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Ancient Monuments Laboratory
Report 67/92

THE IDENTIFICATION OF ORGANIC MATERIAL PRESERVED ON IRONWORK FROM BURTON FLEMING, YORKSHIRE

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Summary

This is an identification report on the mineral preserved organic material associated with ironwork from this Iron Age cemetery. The groups of objects examined include swords, spears, shields, knives and tools, and are discussed under these headings. The swords are a particularly interesting group as a large variety of materials were used in the construction of their hilts and scabbards. In order to illustrate these and some of the organic additions on the other objects, many diagrams and micrographs have been included in this report.

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The identification of organic material preserved on ironwork from Burton Fleming, Yorkshire.

Jacqui Watson and Glynis Edwards

Around 40 iron objects from this Iron Age cemetery were examined for traces of organic material preserved in their corrosion products. These observations are arranged by object type under the headings swords, spearheads, shields, and miscellaneous (mainly knives and tools). Each group includes both a discussion and a catalogue of the individual items with their associated organic material. A summary is presented in Table 1, below.

	Swords	Spearheads	Shields	Knives	Tools
Wood	10	11	4	2	5
Alder	2		1		
Ash	2	1		1	
Birch			1		
Box					2
Hazel	1	4			
Maple/Lime/Cherry	1		1		
Oak	1				
Pomoideae					1
Willow/Poplar	2	4	1		1
not identifiable	1	2		1	1
Antler	2				
Bone					1
Horn	9			2	
Leather	5	6	1	1	1
Fleece	3	5			
Textile		2			
Straw		2			
Total	11	21	4	4	6

Table 1. Summary of organic material preserved on various objects.

Organic material is preserved by contact with metal corrosion products which prevent their decay by soil microorganisms. At the same time the metal salts, especially those from ironwork, can chemically alter the micro-structure of the organic material. However, usually enough features are preserved to identify the different materials with the aid of a low power binocular microscope. Many of the wood species were confirmed and other materials identified by observing gold coated samples in a scanning electron microscope (SEM) (Keepax, 1975; Watson, 1988), and where this technique has been used the sample number is quoted in the catalogue. In the case of mineral preserved organic material from this site the high

magnifications achieved by the SEM were often of little use as only casts of the original structures remain in the iron oxides and these were not particularily well preserved. Where applicable the identification of different materials and wood species is often supported by the inclusion of micrographs. The colour ones were produced on an incident light microscope with similar magnifications to the one used for examining the objects, and the black and white plates were taken on a Cambridge SEM S200.

In addition to identifying the materials used it has been possible to record the original construction of organic additions, such as sword hilts and scabbards. Where appropriate these observations are accompanied by line drawings which illustrate the individual components. From the structures preserved it has also been possible to record the orientation and type of organic materials used, such as the use of horn tips, and both cross section and longitudinal parts of antler. Also it has been possible to note whether mature, coppiced or branch wood has been used - this can clearly be seen in cross section where the annual rings are arranged in parallel lines, concentric circles or pith is present.

From table 1 it is clear that a number of different materials were found in these graves: wood, leather, fleece, textile, horn, antler, and bone. A variety of wood species are represented, but with the exception of hazel, willow or poplar being used for spear shafts, there is no pattern of woods being chosen for specific use. It is not possible to distinguish between willow and poplar with the techniques used to identify mineral preserved wood, and therefore they have to be considered together as one species. All of these materials were available in Britain and Europe during this period, but unfortunately it is not possible to suggest where specific materials originally came from.

Swords

Hilt construction

Several different types of hilt construction made from a variety of materials were observed on the swords from this cemetery, and these are discussed in detail below.

Most of the hilts are made in three sections which very roughly correspond to the guard, grip and pommel sections. Often the grip section is far too short to hold and would have to have extended into the guard and pommel sections. Only a few examples have remains of an original surface, so that on the whole their shape and form must remain speculative.

Horn was most commonly used for the hilts. When fresh this is a plastic material of a pale blonde colour. It is very easy to carve into shape and decorate, although no evidence for the latter survives. Antler was also used on two swords, cut from both the longitudinal and cross sections. This material is also easy to carve, and originally would have been a creamy white colour, the cross section having a marble pattern. Most of the sections have the remains of the original surface and none have carved decoration.

Wood was used on only one example and this was made from a single piece of oak and it is assumed that the guard and pommel sections were cut to shape, but no original surfaces now remain. Where horn was used it may have been necessary to construct the hilt in sections, especially if only the solid apex could be used, as the available horns were comparatively short. Larger horns such as auroch, however, would have been available on the continent.

Scabbard construction

Most of the swords have a scabbard made from a single piece of wood hollowed out to take the blade, which has been covered with leather or an animal pelt. There is evidence on one scabbard (Burial 24) for the leather being sewn up at the side. On the scabbard from Burial 139, there is possibly evidence for this type of scabbard having been repaired with an iron plate. Chalk figurines (Stead, 1988) of the period indicate that the swords were often worn across the back rather than at the side. When worn in this fashion it may have been necessary to have a scabbard with a robust and rigid construction similar to this group. One sword with a similar scabbard construction comes from Stanwick in North Yorkshire and is on display in the British Museum. This is made from a single piece of ash hollowed out to take the blade, and is bound with copper alloy clips around its width (I.Stead, pers.comm.).

A more traditional type of scabbard comes from burial 163, which was made from two lathes of wood presumably held together by a leather covering, but this has not been preserved.

The simplest type of scabbard was found on the sword from burial 107 and the dagger from burial 153, which are just made of animal skins with no wooden reinforcement.

Burial 24
[FN/BP 14] 736719
Iron sword with remains of the hilt and organic scabbard, see figure.1.

The hilt is made up of three sections of horn separated by iron washers which very roughly correspond to a pommel, grip and guard. As the grip is very short it is likely that the adjacent sections were tapered to allow purchase. The grain direction of each section varies, with that of the grip lying parallel to the axis of the tang, and the pommel and guard sections are at right angles to it. The hilt is also decorated with copper alloy strips and roundells, which give an indication of the original width of the grip. The guard has been finished with an iron mount decorated with another copper alloy roundell, and this gives some idea of the original width and shape.

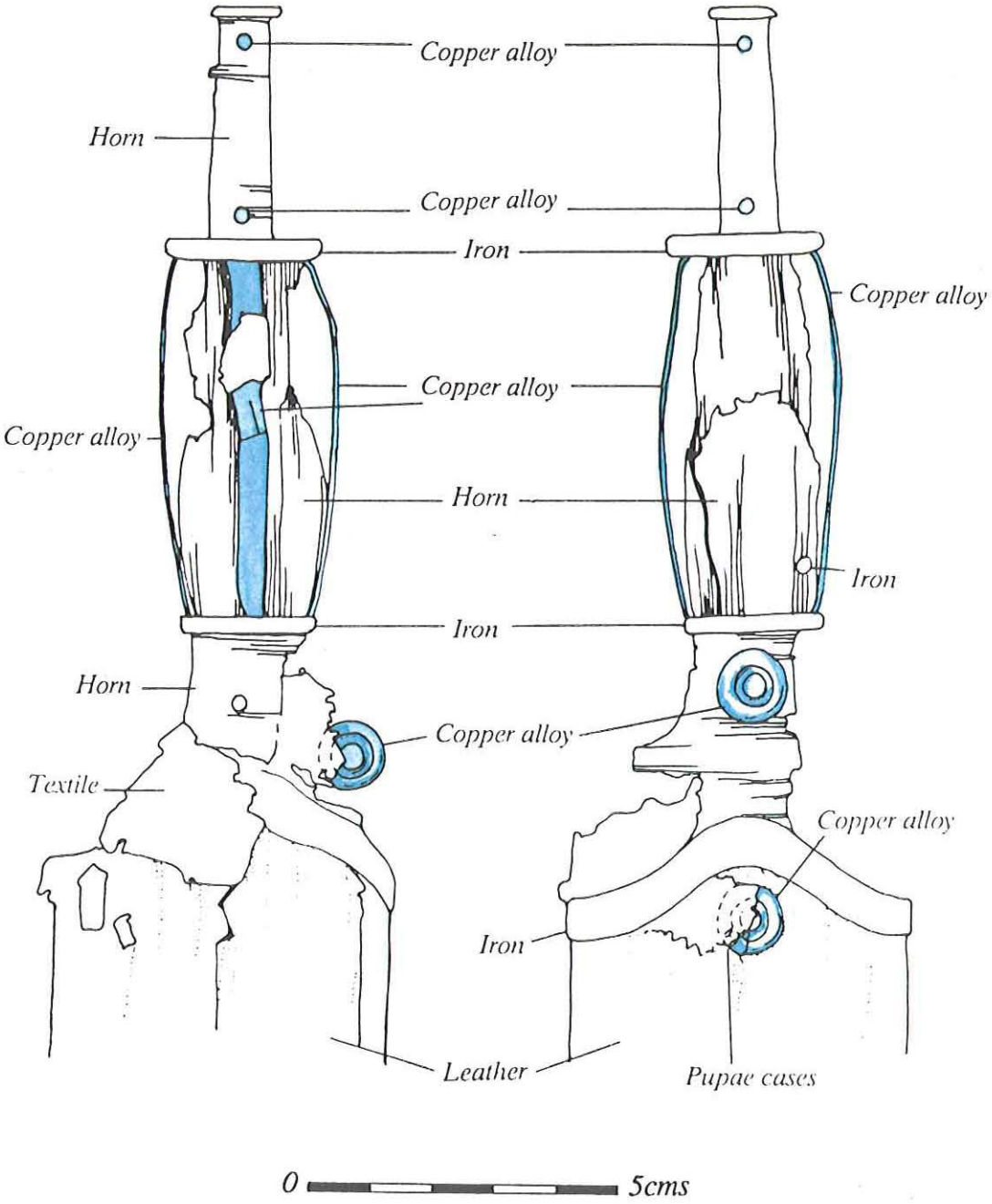


Figure 1. Diagram of hilt and top of scabbard of sword from Burial 24.

The scabbard appears to be made from one piece of wood, Salix sp. (willow) or Populus sp. (poplar), in which a cavity has been carved to house the blade slightly overlapping the edges. Both sides have evidence for a leather covering, with the remains of stitching along one side (fig.2) - this may indicate that one piece of leather was used and joined together along the edge.

SEM No.B252 wood from scabbard.

Figure 2. Micrograph of stitching on edge of scabbard, mag.x4. W38:6.

Burial 57
[FN/BR 17] 736720
Iron sword with no traces of the hilt remaining, but evidence for the organic scabbard. The scabbard appears to be of a single piece of ash, Fraxinus sp., recessed to take the blade. This has been covered in fleece with the fur side towards the blade on the open side. On the outside of the fleece was another piece of mineral preserved wood, but it was not possible to identify the species.

SEM Nos. B249, wood from scabbard; B250, wood on the outside of fleece; B251, fleece.

Burial 107
[FB/AQ 10] 715514
Iron sword with traces of the organic hilt and scabbard.

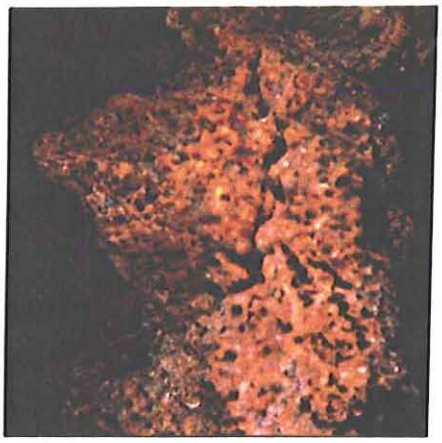
Only the grip and guard regions of the hilt remain and these appear to be made from one piece of wood - probably oak, Quercus sp..

The scabbard seems to be made just of an animal skin, but the scale patterns on the hairs have been covered by consolidants so that they cannot be identified.

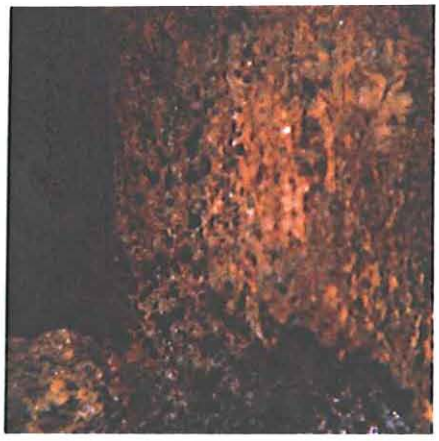
SEM B236 wood

Burial 139
[FD/CT 32] 750844
Iron sword with the remains of both the organic hilt and scabbard, figure.3 hilt section, figure.4 scabbard construction.

The hilt is made up of three sections which roughly correspond to the pommel, grip and guard (figure 3a). The top 34mm, or pommel, is made from antler and the cross section is visible at the front and back of the hilt (figure 3b). The original surface appears to be present in some areas to give a thickness of approximately 13mm. The central



b



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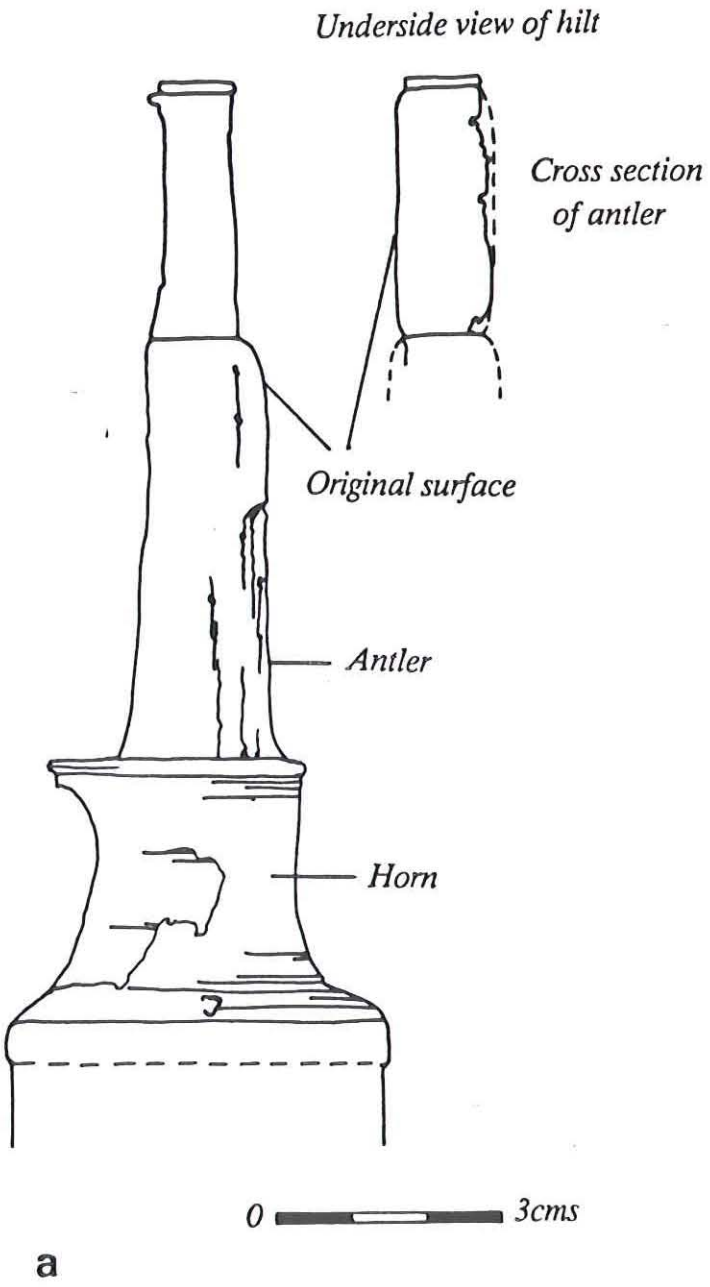
d



a

Figure 3. Diagram and micrographs of sword hilt from Burial 139.
a. Diagram illustrating the different organic components.
b. "Pommel" made from cross section of antler, mag.x4. W38:9
c. Central grip portion made from antler, mag.x4. W38:8
d. "Guard" section made from horn, magx8. W38:11

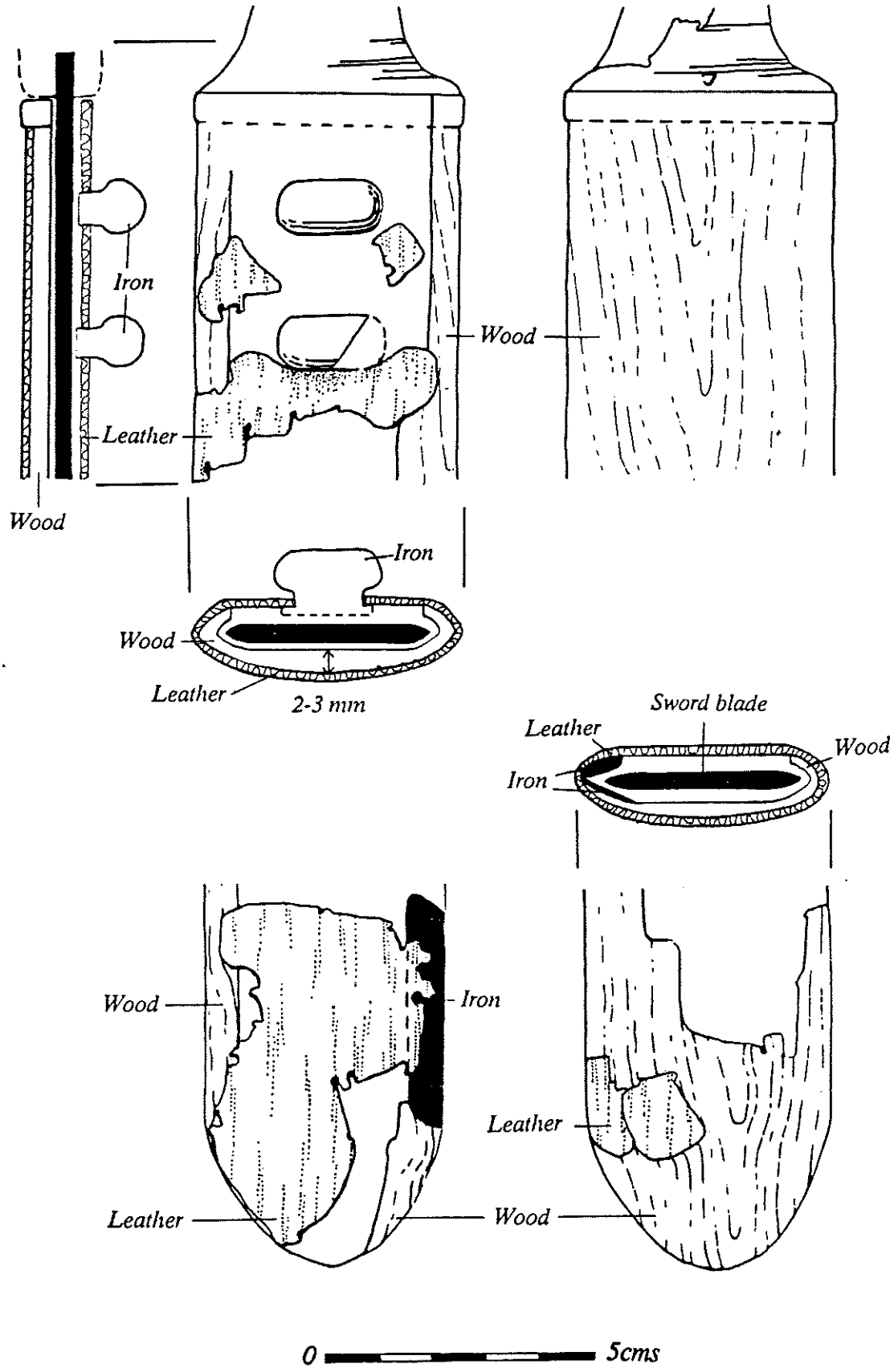


Figure 4. Diagram of scabbard construction of sword from Burial 139.

grip section is also made from antler, but this time the compact boney tissue is arranged along the length of the tang (figure 3c). The bottom 36mm, or guard section, is made from horn with the grain perpendicular to the axis of the tang (figure 3d).

The scabbard appears to be made of a single piece of wood recessed to take the blade and then covered with leather (figure 4). The wood was found to be Corylus sp. (hazel). On one side of the scabbard at the top are two iron posts set into the leather, which may have been used as fastenings to suspend or attach the scabbard to a belt with leather thongs or braids. Where the sword is broken at the tip, two plates of iron can be seen inside the scabbard in the cross section, and are presumably the remains of a repair or reinforcement.

SEM B260 wood from scabbard.

Burial 144
[FA/CC 31] 748098
Iron sword with the remains of an organic hilt and scabbard.

The hilt is made from horn with the grain along the tang, possibly in two sections with a division 62mm from the top.

The scabbard is made from recessed wood, Alnus sp. (alder, fig.5), which appears to have been covered with leather on the front and possibly fleece on the back (fig.6). On the front the leather overlaps an iron mount, so it may belong to a separate wrapping for the sword rather than be part of the scabbard? The back of the blade is covered along its length with pupae cases, the larvae of which presumably ate most of the fleece and any leather wrapping on this side. The scabbard has then been finished with an iron mount to protect the top.

SEM B255, wood from scabbard; B256, fleece from scabbard.

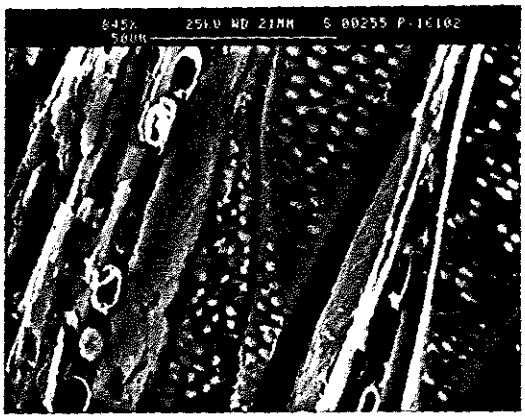


Figure 5. Electron micrograph of scabbard wood. SEM 161:2

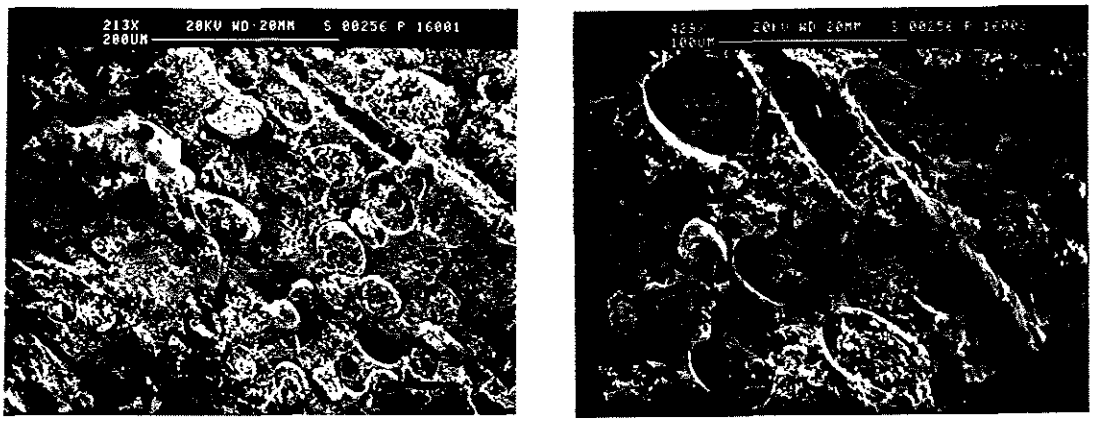


Figure 6. Electron micrographs of fleece from reverse of scabbard. SEM 160:1,2

Burial 146
[FA/BZ 29] 748097
Iron sword with remains of organic hilt and scabbard, figure 7.

There are traces along the tang of mineral preserved horn, but not enough is preserved to indicate whether the hilt was made from a single piece or in three sections. At the top of the blade the horn appears to have been carved to shape and may have been fininshed with an iron mount.

The scabbard is made of recessed wood, Fraxinus sp. (ash, fig. 8), shaped to take the blade. There is no evidence on either side for a leather or fleece covering over the wood, but this may be due to poor preservation.

SEM B254, wood from scabbard.

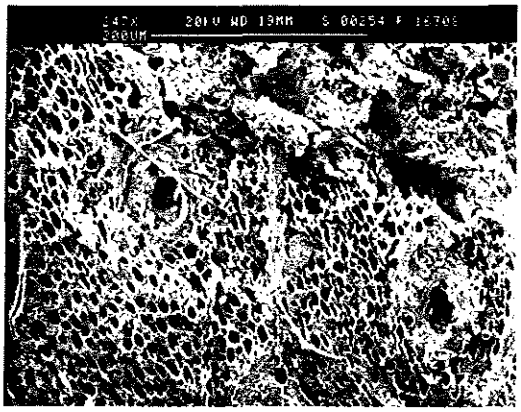


Figure 8. Electron micrograph of scabbard wood. SEM 163:8

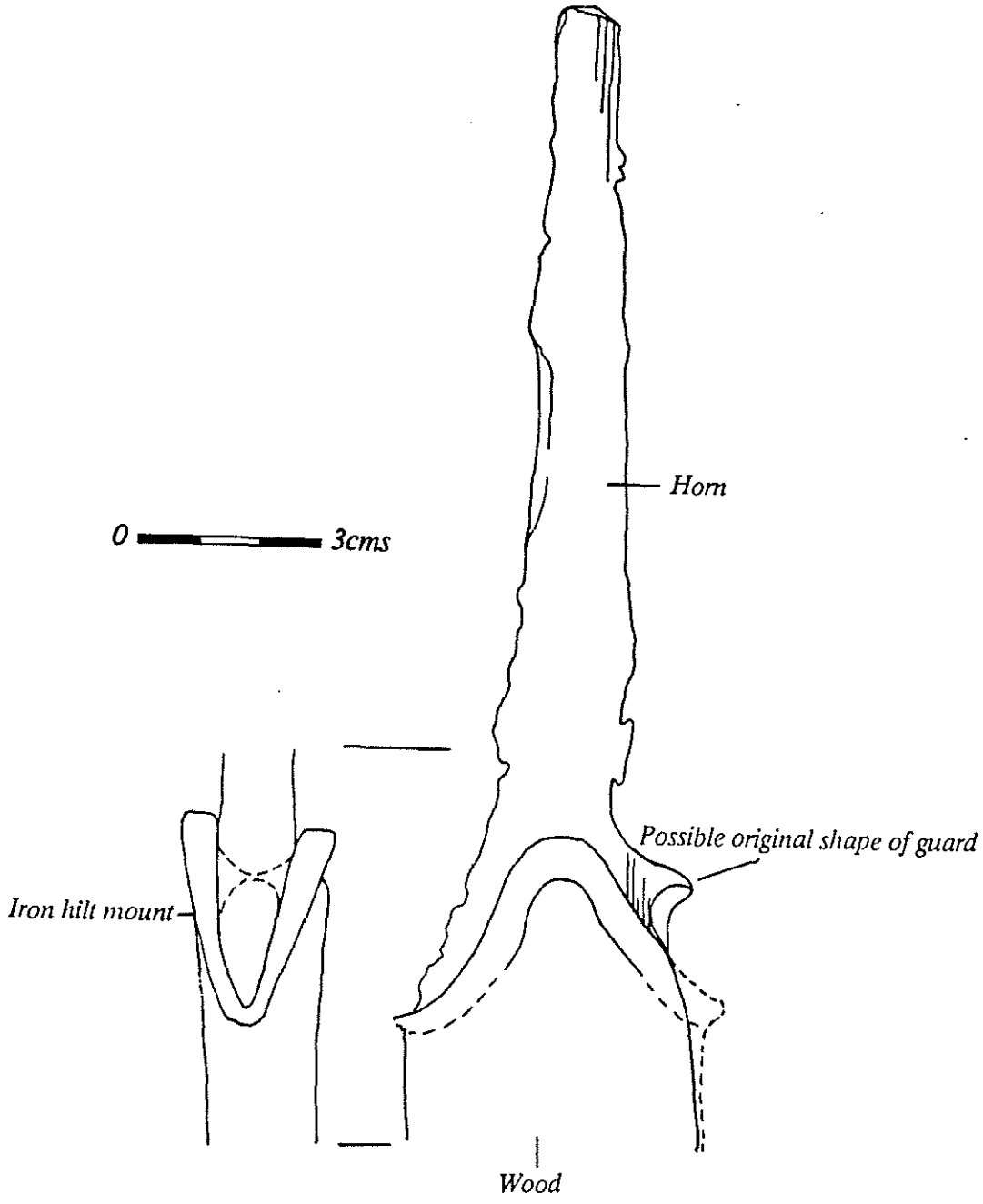


Figure 7. Diagram of sword hilt construction from Burial 146.

Burial 153
[FD/CR 24] 750843
Possible iron dagger with mineral preserved organic material on the tang which may be the remains of a horn hilt, and the blade appears to be covered in fleece.

Burial 154
[FD/BW 23] 750840
Iron sword with remains of organic hilt and scabbard.

The hilt appears to be made from three sections of horn, with possible iron washers between the sections. The top section has grain horizontal to the tang and is 35mm deep; the mid section (fig. 9) extends to 90mm and has grain along the tang like the lower section. The scabbard is made from wood, Alnus sp. (alder, fig. 10), but not enough remains to be certain if it is recessed like the others.

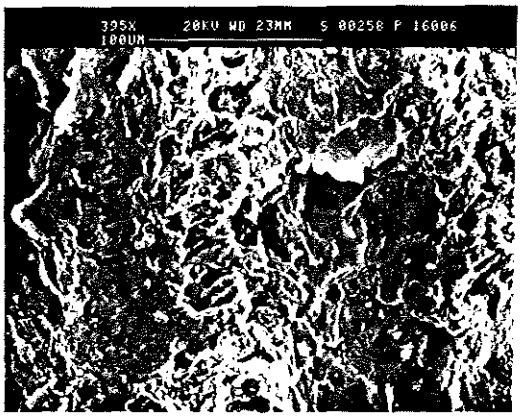
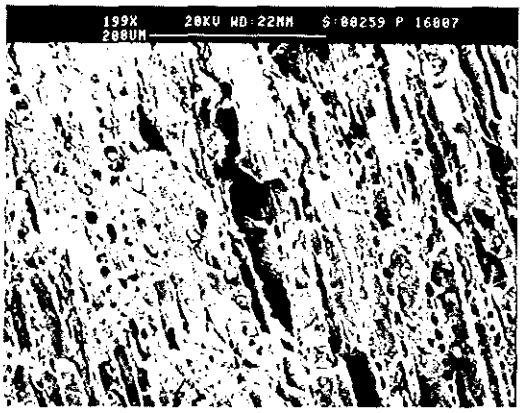


Figure 9. Electron micrograph of horn from mid section of hilt. SEM 160:6



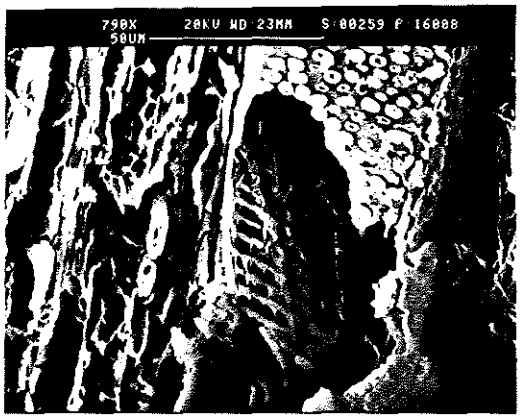


Figure 10. Electron micrograph of scabbard wood. SEM 160:7,8

SEM B258, horn; B259, wood.

Burial 163
[FD/DH 6] 750879
Iron sword with remains of organic hilt and scabbard.

Hilt appears to be horn and made in two sections joined 68mm from the top, both sections have grain along the axis of the tang. Originally it was probably carved to shape but no original surfaces remain. The scabbard is made from two pieces of wood rather than recessed, Acer sp. (maple), Tilia sp. (lime) or Prunus sp. (cherry). There is no evidence for a leather or fleece covering, but this may be due to poor preservation. On top of the scabbard is a piece of radial section wood, Quercus sp. (oak), which presumably belongs to another object in the grave or is a fragment of a grave cover.

SEM B261, wood.

Burial 174
[FD/AE 2] 750839
Iron sword with remains of organic hilt and scabbard, figure 11. The grave plan is included under spearheads (fig. 16).

The hilt is made up of three sections of horn which roughly correspond to the pommel, grip (fig. 12) and guard sections. The grip and guard sections have their grain orientated along the tang, whereas that of the pommel is perpendicular to it. The guard appears to be finished with an iron mount.

The scabbard is made from recessed wood shaped to take the blade, unfortunately the species could not be identified (fig. 13). Both sides are covered in leather.

SEM B257, wood from scabbard.

Figure 12. Micrograph of horn from grip, mag.x8. W38:12

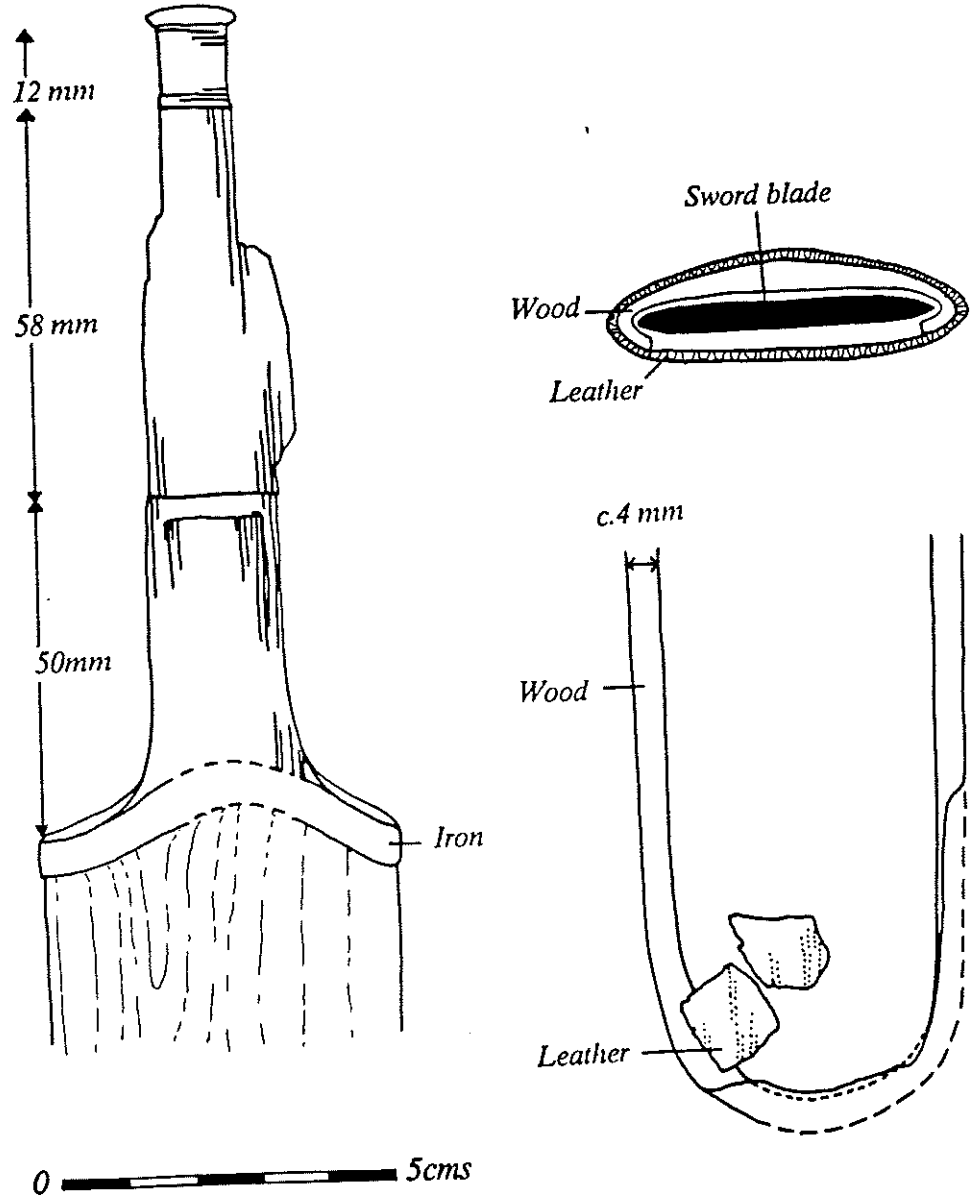


Figure 11. Diagram of sword hilt and scabbard construction from Burial 174.

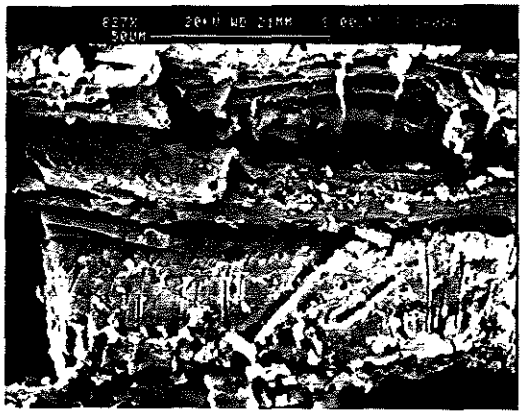


Figure 13. Electron micrograph of scabbard wood. SEM 160:4

Burial 182
[FA/AN 4] 748096
Iron sword with remains of organic hilt and scabbard, figure 14.

The hilt is made up of three sections, two of horn and a narrow central section of antler. The antler section is well preserved with original surfaces that indicate the width of the grip at this point, and tapered ends that suggest they were overlapped by the horn sections. The horn only remains as a very thin layer on the tang, but originally it was probably carved into shape for the guard and pommel.

The scabbard is made from recessed wood, possibly Salix sp. (willow) or Populus sp. (poplar), and is covered and held together by a thin piece of leather that only remains in a few areas.

SEM B253, wood from scabbard.

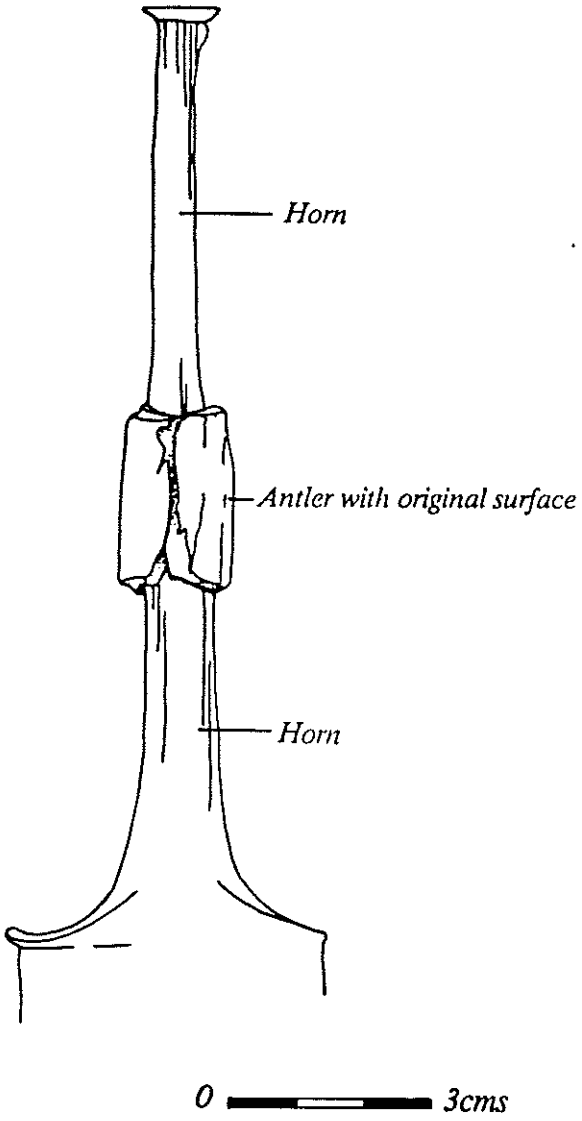


Figure 14. Diagram of sword hilt from Burial 182.

Spearheads

21 spearheads were examined, but only 11 had traces of their wooden hafting. Only a narrow range of woods are represented, ash (1), hazel (4), willow or poplar (4), not identifiable (2). Some of the spearheads were hafted with coppiced timber. This can clearly be seen in the cross section of the preserved wood where the annual rings are arranged in concentric circles or there are minute cracks radiating from the centre.

There is negative evidence for some of the spears having their shafts removed or broken after they were thrown into graves and before interment (burials 94, 140, 152a, 154, 174, and possibly 271). Many of these spearheads have no organic remains in their sockets even though other organic material is preserved on the blades or on the outside of the sockets. Iron corrosion would be more likely to preserve the contents of sockets before they could be commuted by microorganisms rather than the more exposed organic material on the blade. So unless very unusual conditions occured in these graves it is unlikely that these spearheads could have been hafted at the time of burial.

Six of the spearheads have leather preserved on them (burials 57, 146, 152a, and 174), usually on the blade but sometimes covering the socket. This could be indicative of the burial being covered with a skin or fleece.

In at least two examples (burials 154 and 174) wood preserved on the blades of spearheads is the only evidence for the presence of shields in these graves, and they are discussed more fully under shields.

Straw was preserved on spearheads from burials 94 and 154, which may suggest that these burials were covered in straw, at least in part, before interment.

The evidence from the spearheads from burial 174 is discussed more fully below in conjunction with the grave plan (fig.16).

Burial 24
[FN/CE 14] 736707
Iron spearhead with mineral preserved wood in socket, Corylus sp. (hazel).
SEM B232

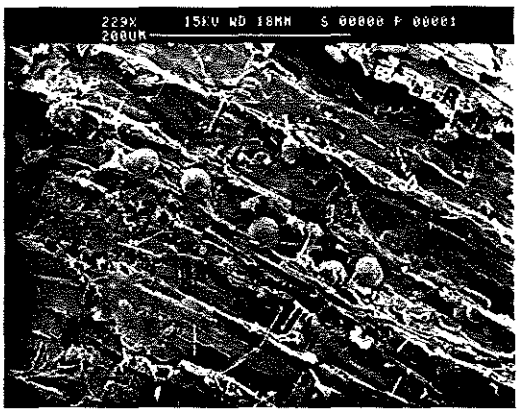


Figure 15. Electron micrograph of wood from spearhead socket. SEM 150:2

Burial 50
[FG/DT 28] 715511
Iron spearhead with mineral preserved wood in socket, from coppiced sapling: Corylus sp. (hazel).
SEM B152

Burial 57
[FN/BS 17] 736712
Iron spearhead with mineral preserved wood in socket: possibly Corylus sp. (hazel) made from coppiced timber. There is also possible leather on the outside of socket and over part of blade.
SEM B234

Burial 94
[FB/AZ 12] 715517
Iron spearhead with no trace of mineral preserved organic material in the socket. Blade and outside of the socket is covered in a variety of organic material including bone, pupa cases, possible textile and straw.

Burial 140
[FD/CK 30] 750836
Iron spearhead piercing pelvis. There is a fragment of mineral preserved wood in the socket, Salix sp. (willow) or Populus sp. (poplar). End of socket is covered with skin.
SEM B324

Burial 146
[FA/CA 29] 748101
Iron spearhead with mineral preserved wood in socket: Salix sp. (willow) or Populus sp. (poplar) made from coppiced timber. There is also leather preserved on the outside of the socket and over part of the blade.
SEM B235

Burial 152a
[FD/CP 25] 750838
Iron spearhead with no trace of mineral preserved wood in the socket, in fact the open end appears to be covered in hairs or fleece - presumably the spearhead was not hafted when buried.

Burial 154
[FD/CA 23] 750827
Iron spearhead with mineral preserved straw in socket, which covers the end and is also on the outside - this spearhead cannot have been hafted at burial.

[FD/BZ 23] 750828
Iron spearhead with a fragment of Fraxinus sp. in a corrosion bubble inside the socket. However, part of the socket opening is covered with mineral preserved organic material, so that one cannot be certain that the wood is the remains of the original hafting.

Also the tip of the ferrule has been put through a strip of wood, approximately 14-16mm thick: Salix sp. (willow) or Populus sp. (poplar).
SEM B161

Burial 170
[FD/BM 11] 750824
Iron spearhead with coppiced wood in socket, Corylus sp. (hazel), and probably nailed.
SEM B323

Burial 174

Six spearheads were found in this grave which appear to have been thrown into the grave piercing both the body and a shield made from alder (see fig. 16).

AP, AO and AN were the only ones that had remains of their haftings, and AP and AO were hafted with coppiced willow or poplar. AO also had leather between the wood and iron socket - possibly to facilitate the removal of the shaft? None of the others had wood remains in their sockets even though other types of organic material were preserved on the blades and outside the sockets. This does suggest that the shafts of these spears were removed or broken before burial.

The spearheads AP, AM, AR and AO were found in the thigh region of the skeleton and have fleece preserved on them. Possibly this part

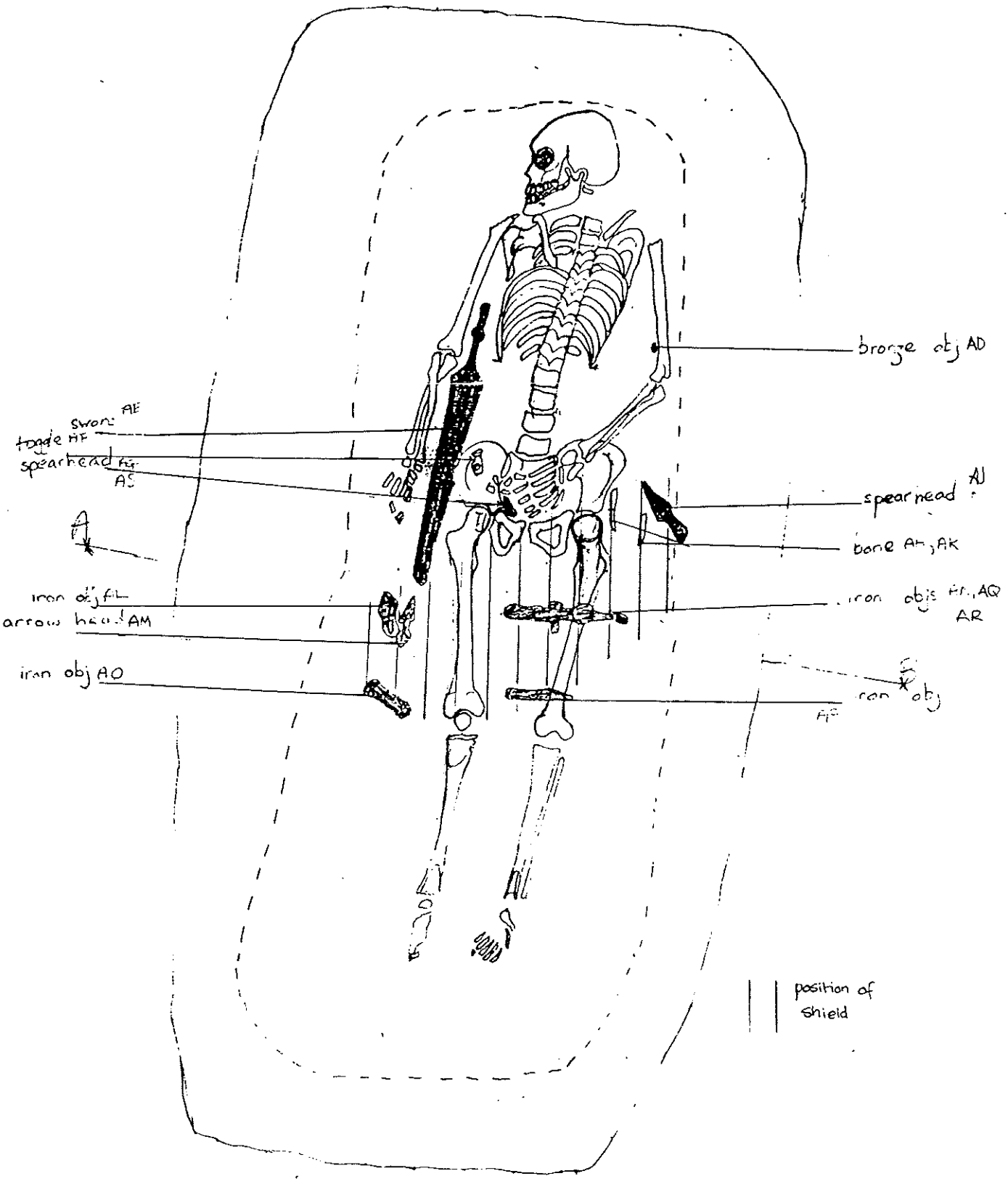


Figure 16. Grave plan of burial 174.

of the burial was covered with a fleece, or maybe it was used as a shield covering.

[FD/AG 2] 750814
Iron spearhead on pelvis with no socket remaining. On one side of blade is mineral preserved textile and possible hair.

[FD/AS 2] 750819
Tip of spearhead AG, which appears to be covered in mineral preserved leather or skin.

[FD/AP 2] 750815
Iron spearhead with mineral preserved wood in socket, from wood: Salix sp. (willow) or Populus sp. (poplar).
SEM B153

The blade originally pierced another piece of wood, approximately 12mm thick: possibly Alnus sp. (alder).
SEM B154

Mineral preserved fleece is folded over one edge of the blade.
SEM B155

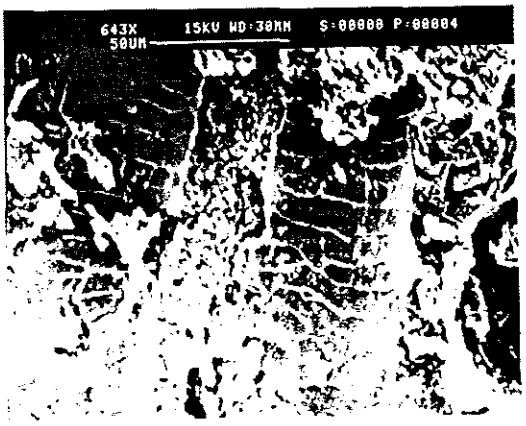


Figure 17. Electron micrograph of fleece preserved on spearhead.
SEM 144:5

[FD/AQ 2] 750816
Iron spearhead with no trace of mineral preserved wood in the socket, possibly the spearhead was not hafted when buried?

The blade pierces a piece of wood, approximately 12mm thick: possibly Alnus sp. (alder).
SEM B156

[FD/AM 2] 750817
Iron spearhead with mineral preserved fleece mainly on one side of the blade. Possible wood remaining in the socket.

[FD/AR 2] 750818
Tip of spearhead with fragments of wood preserved on both sides but

with grain in different directions, Alnus sp. (alder). Fleece is also possibly preserved between the wood and the iron.
SEM B321, B322

[FD/AL 2] 750820
Iron spearhead with no trace of wood in socket, but blade pierces a piece of wood, approximately 10mm thick: probably Alnus sp. (alder).
SEM B157

[FD/AO 2] 750821
Iron spearhead with mineral preserved wood in socket from coppiced wood: Salix sp. (willow) or Populus sp. (poplar).
SEM B158

Possibility of leather preserved between the iron and wood in the socket. Wood has also been preserved on one side of blade.

Also associated with this object is a piece of mineral preserved fleece.

[FD/AN 2] 750822
Iron spearhead with traces of wood in socket, but not well enough preserved to identify. The tip of the blade has possibly pierced a piece of wood, but this is also unidentifiable.

[FD/AJ 2] 750823
Iron spearhead with no trace of mineral preserved wood in socket, but wood preserved on blade: very poorly preserved but could be Alnus sp. like the other examples.
SEM B159

Burial 271
[FZ/BA 2]
Iron spearhead with no mineral preserved organic material either in socket or on outside.

Shields

Most of the evidence for shields comes from spearheads that were thrown into the graves and had pierced the board. Two are also represented by iron reinforcements.

All four shields are made from different wood species, birch, alder, willow/poplar, maple/lime/cherry. With the exception of maple and lime, they are lightweight woods with even grain that does not tend to split when taking blows. However, the available timber would only have been available in short widths, which means that all the shields must have been made from 2-4 boards joined together. If this is the case no nails or fittings were used, and the boards would have been fitted together with some system of mortise and tenon joints. One of the shields has evidence for being originally covered in leather.

Burial 148
[FD/DL 29] 750833-5
Iron shield fittings which are sections of the spine reinforcement, with mineral preserved organic material. Both leather and wood are preserved with leather between the iron and wood on the inside, this suggests that the shield was originally leather covered. All the wood samples examined appear to be of the same species: Acer sp. (maple), Prunus sp. (cherry) or Tilia sp. (lime), although maple seems more likely. The grain of the wood runs along the length of the metalwork and has a tangential section. There is no indication if the wood forming the spine was made from a seperate piece to the planks of the shield board as on the shield from burial 163 (750878).

Straw is also preserved on the outside of binding 750835.
SEM B162, B341, B342

Burial 154
Mineral preserved wood on the outside of the ferrule suggests that there may have been a shield made of Salix sp (willow) or Populus sp. (poplar) in this grave, although there are no recognisable shield fittings to confirm this. The shield board in this case would have been 14-16mm thick.

Burial 163
[FD/DG 6] 750878
Iron shield binding with mineral preserved leather between the iron and the wood, see figure 18. Two sections of wood is preserved which represent the spine of the shield and the shield board. Shield spine is possibly Betula sp. (birch). The shield board appear to be aligned with their grain horizontal to the spine and the long axis of the shield, and suggests that it would have to be made up of several boards joined together, although there is no definate evidence for this.
SEM B163

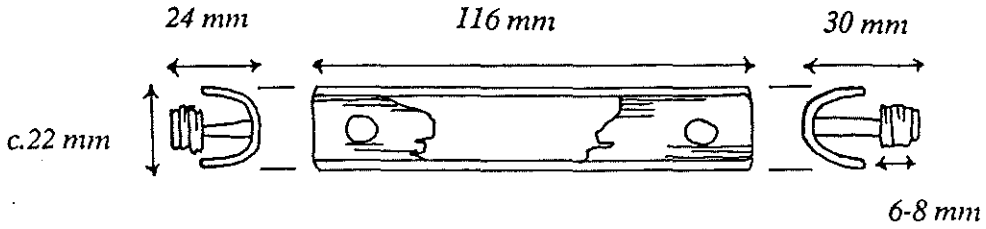


Figure 18. Diagram of wood preserved on shield binding.

Burial 174
Mineral preserved wood on the blades of several spearheads from this grave suggests that it may have contained a shield made of Alnus sp. (alder), with a board thickness of 10-12mm. One spearhead has grain preserved on both sides of the blade but in different directions - this may indicate the presence of a reinforcing rib or may just be due to the board shattering when pierced by the spear. Fleece was also preserved on a number of the spearheads in addition to wood and this may represent a covering for the shield or a fleece laid over the burial at this point (see grave plan and detailed information in the spears section).

Miscellaneous

The four knives form the largest group in this section, and they have handles made from different materials. One (burial 122) is particularily interesting in having a horn collar over the wooden handle by the blade. Only one (burial 271) has the remains of a leather sheath.

The other items in this section are tools of various types. Two hammerheads are hafted with box and one of the Pomoideae woods, both of which are dense fine grained woods and are frequently used for the same purpose in later periods. The same is true for the two files, which have handles of boxwood and bone. Two awls have wooden handles, one of which is made from branchwood.

Burial 50
[FG/DZ 28] 715512
Iron knife with mineral preserved wood on tang, but too degraded to identify.

Burial 63
[FN/BF 4] 736706
Iron file with mineral preserved wood on tang: possibly Buxus sp. (box).
SEM B229

Burial 87
[FG/BR 14] 715505
Iron hammerhead with mineral preserved wood in socket, mature timber: Buxus sp. (box).
SEM B151

[FG/BX 14] 715507
Iron saw with bone handle and possible traces of a leather sheath.

Burial 122
[FN/BF 1] 736703

Iron knife tang with mineral preserved wooden handle: Fraxinus sp. (ash). There appears to have been a horn collar over the wood, where the handle joins the blade, see figure 19, W38:4.

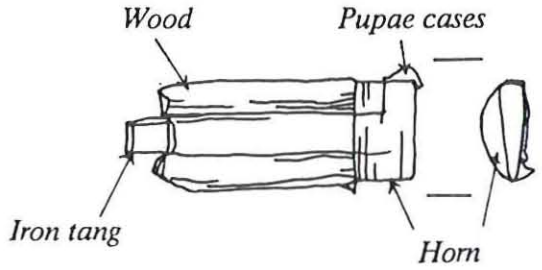


Figure 19. Diagram of organic material preserved on knife tang.

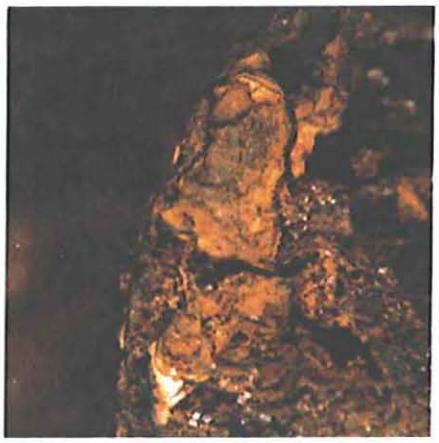


Figure 20. Micrograph of horn collar from knife, mag. x8. W38:4

Also associated with the knife is an iron awl with mineral preserved wooden handle: poorly preserved but is likely to be one of Alnus sp. (alder), Corylus sp. (hazel), Populus sp. (poplar), or Salix sp. (willow).
SEM B231

Burial 154
[FD/CB 23] 750825
Iron hammerhead with mineral preserved wood in socket, from mature timber: one of the Pomoideae family such as Pirus sp. (pear); Malus sp. (apple); or Crataegus sp. (hawthorn).
SEM B160

Burial 271
[FZ/AP 2]
Iron knife with probable horn handle.

[FW/BQ 15] 736718
Iron knife with remains of leather sheath (fig. 21). Also has pupa cases, one of which contains a near adult fly (fig. 22). On top of the sheath is mineral preserved wood: Salix sp. (willow) or Populus sp. (poplar).
SEM B233

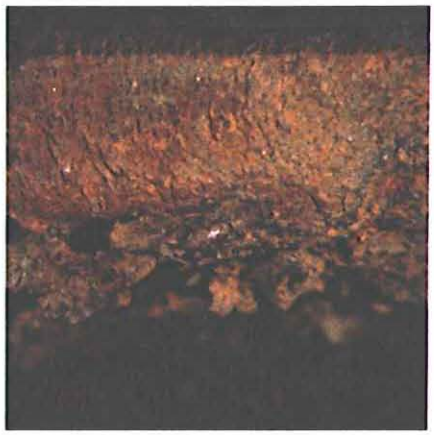


Figure 21. Micrograph of leather sheath from knife, mag.x4. W38:1

Figure 22. Micrograph of pupa case with near adult fly, mag.x12. W38:2

[FW/DX 15] 790732
Iron awl with mineral preserved wood on tang: Salix sp. (willow) or Populus sp. (poplar), made from branch wood or young sapling as pith is present (fig. 23).
SEM B230

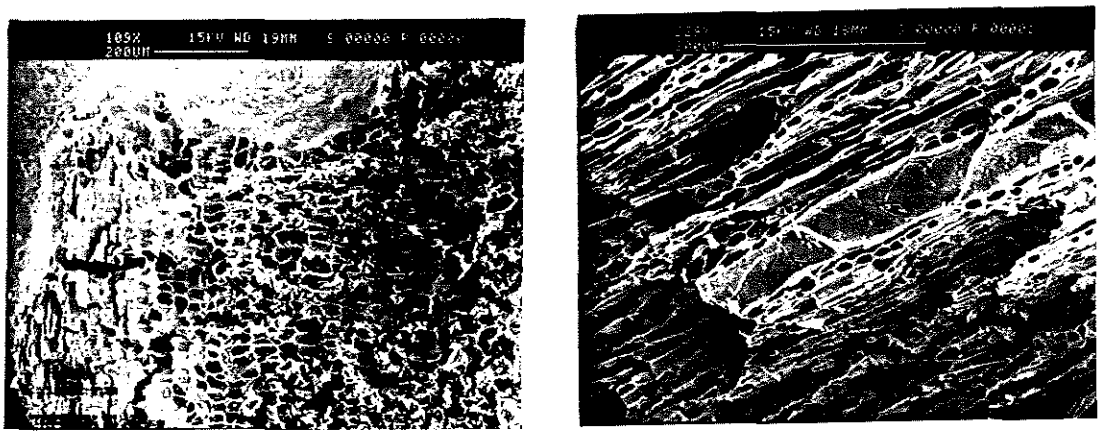


Figure 23. Electron micrograph of wood from awl handle. SEM 149:7,8

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