The use and significance of socketed axes during the late Bronze Age

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Abstract: The widespread employment and acceptance of use-wear analysis on materials such as flint and bone has not been accompanied by a parallel development in archaeometallurgy. This article explores its potential and problems through the investigation of socketed axes in eastern Yorkshire, in England and south-east Scotland during the late Bronze Age. Experimental work on modern replications of socketed axes was compared with wear traces on prehistoric socketed axes. The results indicate that prehistoric socketed axes had been used as multi-purpose tools, but that the nature and extent of their uses before deposition varied considerably. By combining use-wear analysis with contextual information on socketed axes in the late Bronze Age landscape, ideas concerning their significance can be explored.

Keywords: experimental archaeology; landscape; late Bronze Age; socketed axes; use-wear analysis

Introduction

In the frequent absence of any reliable context, the main concern in the study of socketed axes has always been typology. This process continues in the research and publication of huge catalogues exemplified by the *Prähistorische Bronzefunde* series (e.g. Schmidt and Burgess 1981). Whilst these provide an invaluable source for the specialized researcher, they are limited in their ability to aid interpretation and explanation of the past. The employment of use-wear analysis can provide a good indication of the activities undertaken with metal objects. Furthermore, when the results from such analyses are placed in their archaeological context, interpretations concerning the significance of the metal objects to the people who actually used them can be explored.

Use-wear analysis is regularly performed on materials such as flint and bone (Hayden 1979; Vaughan 1985; Gräslund 1990; Van Gijn 1995), the results of which have had their greatest impact on the interpretation of Palaeolithic subsistence practices. In contrast, there has been a relative lack of interest in performing similar analyses on metal artefacts. This can be attributed to fears that the recycling,

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manipulation, re-sharpening and corrosion of metal would seriously limit the potential of such studies. However, this approach has been validated by several scholars (Kristiansen 1978; R. Taylor 1993; Bridgford 1997; Kienlin and Ottaway 1998). When placed in the framework of a wider interpretation, use-wear analysis can do much to dispel the implicit assumptions surrounding metal artefacts as well as provide valuable insights into the economic, social and ideological dynamics of prehistoric groups.

In developing this avenue of research, the uses and significance of a number of socketed axes from east Yorkshire and south-east Scotland (Fig. 1) were studied. These regions were selected on the basis of their variable topography, reasonable density of bronze artefacts and the existence of a significant corpus of relevant research on the Bronze Age. Experimental work was conducted on modern replications of socketed axes of the Roseberry Topping hoard from Yorkshire and the consequent wear traces were recorded. These, together with results from experimental work on flanged axes (Kienlin and Ottaway 1998), were compared to wear traces on 54 late Bronze Age socketed axes currently found in Sheffield, Hull and Edinburgh museums. The results of this analysis will be discussed in their late Bronze Age context.

Figure 1. *Location of study areas*

METHODOLOGY

Use-wear analysis on stone and bone artefacts was first systematically developed by S.A. Semenov in *Prehistoric Technology* (1964: 13–29). His work is criticized, discussed and refined in later research (Hayden 1979; Vaughan 1985; Gräslund 1990). Although it is not possible to transfer specific results from materials such as flint or bone to metal, it is feasible that certain general concepts can be developed.

It is generally accepted that the interpretation of prehistoric use-wear on artefacts must be based upon the results of experimental reproduction to find comparable traces of wear (Kienlin and Ottaway 1998). Unfortunately, the amount of experimental data available for metal is relatively poor compared to studies on stone and bone. There must also be a clear distinction between the manufacture, use and post-depositional stages of an artefact's life in order to prevent confusion in the interpretation of its functional use. This centres upon the existence of a thin patina, which provides protection for the pre-depositional wear traces and can indicate post-depositional contamination.

The methodological approach proposed for this project is adapted from Kienlin and Ottaway's (1998) and Kienlin's (1995:48) study of flanged axes of the north Alpine region.

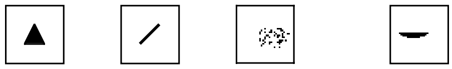
The steps in the examination of the axes were:

- The axe was examined under an adjustable light source and a light microscope at low power or hand lens at ×10 magnification. The axe was then measured, weighed, photographed, described and drawn to scale with any visible marks, including traces of manufacture and post-depositional damage, highlighted.
- If one of the following was observed the axe was excluded from further studies:
  - (a) If the level of oxidation/corrosion, porosity or post-depositional damage was too high then the artefact was deemed unsuitable for micro-analysis.
  - (b) If the axe was too corroded then there was the possibility that the surface may be partially removed by the impression material, which in this case was polyvinylsiloxane.
  - (c) If it was too porous then there was the probability that the impression material would remove the layers of dirt within the pores leaving a mark of its presence upon the blade.
  - (d) If the level of post-depositional damage to the cutting edge was excessive then there was little point in proceeding as the record of use had been destroyed.

  Although these exclusions may make the corpus less representative, they are unavoidable.
- Dental impression material was applied to the lower half of one side of the blade using a syringe dispenser. A plastic or wooden spatula was then used to ensure that it was evenly spread over the surface of the cutting edge. The length of the impression should be no more than 4 cm. This gives an accurate cast of the use-wear.
- After approximately four minutes, the impression material was peeled off, assigned a catalogue number and the impression was placed into a plastic finds bag.
- This process was repeated on the lower half of the reverse side of the blade.
- The casts of the blade edges were then studied using the naked eye and a hand lens of ×10 magnification under various light conditions and from different directions.
- The observable marks on the casts were then recorded in a schematic diagram. This information was then compared to the photographs, notes and schematic diagram of the axe itself.
- It is necessary for the recording to categorize the marks observed upon the blades as traces of manufacture, scratches, nicks and post-depositional changes (Fig. 2).

The recorded patterns were then compared to experimental work on wood, carried out by one of the authors (BR) with the socketed axes, and with work by Kienlin (1995) involving copper and bronze flanged axes. In addition, those marks not obviously caused by woodworking were compared to the impact of a bronze sword on an unhardened socketed axe (Bridgford 2000:154). Whilst the

Key: Nick Scratch Corrosion Deformation



Traces of manufacture

A Visible casting seam
B Rough surface due to incomplete polishing after casting
C Hammer marks
D Scratches parallel to the cutting edge
E Overall impression of heavy damage to the cutting edge
F Overall impression of minor damage to the cutting edge
G Marked asymmetry of the cutting edge
H Signs of heavier deformation or cracks

Scratches

J Inclined scratches less than 2 cm back from cutting edge
K Recognizable pattern but with different orientations less than 2 cm back from the cutting edge
L Random orientation
M Others

Nicks

N Concentrated on one half of the cutting edge
O Randomly distributed
P Others

Post-depositional changes

Q Scratches penetrating through the patina
R Removal of the patina
S Other damage

Figure 2. *Schematic diagram of use-wear traces on socketed axes produced by stated method with key and explanation*

comparisons are undeniably valid, it is readily conceded that it would be preferable if Kienlin's (1995) research had been carried out on socketed axes and Bridgford's (2000) work had been on hardened as well as unhardened socketed axes. As previously stated, the scope for future experimental work of this nature on metal artefacts is vast.

In evaluating the current methodology, several changes are recommended. Firstly, it was found that the original dental impression material, polyvinylsiloxane, left a residual mark when it was used upon lighter coloured axes. Upon further investigation into possible causes, such as porosity and duration of contact, it was found that inadequate mixing by the dispenser meant that the silicon leached into the axe and produced the observable effects. In order to prevent this, an alternative Aliginate-based impression material was used, which provided an accurate record if kept in a sealed environment. However, should the Alginate cast be left in the open for a significant period of time, it would contract considerably thereby losing valuable information.

Secondly, extensive levels of corrosion and post-depositional damage, normally the 'cleaning' of socketed axes by the finders, render micro-wear analysis impossible. However, the macro-wear can still be observed and recorded. This can provide information on the degree of use, method of hafting, production flaws, and deliberate destruction, and in some cases whether the primary material of impact was wood or metal.

Thirdly, the difficulty of interpreting scratches and nicks must be acknowledged. The observed patterns cannot be simply matched with the recorded experimental work as many of the axes have been used for several different functions, some causing more damage than others. It may well be that different activities cause the same or variable patterns. When single scratches and nicks are recorded instead of patterns, then the difficulty of interpretation is exacerbated. Further complication is introduced by re-sharpening the blade, which our experimental work has demonstrated would have been necessary. This would largely eradicate the wear traces that had built up as a result of the various activities undertaken previously. It is assumed therefore that the use-wear record is that of the final use of the axe before deposition. Although these difficulties are acknowledged, they do not invalidate the study of micro-wear as they can be understood and therefore considered with additional experimental work.

The results of the conventional photography of micro-wear are ably demonstrated in both Kienlin (1995) and Bridgford (2000), however neither is able to produce a system that effectively documents the micro-wear on axes to the point where impression materials and schematic diagrams are no longer required. Subsequent pilot studies have shown that new improved digital technology could solve this problem. It was found that when using a high-powered digital camera fixed directly above the axe blade on a white background, illuminated from both sides by artificial light, pictures of micro-wear were attainable. In evaluating them using photo imaging software, it is possible to reduce the effects of reflection and concentrate on any aspect of the image. The software permits the photographer to view the picture at any magnification; angle or colour desired and then print it directly. This means that taking impressions for use-wear analysis is no longer necessary and will in the future be superseded by this more efficient method. Pilot studies are in progress and quantifying use-wear will be one of the next steps to investigate.

EXPERIMENTAL WORK

Introduction

The experimental work comprised three main activities: the design, manufacture and fitting of a haft for the socketed axes, the selection and undertaking of the experimental activities, and recording the wear traces.

Design

Models for the construction of a haft for a socketed axe derive from the rare discoveries of prehistoric hafts for socketed and flanged axes (e.g. A. Harding 1976; M. Taylor 1992; Spindler 1994) and from experimental research (Coles 1979:169; Kienlin 1995; Mathieu and Meyer 1997). In designing our own haft, the numerous methods documented in the archaeological record did not seem to indicate that a single technique was prevalent. Therefore, it was decided to make the haft according to the morphological characteristics of the axe, taking into consideration previous research and debates (cf. A. Harding 1976). In the hafting of the axe, the selection of the type of wood is crucial. The most frequently used in these experiments is ash (*Fraxinus*) in accordance with various archaeological examples (e.g. Spindler 1994) because its hardness and elasticity allow it to absorb shock and prevent breakage (Kienlin 1995). However, it should be noted that the hafts recovered at Flag Fen were all made from oak (*Quercus*), an especially robust and durable wood (M. Taylor 1992). For this study, ash (*Fraxinus*) was selected as the material for the haft.

In discussing the potential designs of the haft for socketed axes with one loop, it was decided that it should be L-shaped with the handle approximately 40 cm in length with a spike of approximately 15 cm for attaching the axe. These dimensions allow for an even distribution of the forces involved in striking a material, whilst maintaining a size that is flexible enough to permit other potential activities. With this in mind, the handle was made thicker towards the top to strengthen the structure and accommodate possible use as a chisel in working wood. It was thus necessary to select a piece of ash with a grain that followed the desired shape in order to benefit from the increased strength and resistance of the wood. As it was wet, the wood was slightly burnt in order to toughen it and make it easier to shape.

Two socketed bronze axes, containing 9 per cent tin and 5 per cent lead, one cast in a bronze and the other in a sand mould, were used (Swiss and Ottaway in press). Both were carefully polished and sharpened. The axes were otherwise left unhardened in order to minimize the number of experimental variables present, though the relationship between use-wear and work hardening may well form the basis for future research. The axes were examined for traces of manufacture such as casting seams and scratches and these were recorded in diagrammatic form according to the methodology set out later in this article. Examination of the use-wear on prehistoric axes seemed to suggest that there was no exclusive method of hafting, with the loop of the axe facing up or down. Thus for this study, the axes were attached with the loop facing down and secured to the handle using a leather strip wound around a groove in the handle as this provided a more secure binding (Fig. 3).

During the hafting process, it was noted that the smooth and rib-less interior sockets made it easier to mount the axe on the wooden handle. There has been some debate as to the nature of the sockets, specifically in relation to the presence of internal ribs (Ehrenberg 1981; Rynne 1983). Discussion centres on the issue of whether these ribs were a by-product of the casting process and, if so, which method of casting. Or alternatively whether they were deliberate creations to ensure a more resilient binding between the axe and the haft. The research presented here can only contribute the observation that the smooth sockets formed from the sand and bronze mould casting in techniques employed by Swiss and Ottaway (in press) seemed to aid the hafting of the resultant axes.

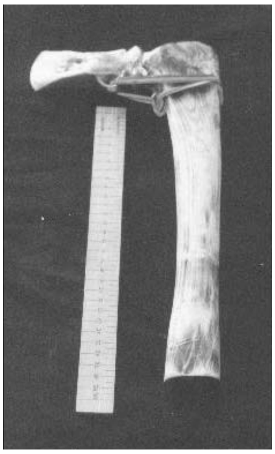


Figure 3. *The experimental hafted axe*

Experimental activities

The selection of experimental activities was dictated by the existence of certain trees in the late Bronze Age, the scale of the task and the permission that could be obtained from the owner of the trees. The decision was taken to focus activity on a coppiced hazel (*Corylus*) tree that was to be cut for a total of four hours by one of the authors (BR) with the socketed axe from the bronze mould (Fig. 4). Blows to the wood were delivered from the elbow rather than the shoulder as the size of the axe and the length of the shaft seemed to render larger movements impractical.

Figure 4. *The experimental hafted axe cutting the wood*

The unhardened blade cast in the bronze mould remained fairly sharp throughout the process and would only have required re-sharpening towards the final hour of cutting. However, research by Kienlin and Ottaway (1998) convincingly demonstrates that even limited cold working of an axe significantly increases the lifespan of a blade. Future experiments with both hardened and unhardened socketed axes will have to be carried out. The hafting method stopped the axe from slipping or becoming detached while remaining easily removable. Little difficulty was encountered in the task as the hafted axe proved itself to be an efficient and robust tool that could be employed in a variety of activities.

Results

The wear traces on the socketed axe blade were recorded after 15, 60, 120 and 240 minutes (Figs 5–8). The wear patterns indicate that scratches can appear quickly, although it takes considerably longer for the blade to become deformed. The absence of distinct nicks on the blade seems to indicate that these might be produced by the axe striking materials other than wood. It is noticeable, but unsurprising, that the scratches and deformation accumulate on the half of the

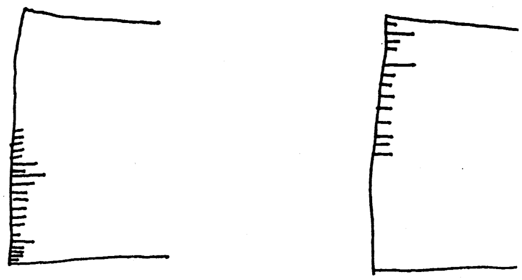


Figure 5. *The wear traces produced by the experimental hafted axe cutting the wood after 15 minutes*

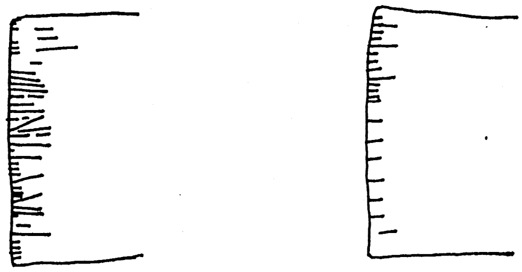


Figure 6. *The wear traces produced by the experimental hafted axe cutting the wood after 60 minutes*

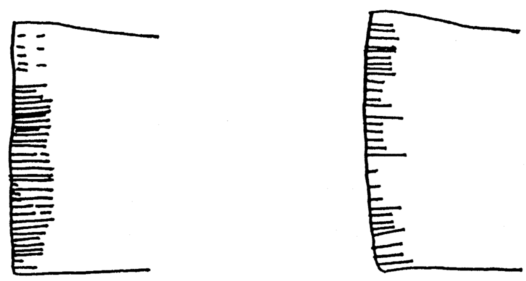


Figure 7. *The wear traces produced by the experimental hafted axe cutting the wood after 120 minutes*

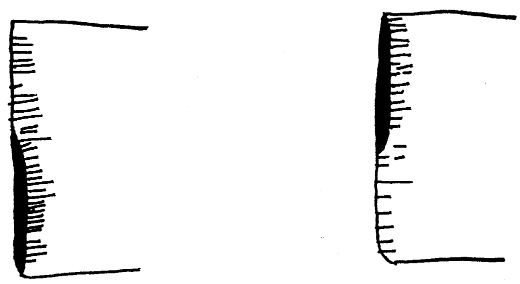


Figure 8. *The wear traces produced by the experimental hafted axe cutting the wood after 240 minutes*

blade that is actually cutting into the hazel branch, thus producing an asymmetric cutting edge.

The socketed axe produced from a sand mould was applied to the stripping of bark from freshly cut branches in order to test its suitability for this task and to observe if significant and distinguishable wear traces were produced. Although it proved to be easily able to detach bark from the wood, no significant scratches were recorded in the 30 minutes. Following Kienlin and Ottaway (1998), it is probable that further experimentation would have caused traces to appear.

Discussion

The concentration and orientation of the scratches on the axe used to cut wood, as well as deformation, can be used, in conjunction with research by Kienlin and Ottaway (1998) and Bridgford (2000), as a basis for comparison with wear traces recorded on prehistoric axes. Variability in the creation of micro-wear caused by types of hafts, different activities and type of wood, as well as the duration of cutting and different users mean that such studies should not be seen as providing ideal templates concerning specific activities. Instead, they should be thought of as giving a good insight into the final uses of an artefact before deposition.

RESULTS

For the purposes of this research project, 54 prehistoric socketed axes (23 from east Yorkshire and 31 from south-east Scotland) were recorded, photographed, had their impressions taken and use-wear analysed for wear traces for comparison with the experimental results discussed earlier (Tables 1–2, Figs 9–10). The axes were selected at random from the participating museums to ensure that there was no bias towards relatively high quality specimens.

This allowed the study to investigate the extent to which the degree of corrosion and post-depositional damage would render use-wear analyses either impossible or meaningless. It was found that even if corrosion is too pervasive to conduct the normal 'micro'-wear analysis, then certain statements could be made about the 'macro'-wear. The latter concerns the extent of blade deformation and asymmetry, caused by frequent re-sharpening, which can give information as to whether the axe had been used 'heavily' or 'lightly' before deposition. Furthermore, suggestions can be advanced about the methods of hafting employed from the asymmetry of the blade. This information should not be dismissed or discounted as it can contribute to the discussion. Of the 54 axes in this study, 43 per cent (8 from Yorkshire and 15 from Scotland) were deemed too corroded or had suffered too much post-depositional damage for any micro-wear analysis to be conducted. However, it is important to note that there is considerable variation within and between axes with recordable micro-wear and those with non-recordable micro-wear. Thus, the full methodology was successfully applied to 31 of the 54 socketed axes examined.

The micro-wear of these 31 socketed axes (15 from east Yorkshire and 16 from

Table 1. Socketed axes studied for use-wear in east Yorkshire

			Use-wear							Context		
No.	Museum code	Type	Analysis	Wear traces					Interpretation	Landscape	Associations	Interpretation
32	J93.515	Sompting	Micro	A, C	F	J, K	O	Q	Cutting wood		Spearhead,	
33	J93.516	Yorkshire	Micro	A, C	E	J, K	O	Q, S	Variable light use	Hillside	hammer, chisel,	Land
34	J93.517	Blade only	Macro		E	J, K	O	Q	Variable heavy use		whetstone, sheet metal and copper lump	
35	J93.502	Fulford	Micro	A, C	E	J, K	O	Q, S	Cutting wood	Lowland	Found singly	Land?
36	J93.495	Everthorpe	Macro	A, C	F			Q, R, S	Variable light use	Upland/	2 socketed axes,	Land
37	J93.500	Meldreth	Micro	A	E, G, H	J, K	N		Variable light use	lowland	2 broken	
38	J93.499	Meldreth	Macro	A, C	E, H			Q, R, S, T	Variable heavy use	boundary	swords and	
39	J93.497	Yorkshire	Macro	A, C	E, G, H			Q, R, S	Variable heavy use		6 spearheads	
40	J93.509	Sompting	Micro	A	F	J, K	O		Variable light use	Unknown	Unknown	Not possible
41	J93.510	Yorkshire	Micro	A, C	F	J, L	O	S	Variable light use	Upland	'wolf skull'	Land?
42	1970.1446	Unknown	Macro	A, C	F		O	Q, S	Variable light use	Unknown	Found singly	Not possible
43	1970.1446	Unknown	Macro	A, C	F		O	Q, S	Variable light use			
44	900.42/100	Yorkshire	Micro	A				S	No apparent use	Hillside	5 socketed axes,	Land
45	900.42/94	Everthorpe	Micro	A	F	J, K		S	Variable light use		socketed gouge,	
46	900.42/93	Everthorpe	Micro	A	F	J, K		Q, S	Variable light use		3 lumps of	
47	900.42/97	Everthorpe	Macro	A	F			Q, S	Variable light use		copper	
48	900.42/103	Everthorpe	Micro	A	F	J, K	O	S	Variable light use			
49	900.42/102	Yorkshire	Micro	A, C	E, H		O	S, T	Variable light use			
50	900.42/98	Everthorpe	Macro	A	F			Q, R	Variable light use			
51	900.42/95	Everthorpe	Micro	A	F	J, K		R, S	Variable light use			
52	900.42/101	Yorkshire	Micro	A	F	J, K		Q, S	Variable light use			
53	900.42/96	Everthorpe	Micro	A	F	J, K		R, S	Variable light use			
54	900.42/92	Everthorpe	Micro	A	F	J, K		Q, R, S	Variable light use			

south-east Scotland) was recorded and analysed (Tables 1–2, Fig. 9). It is difficult to categorize the wide variety of uses that socketed axes were subjected to owing to the lack of experimentation beyond cutting wood and striking metal. In some cases, it is possible that an axe can be placed into several different activity groups. Where possible, probable identifications have been made; however, this still leaves a significant number of socketed axes in the 'variable light use' and 'variable

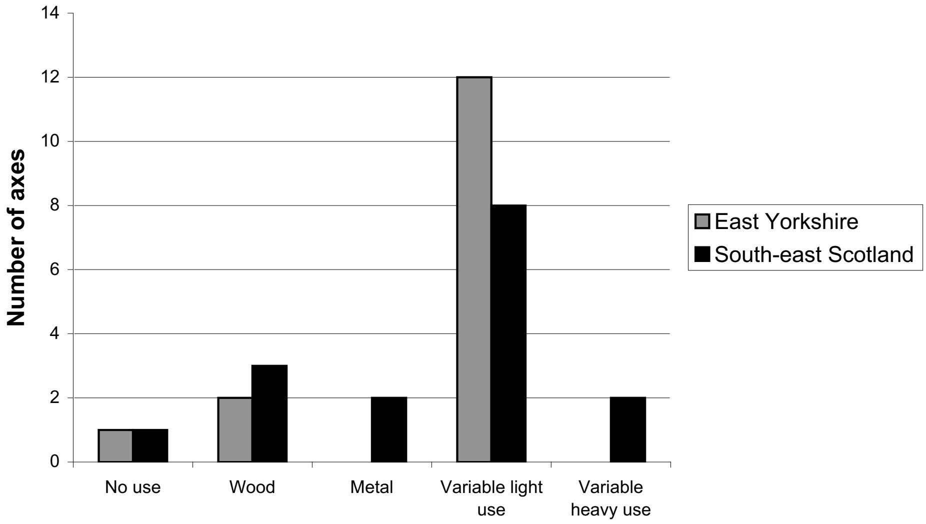


Figure 9. *Socketed axes analysed for micro-wear*

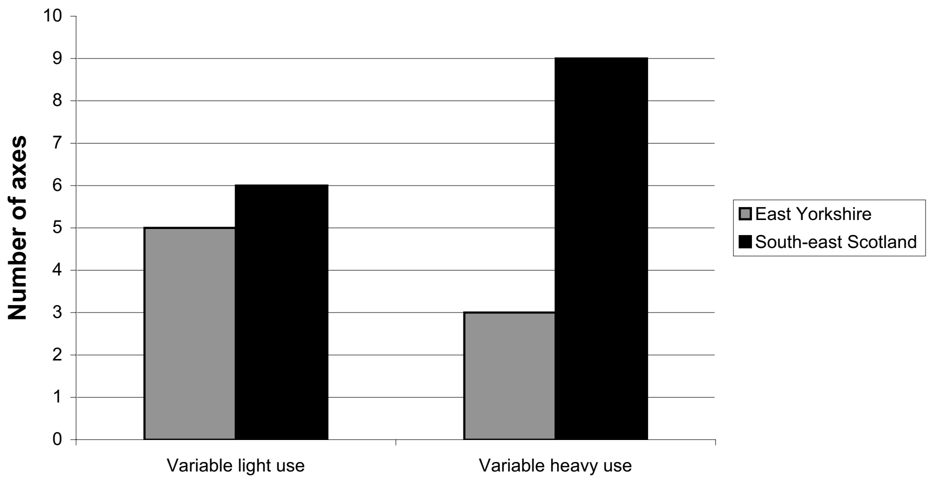


Figure 10. *Socketed axes analysed for macro-wear*

Table 2. Socketed axes studied for use-wear in south-east Scotland

			Use-wear							Context		
No.	Museum code	Type	Analysis	Wear traces					Interpretation	Landscape	Archaeology	Interpretation
1	DQ 69	Portee	Micro	A, C	E,G, H, I	J, K	O	PQ, T	Variable light use	Lowland	'Tumulus' with urns, burnt bone and three razors	Dead
2	DQ 273	Yorkshire	Micro	A	F, H	J, K	O		Variable light use	Hillside	Socketed axe (no. 3)	Land
3	DQ 274	Yorkshire	Micro	A, C	F	J, L	O		Metal impact	Hillside	Socketed axe (no. 2)	Land
4	DE 103	Fulford	Micro	A	F, I	J, L	O	S	Variable light use	Unknown	Unknown	None
5	DE 46	Gillespie	Micro	A, C	E	J, L	O	S	Variable heavy use	Coast	Found singly	Land?
6	DQ 328	Gillespie	Micro	A, D	E	J, L		Q, R	Variable light use	Hillside	Three socketed axes	Land
7	DQ 392	Yorkshire	Macro	A	F	J, L	N	Q, R, S	Variable light use	Unknown	Unknown	None
8	DE127	Melrose	Micro		E	J, L	O	S	Metal impact	Hillside	14/15 swords, ring, pin and mounting	Land
9	DE 7	Gillespie	Macro	A, C	E, H, I		O	R, S, T	Variable heavy use	Upland/ lowland boundary	Found singly	Land
10	DE 10	Gillespie	Macro	A, C	F	J, K	O	R, S	Variable light use	Hillside	Found singly	Land
11	DE 16	Everthorpe	Micro	A, C	E		O	R, S	Cutting wood	Hillside	Socketed axe	Land
12	DE 18	Meldreth	Micro		F	J, K		Q, R	Variable light use	Lake	Four socketed axes	Dead?
13	DE 25	Welby	Micro	A, C	E, G, H	J, K	O	Q, R, S	Cutting wood	Hillside	Found singly	Land
14	DE 60	Gillespie	Micro	A, C	E, G	J, K	N	S	Cutting wood	Hillside	Three socketed axes, rings, discs and strips	Land
15	DE 65	Melrose	Micro	A	F	J, K	N	Q	Variable light use	Hillside	Found singly	Land
16	DE 68	Dowris	Micro	A, C	F	J, K	N	Q, S	Variable light use	Hillside	Socketed gouge	Land
17	DE 69	Dowris	Macro	A, C	F, H	J, K	N	Q, R, S	Variable light use	Hillside	Found singly	Land

18	DE 70	Blade only	Macro		F	J, L	N	Q	Variable heavy use	Hillside	Found singly	Land
19	DE 76	Yorkshire	Micro	A	F	J, K	N	S	Variable light use	Lake	Found singly	Dead?
20	DE 81	Sompting	Macro	A	E			Q	Variable heavy use	Hillside	Found singly	Land
21	DE 83	Blade only	Macro		F	J, K	O	Q, R, S	Variable heavy use	Hillside	Found singly	Land
22	DE 96	Dowris	Macro	A, C	F	J, K		Q, R, S	Variable light use	Upland / lowland boundary	Found singly	Land
23	DE 104	South-eastern	Macro	A, C	E, H	J, K		Q, R, S	Variable heavy use	Unknown	Unknown	Not possible
24	DE 105	South-eastern	Macro	A, C	E, H	J, K		Q, R, S	Variable heavy use	Unknown	Unknown	Not possible
25	DE 106	Everthorpe	Macro	A, C	E	J, K	O	Q, R, S, T	Variable heavy use	Unknown	Unknown	Not possible
26	DE 107	Yorkshire	Micro	A, C	F, H, I	J, K	O	Q, R, S, T	Variable heavy use	Unknown	Unknown	Not possible
27	DE 116	Sompting	Macro	A, C	E, H	J	O	Q, R, S, T	Variable heavy use	Upland / lowland boundary	Found singly	Land
28	DE 125	Highfield	Macro	A, C	E, H			Q, R, S, T	Variable light use	Hillside	Found singly	Land
29	DE 9	Yorkshire	Micro	A	F			Q, R, S, T	No apparent use	Coastal	Found singly	Land?
30	DE 1	Yorkshire	Macro	A, C	E	J, K	O	Q, R, S	Variable heavy use	Hillside	Found singly	Land
31	DE 4	Sompting	Macro	A, C	E			Q, R, S	Variable light use	Unknown	Unknown	Not possible

heavy use' categories. This situation can only be resolved with further experimental work.

The wear traces indicate that socketed axes were occasionally deposited unused as seen in one axe from east Yorkshire and one from south-east Scotland. However, the majority of the axes fall into the 'variable light use' category (12 from east Yorkshire and 8 from south-east Scotland), where micro-wear can be identified; however in these cases the assignment of patterns to a particular activity are beyond the scope of the current experimental data.

In terms of identifying more specific activities carried out with the socketed axes, it is probable that at least 5 axes (nos 32 and 35 from east Yorkshire and nos 11, 13 and 14 from south-east Scotland) were employed in woodworking. This is not surprising given the vast amounts of timber required to construct late Bronze age settlements such as Staple Howe (Brewster 1963) and Thwing (Manby 1980), boats as at North Ferriby (Wright 1990) and crannogs as at Oakbank (Sands 1997). It is very likely that many more were used in this way but either suffered post-depositional damage or were subsequently subjected to other activities.

The identification of two potential metal impacts in the form of nicks on the socketed axes from south-east Scotland (nos 3 and 8) raises the possibility of combat. Socketed axes are usually assumed to have been restricted to manual labour despite their occasional associations with swords and spears in hoards. The possibility of combat is more difficult to prove as there has been only one experiment carried out of metal wear on a socketed axe (Bridgford 2000:154). Whilst the possibility of metal hitting metal is realistic, it seems less probable that the cutting edges of a sword and an unhardened socketed axe might meet in combat. However, this possibility still needs to be investigated further.

Socketed axes on which micro-wear analysis could not be conducted could still be categorized using macro-wear as having undergone 'light' or 'heavy' use (Tables 1–2, Fig. 2). Five of the axes from east Yorkshire were identified as having been subjected to minimal blade deformation and possessed little blade asymmetry, three of the axes from this area showed signs of much heavier use. In contrast, six axes from south-east Scotland had apparently been used sparingly before deposition whereas nine axes had suffered consistently heavier impacts.

Interestingly, there are only 3 socketed axes (nos 18, 21, 34) out of the 54 where the socket was missing leaving only the blade. Despite the fact that on all 3 axes micro-wear analysis was not possible, the blades themselves demonstrated heavy use. However this heavy use would not have been enough to break off the blades from the sockets of the axes. It is thus possible to suggest that the breakage of the socketed axes might, in the case of some specimens, have been deliberate.

In terms of hafting a socketed axe, it is possible to gain indications from the asymmetry of the blade as to whether the axe was hafted with its loop orientated up or down. There appears to be no distinct pattern in either region to indicate that this aspect of the hafted form was a distinguishing feature. However, this does not preclude the possibility that other characteristics of the haft may have signified certain aspects of personal or cultural identity.

Whilst the wear traces on socketed axes can still be interpreted without context and the axe can be assigned to a particular 'type', providing a spatial and temporal distribution, it is none the less desirable to have the archaeological associations and location of discovery in the landscape. The presence of a known context allows far more sophisticated questions and ideas concerning the significance of the axe to those who possessed it. In this study, the context of nearly 80 per cent of the axes (20 from east Yorkshire and 22 from south-east Scotland) is known though the level of detail available varies considerably. The relationship between the use of an object and its context of deposition is discussed next.

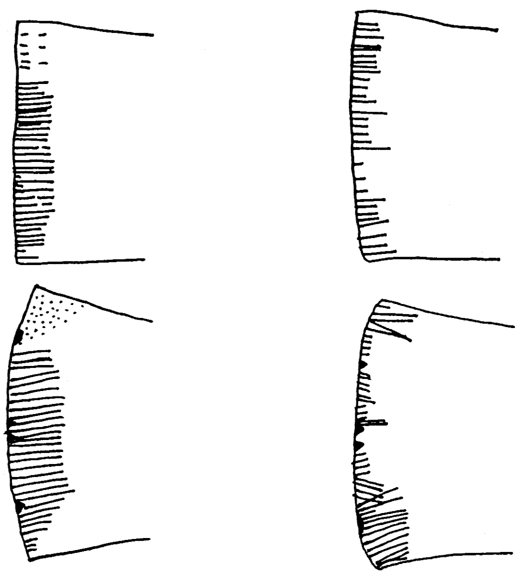


Figure 11. *Schematic diagram of an experimental axe and a prehistoric axe subjected to woodworking*

DISCUSSION

Introduction

Although use-wear analysis can provide interesting data and stimulate further debate, the objects studied must be able to be placed into their archaeological context in order to explore more subtle ideas concerning their significance. In practice, this means that the position in the landscape of each studied socketed axe, its associations and the surrounding regional archaeology must be discussed before being integrated with the use-wear results outlined earlier.

Dating

Through exhaustive work on the typology of socketed axes in northern England and Scotland (Schmidt and Burgess 1981) and on the constant revision of the dating of those typologies (Burgess 1968; Megaw and Simpson 1979; Needham 1996; Needham et al. 1998), it is possible to provide date ranges for the socketed axes examined. The majority are grouped in the Ewart Park phase – *c.* 1020 BC–800 BC (Needham et al. 1998:93–98), though many are thought to have developed in the Wilburton phase – *c.* 1140 BC–1020 BC (Needham et al. 1998:90–93). A minority of the socketed axes (nos 12, 16, 17, 20 and 22) develop in the Ewart Park period and carry on into the Lyn Fawr phase – *c.* 800 BC–400 BC (Needham et al. 1998:98–99). This means that the sample of socketed axes can be securely placed in the archaeological context of the late Bronze Age discussed in the next section.

Archaeological context

The study of the late Bronze Age in northern England and southern Scotland is gradually emerging from the shadow of southern England that has traditionally formed the focus for debate and research in the period. The publication of works such as Challis and D. Harding (1975), Barrett and Bradley (1980), Barker (1981), D. Harding (1982), Spratt and Burgess (1985) and J. Harding and Johnson (2000) have done much to redress the imbalance and enhance the understanding of late Bronze Age east Yorkshire and south-east Scotland. As there is not the space to examine at length the archaeology of the two regions in full, the discussion outlines the main interpretative themes.

The landscapes of late Bronze Age east Yorkshire and south-east Scotland were primarily shaped by the growing complexity of settlement, the intensification of agricultural regimes and an increased concern with territoriality (Manby 1980; Ashmore 1994) reflecting broader geographical trends (Champion 1999). These processes were manifested in the construction of larger and more durable settlements and the division and reorganization of the landscape. Little is known concerning the deposition of the dead during this period, but there appears to be a trend towards urned cremations in barrows (Manby 1980; Ashmore 1994). However, it is possible, given the small number of known barrows, that it was more common for the cremated remains to be placed elsewhere such as at field boundaries and rivers (Bradley and Gordon 1988; Brück 1995). The late Bronze Age is especially notable for the dramatic increase in the deposition of bronze objects (Coles 1959–1960; Burgess 1968; Manby 1980; Sheridan 1999). The importance of this widespread phenomenon in the late Bronze Age is evident from the variety and sheer volume of material recovered. As socketed axes form by far the most common class of item in these depositions and were therefore presumably possessed by the widest group of people, it is necessary to discuss the practice by which they enter the archaeological record in more detail.

Metalwork deposition

Metalwork deposition in hoards is often conceptualized as a single, homogenous and unitary phenomenon that in turn can be analysed, discussed, or even dismissed, as a discrete entity. As such, it is placed beyond the familiar set of inferences that archaeologists use to approach the past (Champion 1990) resulting in limited explanations, such as 'votive' and 'ritual' offerings or chance losses. This treatment has led to certain contradictions becoming embedded in the study of hoards. The assumption that the more 'spectacular' objects, such as swords and spears, were reserved for structured deposition leaving the more 'functional' tools to be discarded or recycled, is not supported by the use-wear evidence (see later). Similarly, the division of single and multiple finds present in many interpretations simply promotes the idea that Bronze Age people lost their individual possessions on a regular basis whilst intentionally depositing collections of them (see Jensen 1973). This is further undermined by the frequent occurrences of single objects being placed in the landscape according to the same patterns as more 'complex' hoards as demonstrated later in east Yorkshire and south-east Scotland. The huge variation in the metal objects recovered from pre-determined locations negates the idea that intentional deposition in the late Bronze Age should only be seen in terms of an élite. It is more feasible that the practice of deposition involved groups within the community. This opens up the possibility that hoarding was not only associated with one form of discourse, rather incorporating a range of ideas potentially reflected in the nature of the objects and their locations of deposition in the landscape. If this were the case, then certain places in the landscape may have been the focus for several temporally distinct depositions (see Barrett and Gourlay 1999; Bradley 2000). It is also likely that the items deposited were not just restricted to metal but included more perishable materials such as food, wood and textiles (see Levy 1982).

A system of classification based on the nature of the object, its archaeological context and its position in the landscape carries with it considerably fewer assumptions than attempts to organize hoards either according to the identity or intentions of the owner such as 'founders'' and 'merchants'' hoards (e.g. Hodges 1957) or as to whether they have 'votive' or 'utilitarian' characteristics (e.g. Levy 1982). Whilst hardly revolutionary, this at least gets away from the conceptualization of all metal deposits as economically based or concerned largely with theories of competitive consumption and élite power struggles. Instead, it allows the development of a framework that, following work by Bradley (1998; 2000), and Fontijn (2002) allows the search for patterns of use, association and deposition that can provide insights into the significance of axes in east Yorkshire and south-east Scotland.

In looking at the general patterns exhibited by the contexts of all the recorded socketed axes in east Yorkshire and south-east Scotland as documented in Schmidt and Burgess (1981), it can be seen that they are rarely found in settlements and burials. The deposition of socketed axes in wet contexts such as rivers or lakes does not appear to occur in east Yorkshire, though several examples of this practice are known from south-east Scotland (e.g. nos 12, 19). Instead, socketed axes were generally deposited either at prominent natural features in the landscape – Roseberry Topping (nos 32–34), Everthorpe Hill (nos 44–54), Eildon Hills (nos 2–3) Arthur's Seat (no. 11) and Gurnside Hill (no. 6) – or, following the observation by Manby (1980:331) in east Yorkshire, at the boundaries of different natural environments, specifically at the border of uplands and lowlands or on the coastline (nos 5, 9, 22, 27, 29, 36–39). This deliberate placing of the socketed axes at these chosen points in the landscape indicates that careful consideration was given to location. It is therefore argued that this level of deliberation would be excessive if the sole motivation was storage either during times of conflict or as a 'scrap hoard'. This is borne out by an examination of the contents of the metalwork depositions in east Yorkshire and south-east Scotland where the contextual associations appear to divide into three broad categories. They are discovered either singly (e.g. nos 5, 9, 10, 13, 15, 18–22, 27–30, 35, 42–43), with other socketed axes (e.g. nos 2, 3, 42 and 43) or with other metal items such as swords, personal ornaments, tools and lumps of metal in various states (e.g. nos 8, 32, 33 and 34).

The virtual absence of socketed axes in burial, settlement and riverine contexts, where, in the case of the latter two categories, substantial amounts of other metal artefacts have been recovered, suggests that socketed axes upon deposition were less associated with daily practices in the settlement or the treatment of the dead. Their depositional patterns indicate instead that they were connected to the land. It is tempting to suggest that the occurrence of socketed axes at prominent natural features and boundaries is a reflection of the growing themes of territoriality and agricultural intensification present in the late Bronze Age. However, the variations in the contents of the metalwork depositions at these chosen places in the landscape demonstrate that, though there may have been a broad underlying theme of dedications to the land, there were many different local re-workings of this tradition.

Use and significance

The integration of patterning seen in the use of socketed axes with their archaeological and landscape context is fundamental to gaining insights into the significance of socketed axes during the late Bronze Age in east Yorkshire and south-east Scotland. It is necessary to dismiss the idea that they were simply discarded upon reaching the end of their functional lives as 20 of the 23 axes (87%) in east Yorkshire and 25 of the 31 axes (81%) in south-east Scotland possessed a robust cutting edge and haftable socket and were therefore still effective tools. Their deposition was thus not determined by their degree of use. Neither can this patterning be accounted for by the attitude that they were all 'chance losses'. The strength of the experimental hafting together with the contextual patterns shows this can be accounted for by their intentional deposition at chosen points in the landscape.

However, this does not mean that they should simply be considered as objects of deposition as the experimental and use-wear evidence demonstrated their effectiveness and widespread prehistoric use as tools. Though it is only possible at present to identify their employment on wood and metal, the wear traces indicate that socketed axes were evidently multi-purpose tools and were seldom deposited unused. The lack of uniformity in the use-wear evidence, even within some socketed axes found together or of the same type (e.g. nos 2–3, 36–39 though not 44–54), appears to indicate that the use of an individual axe was not a major factor to its placing in the landscape. The determining factor in the significance of the socketed axes would therefore seem to be not simply in their widespread possession and use but also in the timing and the location of their deposition, which transformed active tools into offerings to the land.

CONCLUSION

This article has investigated the use and significance of socketed axes in east Yorkshire and south-east Scotland through wear analysis, contextual information and the broader archaeological sequence over 500 years. Consequently, it is argued that the significance and meaning of socketed axes probably changed considerably over this period along with the practices of the individuals and groups involved. The recognition that socketed axes were multi-purpose tools engaged in identifiable activities and were subject to identifiable rules of structured deposition allows various avenues to be explored. It is possible to go beyond the treatment of prehistoric metal objects as functional or economic tokens with one-dimensional purposes. By attempting to reconstruct aspects of their significance through the analysis of manufacture, use and deposition, a greater understanding of metalwork in the Bronze Age can be achieved.

The small number of published use-wear studies on metals, the majority of which have been carried out by students of Sheffield University, means that the scope for future research remains vast. The scale of the present study allowed only for the identification of woodworking and metal impacts and further experimentation is required to determine whether other potential uses for axes such as butchering, hide scraping and grass cutting can be distinguished. Whilst the sample of axes examined gave valuable insights into their general uses, a far larger sample is required if the degrees of wear are to be examined against the context of deposition. The main limitation of the technique is the excessive levels of corrosion and post-depositional damage that afflict a proportion of metal objects in most museum collections rendering micro-wear invisible. However, it has been demonstrated that even examination of the macro-wear can yield illuminating results. Further development of a digital photographic method has been tested and promises more accurate recording of micro-wear on metals. This would not only dramatically increase the level of efficiency in the recording process and make the process more objective, but also make access to museum collections easier as it is a non-contact procedure.

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REFERENCES

ASHMORE, PATRICK, 1994. *Neolithic and Bronze Age Scotland*. London: Batsford.

BARKER, GRAEME, ed., 1981. *Prehistoric Communities in Northern England: Essays in Social and Economic Reconstruction*. Sheffield: University of Sheffield.

BARRETT, JOHN and RICHARD BRADLEY, eds, 1980. *Settlement and Society in the British Later Bronze Age*. Oxford: British Archaeological Reports (British Series 83).

BARRETT, JOHN and ROBERT GOURLAY, 1999. An early metal assemblage from Dail na Caraidh, Inverness-shire, and its context. *Proceedings of the Society of Antiquaries of Scotland* 129:161–187.

BRADLEY, RICHARD, 1998. *The Passage of Arms*. Second edition. Oxford: Oxbow.

BRADLEY, RICHARD, 2000. *An Archaeology of Natural Places*. London: Routledge.
BRADLEY, RICHARD and KEN GORDON 1988. Human skulls from the River Thames, their dating and significance. *Antiquity* 62:503–509.
BREWSTER, THOMAS C.M., 1963. *The Excavation of Staple Howe*. Malton: East Riding Archaeological Research Committee.
BRIDGFORD, SUE, 1997. The first weapons devised only for war. *British Archaeology* March 1997:7.
BRIDGFORD, SUE, 2000. Weapons, warfare and society in Britain 1250–750 BC. Unpublished PhD dissertation: Sheffield University.
BRÜCK, JOANNA, 1995. A place for the dead: the role of human remains in late Bronze Age Britain. *Proceedings of the Prehistoric Society* 61:245–277.
BURGESS, COLIN, 1968. *Bronze Age Metalwork in Northern England*. Newcastle: Oriel.
CHALLIS, ANTHONY and DENNIS HARDING, eds, 1975. *Later Prehistory from the Trent to the Tyne*. Oxford: British Archaeological Reports (British Series 20).
CHAMPION, TIMOTHY, 1990. Review of *The Passage of Arms* by Richard Bradley. *Antiquaries Journal* 70:479–481.
CHAMPION, TIMOTHY, 1999. The later Bronze Age. In John Hunter and Ian Ralston (eds), *The Archaeology of Britain*: 95–112. London: Routledge.
COLES, JOHN, 1959–60. Scottish late Bronze Age metalwork: typology, distributions and chronology. *Proceedings of the Society of Antiquaries of Scotland* 93:16–134.
COLES, JOHN, 1979. *Experimental Archaeology*. London: Academic Press.
EHRENBERG, MARGARET, 1981. Inside socketed axes. *Antiquity* 55:214–218.
FONTIJN, DAVID, 2002. Sacrificial landscapes: cultural biographies of persons, objects and 'natural' places in the Bronze Age of the southern Netherlands, c. 2300–600 BC. *Analecta Praehistorica Leidensia* 33–34.
GRÄSLUND, BO, ed., 1990. *The Interpretative Possibilities of Microwear Studies*. 7th international conference on lithic use-wear analysis, Uppsala 1989. Uppsala: Societas Archaeologica Upsaliensis.
HARDING, ANTHONY, 1976. Bronze agricultural implements in Bronze Age Europe. In Gale de G. Sieveking, Ian H. Longworth and K.E. Wilson (eds), *Problems in Economic and Social Archaeology*: 517–521. London: Duckworth.
HARDING, DENNIS, ed., 1982. *Later Prehistoric Settlement in South-East Scotland*. Edinburgh: Edinburgh University Press.
HARDING, JAN and ROBERT JOHNSON, eds, 2000. *Northern Pasts: Interpretations of Later Prehistory of Northern England and Southern Scotland*. Oxford: British Archaeological Reports (British Series 302).
HAYDEN, BRIAN, 1979. *Lithic Use-Wear Analysis*. London: Academic Press.
HODGES, HENRY, 1957. Studies in the late Bronze Age in Ireland. *Ulster Journal of Archaeology* 20:51–63.
JENSEN, JØRGEN, 1973. Ein neues Hallstattschwert aus Dänemark. Beitrag zur Problematik der jungbronzezeitlichen Votivfunde. *Acta Archaeologica* 43: 115–164.
KIENLIN, TOBIAS, 1995. Flanged axes of the North-Alpine region: an assessment of the possibilities of use-wear analysis on metal artefacts. Unpublished MSc dissertation. Sheffield University.
KIENLIN, TOBIAS and BARBARA OTTAWAY, 1998. Flanged axes of the North-Alpine region: an assessment of the possibilities of use-wear analysis on metal artefacts. In Claude Mordant, Michel Pernot and Valentin Rychner (eds), *L'Atelier du bronzier en Europe du XXe au VIIIe siècle avant notre ère*: 271–286. Paris: CTHS (Documents préhistoriques 10).
KRISTIANSEN, KRISTIAN, 1978. The consumption of wealth in Bronze Age Denmark: a study in the dynamics of economic processes in tribal societies. In Kristian Kristiansen and Carsten Paludan-Müller (eds), *New Directions in*

Scandinavian Archaeology: 158–191. Copenhagen: National Museum of Denmark.

LEVY, JANET, 1982. *Social and Religious Organisation in Bronze Age Denmark: An Analysis of Ritual Hoard Finds*. Oxford: British Archaeological Reports (International Series 124).

MANBY, TERRY, 1980. Bronze Age settlement in Eastern Yorkshire. In John Barrett and Richard Bradley (eds), *Settlement and Society in the British Later Bronze Age*: 307–376. Oxford: British Archaeological Reports (British Series 83).

MATHIEU, JAMES R. and DANIEL A. MEYER, 1997. Comparing axe heads of stone, bronze and steel: studies in experimental archaeology. *Journal of Field Archaeology* 24:333–350.

MEGAW, J., S. VINCENT and DEREK D.A. SIMPSON, eds, 1979. *Introduction to British Prehistory: from the Arrival of Homo Sapiens to the Claudian Invasion*. Leicester: Leicester University Press.

NEEDHAM, STUART, 1996. Chronology and periodisation in the British Bronze Age. In Klavs Randsborg (ed.), Absolute Chronology – Archaeological Europe 2500–500 BC. *Acta Archaeologica* 67:121–140.

NEEDHAM, STUART, CHRISTOPHER BRONK RAMSAY, DAVID COOMBS, CAROLINE CARTWRIGHT, and PAUL PETITT, 1998. An independent chronology for British Bronze Age metalwork: the results of the Oxford Radiocarbon Accelerator programme. *Archaeology Journal* 154:55–107.

OTTAWAY, BARBARA, 2003. Experimental Archaeometallurgy. In T. Stollner, G. Korlin, G. Steffens and J.Cierny (eds), *Man and Mining: Studies in Honour of Gerd Weisgerber on the Occasion of his 65th Birthday*: 341–348. Bochum: Der Anschnitt (Beiheft 16).

RYNNE, ETIENNE, 1983. Why ribs inside socketed axes? *Antiquity* 57:48–49.

SANDS, ROBERT, 1997. *Prehistoric Woodworking: the Analysis and Interpretation of Bronze and Iron Age Toolmarks*. London: University College London.

SCHMIDT, PETER K. and COLIN B. BURGESS, 1981. *The Axes of Scotland and Northern England*. Munich: Beck (Prähistorische Bronzefunde IX, 7).

SEMENOV, S.A., 1964. *Prehistoric Technology: An Experimental Study of the Oldest Tools and Artefacts from Traces of Manufacture and Wear*. London: Cory, Adams & Mackay.

SHERIDAN, ALISON, 1999. Drinking, driving, death and display: Scottish Bronze Age artefact studies since Coles. In Anthony F. Harding (ed.), *Experiment and Design: Archaeological Studies in Honour of John Coles*: 49–59. Oxford: Oxbow.

SPINDLER, KONRAD, 1994. *The Man in the Ice*. London, Weidenfield & Nicolson.

SPRATT, DONALD, and COLIN BURGESS, eds, 1985. *Upland Settlement in Britain: the Second Millennium BC and After*. Oxford: British Archaeological Reports (British Series 143).

SWISS, A. and BARBARA OTTAWAY, in press. Investment or Investment: casting and using a bronze mould. In Peter Northover and Chris Salter (eds), *Founders, Smiths and Platers*. Oxford.

TAYLOR, MAISIE, 1992. Flag Fen: the wood. *Antiquity* 66:476–498.

TAYLOR, ROBIN, 1993. *Hoards of the Bronze Age in Southern Britain*. Oxford: British Archaeological Reports (British Series 228).

VAN GIJN, A.L., 1995. The wear and tear of flint: principles of functional analysis applied to Dutch Neolithic assemblages. *Analecta Praehistoria Leidensia* 22.

VAUGHAN, PATRICK, 1985. *Use-wear Analysis of Stone Tools*. Tucson: University of Arizona Press.

WRIGHT, EDWARD, 1990. *The Ferriby Boats: Seacraft of the Bronze Age*. London: Routledge.

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ABSTRACTS

L'utilisation et la signification des haches à douille pendant l'âge du bronze récent
Ben Roberts et Barbara S. Ottaway

L'approbation des analyses de traces d'utilisation sur des matériaux comme le silex et les os et leur emploi courant ne sont pas allés avec un développement parallèle en archeo-métallurgie. Dans cet article, nous voulons étudier le potentiel et les problèmes inhérents en examinant les haches à douille dans le Yorkshire de l'est et l'Ecosse du sud-est pendant l'âge du bronze récent. Les traces de travail expérimental sur des répliques modernes sont comparées avec les traces d'usure sur les haches préhistoriques. D'après les résultats obtenus, les haches préhistoriques ont été utilisées comme outils polyvalents, mais la nature et l'ampleur de leur utilisation avant déposition varient considérablement. En combinant les analyses de traces d'utilisation avec les informations contextuelles sur les haches à douille dans l'environnement de l'âge du bronze, nous sommes en mesure d'examiner les idées relatives à leur signification.

Mots-clés: analyse de traces d'utilisation, haches à douille, âge du bronze récent, environnement, archéologie expérimentale

Gebrauch und Bedeutung spätbronzezeitlicher Bronzebeile
Ben Roberts und Barbara S. Ottaway

Die Gebrauchspurenanalyse an Silex und Knochenwerkzeugen ist weitverbreitet und akzeptiert. Um diese Akzeptanz auch auf Metallartefakte auszudehnen, wurden weitgehende Forschungen an spätbronzezeitlichen Beilen aus Yorkshire und Schottland unternommen. Versuchserien mit experimentell hergestellten Beilen ermöglichten den Vergleich dieser Gebrauchsspuren mit jenen an prähistorischen Beilen. Die Ergebnisse deuten darauf hin, dass die vorgeschichtlichen Bronzebeile als Mehrfach-Werkzeuge benutzt wurden und dass die Art und der Gebrauch der Beile, sehr unterschiedlich war.
Diese Ergebnisse der Gebrauchsspurenanalyse, kombiniert mit Information der ursprünglichen Umgebung der Beile, führten zu interessanten Einblicken, z.B. in Bezug auf regionale Differenzierung, die in diesem Beitrag vorgelegt werden.

Schlüsselbegriffe: Gebrauchsspurenanalyse, spätbronzezeitliche Bronzebeile, experimentelle Archäologie, Yorkshire, Schottland.