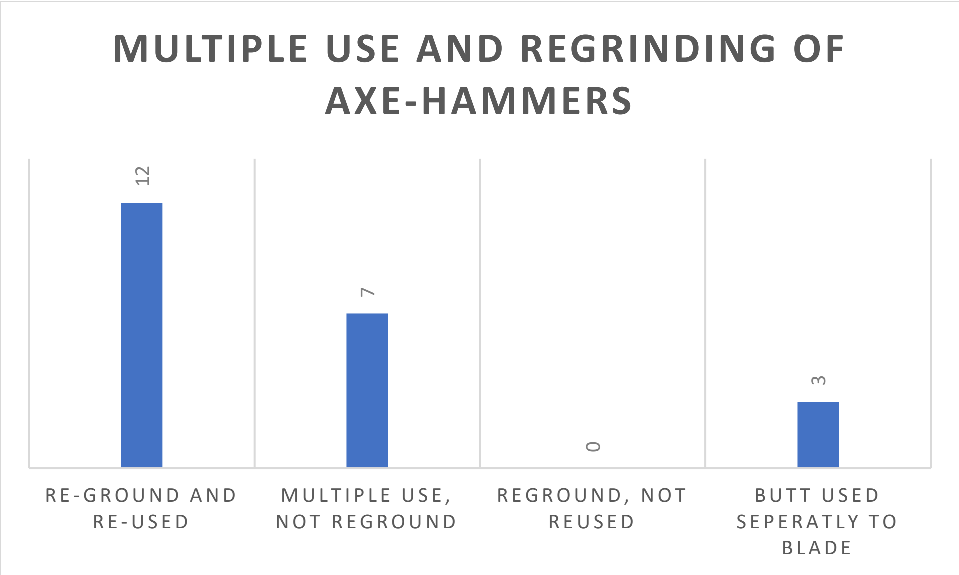


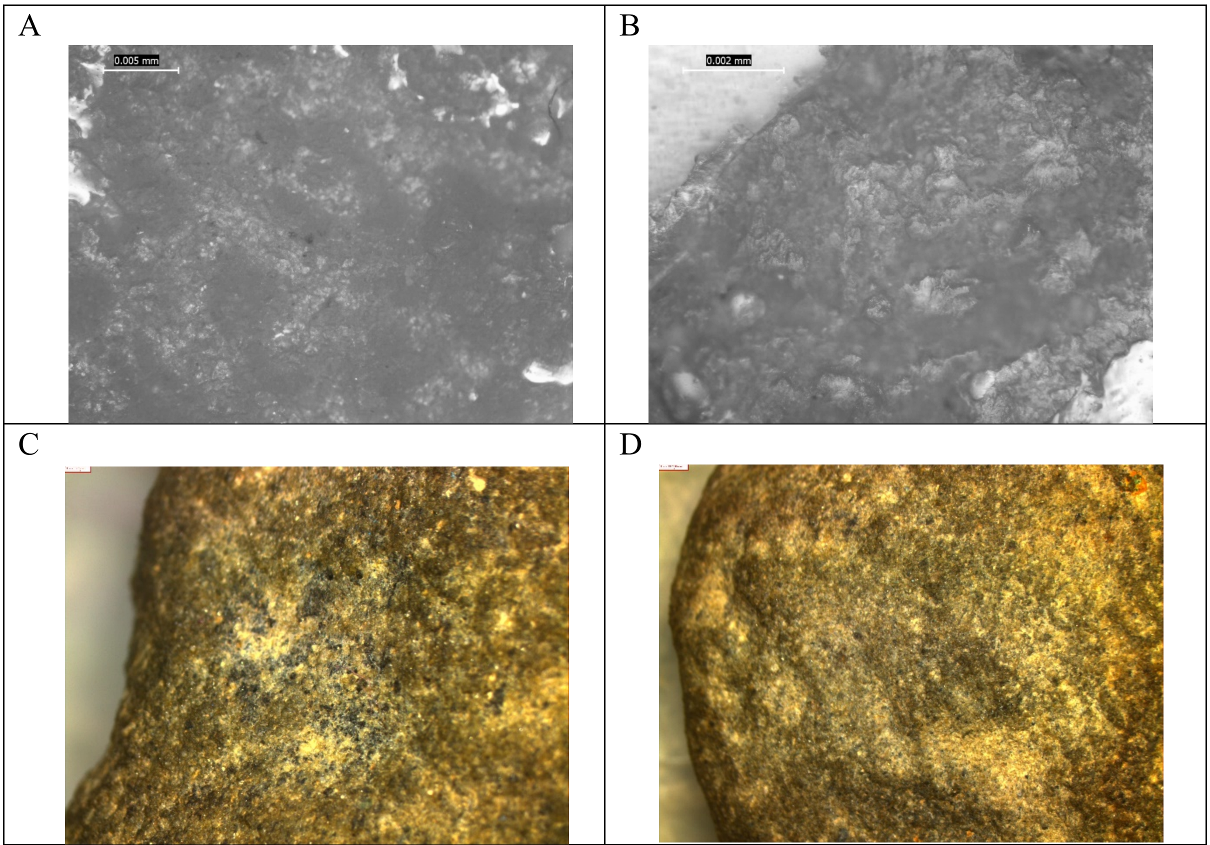
Figure 7.27: A bar graph to demonstrate the re-grinding and multiple use of battle-axes

As discussed above, the butts of three axe-hammers in this group have been used separately to the use of their blades: 83; 98; and 71 (figure 7.26). For all three examples, the butts have been used percussively, in contact with wood. High magnification analysis interpreted the contact material as wood through the presence of wood polish on the butts, while low magnification determined the percussive action. The blade of 98 was used in contact with wood, in a chopping motion with preference to one side of the blade. Its butt has dense pits and associated crushed grains indicative of percussive motions. There is no indication that this is associated with the blade, nor does the blade appear to have been hit into a contact material, such as would occur with a wedge or chisel. Axe-hammer 71 was used in contact with bone in a chopping motion. The blade was used extensively due to the presence of fractures and dense pits and striations. The chopping motion and the high degree of rounding on the blade tip are evidence that this example was not used as a wedge or chisel which would be associated with the percussive traces on the butt. The percussive use of the butt is, in fact, a separate use. The butt was used percussively in contact a medium hardness contact material due to the presence of rounding on the higher topography, particularly towards the edges of the butt. Analysis under high magnifications revealed the contact material to be wood. The third axe-hammer, 83, in this group has undeveloped wear on the blade from limited use, which was a secondary use after the implement had been reground. The butt, on the other hand, has more developed percussive traces.

Several more axe-hammer have wear indicating multiple uses on their blades. Four axe-hammers of these were in contact with wood for each use: axe-hammer 58; 161; 206; and 45. For these implements, the contact material type remains the same, but the motion, amount of use, and hardness of the contact material differ between uses, thus indicating multiple different uses. Axe-hammer 58 is one example which was used in a chopping motion in contact with a medium hardness wood for the secondary use. The previous use was indicated by the presence of a flake negative with a plunging termination on the blade tip. This fracture removed half of the tip and is not related to the wear surrounding it; it therefore occurred before the remaining wear on the implement. There is a potential that this implement was re-ground before the secondary use as the high topography of a flake negative is rounded. This is not related to the use traces on the blade but is related to striations indicative of grinding. Axe-hammers 161 and 206 were used in contact with two contact materials of different hardness. For both the first contact material was a medium soft wood, followed by a medium hardness wood during the subsequent use. The initial contact material for the implement from Woodend was a medium hardwood, followed by a medium-soft wood.

Axe-hammer 70 was used in contact with earth and wood/roots before it was used as a wedge to split wood. In this instance, the contact material type and the motions differ between uses. The initial use was a chopping motion with an earth and roots contact material. The experimental test suggests this may have been to chop through and break apart undergrowth (see chapter 6). The wear indicative of this action has been described in contact with earth and wood/roots section above. The secondary use is indicated by the truncated blade, associated with close density grain removal, crushed grains and long, bifacial striations. The blade was truncated through multiple flake removals. The presence of small multiple step fractures towards the edges of the blade illustrates the process of wear formation which caused the truncation of the blade; small multiple fractures continued to occur, this weakens the blade, and large removals occur, eventually resulting in the truncation of the blade, following which the process begins again.

The final axe-hammer, 37, in the multiple use groups of implements has unusual wear. This implement was found as part of a mine spoil heap associated with Alderley Edge Copper Mine, thought to date to the medieval period. The wear is very different to all battle-axes and axe-hammers in the data sample (figure 7.28). The implement existed as a large fragment of the blade end with highly percussive wear covering the blunt blade and the blade edges. Since the blade was severely truncated, a hard contact material was evident. It is possible that this implement was used percussively against stone as the wear is similar in places to experimental examples used percussively against materials including stone. Analysis of the implement under high magnifications, however, revealed an unusual polish, type unknown. This implement is eroded, reducing the chance of wear interpretation. It is probable this was a secondary use of the implement related to the use of the mine which is not prehistoric. It may be that it was used in mining processes against stone or metal ore.



A. ID 37, blade tip. Patches of unconnected connected polished stone grains, angular in shape. No associated striations visible. X10 MET, unknown contact material.
B. ID 37, blade tip. Patches of unconnected connected polished stone grains, angular in shape. No associated striations visible. X10 MET, unknown contact material.
C. ID 37, blade edge and tip. Dense grains removal pits within a wide and shallow flake negative. Dense crushed grains within the removals indicative of percussive motions. Weathering has rounded the grains slightly. X1.2 STE, percussive motion.
D. ID 37, butt. Wide, shallow grain removal pits and smaller, deeper pits unlike the production wear. Percussive traces rounded by weathering. X0.67 STE, percussive.

Figure 7.28: Micrographs of the wear on Axe-hammer 37, modern use.

7.12 Re-ground: Axe-hammers

Like battle-axe, axe-hammers were also re-ground (n=10). On all ten occasions, the blades of these implements were re-ground to increase their sharpness and continue their functionality (figure 7.31). Many were re-ground after the blade received severe damage, such as losing the tip (figures 7.29 & 7.30).

Figure 7.29: A image of the re-ground tip of Axe-hammer 207 causing the shortening of the length of the implement

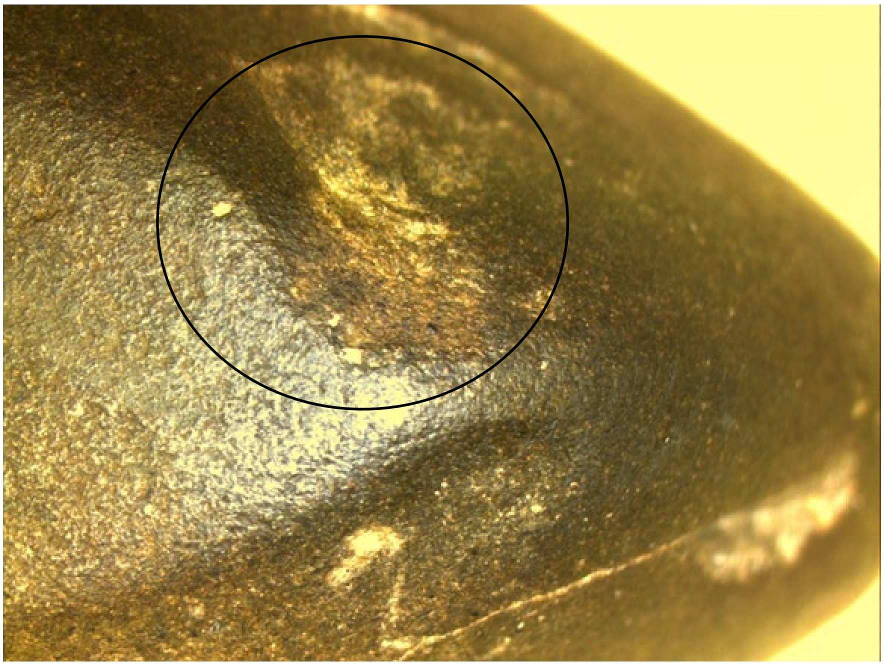
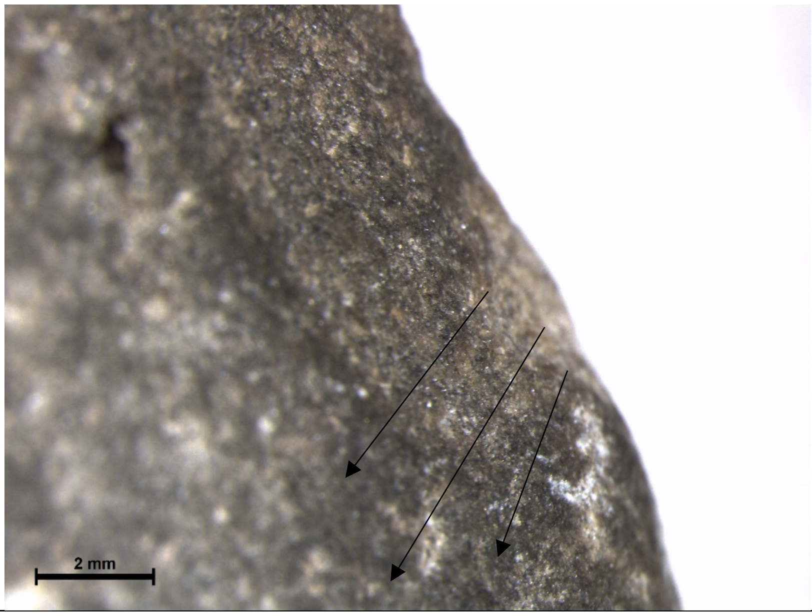


Figure 7.30: An image of a re-ground flake negative on axe-hammer 124

In other cases, the high topography and roughened areas of fractures were ground to reduce the chances of a second break. On no occasion have axe-hammers been re-ground and not re-used. This is a marked difference to the battle-axes which were re-ground and not re-used. It indicates the continued and multiple use of axe-hammers. Axe-hammer 154 is the only axe-hammer with wear indicating the previous use prior to re-grinding. Re-grinding of the blades of the remaining nine axe-hammers removed any traces of previous use or uses. It is probable that many more axe-hammers were re-ground to sharpen the blade and continue the use of the implement, but use has removed any traces of re-grinding. Continued use will remove traces of re-grinding, and therefore, analysis of these implements will only reveal the use or uses after re-grinding.

Axe-hammer 154 was used in contact with wood with a chopping motion for the use after re-grinding. This wear is arranged in the three-patch arrangement indicating a less developed chopping wood use, which means it used for a shorter period of time. Short, parallel striations running perpendicular to the blade edge are arranged in the patches and associated with superficial grain removal pits in a similar arrangement on the blade tip and slightly onto the blade edge. Rounding of the higher topography is present, particularly on the corners of the blade. The use prior to re-grinding is indicated by a large flake negative, a step fracture, which is present on one side of the blade. The roughness and high topography of the fracture have been significantly reduced and rounded through re-grinding followed by the secondary use (figure 7.31).

A



A. ID 154, blade edge. A large, wide flake negative which is superficial due to re-grinding, the rounded edges and flat appearance indicate it was re-ground. Parallel striations run perpendicular to the blade tip are from continued use after regrinding are indicated by arrows. X1.0 STE, contact with wood, chopping motions.

Figure 7.31: A micrograph from the re-ground and re-used axe-hammer 154

The remaining nine axe-hammers which have been re-ground and re-used have been in contact with wood, except two which have undeveloped wear and therefore cannot be attributed to a contact material. These examples have wear indicative of chopping motions at varying degrees of development. It is probable that their pre-grinding use was also chopping wood after which they were re-ground and thus re-sharpened to continue the effectiveness and functionality of the implement at the task.

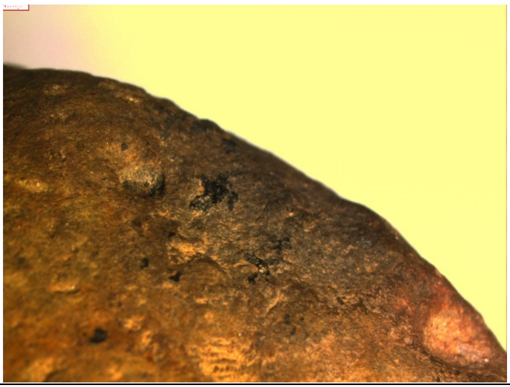
7.13 Uncertain: Axe-hammers

As with battle-axes, there are a small number of axe-hammers with uncertain wear patterns (n=4). Mostly this is with regards to the weathering of these implements. In some cases, the motion or contact material cannot be ascertained since the wear is either limited or sparse. On no occasion is there an axe-hammer with only manufacture traces present. However, there are three examples which have undeveloped wear indicative of use over a short period. Undeveloped wear means that wear started to develop but did not continue enough to be indicative of use. On three more occasions, the extensive use of the blades coupled with slight weathering has removed any traces of wear which can be indicative of contact material.

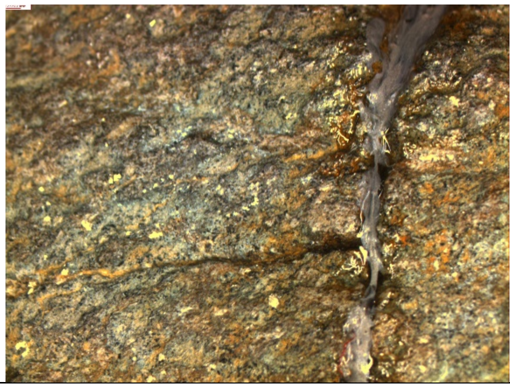
7.14 Heat Alteration: battle-axes and axe-hammers

A number of battle-axes and axe-hammers show signs of possible heat alterations (figure 7.32). The colour of the stone is the most common attribute on these implements, sometimes accompanied by cracks and flaky grains. There are several battle-axes which have been broken, often in half, and have similar cracks. I argue these have also been in contact with heat. It is probable that some of these examples have either been in contact with the funeral pyre or with the hot cremated remains. Battle-axe 188 has a hairline crack or fracture across the surface of the implement which is not related to its use. It is most likely related to being placed with the hot cremated remains it was found associated with (Sheridan, 2008, 108-111). The body of axe-hammer 91 has been blackened, while battle-axe 235 has been damaged enough for large areas of the surface to have been removed. Battle-axes (n=6) with signs of heat damage are more numerous compared to axe-hammers (n=2). Battle-axe 622 was found shattered and blackened inside a Collared Urn with the cremated remains. It is thought that this implement was placed on the funerary pyre with the deceased. There is future research potential to carry out experimental tests to understand the change that occurs to stone battle-axes when they are placed upon a funerary pyre and with hot cremated remains.

A



B



C

D

A. ID 91, blade edge. A blackened area of the implement. Patches such as this cover the object and do not appear to be interrupted by use wear. X0.8 STE.
B. ID 1, body of the implement. A crack which extends the length of one side of the implement, parallel with the perforation and extending into the perforation (it has been glued curatorially) may have been caused by contact with heat. X1.0 STE.
C. ID 1, battle-axe. A crack which extends the length of one side of the implement, parallel with the perforation and extending into the perforation may have been caused by contact with heat. Reddening of the stone is also close to the crack.
D. ID 188, battle-axe. A crack occurred in the same location as ID 1 parallel with the perforation.

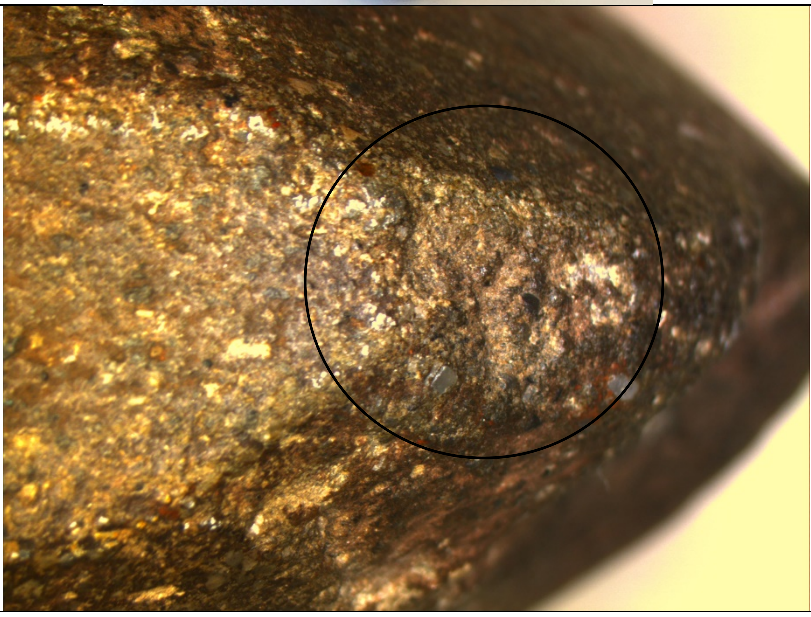
Figure 7.32: Images and micrographs of battle-axes and axe-hammers with heat alteration

7.15 Accidental Damage

On some occasions, singular flake negatives on the corners of battle-axes and axe-hammers appear to be unrelated to the other wear on the blade edge or any previous use (n=4). This is most evident on those implements used in contact with a medium and medium-soft contact material. It is possible that these flake negatives were caused by accidental damage. The continued use of the implements after this breakage causes the rounding and polishing of the flake negative. Accidental damage of two of the replica battle-axes during the experimental tests suggests that this might be the case. Both were dropped onto a hard contact material, stone. The result was a flake negative of one corner which became rounded through continued use. It may also be possible that this accidental damage was not accidental and could have perhaps been broken on purpose. Analysis of the wear would not be able to distinguish between the two. It is also conceivable that damage may also be modern, such is possible with axe-hammer 131 which has a large flake negative on one corner, unrelated to other wear and a different colour (see figure 7.33).

A.

B



A. ID 131, blade tip. A large flake negative exists one corner of the blade. It is unrelated to other wear on the blade, it has not been re-ground, nor has it been used after the breakage.
B. ID 206, blade tip. An impact fracture on the tip corner, not associated with further removals or striations like other wear on the blade. Continued use has rounded the high topography. This example is similar to the accidental damage of the experimental replicas. X0.67, STE.

Figure 7.33: Images and micrographs of accidental damage

7.16 Post-depositional traces

The previous section discussed the accidental damage of battle-axes and axe-hammers. It used axe-hammer 131 as an example which may have been damaged in post-depositional actions. The large flake removal on the tip was not interrupted by subsequent wear processes, for instance, it was not slightly rounded, like the rest of the implement, from post-depositional processes. Modern and post-depositional wear is often easily interpreted.

Weathering rounds the stone grains, if the whole object is rounded, rather than localised areas; then this was caused by weathering processes. Often battle-axes and axe-hammers were found in fields during ploughing. Plough marks are clearly distinguishable from use-marks. They are long, wide scratches that appear bright and fresh, most often white in colour, and located in large areas across most of the implement. Post-depositional use is also a possibility as has been discussed for axe-hammer 31. Signs of modern re-use of a stone implement can be identified by bright, fresh wear marks, often lighter in colour. They may be caused by poor storage, handling and modern use in private and museum collections. These are not as clear as accidental damage of plough marks, however, if the implements have been used functionally, such as for chopping wood. It is possible to recognise these use traces from ancient traces. Ancient traces will be slightly altered from the extent of time since use, predominantly depositional processes will weather the stone a small amount. Changes to the stone from weathering covers the implement and will weather all wear that occurred before deposition. Such weathering may be minimal, but it can still be used to distinguish between ancient use and the modern use which will cut through it; the modern wear will not be founded consistently and to the same degree as the rest of the implement.

Literature has touched upon the modern use of battle-axes and axe-hammers. A common occurrence is their re-use as door stops. Wear from such use is mostly present of the sides and edges of the implement rather than the blade. It exists as patterns of pits, abrasion and crushed grains from percussive actions and rubbing and is irregular information. Often modern wear is caused by poor storage in private and museum collections. One axe-hammer analysed was covered in long strips of white paint along the blade edges, sides and side edges where the object had slid backwards and forwards in a white painted drawer as it was being opened and closed. Some museum collections have kept stone implements in drawers, unprotected from contact with one another. Although they were placed on foam, the potential movement of these implements can cause wear traces. Contact between two stones, which are hard contact materials, can cause crushed grains and flake removals (see figure 7.34 for examples of post-depositional wear).

A

B

C

A. Newcastle 1938.18, axe-hammer. The entire surface of the implement has large pits and has an eroded appearance. The high topography across the whole implement is rounded from weathering.
B. Newcastle 1945.1, axe-hammer. Large scratches across the body of the implement, typical of contact with a modern plough.
C. Yks Mus 1036.1946, axe-hammer. Large areas of white paint exist on the body of the implement from contact with a white painted draw. This is the result of insecure storage.

Figure 7.34: Images of axe-hammers with post-depositional wear

7.17 Conclusion

One hundred twenty-one battle-axes and axe-hammers from across Northern Britain and the Isle of Man have been analysed using a stereomicroscope for low magnification and a metallographic microscope for high magnifications. The analysis revealed that battle-axes and axe-hammers have similar wear patterns and therefore similar uses (see figure 7.35 and 7.36). It was also apparent that both implement types were varied in their contact material, motions and amount of use. Contact with wood is the most common contact material on battle-axes and axe-hammers (b-a=38; a-h=38). Chopping motions were used, but there is also a possibility for their use as wedges to split wood, although further tests are needed to confirm this. Several axe-hammers and battle-axes have polish indicative of contact with bone (b-a=4; a-h=4) and contact with earth and roots (b-a=2; a-h=1), in each case with wear indicative of chopping motions. Additionally, re-grinding is common on both implement types (b-a=13; a-h=12). Axe-hammers were often re-ground after extensive use or breakage before being re-used (b-a=7; a-h=12). Several battle-axes are also reground and then re-used after breakage (n=7), but some were re-ground and not re-used (n=6). There are also a small proportion of battle-axes which have limited or undeveloped wear which suggests they might not have been used (b-a=7; a-h=4), and some only have production traces also indicating that they were unused (b-a=2; a-h=1). Furthermore, by assessing the development of wear during the experimental tests, a new wear pattern was discovered - the three-group arrangement. This wear arrangement is comparable to battle-axes (n=6) and axe-hammers (n=3) in the archaeological record and has aided the interpretation of use which, before the experimental tests, was uncertain. Such discovery can be used to aid the interpretation of blade stone implements in other research projects. The wear analysis results indicate that both battle-axes and axe-hammers were clearly functional tools which could be used for a variety of purposes, over a prolonged period.

Chapter 8 – Discussion

8.1 Introduction

To understand the use of EBA stone battle-axes and axe-hammers a total of 63 battle-axes and 59 axe-hammers from museums across the British Isles were examined using wear analysis. A low and high magnification approach, experimental tests and contextual analysis were employed to interpret the use and significance of these implements. This chapter will combine and reassess the findings from this project to understand the trends and variations in the evidence. The reassessment can be used to answer the research questions regarding function and significance set out at the start of the project.

The results of wear analysis and the experimental tests demonstrate the functionality of battle-axes and axe-hammers. They provide the basis to draw inferences about the use context for these artefacts. Wear analysis and experimental tests revealed specific contact materials, the motions of the implements during use, the extent of use, and the treatment of the implements during the use-life and deposition. Such determinations assist in understanding the roles of these objects as tools and determine that their use as weapons was possible alongside other functional uses. In this way, use context and the treatment of petrological context are used alongside Hodder's five contexts (typological, chronological, stratigraphic, spatial and cultural) to understand the identity of those involved in the life history of these artefacts. This chapter will reach conclusions about the uses of battle-axes and axe-hammers based on this data, including assessing variations in the use of each implement type. Use-wear results will be set alongside the contextual information considered in chapter 5 to understand the use-life of these objects and their meanings, role and significance. The analysis of all battle-axe and axe-hammer contextual information will be combined with discussion of the use context to understand the overall significance of these implements. This approach will establish the roles, meanings and uses of these implements throughout their use-life and deposition. The contextual and use context for battle-axes and axe-hammers will be compared to consider the extent to which these implements are similar. In doing so, the depositional and typological contexts will be cross-referenced to understand if relationships exist between typology and use, deposition and use, and typology and deposition, and whether location affects this. Predominantly, the similarity in use, petrology, and deposition between implement types and across regions is most notable.

8.2 Funerary practices and the life histories of battle-axes and axe-hammers

Chapter 5 discussed the contextual associations of battle-axes and axe-hammers from Northern Britain and the Isle of Man. The typology, chronology, petrology, and the spatial and stratigraphic contexts, including features and associated artefacts, were assessed to discover any apparent trends in the deposition of these implements. Both battle-axes and axe-hammers were deposited in funerary and non-funerary contexts, although the larger number is of non-funerary contexts; 363 axe-hammers and 144 battle-axes whereas the smaller quantity is from funerary contexts; eight axe-hammers and 38 battle-axes. It is central to consider if the use of those in funerary deposits differs from those deposited in non-funerary and unknown contexts, and what this might indicate for their significance. Battle-axes and axe-hammers have been found in similar depositional contexts, both funerary and non-funerary, so a comparison of the use context of those implements in different depositional contexts is needed to understand the extent to which battle-axes and axe-hammers are similar. This thesis has added an appreciation of the use context of these objects to an assessment of their other contextual dimensions. This expansion of Hodder's five contexts by considering a new variable, use context and the treatment of petrology, has increased the variety of information available for assessment. As a result, it is now possible to produce a much-improved consideration of these two Early Bronze Age artefact types.

8.2.1 The deposition of battle-axes and axe-hammers in funerary and non-funerary contexts

We must first consider the depositional contexts of EBA battle-axes and axe-hammers from Northern Britain and the Isle of Man to consider the variation and similarities before the direct comparison of use context. The eight axe-hammers from funerary deposits share feature type and associated artefacts, including cairn and barrow features and cremated remains, cinerary urns, and worked flint. The placement of axe-hammers in similar funerary assemblages to battle-axes makes them contextually associated. The similarities suggest that they were part of the same rules for engagement and the same rules and processes which led to the deposition of certain battle-axes and axe-hammers in funerary contexts were at play.

The use of the same rules of engagement is unsurprising, as the type of grave goods is in keeping with those used in funerary deposits across EBA Britain (Woodward & Hunter, 2015). Also, the variation in grave goods within the funerary assemblages are in keeping with the characteristics of Needham's Phases Two and Three (Needham, 2011). Diverse groups of grave artefacts accompany battle-axes in varying types of feature across the research area. As has been demonstrated in chapter 5, there are 27 different combinations of assemblage out of 31 assemblages where a battle-axe occurs (human remains are treated as an artefact within these assemblages). Those assemblages which appear more than once do not appear in the same feature. Although fewer in number, axe-hammer funerary assemblages display similar variability, which further demonstrates that their placement within funerary contexts was also in keeping with the broader trend for British EBA funerary processes and depositions.

The variation of battle-axe assemblages is the crucial aspect relating to the different features, graves goods and depositional locations. It suggests that each assemblage was created to relay and express different messages through the various associations within the assemblage, such as the graves goods, burial rite, and burial feature, as well as between assemblages, including past burials within the feature and the act and process of burial and deposition. The associations each battle-axe had may have been numerous and highly varied, extending from the moment of creation, through its use-life, to its deposition and onwards to its placement within a museum collection. All moments in the life of these objects were part of different assemblages and had various associations and meanings; this means that objects may have had multiple associations over time and space. As such, there is the potential for both battle-axes and axe-hammers to have had multiple roles and meanings (Hamilakis & Meirion Jones, 2017; Crellin, 2017; Harris, 2017; Ingold, 2007; Bailey, 1981 & 2007; Deleuze & Guattari, 2004). The question is whether the use-life of each object was associated with its circumstances of deposition – does use context influence the variability we see in the funerary deposition of battle-axes and axe-hammers and how similar is the use context of those from funerary contexts compared to those from non-funerary contexts?

The large percentage of battle-axes and axe-hammers are from non-funerary contexts, 79% of battle-axes and 98% of axe-hammers, which further demonstrates the similarity in their treatment. A small proportion of these come from known spatial and stratigraphic contexts, including the deposit of both battle-axes and axe-hammers in rivers, and battle-axes in a house site and a shell midden. Use context can be used to further understand those implements that do not come from a known spatial and stratigraphic context as, despite the lack of depositional information, associations may be inferred through comparable use context.

The consideration of the use and depositional contexts together allows a list of possible reasons behind deposition to be constructed, (Tables 8.8 & 8.9 in Section 8.3.5) which suggest the relationships that the deposition of battle-axes and axe-hammers might have drawn upon, in both funerary and non-funerary contexts. These demonstrate that the deposition of both artefact types might have drawn upon similar relationships within their itineraries because they were used in a similar manner.

Chapter 5 demonstrated that several potential depositional processes and contexts could also have resulted in finding an implement in a river. The information known for these artefacts does not point to a single process; instead, there are several possibilities. For example, they may have once belonged to grave deposits or were single deposits since eroded into the river by flooding events and changes to river courses. However, no information exists for such events. Other reasons include the intentional deposition in a river; to secure the axehead to the haft they may have been placed in the river to soak with the intention of retrieval, but, assuming the wood would have survived in the wet conditions, none have been found with hafts suggesting this may not be the case. Intentional structured river deposition of a prestigious nature is well attested in the Neolithic and Bronze Age across Britain and Europe, particularly with metal hoards as votive offerings (Lamdin Whymark, 2008; Brück and Fontijn, 2013; Bradley, 1990; 2016). Stone axes in the Neolithic have also been discovered in rivers, interpreted as votive offerings (Bradley & Edmonds, 1993, 204), perhaps battle-axes and axe-hammers were treated in a similar manner?

Those battle-axes from the Ness of Gruting house site are more unusual non-funerary deposits, including a miniature battle-axe and two unfinished battle-axes. These deposits are the only implements from a domestic setting, which suggests that the reasons behind their deposition may have been different from those found in non-domestic settings. Does this mean that the use context will also differ? Other associated deposits on this site, including a mace-head, polished stone axes, two stone balls, two Bronze knives, and a spear, are also found in funerary settings (Calder, 1958, 373-375). This presence of these objects suggests their intentional deposition for reasons that may share a similar significance or meaning to those deposited in funerary settings. Calder indicated that this house site was also a stone tool workshop, so the activities that occurred there may also have been related to their deposition (Calder, 1958, 373-375). Furthermore, the intentional placement of unfinished battle-axes may draw upon the function of this site.

Another uncommon deposit is the intentional placement of a battle-axe from the shell midden on the Isle of Coll. Several other artefacts were also deposited within the mound at various points within its use life, similar to other shell middens in the area. No information regarding the location of the implement within the midden exists. However, it may be a later addition to a mound to reflect marine activities when shellfish consumption was a higher component of the diet. Isotopic analysis of individuals from c. 2500-1500 cal. BC, though, indicated none had a significant marine component to their diet (Parker Pearson et al., 2016, 625). Perhaps the deposition of EBA objects in the mound attested to a marine diet and lifestyle, such as fishing, of past generations. Alternatively, they may be referencing the continued consumption and use of marine resources, albeit less frequent than during the Neolithic.

The placement of this shell midden, on the coast amongst several other shell middens, may also be significant. Together they would be visible from the sea and thus may have been markers, used as signs for various things, perhaps changing through time. For instance, these monuments may have played a part in establishing and maintaining links between coastal groups, probably between islands and mainland Scotland. Noble suggests a similar use of coastal monuments in the Orkney Isles (Noble, 2006). It could be that all three processes occurred together and resulted in the deposition of the battle-axe in the shell midden. The point to take away here is that there are several possible reasons behind the deposition of implements. However, with minimal spatial and stratigraphic information, often, a motive cannot be determined. All possibilities must be considered to avoid a narrow interpretation, such as the inclusion of battle-axes in burials to express the relationship between people. In these situations, an assessment of use context can provide further contextual information which can aid the understanding of the life history of the artefact. The variability between funerary and non-funerary deposits begs the question of whether use wear varies between them.

The following sections will assess the relationships evident between the use contexts before it considers the use contexts with the funerary and non-funerary contexts to understand how the use context relates to the final deposition of EBA battle-axes and axe-hammers from

Northern Britain and the Isle of Man. It will also consider how the use context is related to typology, petrology, location and amount of use.

8.2.2 Comparing use context on axe-hammers and battle-axes from funerary and non-funerary contexts

Roe argued that battle-axes were purely ceremonial, and Leahy maintained that axe-hammers were too large to be functional (Roe, 1966; Leahy, 1986). However, the traceological assessment of 62 battle-axes and 55 axe-hammers from across Northern Britain and the Isle of Man reveals that these implements had, in the most part, a functional context: cutting down trees, working wood, sometimes digging or clearing vegetation, occasionally animal slaughter and occasionally used as a weapon. A small proportion of implements (b-a: 7; a.h:1) have undeveloped wear, signifying either very limited or no use, and were deposited either after production or after the re-grinding of the blade to remove all traces of previous use and to re-sharpen the use edge. Forty battle-axes and 42 axe-hammers show signs of contact with wood, which is the most common contact material across all types of battle-axe and axe-hammer. Maps at figures 8.1 and 8.2 show the distribution of battle-axes and axe-hammers with each kind of wear trace. The results suggest that use was consistent across the study area. Contact with bone (b-a: 4; a-h: 4) and contact with earths and roots (b-a: 3; a-h: 1) are less numerous.

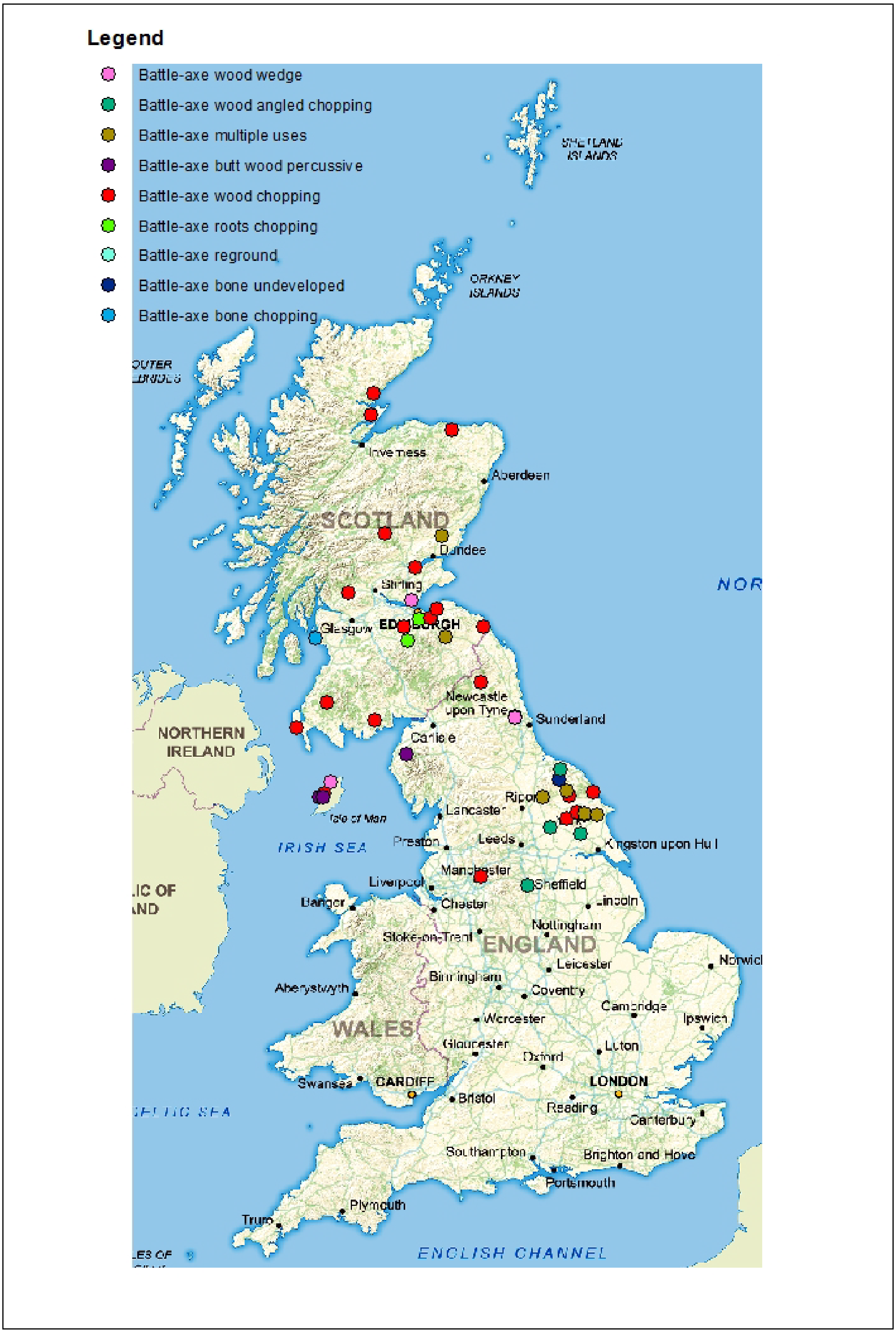


Figure 8.1: A distribution map of the uses of battle-axes analysed

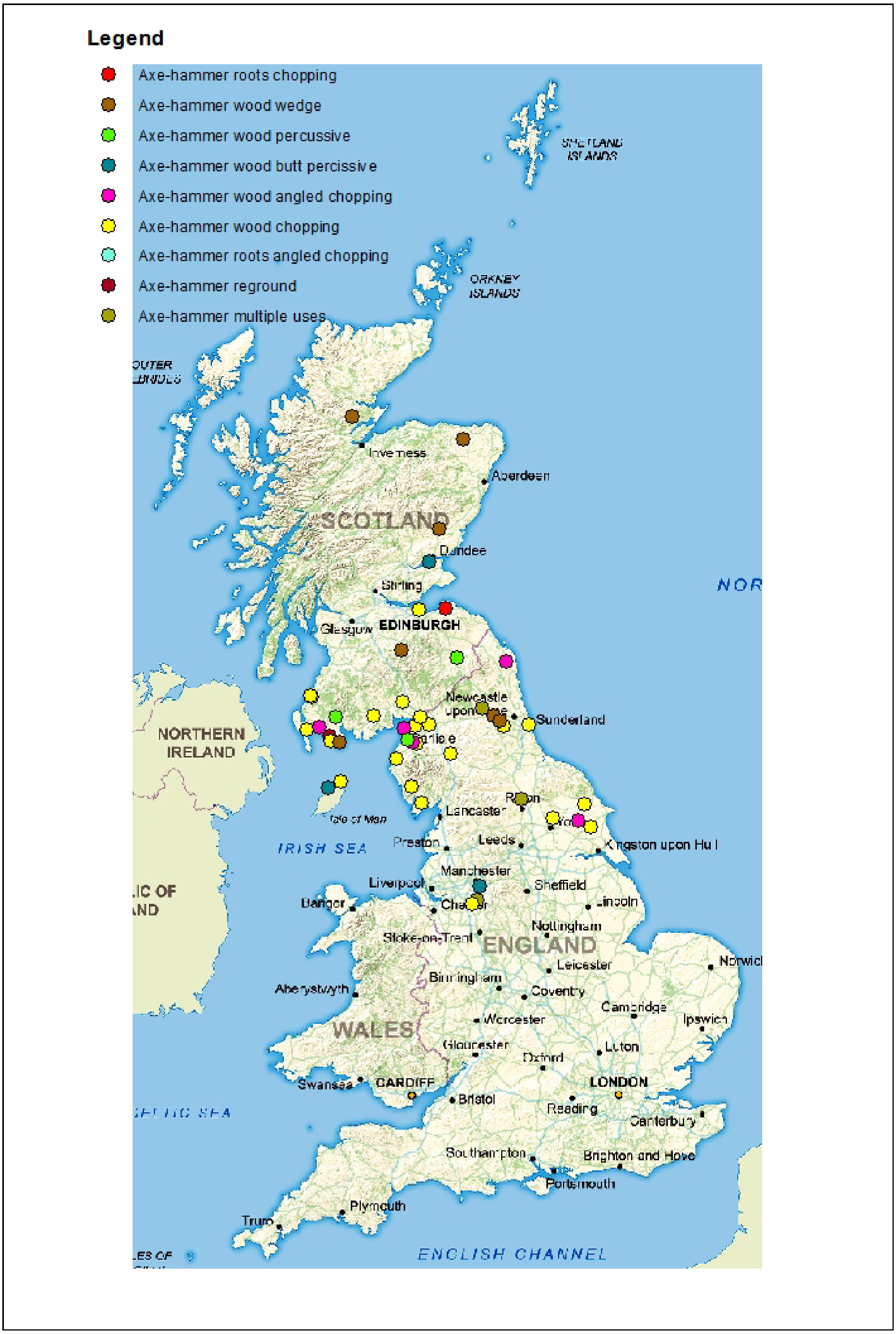


Figure 8.2: A distribution map of the use of axe-hammers analysed

Those battle-axes presenting signs of contact with bone have no geographic trend, while the location of those in contact with earth and roots is in the central and southern areas of Scotland, figure 8.1. This is by no means a strong trend; these three implements are situated at considerable distances from one another and are more probably due to the higher quantity of battle-axes in the central and southern areas of Scotland in comparison with the north.

Battle-axes and axe-hammers are usually interpreted as having one role. For instance, Roe argued that battle-axes were all purely ceremonial (Roe, 1966). However, the variation in use wear on these artefacts suggests that each battle-axe and axe-hammer is different. The difference included a variety of motions utilised, amount of use and the hardness of the contact material. Tables 8.1 and 8.2 demonstrate the variability in the amount of use signified by the development of wear, for example. Experimental tests revealed that less developed wear from chopping motions in contact with wood creates an arrangement of wear dubbed the three-group arrangement (see chapter 7 for a description), which was discovered on six battle-axes and three axe-hammers in the dataset. This new finding is vital for the standardisation of understanding and interpreting the development of wear on implements in the archaeological record, which are currently highly variable. Medium hardness contact materials are the most common, followed by medium/medium-soft. Medium-soft and medium-hard are the least. These are not specific to a use function, or depositional context. The variation is also apparent in the motions of battle-axes and axe-hammers. Chopping is the most common across all contact materials, followed by angled chopping. Marks that likely derive from use in a wedge motion and percussive motion were evident on a small number of battle-axes and axe-hammers; these motions are more numerous amongst axe-hammers in comparison to battle-axes (see table 8.3, for the relative quantities). The experimental tests suggest that chopping motions were the most effective and efficient for a hafted implement with a blade parallel with the haft, like a battle-axe and an axe-hammer. The length of their hafts, 700 - 760mm based on archaeological evidence, were suitable for this motion (Leahy, 1986, 143 & 146). The variability of use context is further demonstrated by the experimental results which indicate that the uses that would employ a chopping motion successfully include chopping wood, splitting wood and hitting animal skulls for slaughter. Other use motions include the percussive action to split wood with a wedge and to percussively hammer wood to drive it into the ground or position it within a wooden structure. Another possible use, not tested, is the use of axe-hammers to crush bone for marrow extraction. The use contexts and experimental results suggest that the functional role of battle-axes and axe-hammers was not singular. Therefore, an interpretation of their purpose and meaning cannot be singular; multiple roles and meanings must be considered.

Table 8.1: A table to demonstrate the variable amount of use indicated by the development of wear on battle-axes

Contact material	Undeveloped	Less developed	Less-moderate developed	Moderate developed	Moderate-well developed	Well developed
Wood	3	17	1	12	5	3
Bone	2	0	0	0	1	1
Earth and roots	0	0	1	0	2	0

Table 8.2: A table to demonstrate the variable amount of use indicated by the development of wear on axe-hammers

Contact material	Undeveloped	Less developed	Less-moderate developed	Moderate developed	Moderate-well developed	Well developed
Wood	3	10	3	10	8	14
Bone	0	0	1	1	2	1
Earth and roots	0	0	0	0	0	2

Table 8.3: A table to demonstrate the variable motions used for battle-axes and axe-hammers

	Chopping	Angled Chopping	Percussive	Wedge
Battle-axe	33	4	5	1
Axe-hammer	30	9	8	8

Chapter 7 also presents evidence for a singular implement having multiple functional uses, which further demonstrates that there is no single functional role for these implements. These were often well-developed and extensively used implements. The blades and butts of the same artefacts were used differently; some blades were re-ground to continue their use or change their purpose, and some clearly show contact with different materials. This underlines that these implements were often multiple-purpose tools. Indeed, the re-grinding of the blade, to re-sharpen and continue use, may have occurred on many more implements than is evident. As described in chapter 9, the Hosterwold and Vlaardingen Neolithic house building experiments indicate that re-sharpening of stone axe blades removes signs of any previous use (J. Wijnen, A. Verbaas & A.Van Gijn, 2018).

This indicates that battle-axes and axe-hammers were very often used for multiple purposes, were re-ground to refresh or repurpose them and their continued use also removed signs of such re-grinding. Therefore, the use of many more implements with multiple different contact materials, lengths of time, and motions is highly likely. There might also have been a connection between such changing uses and fluctuating meanings and associations of these implements, in particular, those that were re-ground and not re-used after the act of re-grinding. In connecting the use contexts of those battle-axes and axe-hammers found with contextual and depositional information, an assessment of such meanings and associations can take place. Does the variation in use context relate to the other five contexts: typological; chronological; stratigraphic; spatial and cultural, in any way?

The variability within the use context is evidence that neither battle-axes nor axe-hammers had a single function and that their roles and meanings may have also been variable. The wear patterns demonstrate that there is no relationship between the use motion and amount of use, the amount of use and contact material, the use motion and the hardness of the contact material, or the amount of use and the hardness of the contact material. Does this variability we see within the use context link with the variability we see in the burial assemblages?

Table 8.4: A table to demonstrate the relative quantities of use context for funerary and non-funerary battle-axes and axe-hammers

	Funerary Battle-axe	Non-funerary Battle-axe	Funerary Axe-hammer	Non-funerary Axe-hammer
Quantity Analysed	20	43	3	56
Contact with Wood	12	29	2	41
Contact with Bone	2	0	0	4
Contact with Earth and Roots	0	2	0	1
Reground and Re-used	2	4	2	10
Reground and not Re-used	5	0	0	0
Not Functionally Used	2	1	1	0

If we consider the depositional information together with the wear analysis results, it is clear that they are not in keeping with one another. The contact materials, use motions, and amount of wear are not related to any specific feature, artefact, or assemblage. Instead, the same variable use contexts exist for those battle-axes and axe-hammers from both funerary and non-funerary contexts (table 8.4). Battle-axes and axe-hammers from funerary deposits also have similar use contexts. However, the undeveloped and production wear on a small number of battle-axes from funerary deposits indicate minimal or no use. This is not the case for axe-hammers. Just one axe-hammer has undeveloped wear after it was re-ground and minimally re-used. This implement was a non-funerary stray find. It may be that those funerary implements with undeveloped wear, suggesting minimal functional use, were used in the funerary process, such as chopping wood for a creation pyre. However, this is difficult to determine as evidence from such preparation is not recorded in the archaeological record. Additionally, tables 8.5 and 8.7 demonstrate the lack of association between the use contexts of battle-axes and their funerary context and axe-hammers and their funerary context.

Roe argues that battle-axes were purely ceremonial and non-functional (Roe, 1966). For the most part, this cannot be correct as the use context indicates that both funerary and non-funerary battle-axes were functional objects. However, the differential treatment of a small number of battle-axes before their deposition suggests that we cannot rule this out altogether. The re-grinding of a small amount of functionally used battle-axes (n=5) before deposition sets them apart as being physically changed. Does this mean that they had a different role and meaning to the other funerary battle-axes? A different role and meaning are not apparent from the spatial and stratigraphic contexts which are in keeping with the contexts of those that were not reground. Battle-axes from non-funerary contexts that were reground were all re-used afterwards, this indicates that they were reground immediately prior to use rather than in preparation for the next use; if the latter was the case, we would find reground and not re-used battle-axes in non-funerary settings. As such, those funerary reground implements were reground prior to, and intentionally for deposition.

The argument that battle-axes were non-functional is correct for a handful of artefacts in the dataset which have only production traces. Interestingly, it appears that there may be a link between the non-functional nature and the deposition. A relationship exists between the depositional contexts of two battle-axes and one axe-hammer and their use context. All three are from burial contexts, two from cists and another from a cairn. There is no association between the associated artefacts of treatment of the burial remains. Two were unfinished, which suggests a functional use was not an attainable aim. A fourth battle-axe was a stray find, ID 80, which indicates that before functional use, either this non-funerary battle-axe was intentionally deposited, lost, or it came from a funerary context now lost.

Table 8.5: A table demonstrating the lack of correlation between the use of battle-axes and their funerary context.

	County	Locality	Stage	Butt Shape	Feature	Cremation	Inhumation	Urn, unknown type	Collared Urn	Cordoned Urn	Food Vessel	Accessory vessel	Worked flint	Arrowhead	Flint dagger	Bronze Chisel	Bronze Knife/dagger	Bronze Pin	Copper dagger	Bone pin	Bone toggle	Bone belt hook	Earrings	Whetstone	Razor	Jet	Stone ball	Medium hardness contact material	Medium-soft contact material	Chopping	Angled Chopping	Percussive	Wedge	Production traces	Contact with wood	Butt used percussively	Contact with bone/flesh	Undeveloped	Less developed	less-moderately developed	Moderately developed	Moderate-well developed	Well developed	Reground	Reused
BM 76 4-10 35	Y	Western Howes	IV	d	Barrow	x			x			x								x	x							x				x							x						
BM 76 4-10 46-47	Y	Herd Howe	III	c	Barrow	x			x																			x			x				x	x					x				
BM 79 12-9 1062	Y	Rudston	II	c	Barrow		x										x											x							x									x	
BM 79 12-9 107	Y	Ganton	II	a	Barrow	x							x															x		x					x						x				
BM 79 12-9 1175	Y	Goodmanham	IV	d	Barrow	x														x						x			x		x				x						x				
BM 79 12-9 605	Y	Cowlam	III	a	Barrow		x						x													x				x								x						x	x
BM 82 2-23 23	Y	Hambleton Moor	IV	b	Barrow																							x											x					x	x
ShM J.93.9	Y	11m E of Pickering	III	d	Barrow	x		x					x															x		x					x				x						
BM 2010, 8035.20	Y	Loose Howe	V	d	Barrow	x			x			x						x	x									x									x							x	
BM Sturge 470	NOR	Seghill	II	b	Cist		x																												x?									x	
NMS EQ 322	BRW	Hagg Wood, Foulden	I	a	Cairn	x					x		x															x		x					x							x			
Stranraer 2008.24.5	WIG	Cairnderry	III	d	Cairn	x						x																	x	x					x					x					
NMS EQ 64	MLT	Pentland	IV	d	Cist																							x		x					x					x					
NMS EP 57	AYR	Nith Lodge	IV	d	Cist	x			x			x																x											x						
NMS EQ 65	AYR	Chapleton Farm	IV	d	Cremation	x		x																					x								x							x	
NMS EQ 916	FIF	Barns Farm	I	a	Barrow	x	x				x																	x				x	x		x	x							x		
NMS EQ 610	PER	Doune	III	a	Cist		x				x																							x											
NMS EP 2	ABN	Broomend of Crichie	IV	e	Stone circle/Cist	x								x																					x?			x						x?	
NMS AH 36	ORK	Whitehall, Stronsay	III	e	Cist		x																	x										x				x							
MNH 1954-0593	IOM	Knockaloe	I	c	Cist								x															x		x					x	x			x	x					

The context of ID 143 from Doune suggests that the non-functional nature of this miniature battle-axe was intrinsically linked with the burial of a child inhumation. The miniature may be drawing upon the fact that the child died before reaching adulthood; the presence of an un-used miniature implement may suggest a desire of the mourners for the identity of the deceased to reach adulthood. The only other miniature battle-axe from Northern Britain and the Isle of Man is from a non-funerary context, ID 164 from the Ness of Gruting house site, this implement is unfinished and shares no further similarities with the Doune battle-axe.

The majority of battle-axes and axe-hammers in funerary and non-funerary contexts were deposited with clear signs of functional use (b-a functional = 60; b-a non-functional = 3; a-h functional = 50; a-h non-functional = 1). The variability seen in the funerary assemblages is in parallel with the variability we seen in the use context of these artefacts which indicates that a relationship between functional use and a specific funerary deposit did not exist. For instance, 12 battle-axes were found with cremation deposits; seven of these showed contact wood and two with bone. The motions included one used as a wedge, four with straight chopping motions and two used in an angled chopping motion. Three battle-axes with cremation deposits were reground and not re-used prior to their deposition. Their previous uses before re-grinding were in contact with bone (n=2) and wood (n=1). These contact materials are the same as those analysed on battle-axes that were not re-ground. The variation indicates that there is no correlation between specific artefacts and the use and treatment of battle-axes associated with cremation deposits.

Battle-axes found with inhumation deposits number eight, of which six were analysed. Only two of these had production traces. A further two were re-ground before deposition; their previous contact material was wood. One was re-ground and re-used although its re-use was minimal, causing undeveloped wear. Just one battle-axe in this group had well-developed wear from multiple uses, including as a wedge to split wood and used with percussive action. This development of wear is in marked difference to the limited wear visible on the remaining implements deposited with inhumation burials, where contact with wood is the most common contact material. Contact with wood is also the most frequently assessed contact material for all functional and non-functional battle-axes and axe-hammers in the dataset. This suggests that the functional use of the implement had no relation to its selection for inclusion with the dead, and that it was insignificant enough for the wear from use to remain visible. The intentional removal of wear marks on the re-ground funerary battle-axes means that they cannot be included in this interpretation. All eight battle-axes found with inhumations were buried with different variations of associated artefacts. Little correlation can be found between assemblage and treatment of the axe, i.e. the variation continues to be present throughout the assemblages of battle-axes found with inhumations and does not change dependent on the condition of the battle-axe at the moment of deposition. The treatment and contact materials of battle-axes found with inhumation deposits are similar to those placed with cremation deposits. However, the burial assemblage for three battle-axes appears richer, having exotic items such as jet and flint and bronze daggers, as demonstrated in table 8.6. For instance, the 'richest' assemblage, from Garton Slack, ID 565, contains a jet button as well as a flint knife and a bronze dagger. The Cowlam burial, ID 234, also contain three pieces of jet of unknown type. These 'rich' burial assemblages are only rich when compared with the other battle-axe burial assemblages, but they are not 'rich' when compared to contemporary British burials (Woodward & Hunter, 2015). There are artefacts not found in battle-axe burials, such as awls that are found in EBA graves; this demonstrates that battle-axe burial deposits drew from a broad pool of objects used in funerary deposits in EBA Britain. For whatever reasons, some objects were never chosen.

Table 8.6: A table showing the spatial and stratigraphic context and the use context of battle-axes found with inhumation burial deposits.

ID	Acc. No.	County	Locality	Stage	Butt Shape	Feature	Cremation	Inhumation	Urn, unknown type	Collared Urn	Cordoned Urn	Food Vessel	Accessory vessel	Worked flint	Arrowhead	Flint dagger	Bronze Chisel	Bronze Knife/dagger	Bronze Pin	Copper dagger	Bone pin	Bone toggle	Bone belt hook	Earrings	Whetstone	Razor	Jet	Stone ball	Medium hardness contact material	Medium-soft contact material	Chopping	Angled Chopping	Percussive	Wedge	Production traces	Contact with wood	Butt used percussively	Contact with bone/flesh	Undeveloped	Less developed	less-moderately developed	Moderately developed	Moderate-well developed	Well developed	Reground	Reused	Analysed
73	NMS EQ 916	FIF	Barns Farm	I	a	Barrow	x	x				x																	x				x	x		x	x							x			x
234	BM 79 12-9 605	Y	Cowlam	III	a	Barrow		x						x													x				x								x						x	x	x
143	NMS EQ 610	PER	Doune	III	a	Cist		x				x																							x												x
565	Hull 26.7.426	Y	Garton Slack	II	c	Barrow		x					x			x											x																				
236	BM 88 9-1 1	Y	Huggate Pasture	II	a	Barrow		x	x																																						
230	BM 79 12-9 1062	Y	Rudston	II	c	Barrow		x										x											x							x									x		x
118	BM Sturge 470	NOR	Seghill	II	b	Cist		x																												x?									x		x
135	NMS AH 36	ORK	Whitehall, Stronsay	III	e	Cist		x																	x										x				x								x

The variable contact materials, motion and amount of use found on battle-axes with cremation and inhumation deposits extend to all battle-axes and axe-hammers found with funerary deposits. No relationships were found between use and artefact type, but the small sample size is likely to have played a part in this – 20 out of 35 battle-axes and three out of eight axe-hammers from funerary deposits were analysed; 35 out of 183 battle-axes and 8 out of 362 axe-hammers were from funerary deposits. A relationship might exist between flint and battle-axe burial deposits. Flint only appears with battle-axes (n=5) that were functional, with varying degrees of wear development. All were used to chop wood, and one had been re-ground and re-used indicating its prolonged use – the wear traces are common and therefore are not distinctive for the inclusion of flint. Flint is commonly found in both burial and domestic settings and is often highly functional. There may be a meaningful relationship between the functional use of objects and the burial process and funerary assemblage. By placing several functional items together, this message, meaning, etc. could have been increased in power or influence. If this is the case, are other less functional objects placed with battle-axes that are not functional?

The non-functional battle-axes from funerary contexts (n=2) were associated with artefacts that had functional uses, a food vessel and a whetstone, although the persistent inclusion of these objects in EBA funerary assemblages suggests their significance within the funerary process. The single non-functional axe-hammer was not associated with artefacts, although its presence in a cairn suggests that information now lost might tell us otherwise. Items can have both a functional and symbolic/prestigious nature. Jet has been found associated with functional battle-axes (n=2), a jet button was found on one occasion with a battle-axe that had moderately developed wear showing contact with wood and an angled chopping motion (ID 233). Jet is often found in burials, so it could be argued to be purely ceremonial, but we cannot ignore the functionality of a button to fasten cloth. This dual functional and symbolic nature suggests there is a potential for multiple roles for funerary artefacts, both functional and prestigious. Again, no objects were recorded with the functional axe-hammers analysed (n=2), this is the result of the loss of information, but their presence in funerary monuments suggests that artefacts and burial deposits could have been associated. Other similarities between battle-axes and axe-hammers further suggest this might be the case.

Objects thought to be prestigious, found in EBA burial assemblages, including bronze items and whetstones, were deposited with battle-axes that had limited use (n=1) or any signs of functional use removed (n=1) or had only production traces (n=1). It is possible that their placement with battle-axes that were reground, had undeveloped wear, or production traces was intentional. As the chapter has discussed previously, these artefacts were chosen from a pool of objects used in EBA funerary deposits. However, not all objects in this pool were selected to accompany battle-axes, and some occur more frequently than others. Take the bronze and jet items, and the whetstone - their deposit with battle-axes may have been chosen to express, secure or enhance something different, or something in a different way, to the other items included in battle-axe burials. The variation on assemblages suggests that items were chosen from this pool of artefacts for a specific reason, perhaps to take a particular role or to express a precise meaning(s).

Fewer artefacts are associated with axe-hammers. Just eight are related to funerary contexts, and only three of these could be accessed for analysis. Table 8.7 demonstrates the limited funerary associations that were discussed in chapter eight. The cairn is the most common burial feature for axe-hammers from funerary assemblages; all three of the axe-hammers assessed for analysis came from cairns. The placement in a burial mound, cairns in Scotland and barrows in England is also the most common burial feature for battle-axes. Battle-axes and axe-hammers from funerary contexts also share the same use contexts. One axe-hammer only had production traces, while the other two were both re-ground and re-used. They were used with chopping motions, in contact with wood, and had well-developed wear. Contact with wood is the most common contact material found on battle-axes and axe-hammers in funerary and non-funerary contexts, so it is no surprise that two out of the three axe-hammers from funerary contexts, and 38 out of the 56 axe-hammers from non-funerary contexts had wear indicative of contact with wood. The similarities in use context and funerary context between these two implement types indicate that may have been treated in the same or similar ways. In fact, battle-axes and axe-hammers from non-funerary contexts also share the same use-contexts. For example, the use context, and funerary context of axe-hammers and battle-axes explicitly suggest similar treatment.

Table 8.7: A table demonstrating the limited correlation between the use of axe-hammers and their funerary contexts

Acc. No.	County	Locality	Stage	Butt Shape	Feature	Cremation	Inhumation	Urn, unknown type	Collared Urn	Cordoned Urn	Food Vessel	Accessory vessel	Worked flint	Arrowhead	Flint knife/dagger	Bronze Chisel	Bronze Knife/dagger	Bronze Pin	Copper dagger	Bone pin	Bone toggle	Bone belt hook	Earrings	Whetstone	Razor	Jet	Stone ball	Medium hardness contact material	Medium-soft contact material	Chopping	Angled Chopping	Percussive	Wedge	Production traces	Contact with wood	Butt used percussively	Contact with bone/flesh	Undeveloped	Less developed	less-moderately developed	Moderately developed	Moderate-well developed	Well developed	Reground	Reused
Dmfs 1965-360	DMF	Whitehall Farm	2	n/a	Cairn																													x											
Dmfs 1965-367	DMF	Chanlockfoot (penpont)	1	n/a	Cairn																							x		x					x								x	x	x
Dmfs 1965-368	DMF	Auldgirth	1	n/a	Cairn																							x		x													x	x	x

Battle-axe and axe-hammers deposited in various settings had a wide range of functional uses and treatments. The variation in the use context indicates that the life history of these implements is not static. Battle-axes were not deposited in the same condition in all burials, with the use context being highly varied and often not directly related to specific burial features. The state of axe-hammers placed in funerary contexts varies less, although this may be due to the small number analysed. Nevertheless, the similarities between the treatment of both implement types in funerary settings are notable.

In many cases, battle-axes and axe-hammers placed within burial assemblages had no changes made to their appearance, i.e. re-grinding to remove traces of use. In these cases, either the use-life of these implements was implicated with the burial, or the use-life was not relevant for the roles they were intended to play by their deposition. Indeed, the fact that the most common use context, wear from contact with wood that is found on both funerary and non-funerary battle-axes suggest that the functional use of these implements might not have been important for their inclusion with the dead. The variation in use context and deposition contexts suggest that there may be various reasons behind the choice to include a battle-axe or axe-hammer in a funerary assemblage.

The deposit of an implement in a funerary setting may draw on any number of reasons and associations which might explain the variability of the funerary assemblages. One reasoning could be that the dead were buried with the clothes and objects that they wore and had on them as a deliberate reference to their lived identity (Renfrew, 1974; Shennan 1982). If this is the case, the variation in battle-axe and axe-hammer funerary assemblages would suggest that the lived identities also varied. In the past, the interpretation that the dead were buried with objects that reflected their identity has been used to argue that weapons buried with a male meant that they were a warrior, and exotic or 'rich' items signified an elite person of status. The idea that battle-axes are prestigious items belonging to an elite has drawn upon this view (Brumfield & Earle, 1987; Earle & Kristiansen, 2010, 4; Knutsson & Knutsson, 2003, 70;). Scholars have argued against this view, stating that modern sexism has influenced the interpretation of objects in prehistory, particularly those items found associated with male burials (Brűck, 2006; Jordanova 1980; Lloyd 1984; Merchant 1980). Brück argues for the role of EBA funerary artefacts as social agents, whose influence is related to the circulation of these objects throughout their life history. This argument, coupled with the wear analysis results, suggests that the role of battle-axes cannot be exclusively prestigious, status indicating artefacts.

If the funerary artefacts were not owned by the deceased or used to express their identity, another option for their occurrence could be that they were gifts from mourners. The role of mourners could have been to prepare the deceased for the otherworld or send messages from the living to the deceased in this other world (Needham, 2011). This funerary process would require a focus on the deceased as an individual (Needham, 2011). Would the variation in the funerary assemblage suggest that different roles were intended for the deceased in the afterlife? Is this determined by the use-lives of the objects interred with them so that those battle-axes used to chop wood meant the deceased would be able to chop wood in the afterlife? If this were the case, we would expect a greater variety of domestic items, such as quernstones, which we do not find.

Perhaps their placement in burials was by mourners to express and navigate through loss. In this case, what role do the different artefacts in the assemblage have? They could reflect the life of the deceased and reflect the relationship between the mourner and the deceased. However, the variations in the assemblage suggest their deposition were complex. Needham suggests that the objects were used to relate to the deceased character or personal history, that could have been used to express specific societal relationships (Needham, 2011).

This relational approach that Needham (2011) touches upon here, and that Brück (2006) uses to argue for the role of EBA funerary artefacts as social agents, points to a final reason for their deposition. Using a specific combination of artefacts as a reference to particular associations and relationships can be attributed to mourners' choice (Needham, 2011; Brück, 2006). This means that funerary rites were not pre-defined according to the status of the deceased as an individual. Instead, they were the choice of the mourners, so the funerary assemblage was not fixed in life, but in death (Needham, 2011; Barrett, 1994). It was those who buried the deceased, the mourners, who decided upon the funerary process and assemblage. Each mourner may draw upon objects which express their relationship with the deceased; they would have used them for a multitude of reasons, such as to claim ownership over land, status, or objects. The placement of artefacts in the funerary assemblage may have had meaning for a group of people as well as individuals within the group; each has their associations with the assemblage.

Multiple mourners mean that multiple reasons, roles and meanings may be intended for a singular funerary deposit (Crellin, 2017; Ingold, 2007; Deleuze & Guattari, 2004). Various associations with the deceased and with the artefacts interred with them may apply to different people. As such, each mourner could have drawn upon one or multiple relational links with between them, the deceased and artefacts to express a variety of different aspects. These links may be with the deceased, the mourners, their kin group and society and any other links that may be present between the people and location involved with the burial, and others and in other locations. The variation in the burial assemblage could also be argued to reflect this choice. Therefore, the artefacts were part of multiple assemblages and had multiple roles specific to different people. This idea can be used to explain the variation in the funerary assemblage.

The lack of association between funerary assemblages and use context demonstrates that the functional use of these artefacts was not itself drawn upon as the critical aspect. However, since the wear from functional use was not removed, the deposition might have drawn upon the social aspects involved in these object biographies. Elements in the use-lives of these artefacts might have been drawn upon during the funerary process to demonstrate certain relational links. In fact, the use life might be used to demonstrate the versatility and strength of the group of people who used them. These are a list of likely reasons which could have been drawn upon to reflect particular meanings and roles. Through this, it is clear that an association with status, prestige and an elite cannot be the only reason for the deposition of battle-axes in funerary contexts. The variation in the use context and funerary assemblages demonstrates that if the deposition was intended to reflect power and status, it, would not be limited to the individual deceased and could have been one of several roles intended for the artefact.

The differential treatment of a small number of battle-axes that were re-ground before deposition further indicates that there were different motives and roles intended for these artefacts when placed in funerary deposits. Through use action, the surface of the implement will change as wear forms and stone grains are altered and removed. Increased use of an implement creates more visible wear which those using and close to the object could view. The removal of these traces severs the link with the use life of the artefact: for instance, by re-grinding the surface. The intentional removal of wear is a deliberate action. This differential treatment signifies the intention for differential roles. Through the re-grinding process, a limited number of people would have been able to view the changing surface of the implement. This would create a link with a small number of people that could be drawn upon during the funerary process and determines that different battle-axes were treated in different ways for different outcomes/meanings/roles.

The same type of use contexts on battle-axes and axe-hammers found in funerary deposits are also evident among those found in non-funerary deposits. Therefore, the use context is not associated to a specific depositional context. If we compare the use traces, such as contact with wood, bone and earth and roots, of battle-axes from funerary contexts with those that are non-funerary single deposits, there are few differences. Both implement types were treated similarly to prolong their use; for instance, a similar number of non-funerary battle-axes were reground then re-used (n=4) compared to those from funerary contexts (n=2). Re-ground and re-used single deposit axe-hammers number ten.

The similarities in use and funerary/non-funerary contexts indicate that, despite Needham's (2011) assessment, regional preferences for either axe-hammer or battle-axes, or a balance of both, existed and that battle-axes and axe-hammers were used in the same ways and sometimes deposited in the same ways. This table also reveals a difference in treatment of battle-axes from a funerary context, which were re-ground before deposition and therefore not re-used (n=5). There is no single type of funerary context which is associated with this treatment of certain battle-axes and the roles they played within these funerary assemblages, as discussed previously in this section.

Very few implements were deposited at the end of their use-lives in both funerary and non-funerary contexts. The end of a use-life is determined by wear that is so extensive and developed that it has limited the functionality of the blade, such as from a breakage that cannot be repaired. The amount of wear, motions producing wear, and range of materials producing contact traces on battle-axes and axe-hammers were just as varied regardless of the depositional context. This further determines that use was not directly associated with the depositional context.

Since the use contexts are the same for funerary and non-funerary battle-axes and axe-hammers, does this mean that the reasons behind the deposition of the non-funerary implements are also the same? This is unlikely as use-context was not the principal reason for their deposit in funerary contexts. However, since the majority of these implements are stray finds which have very limited or no information regarding their depositional context, it is difficult to definitively determine the reasons behind deposition. There are several possible reasons; for instance, some of these objects may have been decontextualised. Those discovered in rivers may have fallen off a haft which had been left in the water to expand, or an axe-head might have flown off its haft during use, getting lost in thick undergrowth. However, the large numbers of stray finds suggest other reasons may also have resulted in the context of their deposition.

The use context similarity could indicate that they were once from burials which have since been decontextualised, particularly those found in farmland areas such as in Cumbria. The changing course of rivers could engulf a burial deposit, thus resulting in artefacts being dredged or fished from river beds, out of context. Equally, extensive farming would have removed and spread the contents of burials across fields, destroying that which is close to the surface with years of ploughing. Farmers found a large number of axe-hammers in their fields, so this is a feasible option.

Alternatively, these non-funerary implements may have been deposited intentionally as single deposits. If this is the case, then their intentional deposition was not a result of the end of their functionality, since only two implements were deposited at this point in the use lives. It may reference the skill of the people or person who used the implement which could be used to express status. Equally, the importance or status of a person or people who used the implement, including the deceased, may have been drawn upon to represent links with places, people and trade networks or confirm the importance of ancestors. For example, an implement which was used for an extended period, and perhaps handed down through generations could draw upon its previous owners and users. This might include the deceased whose character or personal history may be used similarly to express specific roles and connections (Needham, 2011). An ancestral link, which was forged, maintained, and strengthened through generations through ceremonial acts may be another process which resulted in the placement of battle-axes in diverse funerary assemblages. Indeed, Needham has argued that the variation in burial assemblage that we see during the EBA may be related to the veneration of ancestors (Needham, 2011). However, the lack of extensively used implements suggests otherwise – perhaps this was the case for the two axe-hammers deposited at the end of their use lives. While, the re-grinding of funerary battle-axes prior to their deposition may have been an act to severe such ancestral ties.

The other potential reasons, all of which are suggestions for something we cannot know for sure, for the intentional deposition of stray finds as single deposits could be political or social. The deposition to convey a message, create or maintain a claim, or give thanks. The intentional deposition could also have occurred as thanks to the land and that which grew upon it. Since working with wood is the most common use for both battle-axe and axe-hammers, intentional deposition to venerate the trees, the spirits of the trees, or ancestors linked to the trees could have occurred. In order to create or maintain links or claims to land ownership, for instance, the intentional deposit of nodal points in the landscape could have been used as a reference or marker to this. Their deposition could draw upon an area where the implement was used, indicate boundaries of the land, arable, pastoral or wooded. Perhaps the other reason for deposition was a link with farmed land since there are a large number of battle-axes and axe-hammers deposited in the soil. However, with limited depositional information, it is difficult to determine if farming occurred in these areas during the EBA. As a result of the lack of deposition information, none of the likely reasons for deposition can be realised.

The more unusual non-funerary battle-axe contexts are associated with the activities that occurred at those sites. Four non-funerary battle-axes were discovered with depositional contexts, three at a house site/stone tool workshop and another in a shell midden. This association suggests that the reasons behind the deposition of the stray battle-axes and axe-hammers were varied and might be specific to each implement individually.

The implement found in a shell midden and two of the three battle-axes found at the house site at Ness of Gruting were unfinished. These implements were most likely never functionally used as they were deposited before they were finished. Reasons for this may differ between the two contexts. Calder interpreted Ness of Gruting has as a production site for stone implements, which implies the deposition of two unfinished battle-axes was related (Calder, 1958). Likewise, the third battle-axe from Ness of Gruting, which was re-ground, is also likely to be related to such activities. There is a relationship between the roles and meanings of these objects prior and during their deposition and the act of deposition; perhaps the deposition was drawing upon the process of production.

Nonetheless, the difference in context and the trend in the treatment of the implements implies that these depositions are unusual for battle-axes in Northern Britain and the Isle of Man and were intrinsically linked with the activities that occurred there. For instance, the discussion of the shell midden previously in this chapter suggests that the deposit could have attested to a marine diet and lifestyle, such as fishing, of past generations. Alternatively, it may be referencing the continued consumption and use of marine resources, albeit less common than during the Neolithic.

8.2.3 The selection and treatment of b-a and a-h for funerary deposition

The selection of battle-axes and axe-hammers for funerary deposition was not related to their typology or petrology, and no single stone petrology correlates with a specific use for the battle-axes in the dataset, regardless of their depositional context. In comparison, all three analysed axe-hammers from funerary deposits have the same petrological group, Group XXVII. Two of these implements were used in the same ways. The analysed axe-hammers with a Group XXVII petrology (n=7) do not have the same uses. Their uses include as a wedge in contact with wood (n=3) and chopping in contact with wood (n=3). One only has production traces, and another was in contact with wood, although with unknown motion due to modern traces. The choice of petrology for axe-hammers in funerary contexts is related to the locality of Group XXVII and the preference for this type of stone in the production of axe-hammers in the south of Scotland (Clough, 1988, 10). Therefore, petrology has not been explicitly chosen for funerary deposition or use.

The types of battle-axes and axe-hammers that were chosen for funerary deposition are also not specific to their context. No one type is specific to a particular feature, or funerary assemblage. Nor do they correlate with a particular use. The selection of battle-axes and axe-hammers for funerary deposit reflects the range of types in circulation and use. Figure 10.3 demonstrates that the Stage I axe-hammer type is the most common; this trend continues when looking at funerary context. For instance, figure 8.4 shows Stage I axe-hammers to be more common. Taken together, the lack of patterning suggests that form and material were not of importance for funerary deposition.

Despite the similarities between battle-axes and axe-hammers, there is a much larger quantity of battle-axes from funerary deposits (b-a = 39; a-h = 8). Needham has seen the small number of axe-hammers to be an exclusion from funerary contexts, which he calls ‘quite extraordinary’ during a period of ‘prevailing funerary rights’ (Needham, 2011). Just 2.2% of axe-hammers are from known funerary contexts in Northern Britain and the Isle of Man, compared to 21.3% of battle-axes. Although the quantity of battle-axes from funerary deposits is significantly more than axe-hammers, 21.3% is also a small quantity when compared to the 78.7% that are from non-funerary contexts. Does this mean that these battle-axes are also being excluded from funerary contexts in the same way that 97.8% of the axe-hammers from non-funerary contexts are? Section 8.2.2 considered the possible reasons for non-funerary deposits, some of which may have once been funerary. However, without further information, it is difficult to assess the depositional contexts of most non-funerary battle-axes and axe-hammers. Were they intentionally excluded or were they deposited for a specific reason (for the possible reasons, see section 8.2.2)?

The use contexts of funerary battle-axes and axe-hammers are similar and cannot be used to differentiate between the treatment of both artefact types. They were selected for deposition in funerary contexts at varying stages of use; this includes implements with well-developed, extensive, moderate and less developed use. Deposition of implements with just production traces indicated no functional use, and those which were re-ground before deposition (limited to battle-axes only), also occurred. This variation parallels the variation in the amount of use analysed on all implements in the dataset. It indicates that functional implements were selected at various stages in their life histories for funerary deposition. It also suggests that their use-context did not play an integral role in this decision.

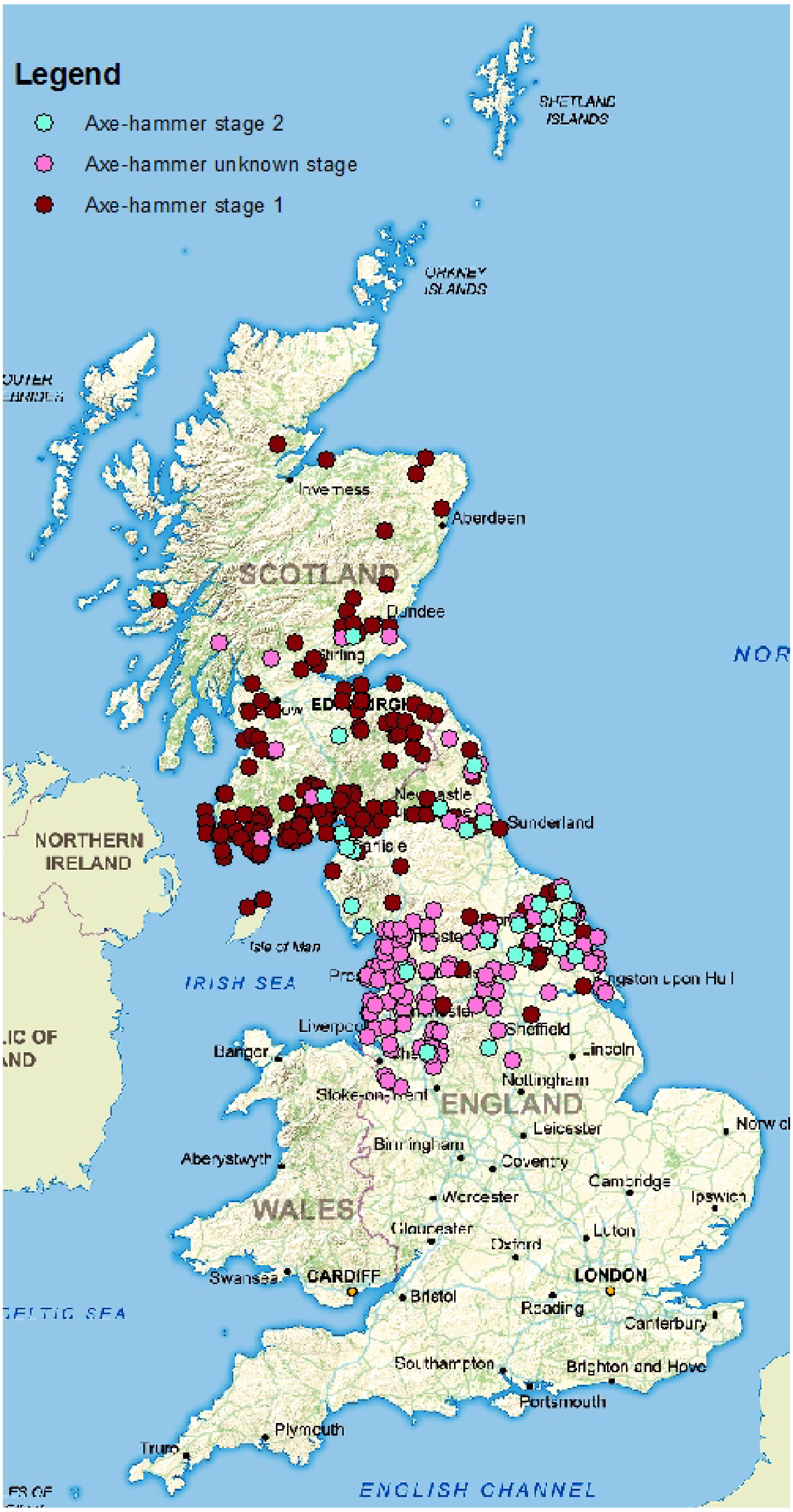


Figure 8.3: A distribution map of the types of axe-hammer

Figure 8.4: A distribution map of axe-hammer types found in cairns

The variation in the amount of use might indicate that these implements were deposited with deceased people of different ages, which may been due to the retainment of an axe by a single individual or its use as an heirloom. If an implement was retained by one person throughout their lifetime it could be assumed that wear would increase as the individual aged, notwithstanding any re-grinding, and also as it was passed down through generations. However, it is also possible that people shared the use of these objects; the extent of use on the object may then reflect the amount of it was used across multiple people. Links such as this could have been drawn upon by mourners through the objects deposited during the funerary process. Uneven wear on the blade edges, such as more wear on one side than the other, could be used to argue for changing users since technique, the height of the user, and handedness would differ from user to user. Uneven wear is seen on four axe-hammers (ID: 58; 185; 238; 293) and five battle-axes (ID: 2; 3; 75; 102; 230), although the reasons for this require experimental confirmation.

Seven battle-axes have information regarding the age of the deceased they were buried with, six of these were analysed. A battle-axe buried with a child and another with a child and adult had production and undeveloped wear indicating limited and no use. Two adults age 18 and 18-24 were buried with battle-axes with moderately developed wear and another adult, of unknown age, was deposited with a battle-axe that had been used, re-ground and then re-used. There is not enough information regarding the ages of the deceased individual to understand if a trend exists, and information is unknown for seventeen further burials with battle-axes, and three with axe-hammers. However, the presence of an unused miniature battle-axe with a child and a limited used battle-axe with an adult and child may point towards the intentional selection of unused, and miniature implements buried with the younger members of society. Gibson has suggested that miniature objects were childhood objects and toys (Gibson, 2004, 273). However, the limited signs of use indicated on the miniaturised battle-axes suggest that these objects were restricted to funerary use only. This small sample hints that funerary battle-axes were biographically linked with the deceased. Previously in this chapter, the variation in wear development was used to argue that these implements were deposited at various stages in their use lives and were rarely deposited at the end of their use lives. This hints that battle-axes were intentionally removed from circulation and use at specific points in their life histories, to draw upon the biographical links that use, up until the moment of deposition, created. For instance, if the use of these objects were shared with the deceased during their lifetime, then the relational links possibly created through sharing the battle-axe could have been drawn upon.

The intentional re-grinding of 5 battle-axes before their deposition in funerary contexts implies that not all implements deposited in funerary contexts were treated in the same manner. Little is known regarding the age and sex of those interred to conclude any relationship. Only the reground battle-axe from Sandmill Farm, ID 189, has limited information about the age of the deceased it was buried with – an adult.

Re-grinding is an act which separates the deceased and the mourners from the previous use lives of the implement by removing the traces of the functional use of the object. Such re-grinding would also remove any relational links created between people and places through use. The re-grinding for the renewal of the blade also occurred to continue the functionality of both battle-axes and axe-hammers from funerary and non-funerary contexts. Perhaps the new, clean nature of a freshly re-ground object was essential for the funerary deposit in those cases. It is likely that this was also an influencing aspect in the selection of axe-hammers and battle-axes with no sign of use, just production traces, for funerary contexts. As this chapter has discussed, mourner's choice determined the processes which led to the selection and treatment of battle-axes and axe-hammers in funerary contexts.

Section 8.3 will continue the consideration of the uses and meaning of these implements, comparing them to understand their differences and similarities further.

8.3 The uses and life-histories of battle-axes and axe-hammers

It has been assumed that battle-axes were non-functional and purely ceremonial due to the presence of some in funerary contexts (Roe, 1966). The obscure nature of axe-hammers has resulted in multiple interpretations of their function but few of their meaning and significance within EBA society. The ideas that they are either domestic tools or non-functional objects have circulated with neither one taking hold. However, the function of these objects has now been properly assessed, and the results suggest that these implements had prolonged and extensive use-lives. Section 8.2 demonstrated that funerary axe-hammers and battle-axes were functional. The similarities in the use-lives and deposition of battle-axes and axe-hammers are also evident. They suggest that the roles and meanings of EBA implements were also similar and would have resulted from the same processes and actions. As such, they are likely to have also been circulated in the same ways, such as through gift exchange, and therefore aided in the construction of identity. Their life histories are entwined with the development of identity and self through the object biographies and itineraries.

To understand the meanings and roles a battle-axe or axe-hammer may have had when it is deposited in a funerary or non-funerary context, it is important to understand the terms ‘object biography’ and ‘object itinerary’. An object biography looks at the social use life of an object from its birth until its death. It aims at understanding how artefacts transform as they move through time and space between people (Gosden & Marshall, 1999). The questions one might ask to understand object biographies include: where does the object come from and who made it? How does the object change with age? What happens to the object at the end of its use life? (Kopytoff, 1986, 66). However, the linear nature of this approach means that lateral associations can be missed. Object itinerary developed from object biography with the aim to better tackle the movement of things using a relational approach (Hahn & Weiss, 2013). This looks at the movement of objects from their point of creation, including physical travel and circulation through actions such as gift exchange, as well as spatial, temporal and material connections at points in the itinerary (Joyce & Gillespie, 2015). For instance, moments in the itinerary include the manufacture of battle-axes and axe-hammers, their distribution through mobility and gift exchange, their functional use through time, and the possible sharing of the use and ownership of these implements - they create relational links between people and objects and transforms their roles and meanings. The movement of these artefacts between people and locations were involved in object transformations entwined with the transformation of people and therefore they influence the construction of identity. The objects may be used in various contexts and settings to metaphorically link the self to a relational network created through the movement and transformation of objects which are intrinsically linked with the relationship between people and things (Brück, 2004; 2006 & 2019).

Identity in the Bronze Age has often been regarded as prominently individual, with actions, such as burial processes deriving from this. Such ideas stem from the view that objects are personal possessions, and thus, their funerary deposition must reflect the identity of the deceased. Movement beyond this idea has maintained that objects were not just personal possessions (Barrett, 1994, 116-18; Bradley, 1999, 223; Parker Pearson, 1999, 85; Thomas, 1991; Woodward, 2000, 113-15). For instance, recently, Brück has focussed on the exchange of artefacts and bodies, their fragmentation, dispersal and re-incorporation, to question this idea of Bronze Age self. Her theories can be applied to EBA funerary battle-axes and axe-hammers. She has argued for the construct of identity as a result of the interpersonal connections that were created through the circulation of objects (Brück, 2004 & 2019). She argues that the placement of objects in funerary contexts is a mortuary transaction in which the mourners are acting out personal exchanges with the deceased. Such transactions highlight the ongoing relationship between the living and the dead, which Brück argues facilitate the regeneration of society (Brück, 2006, 77 & 88). As such, the roles objects played in Bronze Age society acted in the construction, transformation and breakdown of social identity within vast social networks of society (Weiner, 1992, 129).

The differing funerary assemblages of EBA battle-axes and axe-hammers that were the result of mourner's choice demonstrate that different relational links were being drawn upon. These developed through the life of these objects. Indeed, the variety of different use contexts, such as chopping and splitting wood, clearing undergrowth and multiple uses, indicates that the itineraries varied from implement to implement. The relational activities of each implement were part of their unique itinerary creating their life histories. The consideration of use context with the spatial, stratigraphic, typological, and petrological contexts in this chapter has illustrated the complex nature of the itineraries of these objects. This section examines the itineraries of these object further beginning with their manufacture of battle-axes and axe-hammers and the potential for their use as tools and weapons. I argue for the functional use of both battle-axes and axe-hammers as tools, while their potential use as weapons is more uncertain. A regional assessment of their distributions looks at the physical movement of these artefacts and discusses how the dispersal of these objects might create a significance or prestige through the creation of interpersonal connections (Brück, 2006, 77 & 88).

The chapter ends with a discussion of the level of significance of EBA battle-axes and axe-hammers in light of the data gathered through contextual assessment, wear analysis and experimental tests. It determines that there are multiple possibilities for the creation of a significance or prestige and that placement in burial is just one aspect with a relational web of potential causes within the object itineraries for their meaning involved in function, treatment and deposition.

8.3.1 The manufacture and movement of battle-axes and axe-hammers

A wide range of petrologies was used to make both battle-axes and axe-hammers. No specific petrology was limited to a specific type or portion of the chronology of either implement. This lack of relationship correlates with Fenton's finding that the haphazard exploitation of cobbles and glacial erratics were used to make a vast majority of battle-axes and axe-hammers in Scotland (Fenton, 1984). Although known petrological groups were used, such as XII, XIII, XIV, XVIII, XXIII, these were not exploited to the large scale seen during the Neolithic. Stone was procured and chosen for its ease rather than for the significance of specific petrology. This signifies a marked difference in the processes of choice.

The stone sources for Neolithic polished stone axes have been interpreted as symbolic places which were often extreme or liminal. The Pike O' Stickle working floor at Langdale was difficult to access due to the steepness and height of the peak. The significance is furthered here since the same Group VI stone quarried at Pike O' Stickle could be found in more accessible locations (Bradley & Edmonds, 1993, 42 & 125). Pike O' Stickle is a prime example that the choice of the stone source was the result of more complex meanings for these sites. Cooney argues the act of quarrying, procuring and exchanging axes from such symbolic sites may have been critical to understanding what it was to be Neolithic (Cooney, 2011, 438). This symbolism is further demonstrated by the vast trading networks, which distributed Group VI throughout the UK.

In comparison, Fenton's demonstration that the haphazard exploitation of scree and river deposits for the production of battle-axes and axe-hammers establishes that the meanings and roles of the stone sources were different. The ease of stone procurement determines that stone no longer held the high prestige it did during the Neolithic. As such, any prestige or significance must have developed during subsequent narratives within the objects' itineraries, such as the possible sharing the use of an implement.

Movement of battle-axes away from their stone source is evident for every known petrological source. The actions behind this movement could be the result of trade and exchange, the mobility of those using the implements, mobilisation, or the exploitation of glacial erratics. The distribution of battle-axes made of known petrological groups away from their sources indicates that battle-axes were moving around Northern Britain and the Isle of Man. For instance, Group XVIII battle-axes are spread widely across northern England and

Southern Scotland, moving vast distances from their source in the northeast of England. Group XIII have been found as erratics pulled from the Whin Sill to the northwest to the southeast, following the ice flows of the last Ice Age. Several Welsh stone implements have been made from erratic, river and outcrop sources (Williams-Thorpe, et al., 2006). Likewise, the location of Group XII source is in the Shropshire/Montgomeryshire border, and battle-axes of that petrology were found in Yorkshire and Fife. Clough and Cummings (1979) assessed that stone implements made from Group XXXI are so rare outside of Yorkshire that they are almost unknown, yet the only battle-axes of this type are found in southern and northern Scotland which suggests that these battle-axes travelled well outside Yorkshire through routes of trade, gift exchange or mobilisation. Many battle-axes also travelled to southern England, Group XVIII spread throughout the UK, and Groups XII and XV moved as far as the Midlands.

The manufacture of axe-hammers is little different to that of battle-axes, although there is a more substantial variation in the types of petrology used to manufacture axe-hammers. There are more axe-hammers in the archaeological record, which may relate to this broader source variation, but the variation indicates the same haphazard exploitation of sources that we see with battle-axes (Fenton, 1984). Within the varied petrology, known petrographic groups were also exploited, including Groups VI, XV, XIV, XVIII, XXIX, XXVII, XXVIII and XXX. Group XXVII was the most common, with axe-hammers in the south of Scotland close to the source as well as the small number found in Northumberland (n=5); Cummins and Harding (1988, 79) have suggested that the manufacture of battle-axes and axe-hammers made from Group XXVII occurred in the southern uplands from Berwickshire to Wigtownshire. Those in Scotland demonstrate the exploitation of local sources for use in southern Scotland. The proximity of Northumberland means it is no surprise that Group XXVII axe-hammers have been found there whether this is through movement, trade and exchange or the exploitation of glacial deposits (Cummins & Harding, 1988). The movement of axe-hammers from the area of their petrological source is noticeable; the furthest axe-hammers have moved from northern Scotland to southern Scotland and from Southern Scotland to Northern England (Clough, 1988, 9; Williams-Thorpe et al., 2003; Williams-Thorpe, et al., 2006). Three of the petrological groups, XV, XIV and XVIII, sourced in the north, were used to make axe-hammers discovered in southern England.

However, some of the petrological groups are also spread across Britain as glacial deposits which makes the sourcing of stone from glacial erratics possible (for an example of erratic distributions originating in Cumbria, see figure 8.5). Shotton (1998, 51) suggested that a large amount of stone implements from the West Midlands, the location of several Group XII battle-axes, that are ungrouped indicates that these implements might have been made from glacial erratics. The large number of ungrouped battle-axes and axe-hammers from Northern Britain and the Isle of Man could be the result of erratic exploitation. Those implements that have a petrological group and appear some distance from the group source may also be from erratic use. In particular, the battle-axes and axe-hammers found in areas of Southern Britain where the stone is uncommon are likely to use erratic boulders. Stone axes in Essex are known to have been made mainly from glacial erratics in the area (Cummins, 1979, 10). The exploitation of erratics of Groups VI and XII petrologies is also known for stone axes, and it would therefore not be unreasonable for these also to be quarried during the EBA when stone procurement exploited easily accessible sources.

Movement of people and gift and exchange networks could be used to understand the distribution of battle-axes and axe-hammers, long distances from their petrological sources. The movement of people during the EBA is known from isotopic results which demonstrates a considerable amount of mobility of all ages during the Chalcolithic and EBA (Evans et al. 2006; Parker Pearson et al. 2016; Pellegrini, 2016). The Beaker People Project revealed that the highest mobility was found in northern Scotland, Yorkshire and the Peak District. They also noted that the complex geology of Scotland produces significant changes in biosphere strontium isotopes at relatively small geographic scales, so movements in Scotland might not have covered large distances (Parker Person et al., 2016, 630). This suggests that movement within communities and between neighbouring communities was probable.

It is, therefore, entirely possible for people to be moving around with artefacts, which were then deposited in locations away from their area of manufacture. However, were these artefacts battle-axes and axe-hammers? What possessions did people bring with them? The Beaker People Project analysed individuals buried with artefacts commonly found in EBA funerary assemblages, such as an awl and bronze pins found with a male from the Peak District who is thought to have grown up in east Scotland or outside of Britain (Parker Pearson et al., 2016, 631). Objects found in the funerary assemblage could have travelled with these people, and styles of the artefact, such as beaker pottery have been used to suggest continental connections.

It is likely that the manufacture and use of British battle-axes and axe-hammers were influenced by their counterparts on the continent (Roe, 1966; Needham, 2011), but we rarely find continental battle-axes in the UK, so the movement of these object was limited to British exchange networks. Equally, neither implement has been found with beakers in Northern Britain, although they do occur together in the south. The spread of battle-axes and their larger counterparts, axe-hammers, would have also been caused by emulation through the vast, long-established exchange networks (Needham, 2007, 44). Such exchange networks for gift exchange and trade would have added to the movement of objects (Brück, 2019, 232; Needham, 2011; Maus, 1925). Brück's research demonstrates the significance of exchange during the EBA was created through the construct of identity, as a result of the interpersonal connections that were created through the circulation of objects (Brück, 2019, 69-114 & 2004). The placement of battle-axes and axe-hammers in funerary assemblages by mourners drew upon the relational connection between people and objects. Brück sees such transactions an extension or continuation of exchange networks between the living and the dead (Brück, 2004), which suggests that these exchange networks were drawn upon in death. If this is the case, the large number of battle-axes and axe-hammers from non-funerary contexts might not have been involved in exchange networks, or the right exchange networks to necessitate their funerary inclusion. There is no association between the distribution of these, the context of these implements and specific petrology, which demonstrates that movement was not limited to those found in funerary contexts. As such, significant elements from the itineraries of these objects, not limited to their manufacture or distribution, are being drawn upon on their deposit.

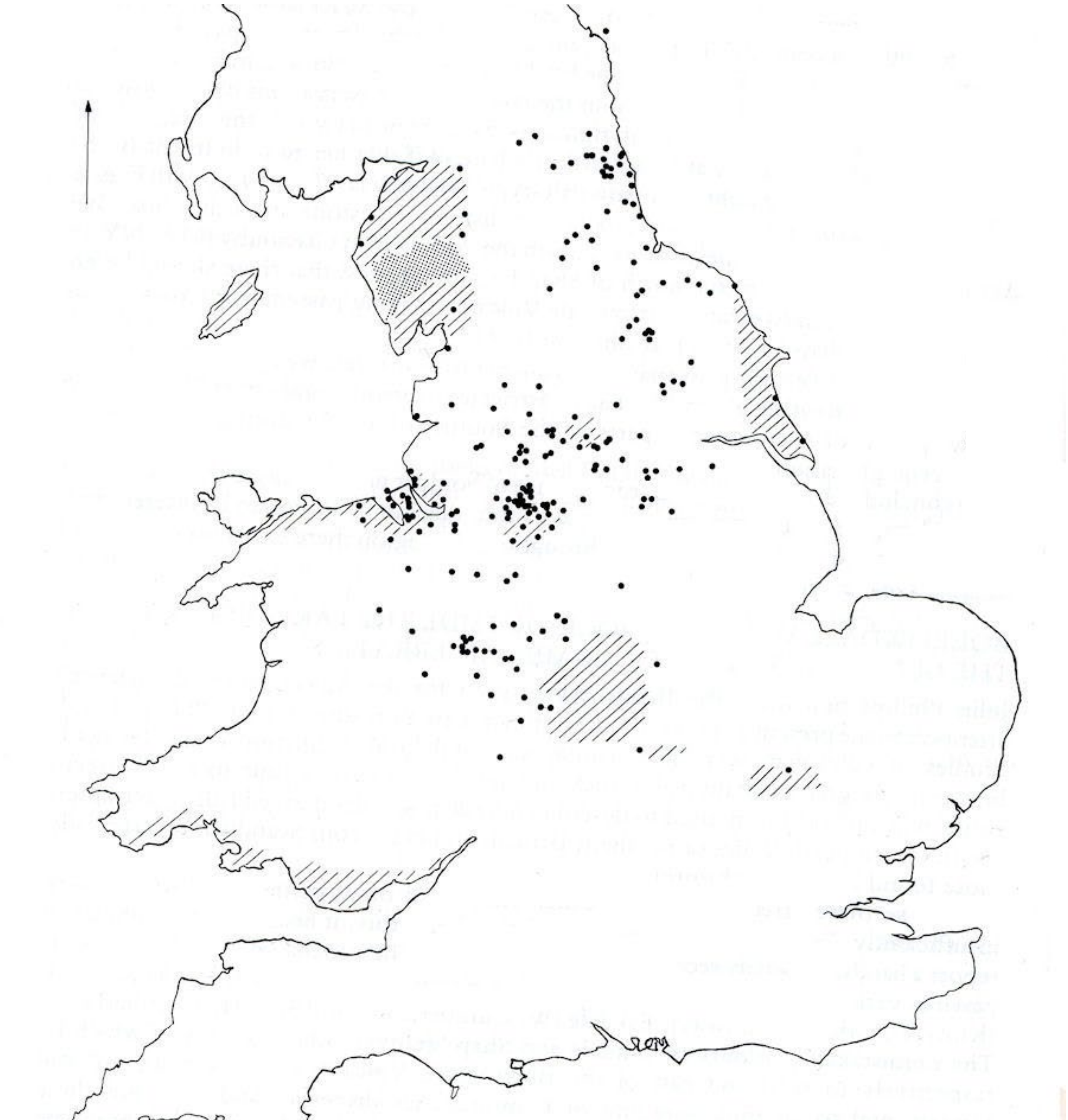


Figure 8.5: Cumbrian erratic dispersals signified by the dots (Briggs, 2009)

Group XVIII, used for battle-axes and axe-hammers, is sourced from the Whinsill outcrop in Northumberland, but it is also found as glacial erratics scattered across Yorkshire (Keen & Radley, 1981, 27; Manby, 1979, 73;) and as far as the south-east coast (Williams-Thorpe et al., 2003). It is thought that the Group XVIII implements in southern England are the result exploitation of erratics dragged to the southeast coast during the Ice Age (Williams-Thorpe et al., 2003, 1264). However, analysis of different sites along the Whinsill, such as Holy Island, is yet to be undertaken so further information regarding the distribution and petrological variation within this group may tell a different story. The exploitation of glacial deposits along with scree and river sources for the manufacture of battle-axes and axe-hammers further establishes that the stone sources no longer held the prestige they did during the Neolithic.

Overall, the exploitation of glacial erratics, as well as outcrop and scree sources, are both likely. Movement of implements is most likely to have occurred in more localised areas, between and within neighbouring communities. A good example is the movement of Group XXVII from southern Scotland to Northern England (Clough, 1988), although it is possible that this was through glacial action; perhaps both movement of the implements and exploitation of glacial erratics occurred. Such localised movement of objects would have provided a significance specific to that region, demonstrating community and inter-community relationships. As a result, the more axe-hammers or battle-axes travelled through mobilisation, gift exchange and trade within and between these communities, the more significant they became. Indeed, the location of axe-hammers made from Group XXVII occurs in areas where axe-hammers were more dominant.

8.3.2 Regional patterns in the types, uses, distribution and deposition of battle-axes

There is no correlation between use and petrology, petrology and type or use and type within the dataset. There are limited regional patterns related to the deposition of battle-axes and axe-hammers, figures 8.11, 8.12, 8.13 and 8.14. Fourteen out of fifteen of the battle-axes from funerary contexts in Yorkshire are from barrows, and on only one occasion was a battle-axe found in a barrow outside Yorkshire, at Barns Farm, Fife, a site with a potential mound (Watkins, 1982). Likewise, there are features which only contain battle-axes in Scotland, for instance, cairns, rivers and stone circles/cists. The features in all three examples are spread across Scotland. The use of battle-axes in different features, cairns vs barrow, for example, are regional preferences for the burial of the dead, in this case, barrows and cairns are both burial mounds and were treated in the same manner; they are a regional interpretation of a broader burial trend. Another example of this is within Early Bronze Age burial assemblages where the inclusion of Collared Urns in burials in East Yorkshire is often accompanied by an accessory vessel, whereas in Wessex they are accompanied by an awl (Bukach, 2015, 533).

There is a noticeable lack of battle-axes from known depositional contexts in Northern Scotland (n=3) and the North West of England (n=0). These areas have fewer battle-axes than the rest of northern Britain and southern Scotland. The mountainous terrain of Northern Scotland means that fewer archaeological features and artefacts are found through development and farming as they are less extensive. In contrast, the lack of battle-axes in the north west of England could be related to the higher quantity of axe-hammers in this region. Axe-hammers from funerary contexts have also been found here which suggest that they were treated as battle-axes were in the rest of Northern Britain. The same goes for the south west of Scotland where there is more substantial number of axe-hammers compared to battle-axes, and axe-hammers appear in funerary contexts.

There is no relationship between the function and type of battle-axes and axe-hammers and a specific region, see figures 8.18 and 8.15. However, the distribution of battle-axes in comparison to axe-hammers shows regional centres where one implement type is much more common. Figure 8.5 demonstrates the distribution of battle-axes and axe-hammers relative to one another, backing up Needham's argument that there are regional foci of battle-axes and axe-hammers (Needham, 2011).

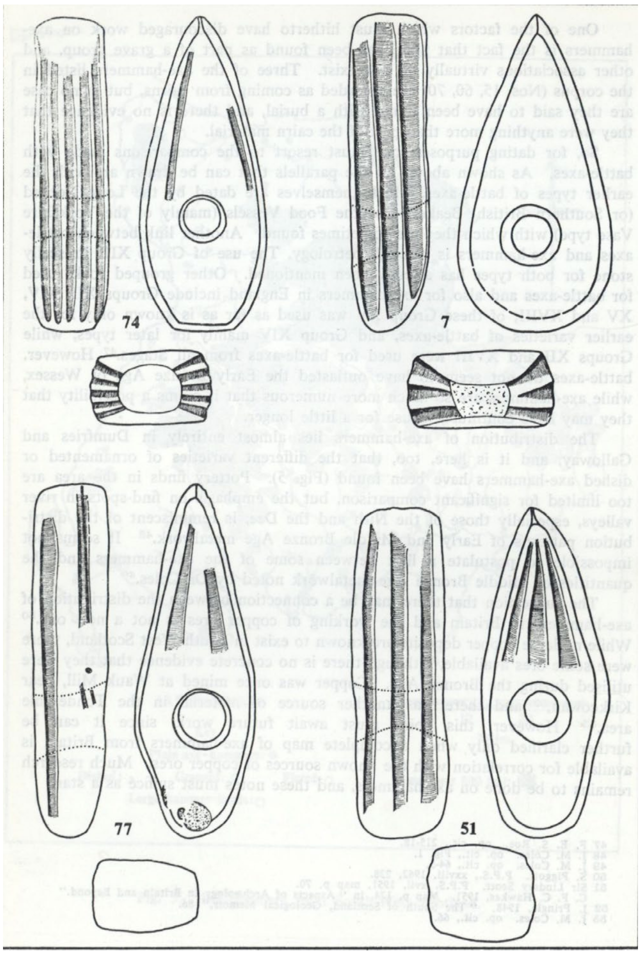


Figure 8.6 Illustrations of four fluted axe-hammers (Roe, 1967, 70)

The typology for axe-hammers is less varied; there are just two types: Class I and II. Class II is uncommon, but there is no difference in the use-wear between the two types. The distribution of axe-hammers and battle-axes suggests that there are certain areas where one type is more prevalent. For instance, axe-hammers are more common in the south west of Scotland and the Northwest of England. The south-west of Scotland and the north-west of England is also where a small number of axe-hammers with fluted decoration – wide, shallow grooves on the lateral edges – are found, some of which also appear in funerary contexts. Fluting (for examples, see figure 8.6) occurs on early battle-axes and a small number of axe-hammers limited to Dumfriesshire and Kirkcudbrightshire, south-west Scotland (Needham, 2011). Fluted axe-hammers occur in areas where there are fewer battle-axes which suggests an equivalence between fluted battle-axes and fluted axe-hammers. Roe identified four fluted axe-hammers (ID 14; 352; 372; 336) from the south west of Scotland, and a fourth exists from Cumbria (ID 45), identified by myself during data collection at Tullie House Museum. Cumbria also has fewer battle-axes and examples of axe-hammers deposited in funerary contexts, like south-west Scotland, which indicates that the treatment of axe-hammers was equivalent to battle-axes in both areas. Figures 8.7, 8.8 and 8.9 demonstrate that the distribution of fluted battle-axes and axe-hammers is spread across the north-west of England and south-west and central Scotland. Fluted axe-hammers are in areas of dense and moderate axe-hammer populations, and where battle-axe and axe-hammer quantities are equal. The relative distributions indicate that fluting occurs on axe-hammers in areas where battle-axes are few and on battle-axes in areas where the quantities are equal. For the latter, they only occur in central Scotland which suggests a regional preference, perhaps in deliberate contrast to the axe-hammers in the south-west of Scotland.

A small number of axe-hammers are a lot bigger than other axe-hammers. Out of those analysed, these number just two, from Cumbria. One of these axe-hammers (ID 50) is 275mm long and has an extreme hourglass shape with a thin central area, 15mm in diameter at the centre and 45mm at the ends. This would appear to allow too thin a haft to be practical, given what is currently understood about hafting. However, this axe-hammer had wear indicating use over a prolonged period, so hafting did not affect its functional use (this requires further experimental testing to clarify). The other large axe-hammer is 300mm in length and has a straight perforation. This implement was also clearly used functionally. So, size did not restrict functional use and may have even aided it.

The larger axe-hammer might also have been used for non-functional roles, as their size could be used for show, to demonstrate power or strength. This may be related to the areas of more dense axe-hammer populations, therefore further demonstrating the regional difference in interpretation of these objects. There is no reason why the smaller axe-hammers could not have been used in this way either as they are also large, ranging from 190mm to 265mm.

The wear analysed on the two larger implements does not differentiate them from the remaining axe-hammers. There is, in fact, no relationship between use and depositional context, use and petrology, or use and typology, see figure 8.13 for the distribution of use. Figure 8.4 demonstrates that there is no regional preference for axe-hammer type, although the typology of a large number is unknown due to the limitations accessing these implements. The clusters of Stage I axe-hammers exist in the areas where axe-hammers are more prevalent over battle-axes. See figure 1.1 for the distribution of axe-hammers and battle-axes. Figure 8.14 determines that stray finds are the most common depositional context for axe-hammers across Northern Britain and the Isle of Man. There is a small number which are from funerary contexts. These are in areas where axe-hammers are predominant, see figures 8.10 and 1.1. They demonstrate that in some cases, axe-hammers were being treated in the same way as battle-axes.

Figure 8.7: The distribution of fluted axe-hammers and battle-axes relative to non-fluted battle-axe and axe-hammers

Figure 8.8: The distribution of fluted battle-axes relative to non-fluted battle-axes

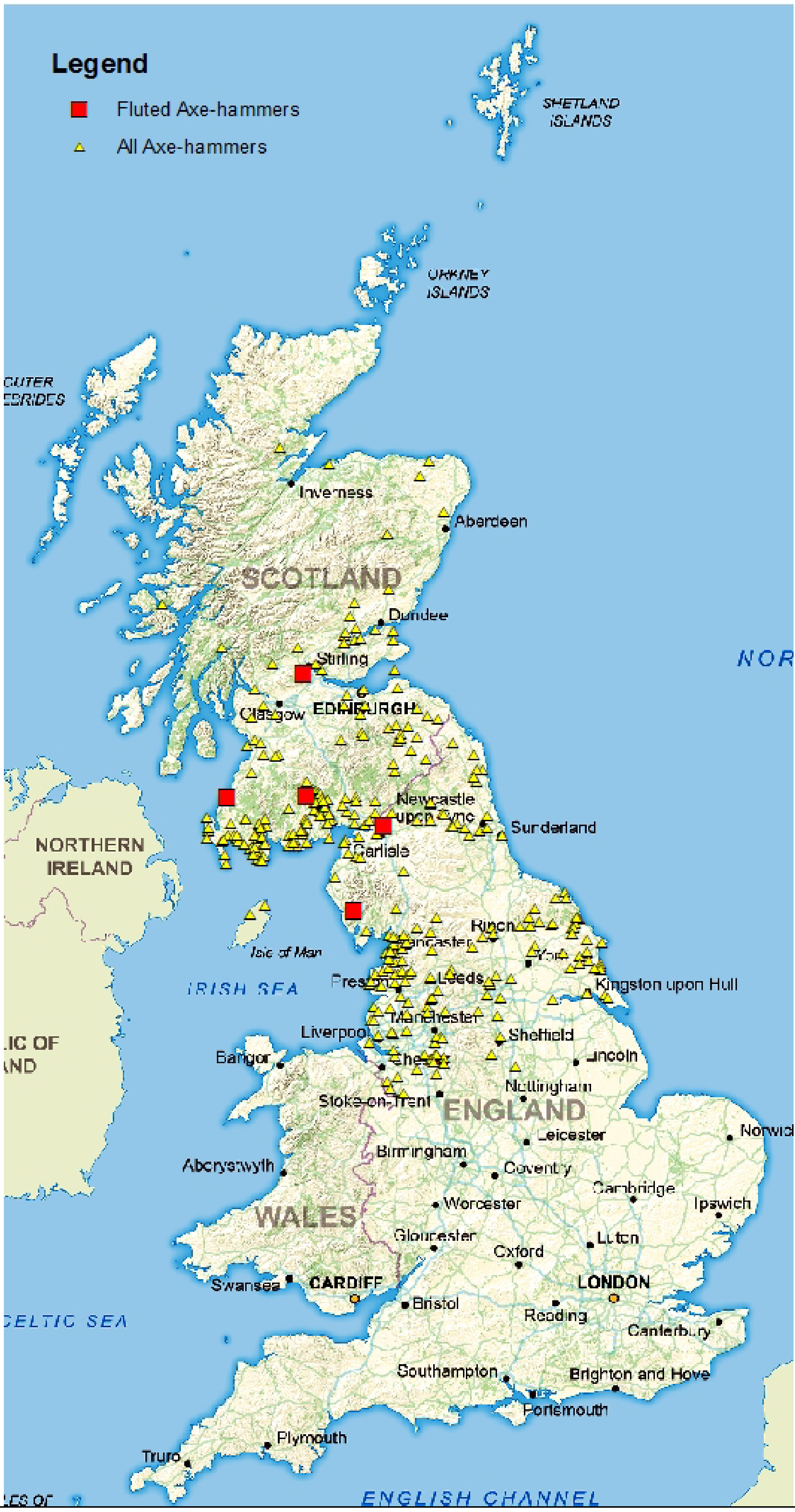


Figure 8.9: The distribution of fluted axe-hammers relative to non-fluted axe-hammers

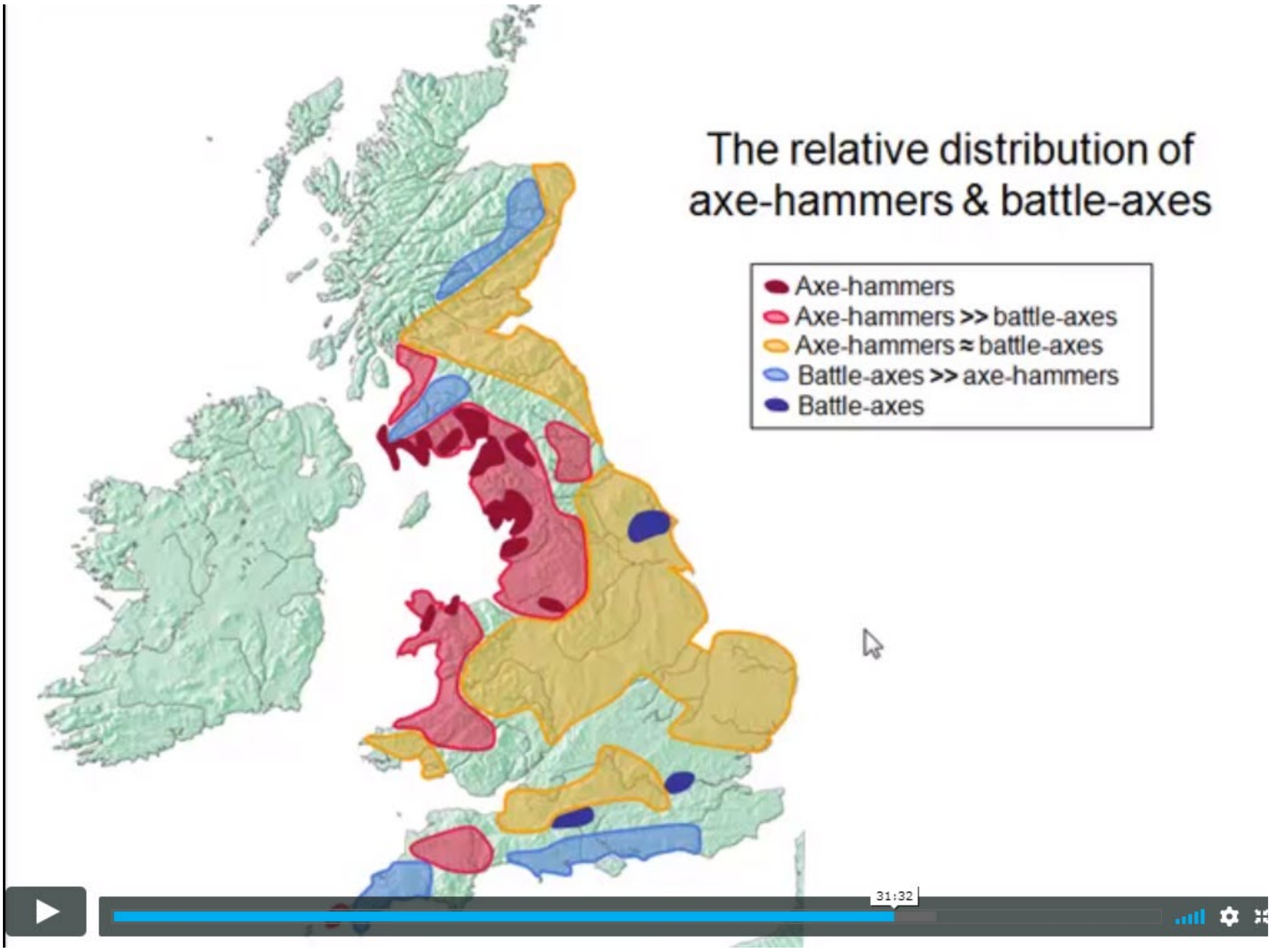


Figure 8.10: Needham's distribution of battle-axes and axe-hammers (Needham, 2011)

The preference for axe-hammers over battle-axes is some areas and battle-axes over axe-hammers in others indicates that regional preferences were at play (Needham, 2011). However, the similarity in use context across all regions suggests they were being treated the same across Northern Britain and the Isle of Man, irrelevant of their location. So, what made some choose axe-hammers over battle-axes and vice versa?

Most of Britain has both battle-axes and axe-hammers in more or less equal numbers, so the pockets of these areas of preference are highly localised. As a result, the reasons for this preference will be different from the general, nationwide reasons for the use and ownership of these implements. Needham has suggested that the origin of axe-hammers was a result of a more profound symbolic role related to their grand nature (Needham, 2011). Another suggestion he made was that preferences were related to function, which data from this thesis cannot support. He supposes that axe-hammers localised at Alderley Edge and the Great Orme might indicate their use in mining metal ores, however, wear on the axe-hammer from around Alderley edge, ID 37, does not indicate this function, nor does the remaining axe-hammer analysed. The reasons for regional preference are not certainly known, but it is clear that the interpretation of the significance of a small number of axe-hammers was paralleled with battle-axes. In those areas with a larger number of battle-axes, perhaps the significance and status of axe-hammers were different or significantly less than the rest of the country?

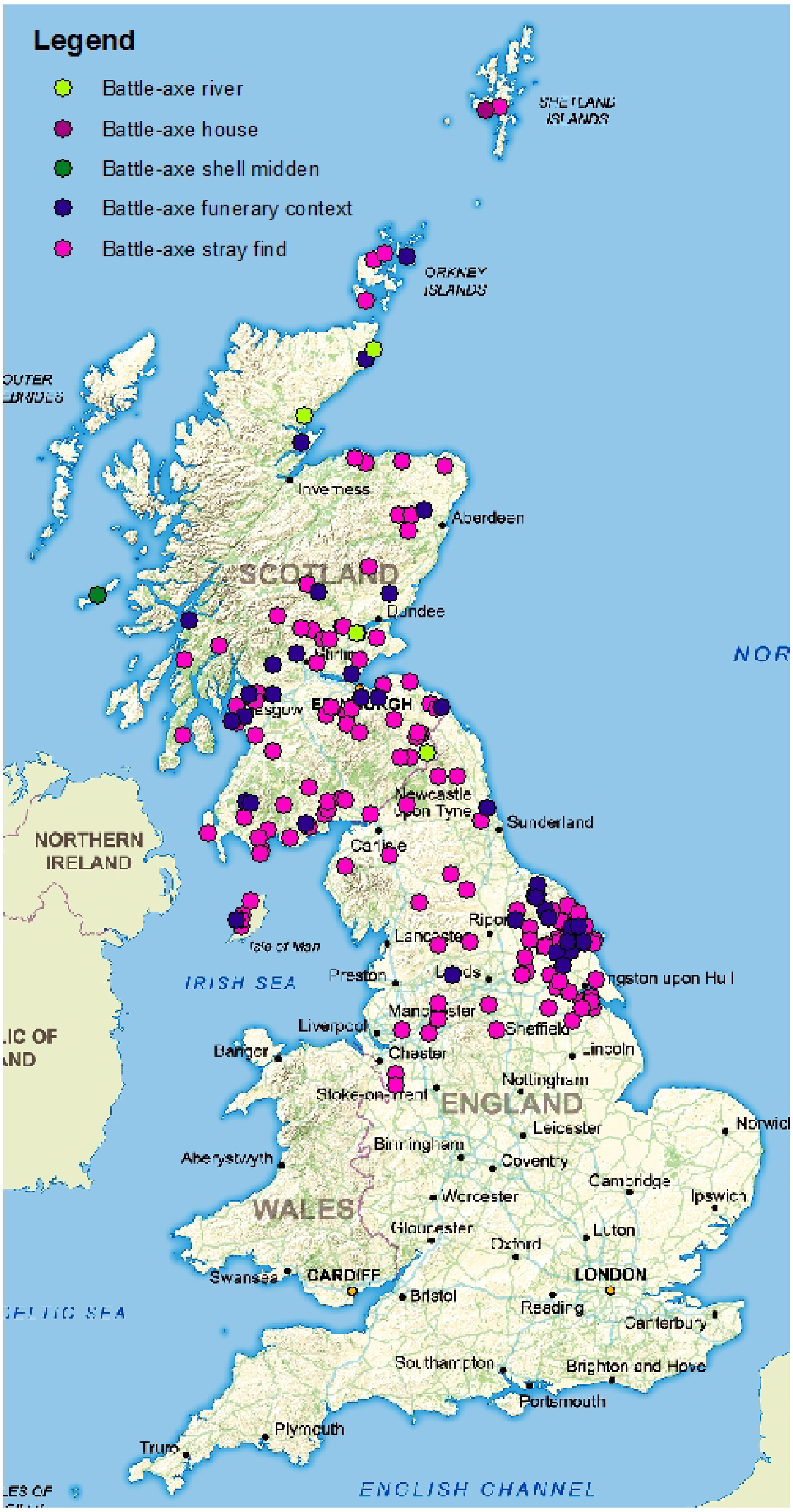


Figure 8.11: The distribution of battle-axe funerary and non-funerary contexts

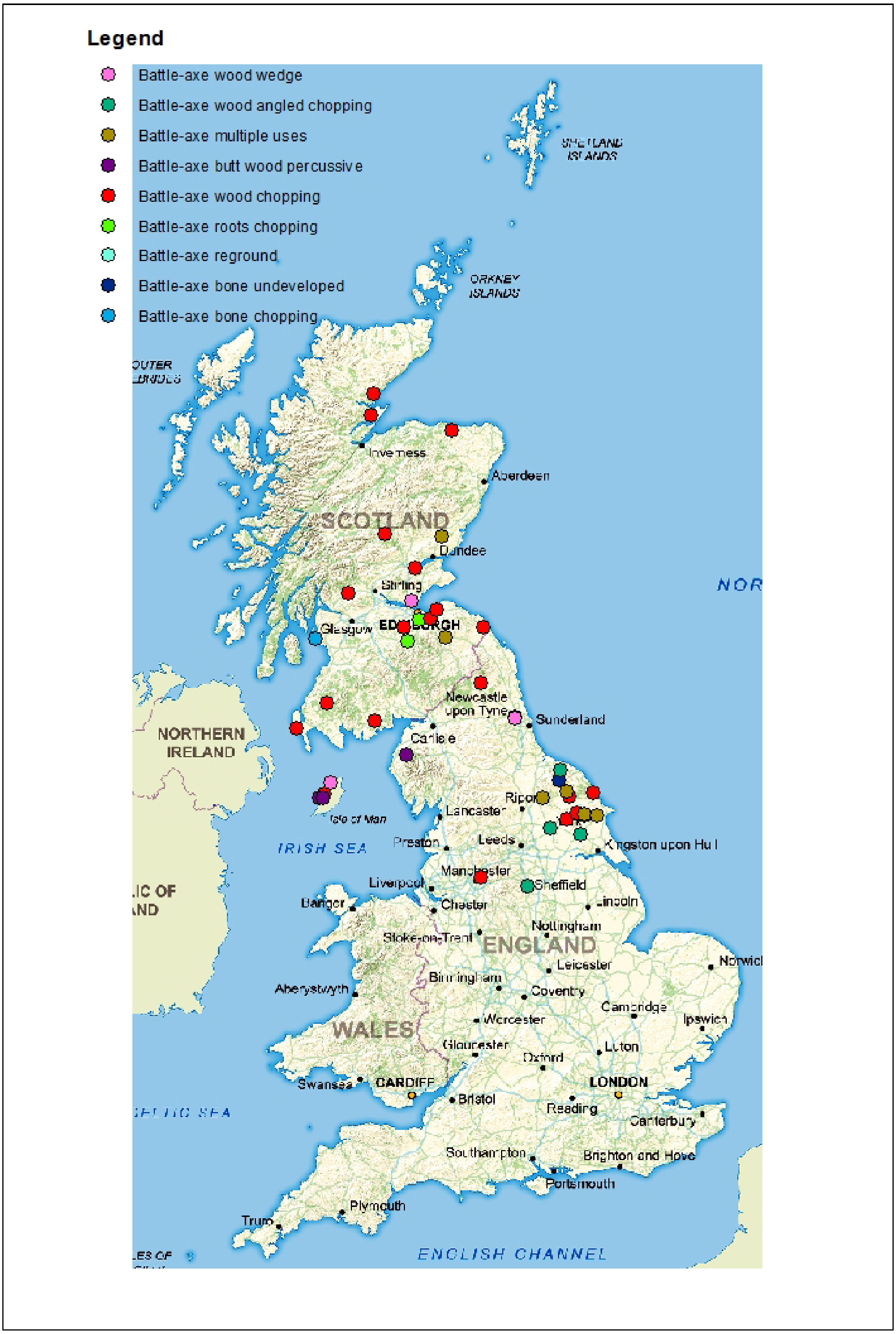


Figure 8.12: The distribution of uses of battle-axes

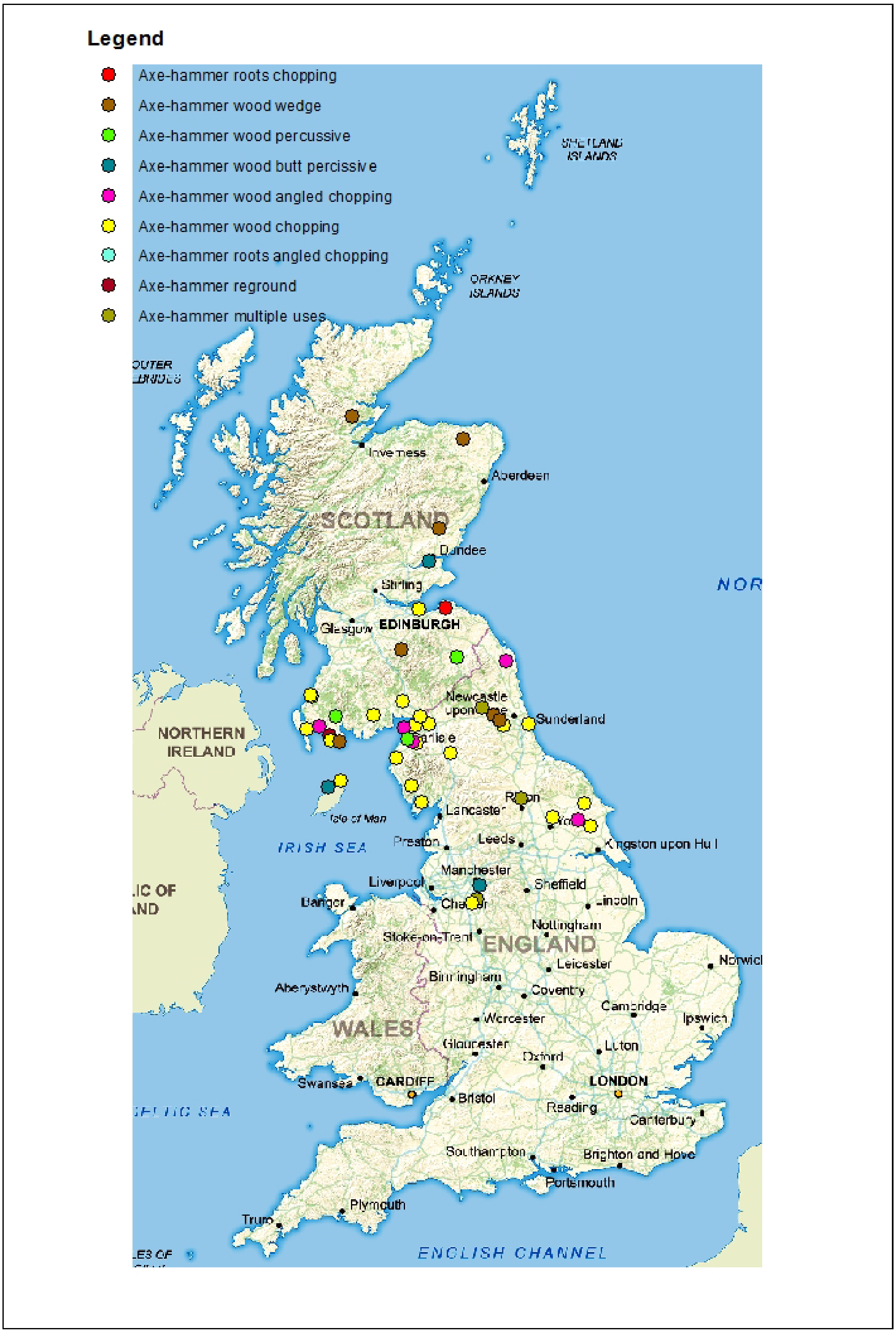


Figure 8.13: The distribution of analysed uses of axe-hammers

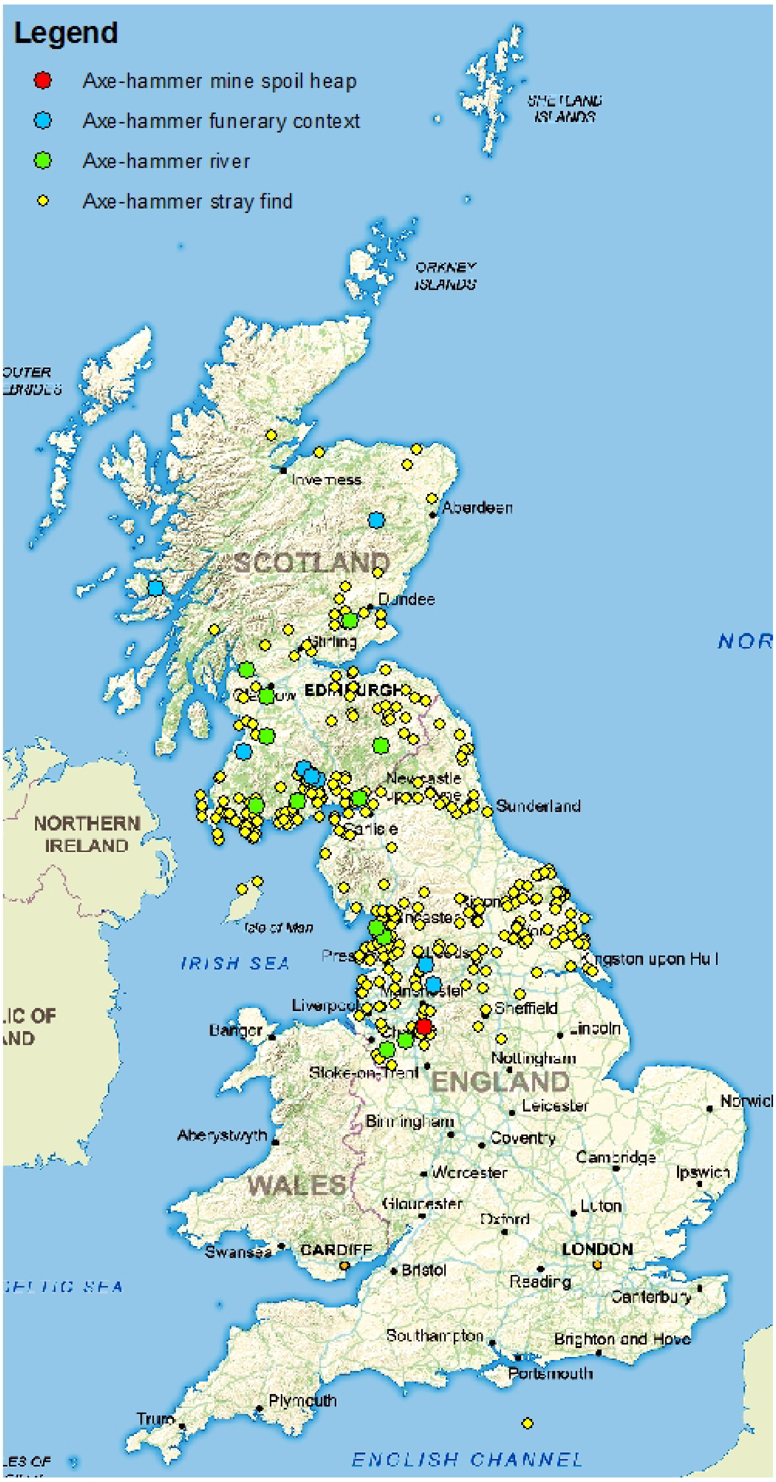


Figure 8.14: The distribution of axe-hammers from funerary and non-funerary contexts

8.3.3 Battle-axes and axe-hammers as weapons

The traditional view that battle-axes were weapons or symbols of a warrior elite, has been used to describe the uses and prestige of battle-axes in the UK and Europe (Mortimer, 1905, 159; Anderson, 1942, 80; Evans, 1872, 185; Greenwell, 1877, 159, 298; Smith, 1925, 80). The diversity of the funerary assemblages has already been used in this chapter to establish the various roles and meanings that battle-axes played for the mourners. The roles mourners played in the deposition of battle-axes indicates that they do not just represent the identity and status of the individual deceased. As such, the representation of a warrior elite in the burials is dubious. Indeed, recent arguments have demonstrated that many of the objects found in so-called warrior burials may not have been weapons. Using their shape and macroscopic wear, Skak-Nielsen has argued that Scandinavian flint and metal daggers were implements used to sacrifice livestock. He considered that their compact shape suggests a stabbing or thrusting motion that would require the user to get very close to their victim, whereas longer weapons, such as rapiers, were much more suitable for combat. Also, the wear on the edges of daggers indicated they were in contact during cutting use rather than the pointed end when stabbing – he proposes that the bifacial symmetry of the blades is better suited to butchering animals (Skak-Nielsen, 2009, 352-354; Apel, 2001, 311; Rassmann, 2000).

However, battle-axes may have still been used as weapons. Just three battle-axes and four axe-hammers were interpreted to have been in contact with bone. However, it is difficult to assess their use as weapons since wear indicative of contact with bone cannot be distinguished between human and animal bone. The small quantity of these implements with wear indicating contact with bone, just 9% of the axe-hammers and 9% of battle-axes analysed, suggests that their functional use as weapons was not the primary purpose of these implements (figure 8.18). In the past, axe-hammers have been considered as weapons, but the consensus is that their size and weight is too big for this practical use (Pegge, 1775). However, without carrying out an experiment to test their functionality as weapons, this cannot be assessed accurately. Needham has regarded axe-hammers as 'blunt instruments of power' (Needham, 2011). If axe-hammers were too unwieldy to be used as weapons, their size could have been used as an expression of power over an opponent - if axe-hammers were used in relation to violent combat at all.

Observed bone wear, similar to the wear formation on the experimental replica axe-hammer used to hit pig skulls, which could indicate their use in animal slaughter. However, the use as a weapon cannot be ruled out. Pigs are widely used in forensics as human analogues due to the similarities (Connor, et al., 2018; Payne, 1991; Micossi, 1991). The thickness and shape of a pig skull are more similar to the human skull than other animal skulls. Therefore, wear from contact with a human skull may well be the same or very similar to the wear that developed from contact with a pig skull. Without experimenting to test the functionality of a battle-axe as a weapon, we cannot assume it was not a weapon.

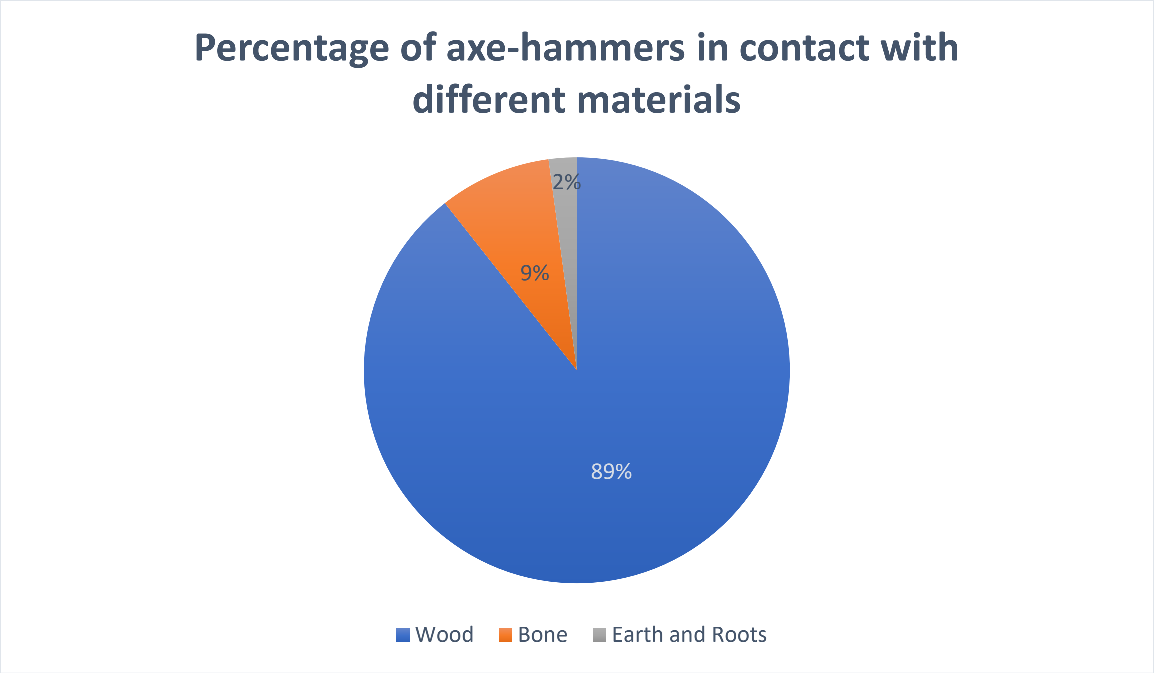
Essentially, any object could be used as a weapon irrelevant of the original purpose. Take an ordinary kitchen knife, for example; its purpose is to cut up food into smaller pieces easier to cook and eat. However, knives such as these are commonly used in violent interactions. Likewise, objects that are large, blunt, and heavy have been used as percussive weapons, such as bricks and metal objects. Not only does this indicate that an object can have multiple purposes and roles, but it also tells us that any object can become a weapon if it is regarded as the best option for this purpose out of a variety of domestic objects at that moment in time and space. Therefore, a battle-axe or axe-hammer could have been used as a weapon perhaps only once or twice when it was most appropriate. Use as a weapon would include the single use of one strike, multiple strikes throughout a violent event, and its use in multiple violent events. The single use of a battle-axe or an axe-hammer as a weapon would leave undeveloped traces which would not be interpretable. The experimental tests demonstrated that wear was often not developed enough to become interpretable until at least 200 strikes. As such, an implement could have been used for multiple uses, some more visible than others. For instance, it may be used in contact with wood, and, for a limited period, with bone. Alternatively, they may have been used for intimidation in violent contexts, as well as for other functional purposes; this is more likely for axe-hammer due to their size.

The size of an axe-hammer does not limit its functional use, despite arguments that they are unwieldy (Pegge, 1773, 126-127). The effectiveness of the experiment using a replica axe-hammer in contact with pig skulls suggests these implements would have effectively and quickly stunned or killed a pig or cow intended for slaughter. The size of the axe-hammer left significant percussive traces on the pig skull, which are similar to cranial trauma on cow skulls in EBA burial mounds in Yorkshire (Mortimer, 1905). The axe-hammer used for the experiment was the average size for these implements, but larger and heavier axe-hammers exist (see section 8.3.2). These are wieldable, but they would require the user to have greater strength than is needed to wield the smaller axe-hammers and thicker hafts to support the weight.

Evidence for close combat interaction demonstrates that violent events, of possible raiding groups, occurred across northern Europe during the Bronze Age (Jantzen et al., 2010; Meyer et al., 2009, 416; Mercer, 2006, 136; Fyllingen, 2003, 27). The presence of such sites remains uncommon in the Early and Middle Bronze Ages; however, they indicate the capability for violent events to occur for multiple reasons across northern Europe. Evidence for violence and combat indicates that weapons were used and needed for such violent events. Battle-axes and axe-hammers may have been used in this way, either as symbols of strength and power, functional weapons, or both.

However, other contemporary weapons also existed, which could have been more appropriate for the job. For example, the haft of the experimental axe-hammer needed to be held with both hands due to its weight; this means that during close combat a shield could not be used unless the combatant was significantly stronger than the experimenter. Other objects regarded as weapons could be used with one hand, leaving the other free to use a shield or another weapon. Battle-axes are lighter than axe-hammers, so use with one hand would be easier, which suggests that combat styles would differ. Experimental tests are needed to assess the effectiveness of both implement types during combat to discuss this further.

It is clear that both uses as a weapon or tool for slaughter are possible; only 9 % axe-hammer and 9% of battle-axes had wear from contact with bone. If these artefacts were used for animal slaughter, or other non-weapon use, they might also have had a secondary role as a weapon for appropriate scenarios. The secondary use of objects as weapons may be applicable for many functional objects which could be used to inflict damage on a person. If this is the case, these artefacts were stand-by weapons, ready for use if the time came. Implements thought to have been used to inflict violence in Neolithic central Europe have been interpreted as weapon-tools, since they were also used for craft and domestic work (Fibiger, 2014, 139). The secondary use of battle-axes as weapons suggests they would be called ‘tool-weapons’.



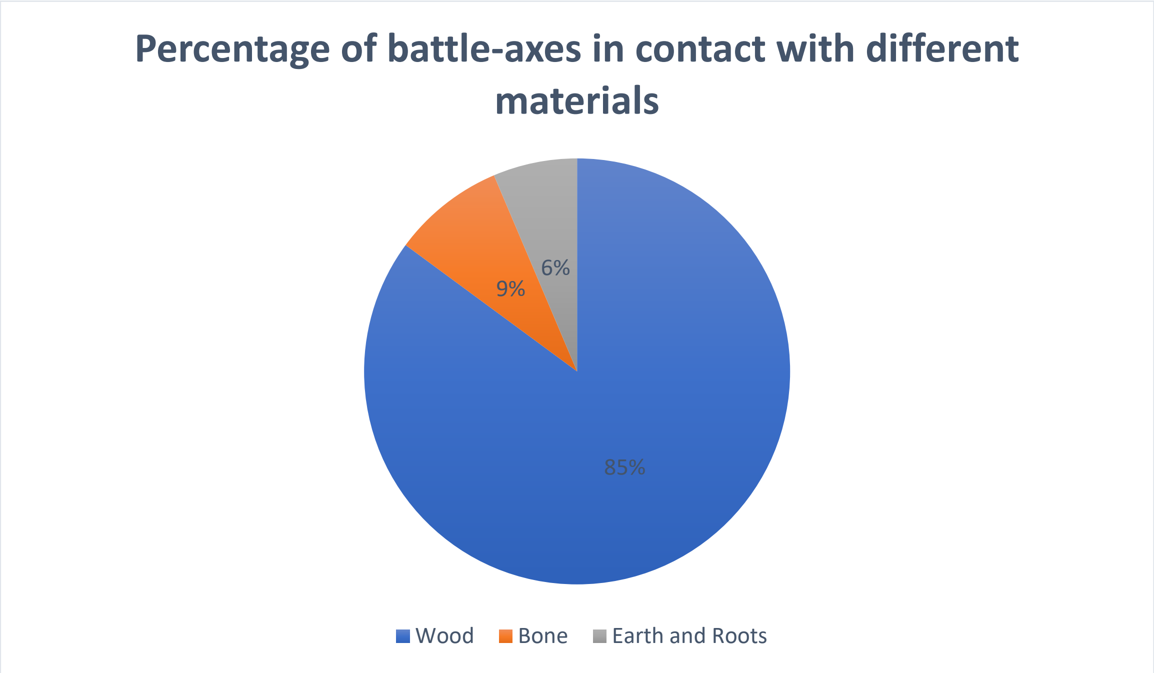


Figure 8.15: Two pie charts to demonstrate the percentage of axe-hammers and battle-axes in contact with bone in relation to the other contact materials.

8.3.4 Battle-axes and axe-hammers as tools

Battle-axes and axe-hammers were functional objects used as tools during a large part of their life history, as indicated by the wear analysed. Wood is the most common contact material, the wear demonstrates these implements were used in multiple woodworking activities, such as chopping, splitting and hammering, most probably in combination with other tools. The use of battle-axes and axe-hammers as wedges was also possible. However, further experimental tests are needed to secure this interpretation.

It is probable that those used in contact with roots and soil were used to clear undergrowth. The experiment used a battle-axe, but as axe-hammers and battle-axes have similar blade orientations and angles, it is probable that the results of an experiment with an axe-hammer would have been the same. The test found that implements with a blade parallel with the perforation were ineffective at removing soil, but are effective at breaking apart soil and roots, ready to be shovelled away with another tool.

Contact with bone on a small number of battle-axes and axe-hammers indicates a possible animal slaughter role. The experiment, carried out with an axe-hammer, suggested that the implement could have been used as the modern-day poleaxe to stun the animal before slaughter. Cranial trauma on the skeletal evidence of cows indicates this may have occurred (Mortimer, 1905). The smaller, lighter battle-axe would stun, whereas the axe-hammer may also have been used to kill due to its heavy weight and the amount of cranial trauma it could cause when striking the skull. Cranial trauma on the skeletal evidence of cows indicates this may have occurred during the EBA (Mortimer, 1905). However, we cannot ignore the possibility of their use as weapons also, for which see section 8.3.3.

The prolonged use and functionality of these implements have been demonstrated by the evidence of multiple uses, their re-grinding to continue their functionality, and the examples of extensive use. The idea that battle-axes were only non-functional is, therefore, invalid. The experimental tests confirmed the effectiveness of these implements during their functional use. The use-wear that was analysed throughout each experiment was comparable to battle-axes in the dataset, thus further supporting the interpretations of use. Each experiment demonstrated the ease of using a battle-axe with effectiveness; this suggests that almost anyone in society would have been physically able to pick up a battle-axe and use it without much, or any training. Roe (1966) has argued that these objects were purely ceremonial, but due to their obvious functionality, this also appears to be incorrect. However, land cleared or chopping wood for building a funerary pyre, a cairn or a barrow, could be considered as ceremonial. Therefore, their use in functional, ceremonial tasks remains possible.

The evidence also suggests that the interpretations of axe-hammers as being too unwieldy for functional use are incorrect. The wear analysed throughout the experimental tests supports this statement as they are analogous to wear analysed on axe-hammers in the dataset. Each experiment demonstrated the ease of using an axe-hammer with effectiveness, although the weight of these implements indicates that small children and those not regularly exercising would find it difficult to sustain the continued use of an axe-hammer. Since Bronze Age society was a lot more active than modern society, it is probable that most people would have been able to use an axe-hammers. Like the use of a battle-axe, the experiments also suggest that little training would be needed.

The moments of use as a tool cannot be pinpointed to exact moments in time within the object itineraries. It is known, however, that it occurs for extensive periods after manufacture and before deposition. Whether this is split up by periods of use and non-use is unknown. There is no single state of use that a battle-axe or axe-hammer must have for it to be deposited in funerary or non-funerary contexts. They were, as such, deposited at various stages of their functional use. This is similar to the Swedish battle-axes, which were deposited at various stages of consumption (Lekberg, 2002).

8.3.5 The significance of battle-axes

Battle-axes have been long assumed to be prestigious items of significance. Many commonly argue for the high-status nature of EBA burials due to the presence of exotic artefacts (O'Shea, 1996; Randsborg 1973; Shennan 1975). Bone belt hooks, for instance, are objects interpreted as high status, which are found in some battle-axe burial deposits (Sheridan, 2007). Likewise, items made of bronze are also considered to signify status, such as the bronze earrings found at Stanbury (Richardson & Vyner, 2011). Often battle-axes are interpreted in the same manner. Similarities with the Single Grave Culture in Europe, such as the placement of battle-axes by the heads of deceased males has influenced the interpretation of battle-axes as weapons and symbols of an elite (Brumfield & Earle, 1987; Earle & Kristiansen, 2010, 4; Knutsson & Knutsson, 2003, 70; Lekberg, 2002, 68). Equally, modern sexism has influenced the interpretation of objects in prehistory, particularly those items found associated with male burials which are often understood as items of status which reflect the status of the individual deceased (Brűck, 2006; Jordanova 1980; Lloyd 1984; Merchant 1980). The interpretation of funerary objects as status indicators resulted in arguments that the deceased was a chief, merchant, or another role of high status due to the association with such “exotic” objects. The presence of items interpreted as weapons led to these individuals being seen as male warriors, or symbols of a warrior elite (Kristiansen 1998, 161–180; Demokopoulou et al. 1999; Kristiansen 1987; Kristiansen and Larsson 2005; Treherne 1995). The presence of archery equipment, daggers, battle-axes and mace-heads in Beaker burials, for example, have been interpreted as signs of a warrior (Vankilde, 2006). Mortimer is one among many who have interpreted those buried with battle-axes as warriors with muscular arms strong enough to wield the battle-axe as a weapon (Mortimer, 1905, 159; Anderson, 1942, 80; Evans, 1872, 185; Greenwell, 1877, 159, 298; Smith, 1925, 80).

More recently, interpretations of the Stanbury pit burial described the deceased individual as high status due to the prestige of the associated artefacts, including a battle-axe, bronze earrings, a bone belt hook and pin, an accessory vessel and two Collared Urns (Richard & Vyner, 2011). Saville and Roe also described battle-axes as highly prestigious and purely ceremonial due to their frequency in burial contexts, and Walsh agreed with McLaren’s interpretation that the miniature battle-axe from Doune, Perthshire, is an indicator of the high status of the deceased (Saville & Roe, 1984, 20; Walsh, 2013, 18; Mclaren, 2004, 289). The use of an object to infer the status of the individuals is still used to interpret the status of the deceased. This approach uses an assessment of the status and meaning of an object at the point of its deposition. Battle-axes were interpreted as high status due to their presence in burial contexts, but their previous life history and object itineraries are ignored, which limits the interpretation.

Scandinavian battle-axes have also been interpreted similarly. These battle-axes, from the Scandinavian battle-axe/single grave culture, were often found deposited close to the head of the deceased in burials. Their deposition contexts have been argued to represent a high-status warrior elite. Authors such as Childe and Jensen, for instance, have argued that the development of a ranked society can be seen through the construction of graves with specific prestigious grave goods, including battle-axes, which revealed the social position of the buried person (Childe, 1925; Jensen, 1982, 110). However, alternative interpretations for Scandinavian battle-axes have looked at other aspects of the battle-axe itineraries. Damm has argued the associated status was not from the axes themselves but instead from a status acknowledged through other means, such as through their trade which maintained vast networks (Damm, 1991, 65). Lekberg has used the biography of Swedish battle-axes to understand the various purposes and meanings and how these objects were used to furnish the landscape. He determined that the axe-heads were deposited in different contexts dependant on their length and for different reasons. In particular, he found that short axes were deposited in graves and generally indicated linear distributions patterns, marking paths and roads along ridges, eskers or waterways, and the longer axe-heads found in hoards were often placed in coastal zones or at inland areas of liminal transgression such as fords and harbours (Lekberg, 2002, 307). He saw this distribution of axe-heads as signifiers of an accumulation of wealth in areas with political entities, suggesting that there was an unequal spread of wealth between centre and periphery (Lekberg, 2002, 381-3).

Lekberg's study of biography and contextual information demonstrates that alternative interpretations of the roles of these implements are possible when their biography and itinerary are considered. Unlike Lekberg's finding, there is no relationship between the size and shape of northern British battle-axes and axe-hammers and their depositional context. The lack of information for those deposited in non-funerary deposits makes it difficult to attach a relationship between type, use and treatment with a type of depositional context or landscape.

Paralleled interpretations also exist for the British EBA funerary material. Brück argues that these objects were relational and did not represent the deceased individual or their status, power, or gender. Exchange of these objects was, instead, essential and central to the construct of self as it established the person as a relational entity, rather than an elite individual (Brück, 2006). She understands that the placement of objects in the funerary assemblage was to comment on the relationship of the deceased with the living (Brück, 2019, 28). Needham has suggested that objects placed in funerary assemblages were used to represent past connections or state claims on behalf of mourners seeking to gain an advantage (Needham, 2011).

The use and depositional contexts of battle-axes and axe-hammers from northern Britain and the Isle of Man demonstrate that the interpretations of Brück and Needham are suitable for understanding their deposition in funerary contexts. The variation in funerary assemblage and lack of relationship between the funerary assemblage and use, location, and so on, which indicates that no set funerary assemblage was used. Artefacts were being drawn from a pool of objects used in burial during the EBA by the mourners to express the individual relationships between them and the deceased and the society they both belong in order to gain, maintain or breakdown social and political claims. As such, we cannot argue that the status of the deceased or their identity in life was the only reason behind the deposition. Mourners could have drawn upon the status of the deceased through the relational connection between the mourner, an object and the deceased. However, this is just one of many possible reasons for the deposition of objects in a burial. Significance was an aspect which would have been drawn upon alongside other connections to express the meanings and roles the mourners intended.

The development of the prestige and significance of battle-axes would have occurred at various stages through the object's itinerary and could have been created, maintained, and broken down at various points. It, therefore, would not have been static. The funerary assemblage suggests there were multiple reasons for the deposition of battle-axes in funerary deposits, so, it could also be suggested that the status and prestige of these objects may have also differed depending on the reasons they were included in the burial.

In her assessment of the Cairnderry battle-axe, Sheridan suggested that function and prestige could exist together (Sheridan, 2007, 110). It is important to consider that these objects may have had multiple meanings and functions. As I have demonstrated in this thesis, both battle-axes and axe-hammers from funerary and non-funerary deposits were functionally used, and there was no relationship between the use and the types and location of their depositional context. The functionality and the variety demonstrable indicate there cannot be one reason or meaning attached to these implements. The level of skill and strength needed to use a battle-axe was low, and the wear analysis suggests that there were plenty of functional uses for these artefacts, wood working and land clearance being just two examples. The ease of use of the battle-axe would not require any special skill to use, and therefore it would not have been limited to a select number of people, lowering its prestige in relation to this aspect of the battle-axe. However, other aspects may have been used to restrict their use; Topping has suggested that Neolithic communities restricted access by age and sex to some of the British stone axes production sites (Topping, 2017) despite the ease of use of stone axes.

The exploitation of easily accessible stone for the creation of these implements also suggests that the manufacturing process did not instil prestige in the objects at this time in their life history. However, significance and prestige could be created from other actions in an object's itinerary, such as the relational links created during use, exchange and deposition. The status of battle-axes and their burials is consequently more complicated and cannot be attributed from just the presence of an exotic artefact.

Table 8.8: The potential actions for battle-axes and axe-hammers, the relationships involved and created and their significance

Action Colour code: Red: evident Orange: probable	**Relationship**	**Significance – how it is created**
Sharing use of the tool	• Links created between the users, the areas and materials they are using the tool and between the implement and users; • Inter-community ties created between the groups of people using a specific tool and between individuals sharing the tool; • Ties created between people who use the implement for the same purposes; • Sharing can also strengthen ties between people.	• Ties between people and communities could be drawn upon for social and political gain, such as access to a trade network, claim to land, inter-marriage possibilities; access to materials and other claims or access through communal sharing; • The power that these connections create to enact social and political determinations gives the objects and the significance of the actions.
Prolonged use	• Links created between the user or users and the implement through its functional use; • Links created between the user or users and the materials and the actions used; • Links created with an area that uses occurred	• The ties created between the user and the area or materials working on with the implement could allow claims to land and materials; • The continued use of an implement would create ties with others who use battle-axes or axe-hammers in the same way which could be drawn upon to gain sharing privileges.

Implement handed down through generations	• Ancestral links maintained	• The maintenance of ancestral links could allow for ancestral claims or access to trade and exchange networks to be drawn upon
Movement of people	• The use of an implement in different places links the users to the places they have moved to and from	• Links with far-away places, resources and communities in other locations could be drawn upon to allow trade and exchange networks to be created or maintained.
Trade and exchange	• Links created between people through the movement of objects through exchange networks; • Ownership and claims to objects expand and change.	• The construction of identity and the sense of self because of the relational interpersonal connections that were created between people and people and objects; • Connections between people, and people and objects could later be drawn upon in ceremonial actions to achieve access to resources and claims to exchange networks.
The exploitation of stone sources	• Stone quarrying creates links between people and the location of the stone and links between people and the skill and knowledge needed to quarry.	• Procurement of stone was haphazard and easy to access resources were exploited making the skill and knowledge needed less; • The ease of stone procurement and manufacture gives this process little prestige. • Yet, found stones could have been carefully chosen for their shape and properties, or because they were personally meaningful, which would have given the object importance.

Land clearance	• Land can be used for arable and pastoral farming and to build burial monuments, funeral pyres or domestic structures; • These create links between the people doing them and the area or materials and the skill needed.	• Relationships created between people carrying activities together and between people and the land; • The tools become ceremonial when used for ceremonial activities which links it to the significance of the funerary deposit and activities; • Relationships could be used drawn upon to gain access to resources on the land worked or access to the land and activities occurring there.
Woodworking	• Wood was available to build burial monuments, funeral pyres, firewood, tool production or domestic structures; • These create links between the people doing them and the area or materials and the skill needed.	• Relationships created between people carrying out activities together and between people and the land; • The tools become ceremonial when used for ceremonial activities which links it to the significance of the funerary deposit and activities; • Relationships could be used drawn upon to gain access to resources or access to objects and structures created with the wood.
Animal Slaughter	• Animals were slaughtered for food or ceremonial purposes; • These create links between the people doing them and the area or materials and the skill needed.	• Relationships created between people carrying activities together and between people and the land;

		• The tools become ceremonial when used for ceremonial activities which links it to the significance of the ceremonial activities; • Relationships could be drawn upon to gain access to resources, such as domesticated animals. Links with ceremonial activities and the people involved could create interpersonal ties, claims to resources and exchange networks.
Weapon	• Used in combat by skilled warriors, or used by people with no skill needed to defend themselves; • A relationship created between the object, the action of hurting or killing another, and the person or people involved;	• Power and strength of communities or individuals created through connection with successful violent interactions; • Symbol of power and strength drawing upon the violence possible through the use of other weapons or, for axe-hammers, drawing upon their size to demonstrate strength; • Power can be used to claim resources, such as through force or intimidation.

Table 8.9: Possible inferences about the meaning of selecting axe-hammers and battle-axes for funerary deposition

Meanings	Indications	Likelihood

Highly Biographical	Multiple relationships developed through the life of the objects, including movement, functional use, sharing use and ownership, prolonged use, and links with materials and land.	Highly likely, due to the variation in the funerary assemblages
Functionality not relevant or not drawn upon	The actions and the relationships created through functional use were not important, such as for those battle-axes that were re-ground before deposition.	Less likely since most funerary implements have wear visible, which means for these, signs of use might not have mattered. It is more likely to have mattered for those that were re-ground or unused.
The wear was not significant, but it was used to reference functionality, and the relationships created	The specific use was not important, but the relationships were created through the functional use between people and people, and materials and land. These were drawn upon.	Highly likely, wear is visible on most funerary implements. No specific use is related to depositional context, but the presence of wear suggests it might refer to the relationships created through functional use.
Function not important, the significance of the movement of these objects drawn upon	The relationships created through the movement of objects through trade, exchange and mobility which created important relationships that aided the construction of self (Brück, 2006 & 2019).	Likely, but not the only reason as not all implements moved through circles of gift exchange, trade and mobility due to the exploitation of glacial erratics.
The importance of the relationship between the deceased and the object drawn upon	The relationship between the deceased and the object created through the life of the object and the deceased through various actions, including use, movement, sharing, and so on. This was not related to the identity or status of the deceased, but instead the relationship between the deceased and others.	Likely, but still biographical and referencing relationships created through the itinerary of the object which means that relationships with other people were also created and were therefore also likely to be drawn upon.
The importance of the relationship between the deceased and the mourners, through the object	The relationship between the deceased and other people referenced using an object associated with this	Highly likely, and biographical. The variation in the funerary assemblages suggests this is the case.

	relationship. Through actions such as functional use, prolonged use, sharing of use or ownership, gift exchange and trade, use of the object on a material or area, and so on.	It is possible that the power relationships had could be used for specific outcomes such as those discussed in table 8.8.

The inclusion of a battle-axe in a funerary context would draw upon relational links created throughout the object's life history, such as through exchange, which this chapter will touch upon later, and through the ceremonial funerary process. For the latter, inclusion in a burial creates a significance related to that deposit and the processes involved in burial. As such, prestige may have been given to battle-axes in death.

Using an implement in ceremonial actions can draw upon the ties and significance created through the life history of the object to enhance, create, maintain or break down the social and political outcomes that were enabled through its use; the ability to draw on relationships for such outcomes is powerful. The ceremonial use of an object to clear land or prepare wood for the funeral pyre would also create a significance related to the burial which could then be drawn upon in the burial deposit. Burial deposits containing battle-axes also included other artefacts that together created the burial assemblage. The significance of the bringing together of various artefacts and the links that could be drawn upon through that process was significant. The power these assemblages had to enact social and political outcomes dictates that the assemblage as one was prestigious and the artefacts within, used in this relational process, would have had varying degrees of significance depending on the part they played, and the power they had to enact different outcomes. For example, maintaining links with an exchange network or land may be less potent than creating links or breaking them down.

Battle-axes were used functionally for a varying amount of time, the development of wear indicates that some axe-heads were used for a limited period, and others a moderate or an extensive amount. Several battle-axes were used for multiple functions or were re-ground to sharpen their blades and be re-used, which suggests that they were used for prolonged periods. The more actions were enacted throughout the life history of the artefact, the stronger the relational link between people and objects became. The stronger a link was, the more power it would have had during the funerary process (see the description of mourner's choice in section 8.2.3). The repeated functional use of a battle-axe would have secured a link between the users and artefact. If the battle-axe was shared, then the link between people would have been strengthened with each use.

Additionally, those implements that were used for multiple functions had different associations and were involved in multiple assemblages. Likewise, any which had multiple users would have had multiple relational associations. Each diverse assemblage and association will have had a different significance, and the interpreted significance may have differed from person to person. This also means that the inclusion of a battle-axe in a burial deposit could draw upon multiple associations at any one time, each of which may have a different significance and be used for a different motive, for one or more people (Hodder & Hutson, 2003, 173; Crellin, 2017; Ingold, 2007; Bailey, 1981 & 2007; Deleuze & Guattari, 2004).

The movement of battle-axes through processes such as gift exchange was intrinsically linked with the construct of identity and the sense of self because of the relational interpersonal connections that were created between people and people and objects. Battle-axes made from known petrological groups have been traced far from their source. Gift exchange and trade are two reasons for this movement. For instance, battle-axes made of Group XII have been found in Fife, central Scotland, c. 500 miles from their source at Cwn Mawr, the Vale of Glamorgan. The act of constructing a sense of self is significant and is one aspect that would have given battle-axes significance to a specific person or people involved in the networks of connections (Brück, 2006). The further the implement travelled within these networks, the length of time it travelled and the number of networks it travelled within would have increased the significance of the battle-axe. These links and the significance created through them was an aspect which would have been drawn upon alongside other connections to express the meanings and roles the mourners intended.

Due to the limited number of burials in EBA Britain compared to the estimated population, it has been assumed that these burials held a particular significance, more significant than those deposited in non-funerary contexts which are much more numerous (Needham, 2011). However, the object itineraries of battle-axes from non-funerary contexts have many similarities to those from funerary contexts. They too would have been involved in methods of movement which created interpersonal links between people and objects. The significance related to the construction of identity through such relational networks is no different from the significance these processes gave battle-axes from funerary deposits since they occurred before their deposition. Actually, there is little difference between the use-lives of those battle-axes deposited in funerary and non-funerary contexts. The foremost differences come about at the point of deposition, which suggests the roles and meanings of these implements changed at this point, taking on the meanings and roles meant for them by their depositors. The significance and roles of these implements were fluid and therefore changeable.

The reasons for the deposition of battle-axes in non-funerary contexts may vary, and so there may be a varied associated significance of such depositions. For example, if the stray finds were deposited as rubbish or lost, then their deposition would lack significance. However, if they were votive deposits marking critical points in the landscape, to create or maintain links with an area, as an act of remembrance, or as an act of thanks for the use of the land and its resources, then there would be a significance associated with each act that the associations they had. However, without further depositional information for these stray finds, a definitive location and deposition context and process is unknown (see section 8.2, for the depositional contexts, and Tables 8.8 and 8.9 for the significance and meaning of various actions)

The more unusual deposits and battle-axe types would also have had a significance associated with their use-lives and their deposition, created in the same way as described above. The unusual deposits include the battle-axes from the Ness of Gruting House site and the shell midden. The deposit of three battle-axes at the house site, one unfinished miniature, an unfinished full sized axehead, and weathered full sized axe-hammer possibly reground. They were found separate from one another and are thought to be associated with the function of the site, for stone production. These implements were deposited intentionally at the house site which suggests that their deposit was of significance, perhaps to mark the actions of stone production and maintenance that occurred there. In section 8.2.1 I suggest that the significance of these implements might be similar to the significance of those deposited in funerary settings since there are a number of other associated deposits on this site, including a mace-head, polished stone axes, two stone balls, two Bronze knives, and a spear, that are also found in funerary settings (Calder, 1958, 373-375). They may have been used in the same way artefacts are in funerary settings, to express a social or political motive, in this case, it would be related to the house or stone production site.

Less information is known about the unfinished battle-axe from the shell midden which was unused. In section 8.2.1 I suggest the possible reasons for its inclusion in the midden, such as to draw upon a marine diet in the past, or contemporary, or to reference marine and coastal activities. If this is the case, then the axe-head was seen as significant enough as a reference to this. Since the implement is unfinished and unused, it would have gained significance from other activities, such as the inclusion in the midden at point of deposition. The movement of the stone through mobilisation and trade would have also created a significance (Brück, 2006). For instance, this battle-axe was made of porphyritic olivine basalt; basalt lavas on the

Isles of Skye and Mull may been exploited for the manufacture of this implement. If this is the case, the stone ready to shape into an implement, or the unfinished battle-axe travelled between the islands of the Hebrides, through the movement of people, and possibly trade and exchange.

The unusual battle-axe types are the miniature battle-axes, which, when analysed only show signs of production wear and thus they were unused. One was found with a child inhumation at Doune, and the other was a non-funerary deposit from the Ness of Gruting and was unfinished. As mentioned previously, it has been argued that the Doune miniature battle-axe placed next to a child inhumation was highly prestigious and signifies the high status of the child (Walsh, 2013, 18; Mclaren, 2004, 289). I disagree with this assumption that the funerary kit is a status indicator. The alternative perspective of the mourner's choice with multiple associations influencing processes has already been put forward.

In the case of miniature battle-axes and other battle-axes which show only production traces, or have been reground prior to deposition, their treatment was chosen for reasons associated with the purpose of the funerary assemblage. The inclusion of unused battle-axes means that it was taken out of circulation before its functional use. The petrologies of the unused battle-axes are not grouped, and therefore their sources are unknown. Common stone petrologies were used so it is difficult to determine the distance they could have travelled before deposition. It may be that these implements were manufactured specifically to be included in the burial, particularly the miniature battle-axe found with a child inhumation at Doune (ID 143). This implement was unused and was placed by the head of the child possibly to demonstrate the adult the child should have become (see section 8.2.2). It is possible, therefore, that the unused battle-axes were deposited for their function in the afterlife.

Battle-axes that were re-ground and not re-used were only deposited in funerary contexts. Re-grinding removes traces of use and thus would remove any relationships that occurred through the use of the object. It also renews the implement, perhaps ready for the afterlife. This action created a significance in death, rather than from the life of the object. No axe-hammers were treated in this way. These re-ground battle-axes occur in areas where there are equal amounts of each implement type, and axe-hammers were functionally used the same ways. However, they were not included in funerary settings; this implies that battle-axes which were included in burials were more significant than axe-hammers in areas where there were equal quantities of both implement type.

Overall, the significance of most battle-axes appears to be related to multiple aspects within the life history of these implements. It grows through the use and movement of these objects as they were involved in the formation of relationships between people, between people and objects and between places and objects. This significance could then be drawn upon on the deposition of these implements in burials, for instance. Likewise, the burial process would give battle-axes significance which could be drawn upon in their deposition. This section demonstrates that significance could have built up through multiple processes and activities, all of which, several, or just one may be drawn upon in their deposition.

It is also apparent that the significance of axe-hammers may differ from battle-axes. The next section will discuss the significance of axe-hammers and assess how this differs from battle-axes and if significance can be used to understand why some battle-axes were chosen over axe-hammers in some areas and axe-hammers chosen over battle-axes in others.

8.3.6 The significance of axe-hammers

Axe-hammers are rarely interpreted as prestigious or significant items. They are often seen as crude, domestic items, too crude to be prestigious (Leahy, 1986, 148). Their large size has also led to suggestions that they were too unwieldy to be functional (Pegge, 1773, 126-127). Roe suggested that there may be a correlation between the location of axe-hammer finds and metal ore (Roe, 1967, 69). Needham, however, has described these implements as 'blunt instruments of power' (Needham, 2011) thus, implying their prestige to EBA societies. He argues that their origin lay in a symbolic role, while any functional use was an added, marginal benefit. This argument is the result of Needham's regional assessment of axe-hammers across the British Isles, indicating that they existed in higher numbers in particular areas, often where numbers of battle-axes dwindle (Needham, 2011). In the areas where axe-hammers are more numerous, they also appear in burials in the same manner that battle-axes do. The burial process would have given them significance, just as it would for battle-axes. It may also be that significance in life, created through actions in the itinerary of the objects, was drawn upon in death.

As this thesis demonstrates, the functional use of axe-hammers was not different to that of battle-axes. They too were used for an extended period and had evidence for multiple functional uses. The axe-hammers deposited in burials were extensively used, two of the three that were analysed were reground and re-used to prolong their functionality. As such, relationships between the objects and people would have created significance, the more extensively used then the higher the significance. The multiple functions of these implements might suggest that they were shared which would develop relationships between people and between people and the objects, therefore creating significance. The creation of significance through use is the same as for battle-axes because they were functionally used in the same way. This significance could have been drawn upon in the deposition of axe-hammers in funerary contexts.

Like battle-axes, movement of axe-hammers through gift exchange and trade networks would have enhanced the significance of axe-hammers (Brück, 2006). Axe-hammers made from known petrological groups have been found vast distances from the petrological sources, such as from Scotland to the south of England. However, the exploitation of glacial erratics is possible and has been demonstrated for Group XVIII (Williams-Thorpe et al., 2003, 1264). The distribution of other groups shows smaller areas of movement, such as Group XXVII which spread from south-east Scotland to the north-east of England. Localised movement of objects would have provided a significance specific to that region, demonstrating community and inter-community relationships. As a result, the more axe-hammers travelled through mobilisation, gift exchange and trade within and between these communities, the more significant they became. Significance and meaning within these communities might explain why regional preferences for one of the implements over the other occurred. Axe-hammers and battle-axes share petrologies and appear to have moved similar distances, but, the location of axe-hammers made from Group XXVII found in areas where axe-hammers were more dominant suggests these implements had regional currencies specific to communities.

Significance of an object can be created at any stage in its itinerary. It has already been established that the choice of stone and production of battle-axes and axe-hammers was not associated with the prestige of the stone source. Axe-hammers are a lot larger than battle-axes and so take longer to make. Needham describes this process as a phenomenal input of labour which attests to their symbolic nature. However, experimental tests by Fenton have determined that an axe-hammer could be created in 20-25 hours, or two or three days of intensive work, with no great skill (Needham, 2011; Fenton, 1984, 230). Fenton also determined that cobbles were most commonly used to create axe-hammers, such could be easily collected from rivers, for instance. Based on Fenton's results, I do not consider the time scale and ease of production to have been a ‘phenomenal’ input of labour and therefore this is not a valid argument for the creation of prestige.

The experiments indicate that axe-hammers could easily be used functionally, despite their size. Section 8.3.3 suggests that the size of axe-hammers may have been used to intimidate. This would be a power gesture and therefore the use of axe-hammers in this way could give them prestige. However, if size meant power, why are more not deposited in burials at major monuments or with other grave goods to indicate this prestige?

A small number of axe-hammers are treated the same as battle-axes in life and death, i.e. use context and depositional context, only in regions where battle-axe quantities are few. This is also notable in the fluting of axe-hammers in these regions. Therefore, those few funerary axe-hammers may have had a higher significance over battle-axes in the regions where axe-hammers were numerous. They were perceived as battle-axes were in other communities. Needham (2011) pointed out that in the areas where axe-hammers were dominant there were no high-profile burials. These areas also have fluted axe-hammers and axe-hammers deposited in funerary contexts. This suggests that attitudes to death may also be different in different areas. Implements usually placed in EBA burials may have had different kinds of significance, some of which were relevant for the funerary process. The associations of these objects with the processes of deposition, including other artefacts, people and actions, influence the roles these objects play and their significance in relation to that context. As such, the roles and significance of these implements were relational. However, the meanings and roles were not specific to the depositional context. Connections made throughout the object itineraries continued and connected people and things across different assemblages, through time and space. This means that the roles and significance of these implements may differ with each association and assemblage, giving them multiple possible significances and roles at any one time (See Tables 8.8 and 8.9 for the relationships that could have created different roles, meaning and significance.).

The remaining axe-hammers were stray finds. Section 8.3.5 discussed the various possibilities for these decontextualised stray finds. While we can infer significance through movement and use circles for these functional objects, we cannot assume any level of significance from their deposition as the information is unknown.

Overall, the significance of axe-hammers appears to come from the same processes as battle-axes, such as through use, engagement and movement. However, far fewer axe-hammers end up in funerary contexts. Even if some of the stray finds were from burials, now lost, there are too many stray axe-hammers for this to apply to all of them. In south west Scotland and north west England the significance of axe-hammers may have also been different to battle-axes, which resulted in the lack of battle-axes in those areas and vice versa for battle-axe dominant areas, such as areas of north Scotland and Yorkshire. The significance of axe-hammers in these regions reflects the possible difference in attitude towards death (Needham, 2011). However, outside these areas, there were equal numbers of battle-axes and axe-hammers, areas where one dominated and areas where both were fewer, which suggests the significance of these battle-axes and axe-hammers varied from region to region, community to community. Both these implement types share the same uses, meanings and kind of significance throughout their itineraries and any variation within this was present for both. The arrangement of this variation can be seen through the regional preferences.

8.4 Conclusion

The wear analysis results indicate that the previous interpretations of use are incorrect. Few battle-axes and no axe-hammers were unused. Nearly all were used in a range of motions, coming into contact with a range of materials, of which wood was the most common. The functional nature of battle-axes and axe-hammers – including those found in funerary assemblages - suggests that these objects were not purely ceremonial. The functional uses of battle-axes and axe-hammers detected from the use-wear analysis are as follows:

- Battle-axes and axe-hammers were frequently used to chop wood and fell trees;
- Battle-axes were frequently used to split wood into smaller pieces ideal for other uses or firewood;
- Axe-hammers were occasionally used as wedges to split wood into planks;
- Battle-axes and axe-hammers were occasionally used to clear undergrowth and roots;
- Battle-axes and axe-hammers were rarely used to dig through soil;
- The butts of axe-hammers were occasionally used as mallets to hit felled tree trunks;
- Battle-axes and axe-hammers could have been used as weapons; this may have been more widespread but not evident since it would cause little wear;
- Battle-axes and axe-hammers were occasionally used to slaughter animals by delivering blows to the skulls; this may have been more widespread since it would cause little wear.

These conclusions proved that most of the hypotheses set out in chapter 1 were correct. Furthermore, while the test to dig soil suggested the ineffective nature of using a blade running parallel with the haft for such tasks, it was apparent that the blade is still effective at breaking apart undergrowth and soil on contact. The experiment using an axe-hammer as a wedge to split wood failed to split the wood at all. It is possible that this experiment was not a faithful reproduction of how these tools were used as wedges. A repeat of the experiment, changing the parameters, is needed to test the hypothesis further that battle-axes and axe-hammers were used as wedges to split wood. Additional experimental tests are also needed to confirm the hypothesis of using battle-axes and axe-hammers as weapons, testing their functionality during combat.

It is apparent that the similarities in use between battle-axes and axe-hammers reinforce that they were treated similarly in life and their significance could be drawn from the same aspects in their itineraries. They were used for the same kind of things, with similar variability in use motions and contact materials. For instance, both types were most commonly used for woodworking. The relationships that were created through use between people and people and objects could be drawn upon later in the deposition of these objects. The creation of inter-community ties through the movement of these objects through mobilisation, trade and gift exchange would have given further significance. Due to the likely exploitation of glacial deposits, movement of battle-axes and axe-hammers probably occurred mostly at shorter distances (Parker Person et al, 2016, 630), within a community and their neighbouring communities travelling distances, such as from southern Scotland to northern England. Movement within and between neighbouring communities may suggest that there were regional variations in the significance of these implement types, indeed in areas of dense axe-hammer populations in some cases they were being treated like battle-axes when deposited.

The regional centres of battle-axes and axe-hammers are reflected in the treatment of a small number of axe-hammers in the same way as battle-axes. In life battle-axes and axe-hammers were similar and, for these few axe-hammers in death, they are also similar. It is in death – their deposition – that the change in significance is apparent. It was in their deposition that the roles and identity of these objects changed and transformed, as such identity in life was not the same as identity in death (Fowler, 2005). Wilkin has interpreted that regional differences are regional preferences for different material cultures and associated ideas, and ritual and social practices (Wilkin, 2013, 175). Needham suggests a preference for axe-hammers in certain areas, being dominant over battle-axes, and lacking any high-profile burial (Needham, 2011). As such, the attitudes to death may also be different in these areas, further indicating that regional interpretations of significance and meaning of objects occurred during the EBA.

The variation present throughout the funerary assemblage and the choice of funerary assemblage reflects the burial choices made throughout the EBA. It is not specific to funerary battle-axes and axe-hammers alone. The differentiation in funerary assemblage and the treatment of the implement were choices made by the mourners who drew upon the relationships created through the life history of these objects to express particular wants and needs and create, breakdown and maintain social and political ties with people, areas, materials, and so on.

Since many lack depositional information, we can only assess the probable significance that could build through use and movement. It may be that many of these are from decontextualised burials, destroyed over time. These stray finds share the same use contexts as battle-axes and axe-hammers from funerary contexts. Some of these may have belonged in a funerary deposit, but we must assume that this is not the case for all stray finds due to their quantities.

The new contextual variable, the use context, demonstrates the functionality of battle-axe and axe-hammers which significantly aided the interpretation of these implements. They were both used for similar activities, such as woodworking, land clearance and animal slaughter. These objects were capable of being prestigious and functional at the same time, as demonstrated by the inclusion of obviously functional battle-axes and axe-hammers in burial deposits. Both object types have many similarities in functions, associations and possible meanings but it is not clear how they are related to each other. I suggest that differentiation in significance between the two object types was dependent upon the community using them. The functional use of these implements is not related to their depositional context. Instead, it was the relationships that build up through use, over extended periods and possibly through sharing the use of the implements. Movement through circles of gift exchange, trade and mobilisation extend the relationships between these objects and people. The significance of these relationships was later drawn upon during the deposition of these implements for mourners to create, maintain and break down social and political ties. In death, the difference between battle-axes and axe-hammers was increased, since few axe-hammers were treated in this manner, the role of battle-axes in funeral processes is much more established and reflects the significance they had – this is the case for all regions where battle-axes are found equal to or in greater quantities than axe-hammers. Additionally, the regional variation or preference which determines the differential treatment of some axe-hammers like battle-axes reflects the variation in the types of significance.

Chapter 9: Conclusion

9.1 Introduction

This PhD project has focussed on the use and significance of perforated ground stone tools from the Early Bronze Age in Northern Britain and the Isle of Man. The primary purpose of this research has been to employ the techniques of use-wear analysis, experimental archaeology, and an assessment of the depositional context to determine the main uses of stone battle-axes and axe-hammers from this area. As outlined in chapter two, previous understandings have assumed battle-axes were non-functional symbols of power, too fragile to be functional, or purely symbolic or prestigious objects, perhaps of a warrior elite (Saville & Roe, 1984; Kristiansen 1998, 161–180; Demokopoulou et al. 1999; Kristiansen 1987; Kristiansen and Larsson 2005; Treherne 1995). Older interpretations have argued for their use as weapons (Mortimer, 1905, 159; Anderson, 1942, 80; Evans, 1872, 185; Greenwell, 1877, 159, 298; Smith, 1925, 80), whilst the axe-hammer was often considered as neither functional nor prestigious due to their large size and crude form (Leahy, 1986, 148). Others have seen their functional potential (Pegge, 1773, 126-127; Bradley, 1978, 13; Sheridan, 2007; Needham, 2011), but have not applied detailed analysis, such as experimental tests and wear analysis to test these ideas. Previous authors have suggested that the uses include: as domestic tools (Pegge, 1773, 126-127); in the preparation of copper and tin ore for the creation of bronze (Roe, 1967, 69); as wedges to split wood (Bradley, 1978, 13); and to sacrifice animals (Pegge, 1773, 126-127). Previous interpretations of both battle-axes and axe-hammers were based on the form and contextual associations of these implements, but, as established in Chapter 5, such interpretations were based on stereotypical assumptions of past societies using modern preconceptions, such as using the single grave culture to infer interpretations about the gender of objects in burials. Through the application of wear analysis, with direct observation by optical stereoscopic and metallographic microscopy, along with experimental tests, the uses of battle-axes and axe-hammers have been critically and scientifically assessed. This approach has allowed for a reliable assessment of the use and significance of these implements, based on direct observations.

The importance of the research, therefore, is twofold. Primarily, this is the first time that use-wear analysis has been applied to a large sample of British Early Bronze Age battle-axes and axe-hammers, providing an opportunity to reassess the role and significance of these objects.

Furthermore, this has been a valuable methodological addition to traceological research on ground stone tools, which have thus far received less attention than knapped and flaked industries.

The recording methods set out in chapters four and five allowed for a detailed record of the use wear marks and an interpretation of the use of these implements. Direct observation was carried out using a stereomicroscope, which was taken to the chosen museums to carry out low power analysis. While at the museums, acetate film was used to replicate the surface of the implements using a methodology created by myself for this project. The casts were taken of the relevant areas of the implement, including the blade, perforation, and butt, before being analysed under a metallographic microscope in the Wolfson Laboratory at Newcastle University. The findings were used to understand the type of materials these implements came into contact with over their use-life as well as the motions and the extent of use which caused wear formation. The series of experimental tests carried out as part of this project were based on the wear analysis results. Their purpose was to understand the type of wear that developed from different uses and how it developed of wear over time and throughout use.

The research project has thoroughly assessed the uses of stone battle-axes and axe-hammers. It concluded that these objects were used functionally for a variety of uses, such as chopping and splitting wood, as hammering tools, and in land clearance and animal slaughter. Unless they were used to prepare material and clear space for the funeral pyre, the functional use of these implements was not related to their depositional context. Instead, it is the relationships that build up through use, over extended periods and through sharing the use of the implements.

The functional use of those in funerary contexts indicates that these objects were not purely ceremonial and in fact, had multiple roles and meanings. The different roles they played were both functional and symbolic, as demonstrated by the functional nature of battle-axes and axe-hammers placed in funerary settings. Many had multiple functional uses and were used for prolonged periods, suggesting they could have had multiple users and been handed down through generations. Over the life course of these objects, from their manufacture through to their deposition, relational links were created between the artefacts and people, actions, land, and so forth. These entwine the artefact with those involved in these links which could be drawn upon. Many links could be drawn upon at any one time, such as during their trade and exchange, or deposit in a burial.

Movement through circles of gift exchange, trade and mobilisation extended the relationships between these objects and people. This created interpersonal connections between those moving and sharing the object, which aided the construct of self and therefore gave the objects significance. The relational links that were created between battle-axe/axe-hammers and people also occurred through all aspects of their itinerary, such as their use. Those links could be drawn upon through the life course of these objects and may have influenced their inclusion in networks of exchange and the funerary process (see table 10.8 for the actions and relationships, which may have caused meaning and significance through the itinerary of battle-axes and axe-hammers).

The relational processes that could have created significance are similar for both battle-axes and axe-hammers, yet many more battle-axes were deposited in funerary settings, compared to axe-hammers, which suggests that meaning and significance differed at the time of deposition. Differentiation occurred regionally and reflected the differentiation in interpretation. The differential interpretations of battle-axes and axe-hammers are reflected in the treatment of a small number of axe-hammers in the same way as battle-axes. In life, battle-axes and axe-hammers were similar and, for these few axe-hammers in death, they were also similar. It is in death – their deposition – that the change in significance is apparent.

9.1.1 Research Questions

The project followed several research questions with the overall goal to understand the use and significance of EBA stone battle-axes and axe-hammers. The questions were as follows:

- What evidence is there for the uses of stone battle-axes and axe-hammers in funerary practice, at ceremonial monuments, in craft production and other practices?
- What evidence is there for use-wear on these implements, how should that be interpreted, and how does this compare with the uses implied through burial contexts, and between implement types?
- To what extent were these implements used as tools or weapons?
- To what extent were some implements more significant than others, and can this be implied through the length of use?

- What evidence is there for regional variation between typologies, and to what extent is this related to the significance and use?
- To what extent does material variation within such hafted stone implements relate to, and be influenced by, regional variation, significance, and uses?

The following sections address the research questions, summarising the research undertaken and illustrating how it assisted in answering the questions set out at the start of this project.

9.2 What evidence is there for the uses of stone battle-axes and axe-hammers in funerary practice?

Chapter 5 discussed the contextual associations of battle-axes and axe-hammers (finalising aim 1: clearly define the possible varied uses of battle-axes and axe-hammers, using the evidence from use-wear analysis, experimental archaeology, and a contextual assessment). Trends within their typology, petrology, chronology and spatial and stratigraphic contexts were assessed and discussed to understand the potential meanings and roles these objects played. Battle-axes of all types were found in funerary assemblages. Variability within the assemblage was clearly apparent. The artefacts placed in the burials vary in combination, so do the funerary features. For instance, battle-axe have been found deposited with burials in cairns, barrows, pits, stone circles and henges. The variation within the funerary assemblages are in line with the broader pattern of EBA burial assemblages in the British Isles. A prime example of this is the deposition of battle-axes with cremation deposits which outnumber those with inhumation deposition 19:8. This reflects the common burial rite used in the EBA.

The variation within the funerary assemblages suggests variation in the meanings and roles that these burials had, and the different relational links that were drawn upon. The choices made regarding the deposition of battle-axes and axe-hammers were related to prescribed rules of engagement. These choices were made by those persons depositing each implement and were based on the relationship they had with the deceased. The objects use-life may reflect the choice of deposition, including the relational links that developed through use, which played an essential part in this selection. Their deposition drew upon moments in the use life of the object, and the associations and relations that were created through its itinerary. Creation, maintenance and a breakdown of links and claims could be actioned in the funerary assemblages. The action of deposition in various contexts and with various associations could have been used to reflect relationships in life between people and people and objects that were created, such as, through their functional use over time, and their movement between people in sharing, trade and exchange networks. These could be used to maintain relationships and networks despite the death of an individual involved, they could also have been used to create connections or alliances with land, people, actions and so on through drawing on associated relationships. Such relational actions would have needed to have a prestigious significance, perhaps related to the construct of identity, which gave them the power to enact such social and political outcome during the funerary process.

Multiple relationships could have been drawn upon in this process to express multiple potential meanings and roles. Among these signalling or negotiating prestige were elements as well as those unrelated to status and power. With many of these, the lack of information available means that they remain suggestions. For example, the deposition of an object which was used in a particular location over a prolonged period could have been used to claim access to land and resources, through drawing on the relational link between the object and the user and the action used on a material or land. The wear analysis suggests extended periods of use of the use of an object, which would have created relational links between people. Prolonged use also suggests the sharing of and handing down objects through generations. All would have given the object a prestigious significance related to identity – this could be drawn upon in its deposit in burial to demonstrate the relationship between two people and what this might mean for their identity. Multiple associations between people and battle-axes and axe-hammers were possible during their use lives; each could have been drawn up in death for various outcomes, which suggests that there was not one single reason for their inclusion in burials.

Axe-hammers are rarely found in funerary contexts, and only in regions where battle-axe quantities are few. The small number of axe-hammers from funerary contexts are similar to the battle-axe funerary contexts. Although this number is small, it is significant. The similarities in the use and treatment of these axe-hammers with funerary battle-axes suggest that those deposited in funerary settings were part of the same rules for engagement. Their inclusion in funerary settings occurred in specific regional areas (northwest England and southwest Scotland) and correlated with the regional preference for the use of axe-hammers over battle-axes. Therefore, those few funerary axe-hammers must have had a different, perhaps more prestigious, significance over battle-axes in the regions that axe-hammers were numerous. They were perceived as battle-axes were in other communities. As such, their deposition drew upon moments and relations in their use lives, just as the deposit of the battle-axes in funerary contexts did. For instance, the links created though the action of functional use over a prolonged period, perhaps with several users.

9.3 What evidence is there for use-wear on these implements, how should this be interpreted, and how does this compare with the previous interpretations of use. Moreover, to what extent were these implements used as tools or weapons?

Chapter 7 presents the use-wear results of a selection of battle-axes and axe-hammers from across Northern Britain and the Isle of Man (finalising aim 1 and 2: assess the extent to which such implements were used as tools or weapons). There was a great deal of observable wear on these implements, with over 98% of axe-hammers and 88% of battle-axes displaying clear wear traces from use. In combination with the experimental tests, it was found that both battle-axes and axe-hammers were highly functional objects and could have been used with ease and effectiveness. The uses include: woodworking, such as chopping and splitting wood, and hammering wooden materials; as land clearance tools to break apart soil and undergrowth; and as tools used in slaughtering livestock such as pigs and cattle. The use of battle-axes and axe-hammers as wedges to split wood is also possible; however, further experimental tests are needed to confirm this hypothesis.

Chapter 2 discussed the previous interpretations of battle-axes and axe-hammers. Roe interpreted battle-axes as purely ceremonial (Saville & Roe, 1984, 20), and others have seen them as weapons or symbols of a warrior elite (Mortimer, 1905, 159; Anderson, 1942, 80; Evans, 1872, 185; Greenwell, 1877, 159, 298; Smith, 1925, 80). The functional nature of these implements and the inclusion of functionally used battle-axes in funerary contexts signifies that these objects were not purely ceremonial or just symbols. They had the capacity to have multiple meanings and roles and therefore, could be both functional and symbolic. Axe-hammers have been interpreted to be too large and crude to be either ceremonial or functional (Leahy, 1986, 148) – this is incorrect; the wear analysis revealed the extensive use of these implements, including those found in funerary contexts.

Other interpretations are similar to the findings of this research project. Pegge considered the use of axe-hammers as domestic tools to slaughter animals (Pegge, 1773, 126-127). A woodworking role was suggested by Bradley, who put forward a suggestion that axe-hammers were used as wedges to split wood into planks (Bradley, 1978, 13). Leahy disputed this, suggesting that axe-hammers were too weak for such a task and therefore would break (Leahy, 1986, 148). However, the experimental tests suggest that axe-hammers were not weak and could withstand prolonged use despite not splitting the wood. Thomas suggested the role of axe-hammers in agriculture, as ard points to plough soil. This argument was based on the discovery of the tip of an axe-hammer within a middle Bronze Age plough furrow, Gwithian, Cornwall (Thomas, 1970, 13). Contact with soil and roots was evident on several axe-hammers, although no experimental tests have been carried out to test this use. The use of axe-hammers in land clearance, however, has instead been suggested. Further tests will confirm the use of axe-hammers as ard points.

The general opinion in the late nineteenth and early twentieth centuries regarded these implements as weapons wielded by warriors (Mortimer, 1905, 159; Anderson, 1942, 80; Evans, 1872, 185; Greenwell, 1877, 159, 298; Smith, 1925, 80). As discussed in chapter 8, the use of battle-axes and axe-hammers as weapons cannot be ruled out. However, their placement in funerary contexts does not reflect the identity of the individual deceased. It is an erroneous interpretation to see EBA burials with associated artefacts such as daggers, knives, bronze axes, battle-axes, and so on as warrior burials, often influenced by an awareness of the single grave culture in Europe (Brumfield & Earle, 1987; Earle & Kristiansen, 2010, 4; Knutsson & Knutsson, 2003, 70; Lekberg, 2002, 68). However, EBA burial assemblages reflect a shift in attitudes towards identity in death, shown by the greater diversity in the treatment of the dead (Fowler, 2013, 10; Wilkin, 2011, 26). Such diversity is a marked difference from the gendered single graves of the single grave culture buried according to a specific set of rules with specific orientation and graves goods.

Alternative interpretations have suggested other functional uses and roles for objects previously interpreted as weapons. Skak-Nielsen (2009), for instance, has argued for the use of flint and metal daggers as weapons used to sacrifice of livestock.

9.4 To what extent were some implements more significant than others, and can this be implied through the length of use?

Chapter 8 discussed the contextual, use-wear and experimental findings together to understand the use and significance of EBA battle-axes and axe-hammers (finalising aim 1, 2, 3: explore how the level of significance differs between the different typologies through an examination of deposition, material, typology, distribution, and use; and 4: assess the level of variation between and within implement types in relation to use, deposition, material and type of significance). It was concluded that the significance of an implement was not fixed and could be different for different people, in different contexts and assemblages. This means that one implement might have multiple levels of significance at any one time. Significance would have been achieved through the links and relations the implement had through their involvement in activities and their movement through time and space in trade and gift exchange (Brück, 2006). The movement of both battle-axes and axe-hammers and their similar functional uses suggests their significance may have been the same during the use-life. Only during the deposition does this significance change. Those deposited in burial contexts may have had a different significance, with a more prestigious meaning, if we assume the smaller percentage of implements deposited in these settings indicate special circumstances and importance.

Both battle-axes and axe-hammers were deposited at various stages of their functional use, and this did not correlate with a particular depositional context or treatment (i.e. there is no discernible difference between those in funerary contexts and other implements). This indicates that the length or intensity of use was not significant for the deposition of both implement types. Nor did those deposited in funerary contexts have more or less extensive use histories than those from non-funerary contexts. Indeed, the length of use of the funerary battle-axes and axe-hammers are no more or less extensive than those that are non-funerary. The same variation in use length is present for both categories. As such, the deposition of these implement may not have drawn upon the duration or intensity of use. It could, however, have drawn upon the relationships which developed through use; examples of how such relationships may have developed include, but are not limited to: from the single use of the object; a shared use; the use of the object on multiple occasions; in a specific location or for a specific function.

9.5 What evidence is there for regional variation and to what extent is this related to significance and use?

Chapters 5 and 8 presented the regional trends in battle-axe and axe-hammer distribution, which indicated some regional preferences for one or the other implement type, battle-axe or axe-hammer (finalising aim 4). It appears that in some regions axe-hammers have been used in the same ways as battle-axes were elsewhere. There were also similarities in depositional contexts. Many of both implement type are singular deposits, a small quantity of each have been found in rivers, and both were sometimes deposited in burial features, although this was rarer for axe-hammers. Moreover, chapter 7 interpreted the use-wear on both implement types, suggesting that both used in the same way for the same type of activities. Their functional use-lives cannot be differentiated; it is in their deposition that they were most often differentiated. However, even in their deposition, many were treated in the same manner, with the vast majority of both battle-axes and axe-hammers were single deposits. The indifference between the life histories of these implement types suggests that their significance may have developed in the same manner, through the relational links between person and object as the object moved through time and space. Differentiation in prestige and significance may have occurred in their deposition, in particular, the inclusion of certain battle-axes and axe-hammers in funerary contexts. It is in this way that the significance and meaning of these implements changed along with their treatment.

9.6 Implications of the findings

The research presented in this PhD demonstrates the results that can be obtained when assessing multiple strands of data together, i.e. the analysis of all information available. For example, this PhD assessed all contextual information available for the dataset analysed, including the chronological, typological, petrological, spatial, stratigraphic, cultural, and use contexts, which enabled a more accurate understanding of the itineraries of battle-axes and axe-hammers.

However, when assessing artefacts and burial assemblages in the EBA the itineraries are rarely considered by archaeologists. Although there have been developments in the theory of itineraries in recent years, to understand transformation of objects through time and space (Kopytoff, 1986, 66; Gosden & Marshall, 1999; Hahn & Weiss, 2013; Joyce & Gillespie, 2015), it still remains that archaeologists are using older interpretations to assess artefacts and the assemblages in which they belong. A good example is a recent paper discussing the Stanbury pit burial (Richardson & Vyner, 2011), which interpreted the deceased as high-status due to the presence of certain items in the burial assemblage including a battle-axe, bronze earrings and a bone belt hook. On this occasion, only the deposition of these objects was considered, which is a single moment in their itineraries. The findings of this PhD show that by using all the data available, we can better and more accurately understand object itineraries and therefore the changing meanings and functions of these objects through time and space and how this might have influenced their deposition. Indeed, this research indicates that Bronze Age objects can have multiple functions and meanings (as has also been demonstrated by the recent advances in assemblage theory, for which see Deleuze & Guattari, 2004; Hamilakis & Meirion Jones, 2017; Crellin, 2017; Harris, 2017; Ingold, 2007; Bailey, 1981 & 2007) and that they can be both functional and symbolic. Assessment of Bronze Age artefacts in the future must consider this to avoid limiting their interpretation and missing the complexity of these objects.

Also, the re-assessment of past interpretations, based on dated understandings, in this project illustrates the importance of re-interpretation and questioning such conclusions. Archaeologists need to question all interpretations to understand how they can be developed by considering new data and methods of analysis. In this way, understanding of archaeology becomes more accurate.

The success of the methodology used in this project brings to light the benefits of its application on other EBA artefacts and burial assemblages, which would allow a much more precise interpretation of these objects and further develop a better understanding of such assemblages. Researchers can use the methods, data and conclusions presented in this PhD thesis to assess discoveries of EBA battle-axe and axe-hammers as well as burial assemblages. It will allow for more accurate interpretations and will contribute to the understanding of how Bronze Age society interpret the world around them.

Finally, Chapter 4 presented a new ground-breaking method using cellulose acetate to replicate the wear on ground and polished stone. The method provides a significant breakthrough that enables researchers to overcome drawbacks when analysing wear on museum collections. Unlike the silicone-based casting products it does not damage ground and polished stone and allows high power analysis of groundstone objects, which is often not an option for those analysing large artefacts. As demonstrated in the chapter, acetate correctly replicated wear on such objects to a high quality. The method presented can be used by groundstone wear analysts to increase their accuracy of interpretation and to remove the obstacles faced when analysing wear under high magnifications using metallographic scopes, confocal scopes and SEMs (Dubreuil et al., 2015).

9.7 Future research

Several potential research directions can be taken from this project to further its findings and understanding of the use and significance of EBA stone battle-axes and axe-hammers. Further experimental tests would provide information on any further uses which may result in similar wear patterns, in particular, a test crushing bone to extract marrow is possible, as is the use of an axe-hammer as an ard point to plough soil and as a tool for mining and crushing ore. Additional experiments must also be carried out to test the use of battle-axes and axe-hammers further as wedges to split wood into planks, and the use of their butt to hit wooden wedges or posts. The splitting wood experiment carried out as part of this project was unsuccessful in splitting the wood, but the wear patterns caused in the process were observed on eight EBA a-h and three b-a, suggesting that this is the most likely use. The majority of human remains found in burials associated with battle-axes and axe-hammers are of unknown sex and age-at-death. A reassessment of the human remains from battle-axe deposits may allow a more thorough assessment of the relationship between the age of the deceased and the extent of wear on the object. It would also be useful in arguing for or against the view that battle-axes were buried with males. Finally, it was not within the scope of this project to include the implements from the southern British Isles in this study. Future research could extend the scope of this project to include those implements from the South and Ireland. A comparison of use and significance would be important, particularly as battle-axes deposited in funerary contexts in this area are found with a wider range of artefacts, including those made of gold.

The results from this project show that it is important to reassess previous interpretations of function. The successful methodology used in this research project could be implemented for other artefacts from the EBA, including metal daggers and course stone grinders and quernstone, and on course stone tools from other periods, such as Neolithic mace-heads, for a better understanding of their roles, meanings and treatments.

Appendices Contents (See attached USB for appendices)

Experimental tests	Micrographs from a stereomicroscope and a metallographic microscope from each pause during the experimental tests.
Images of analysed battle-axes and axe-hammers	Macroscopic images of analysed battle-axes and axe-hammers from northern Britain and the Isle of Man.
Micrographs of battle-axes and axe-hammers from northern Britain and the Isle of Man using a metallographic microscope	
Micrographs of battle-axes and axe-hammers from northern Britain and the Isle of Man using a stereomicroscope	
Spreadsheets of wear and depositional contexts	Excel spreadsheets of object ID's, and overviews of the wear analysed

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