Chapter 11: The Tower Hill Axe Hoard

by the late David Coombs, Peter Northover and John Maskall

BACKGROUND

An unusual hoard of 92 pieces of Bronze Age metalwork was found at this site (Plate 11.1) comprising 22 complete socketed axes, 24 fragments from socketed axes, 6 complete and 5 partial rings, 2 partial bracelets, a piece of coiled strip, part of a ring headed pin and 2 partial rods. In addition there were 8 pieces resembling casting jets, 19 pieces of scrap, a small unidentified fragment and one possible piece of slag. The total weight of the Bronze Age finds from the site was 9.882 kg. An additional 7 items, 6 coins and an Anglo-Saxon brooch are reported upon in the next chapter together with other finds from the site. The typological aspects of the hoard are considered, and 73 of the items are illustrated and described in detail in the catalogue. Samples for metallurgical analysis were taken from 86 of the objects.

THE AXES
by the late David Coombs

Sompting axes

The socketed axes in the hoard belong to the Sompting type, named after the Sompting hoard, Sussex (Curwen 1948) and defined by Burgess (1967–70) and Schmidt and Burgess (1981). Burgess (1967–70) described three such axes from Yorkshire and gave a general description of the type, which is quoted here. 'The distinctive form represented by these Yorkshire axes is by far the largest and heaviest in the Irish/British socketed axe series. Even the few comparatively small examples have a massive appearance. The body of the axe is roughly rectangular in section, broad above the blade and narrowing towards the top. The sides tend to be fairly straight, diverging to an unexpanded, or moderately expanded blade that is often straight edged. The collar is heavy and pronounced, generally biconical in profile. Loops tend to be quite small but broad, and often have a distinctive spurred base which is peculiar to this socketed axe form. The socket is sometimes square but is more often subrectangular and disposed in a distinctive front to back plan, with the long axis at right angles to the cutting edge, instead of parallel to it in normal socketed axe fashion'.

Schmidt and Burgess (1981) catalogued the Bronze Age axes from Scotland and the north of England and provided a catalogue of Sompting axes in that

Plate 11.1 The Tower Hill hoard: 92 pieces of late Bronze Age bronzes including 22 complete axes, possible horse gear, and ornaments and waste (By kind permission of Eric Penser. Photograph by Michael Dudley).

region. They added two variants, Roseberry Topping and Gembling. The Roseberry Topping variant was similar to Sompting but wider across the upper body with more or less parallel sides. The distinctive back to front plan was less evident and spurred loops were not as common. The Gembling variant had a rather slender, faceted, splayed form and had a prominent heavy bulbous or biconical collar. According to Schmidt and Burgess the body shape, narrow below the collar and broad at the cutting edge is also reminiscent of Meldreth axes, but the Gembling variant is best described as a linear faceted axe (Butler 1963; Moore and Rowlands 1972; O'Connor 1980). All of these forms of axes have been found in plain and decorated forms, sometimes quite elaborate.

The possible connection between Sompting axes and Armorican axes (Briard 1965) has been considered, with the latter belonging to 6th and possibly 5th centuries BC. The Sompting type along with the linear faceted type (Butler 1963; Moore and Rowlands 1972; O'Connor 1980; Thomas 1989) form the two axe forms distinctive of late Bronze Age 4 (Llyn Fawr phase-Hallstatt C) in Britain. It is also possible that a third form of axe, triangular and slender with three or more thin vertical ribs might belong here. This form also shares common features with Sompting axes as they are often found unused and straight from the mould, sometimes with a number of examples from the same mould decorated with vertical ribs or rib and pellets. Both the Salisbury hoard, Wiltshire (Stead 1998, 2 and 3) and the Portland hoard, Dorset (Pearce 1983, fig. 55) contained axes of this form found with those of the Sompting type.

The origins of the Sompting axe form are rather complex and present a problem, which would best be served by better dating evidence. Schmidt and Burgess (1981) stated that the back to front mouth section could also be found on other possibly earlier forms, which could be earlier. An axe with a back to front mouth section was found in the Petters hoard, Surrey (Needham 1990, fig. 2, 10), about which Needham wrote 'together with its broad loop and heavy mouth moulding, makes it typologically close to the Sompting type. Whether this represents a transitional typological stage or a hybrid does not affect the conclusion that, if the link is accepted, the axe should date to a later rather than earlier phase of Ewart Park'. A number of Sompting axes have decoration consisting of ribs ending in pellets, and this type of decoration is also seen on different, earlier axe types, namely of the south-eastern type which belong to late Bronze Age 3 (Ewart Park and Carps Tongue phase). The latter axes have short rib and pellet decoration as opposed to the long rib and pellets of the Sompting type. Axes with the short rib and pellet have been found concentrated in East Anglia, including hoards from Carlton Rode, Eaton and Norgate Road, Norwich (Coombs 1979a, fig. 331, 2.4), Feltwell Fen (Smith 1956) and Gorleston I (McK Clough and Green 1978, fig. 3.5, 6) all in Norfolk, and at Watford, Herts (Coombs 1979a, fig. 11.1.7) and Reach Fen (Smith 1956, fig. 7), Meldreth (Hawkes and Smith 1955, fig. 19). An axe of this type that was found in the hoard from Challans, Vendée in France (D Coombs, pers. comm.), also had the back to front section.

Short rib and pellet decoration is also found on Armorican axes (Briard 1965, fig. 93.8.9). Similarly other forms of decoration which occur on Sompting axes can also be found on earlier forms, such as horizontal rows of three pellets on two axes in the Ketton hoard from Rutland (McK Clough 1979, fig. 5.4.8 and 15). This hoard also contains ribbed axes, which have the back to front mouth section. These factors, combined with the heavy concentration of faceted axes in East Anglia strongly suggests that influences from this area had a part to play in the origin of the Sompting form.

The Tower Hill axe hoard

This hoard contains only a few decorated axes when compared to other Sompting type hoards. For example, 20 of the 21 axes in the Figheldean Down hoard, Wiltshire, were decorated (Coombs 1979b). In the Ferring hoard from Sussex there were seven decorated axes (Huth 1997, taf. 36, 37), and axes were decorated in the Llyn Fawr hoard from Glamorgan (Savory 1976), and the Sompting hoard itself from Sussex (Curwen 1948).

The decoration on the Tower Hill axes varies. Axe 1 (Fig. 11.1) has one face with five ribs with pellets at either end, and the other face with five ribs with pellets only at the lower end, but with the central rib joined to the ribs either side by short sloping ribs, giving an m-shaped configuration, but the decoration is obscure in places. Axe 8 (Fig. 11.4) has three pellets in a horizontal line. Axe 45 (Fig. 11.12) is a fragment of a socketed axe body which shows two groups of ribs or grooves which appear to be converging or diverging. Axe 50 (Fig. 11.12) retains a corner fragment of socketed axe showing a lattice pattern, and axe 53 (Fig. 11.12) is a mouth fragment with three thin ribs which appear to be curving. A corner fragment of socketed axe 44 (Fig. 11.12) shows a groove along the edge, and a corner fragment of socketed axe 70 (Fig. 11.13) has a single rib and roundel ornament.

Decoration and Sompting axes

Of all the socketed axe forms from the late Bronze Age in the British Isles, the Sompting form contains the greatest variety of designs and is also the only axe form which contains different types of decoration on either face. Many of the designs are also shared with Armorican axes (Briard 1965).

Pellet decoration on axes, ranging from single to a horizontal row of four are known on south-eastern axes of the Ewart Park and Carps Tongue phase and Armorican axes (Briard 1965, fig. 93.5.6). In particular, axes with three pellets are known from the

hoards of Levington (Coombs 1972, fig. 386.2), Butley II (Coombs 1972, fig. 373.12), both in Suffolk. Such axes are also known from Grays Thurrock (Coombs 1972, fig. 126 12), Thurloe Walk Grays (Coombs 1972, fig. 133.1), and Chrishall (Coombs 1972, fig. 112.4) all in Essex. Similar axes have been found at Bexley Heath, Kent (Britton 1960, 53.14) and Ketton, Rutland (McK Clough 1979, fig.5.4.8, 15). Single finds are known from Cookham, Kent, the Thames at Kingston, and Washingborough, Lincs (Davey 1973, fig. 13.139). There is only one axe from Scotland and the north of England and this is a questionable find from the Borders (Schmidt and Burgess 1981, pl. 86, 1292). It is also possible to find rib/pellet decoration in association with a free standing row of pellets, for example at Methwold, Norfolk, and Boston, Lincs (Davey 1973, fig. 13.141), and from the Thames at Putney in London.

Rib and pellet ornament is a well known decorative device, but ribs with pellets at either end are very rare. There is an example from near the Old Kent Road, London and an axe in the Ferring hoard, West Sussex has ribs with pellets at either end in conjunction with ribbed wing pellet decoration (Huth 1997, taf. 36.6). There are also examples where there are only pellets on top of the ribs, such as hoards from Ketton, Rutland (McK Clough 1979, fig.5.3.2), Elenger, Suffolk and single finds from Knebworth, Herts. These are also known from Docking, Norfolk, Dover, Kent and Taradale in Scotland (Schmidt and Burgess 1981, pl. 103, 1626). Similar decoration can also be found on Armorican axes (Briard 1965, fig. 93.10) and on other forms, as in the Carcassone hoard, Aude, France (Huth 1997, taf. 79.5). If there is an m-shaped configuration on one face, this is the type of arrangement seen on an axe from Caston, Norfolk (Evans 1881, fig. 131), and in much more complex forms from Eastbourne, Sussex and Holme Pierrepont, Nottinghamshire (Scurfield 1997), and in the hoard from Skelmore Heads, Lancashire (Schmidt and Burgess 1981, pl. 101, 1598, pl. 103, 1621).

There are a number of axes known where ribs forming chevron patterns as in axe 50 join the vertical ribs of the rib/pellet design. This seems to have been a northern trait being found on axes from Holme Pierrepont (Scurfield 1997, fig. 14.63) and Rampton, both in Nottinghamshire, at Skipsea, Yorks (Schmidt and Burgess 1981, pl. 103, 1624), and Winwick, Lancs (ibid., pl. 104, 1631). There is also an example from Boughton, Norfolk, where the rib and pellet design is joined to a row of pellets by short ribs and an example from the River Trent where the ends of the ribs are joined by crosses (Davey 1973, fig. 13.143).

The rib and roundels or rib circles of axe 70 (Fig. 11.13) are characteristic of Sompting and Armorican axes. They can be found as simple rib and roundel or rib and circle or as part of much more complex designs in association with rib and pellet, lines of vertical pellets and with the patterns joined in complex configurations. It is impossible to say from the Tower Hill piece what type of decoration this was originally. The more complex forms seem to be concentrated in the north of England and Scotland. Unique to Sompting axes are examples where the mould has been altered (Burgess 1967–70, fig. 1b.c).

The Sompting axe hoards exhibit many unique features when compared to hoards of the previous phase. A large proportion of the axes are as straight from the mould and have never been sharpened or show little signs of wear. In the Tower Hill hoard axe blades have been hammered, polished but never sharpened. There are a number of instances where there are axes from the same mould within the same hoard. Again compared to earlier hoards the Sompting hoards are largely composed of axes of the same type. Occasionally these axes are associated with those of linear faceted type, with which they share similar decoration and the unfinished or unused state. The latter type also tend to be found in hoards only associated with axes of the same type, though they are also found occasionally associated with Sompting axes (Curwen 1948, pl. 22, 5 and 6; Huth 1997, taf. 37, 2 and 3). There appears to be less fragmentation among the axes in the Sompting hoards when compared to Ewart Park and Carps Tongue hoards.

Continental connections and dating

There is a possibility that some of the Sompting axes or related forms reached the Continent. Burgess (1967–70) suggested that two axes in the hoard from Bergen, Rugen could be such exports. O'Connor (1980) mentions axes with long rib/pellet decoration are found along the Scheldt Valley, Belgium and Verlaeckt (1996, pl. 11, cat. 147) illustrates such an axe from Schellebelle and describes it as being related to Sompting type. There is a radiocarbon determination for wood (beech) in the socket of the Schellebelle axe of 2790 ± 50 BP (UtC-4194: 1080–820 cal BC, 95.4% confidence), and another axe he describes as Sompting, from Wichelen has a radiocarbon date of 2465 ± 35 BP (UtC-3917: 770–400 cal BC, 95.4% confidence). There is a Sompting axe from the Thames at Kew Deer Park, (Needham *et al.* 1997, ill. 23.1) which has a date of 2545 ± 55 BP (OxA 4658: 810–480 cal BC, 91.7% confidence. All radiocarbon dates have been recalibrated with OxCal v3.5.).

Objects which have been radiocarbon dated of the Llyn Fawr phase are rare, although at Broom, Warwickshire, cremation burials within a ring ditch associated with type B2 cauldron fragments gave dates of 2570 ± 55 BP and 2475 ± 55 BP (OxA 6282 and 6283, 840–510 and 780–400 cal BC, 95.4% confidence) from the pyre (Needham *et al.* 1997). At Staple Howe, Yorkshire with Llyn Fawr type metalwork including a fragment of a possible Sompting axe (Brewster 1963, 139–40) there is a date of 2400 ± 150 BP (BM-63, 850–100 cal BC, 95.4% confidence). Needham *et al.* stated that 'The scientific data now suggests a transition from Ewart Park to Llyn Fawr metalwork close to 800 BC, equating to a

central radiocarbon determination of approximately 2600 BP; soon after this point in time the calibration curve makes its radical shift from steeply falling slope to undulating plateau (Pearson and Stuiver 1986). Consequently the distinction between the two in terms of radiocarbon measurements may be good even though this will still leave unanswered the duration of Llyn Fawr after about 800 BC' (1997, 98). The grave at Wehringen, Tumulus 8, Bavaria (Frierich and Hennig 1996) is relevant as the Hallstatt C timber-lined grave with four wheeled cart and Gündlingen sword and winged chape has a timber felling date of 778 ± 5 BC which fits well with the radiocarbon dates. Absolute dates can now give a chronology for the Hallstatt period in south-western Germany of 778 ± 5 BC for the beginning, 616 BC for its development and 520 BC for its end. Another group of Sompting type axes is located in North Germany and Denmark (Butler 1963, 93–4), and most are dated to Montelius V. However, as Verlaeckt pointed out the real Sompting form are heavier and bigger than the northern group but the East-Flemish axes clearly relate to the English type (Gerdsen 1984, 53–8).

Distribution

To date Burgess (1967–70) has produced the most complete distribution of Sompting axes, though this also contains axes with short rib and pellet, which strictly speaking may not be of Sompting type. The axes are concentrated in the Thames Valley, East Anglia, North Lincolnshire and Yorkshire with a scattering through the north of England and Scotland. To this map has to be added, besides single finds the hoard finds of Figheldean Down, Wilts (Coombs 1979b), Danebury, Hants (Cunliffe and O'Connor 1979), North Ferring, West Sussex (Huth 1997), Salisbury, Wiltshire (Stead 1998) and the present hoard.

ORNAMENTS

The Tower Hill hoard contains a number of objects, both complete and fragmentary, which can best be described as ornaments. A number of these objects are unique to the British Isles and so far it has been impossible to find close parallels on the Continent.

Rings 22 and 23 (Fig. 11.14) appear to have too great a diameter to have served as bracelets and 22 has a rectangular slot, which probably means that it was meant for suspension. Other objects or fragments might have been bracelets, some of which are decorated; these are 24, 26, 27 and 78 (Fig. 11.14) and 29, 30, 31 and 81 (Fig. 11.15).

Ring 25 (Fig. 11.14) is complex with eight slots, perpendicular to each other and with a D-shaped suspension loop. Rings with horizontal rectangular perforations are known in the Wilburton hoard, Cambs (Burgess and Colquhoun 1988, pl.152, A 23) and the same style was also found on more elaborate discs from the hoards at Isleham, Cambs, Welby, Leics (Powell 1950), Parc-y-Meirch, Denbighshire (Savory 1976, fig. 9.8.10) and Heathery Burn Cave, Co Durham (Britton with Longworth 1968, 55, 10.2, 42). These examples have been described as strap distributors and on the Continent during Hallstatt C and D objects with a similar function are described as domed rein knobs (Pare 1992). Unlike these objects, the Tower Hill piece has a D-shaped suspension ring; its actual function is not certain.

The complex ring 28 (Fig. 11.15) is unfortunately broken and its original form is impossible to reconstruct. It is an interesting casting though the decoration is rather rough. Outer rings joined to inner rings, though not as complex as the Tower Hill object, are known from Hallstatt Continental Europe generally associated with wagon equipment. Two of these objects with suspension loops are known from the Wijchen grave, Holland (Pare 1992, pl. 6.9.10) and nailed double rings have been described as wagon box decoration (ibid., fig. 74. 17–20). Inner rings joined to outer rings in a number of ways are known in Bronze Age and Iron Age Europe and the style can be traced back to the wheel headed pins of the early Bronze Age.

There is a single dished disc-headed pin head from the Tower Hill hoard. A similar pin with a dished head comes from the Heathery Burn Cave find (Britton with Longworth 1968, 104). Disc headed pins have a long life in Europe and have little chronological significance.

CONCLUSIONS

Sompting axes stand out as they contain a wealth of decoration, sometimes quite elaborate. This is remarkable as late Bronze Age objects in the British Isles lack decoration when compared to areas on the Continent, and 'One cannot escape noticing the lack of sophistication in the (Atlantic) metalwork, it is plain and straightforward – there is none of the stylistic artistry of the Nordic tradition or the technical mastery of the Urnfield specialist workshops. Quantity rather than quality, with some exceptions, seem to be the rule. We can only guess at the other, perishable materials, that were the objects of artistic creativity, perhaps textile production and wood working' (Kristiansen 1998, 145).

If the Tower Hill hoard was associated with the circular structure in trench 1 as discussed then it relates to practices which can be taken back into the Neolithic. Deposits at boundaries are a well known feature of prehistory, occurring in ditches, terminals of ditches, entrances and ramparts and these often consist of a variety of types of objects (Coombs 1996). Tower Hill presents another such example. Other contexts where Sompting axes occur include the Danebury hillfort associated with, amongst other things, an Armorican axe, and in the wetter context at Llyn Fawr, Wales. There was the unsharpened blade of an axe beneath the midden at East Chisenbury, Wilts (McOmish 1996) and fragments of a lead axe with vertical ribs of possible Sompting type,

from the hillfort at Mam Tor, Derbyshire (Coombs and Thompson 1979; Guilbert 1996). There was also a fragment of a Sompting axe from the Staple Howe settlement in Yorkshire (Schmidt and Burgess 1981, 244) which also contained other metalwork of the Llyn Fawr phase (Brewster 1963).

The dynamics of the transitional period, the late Bronze Age to early Iron Age is extremely difficult to identify. The origins of Gündlingen swords (Cowen 1967; Schauer 1972) have not been satisfactorily solved and many of the so-called typical Hallstatt objects in Britain may be of local manufacture (Meyer 1984–5). Warmembol (1988), in reviewing this transitional period in the Netherlands met with similar problems, stated 'As far as our evidence goes, and it does not go very far yet, we could thus have Atlantic proto-Hallstatt swords being replaced in the Low Countries, by Atlantic Hallstatt swords ... The chapes found in the Low Countries in Hallstatt graves can all, with the probable exception of a fragment from Court Saint Etienne, be regarded as Atlantic types ... The razors also show that very close connections existed during this period between say, north-western France, south-eastern England and the Low Countries ... The rings must serve here to show that the metalwork in the aristocratic graves, other than the sword-graves is also Atlantic'.

The hoard from Tower Hill is typical of the Sompting hoards of the final phases of the British late Bronze Age, though it does contain more ornaments than usual. The transitional phase Bronze to Iron is confusing, the hoards seem to indicate some kind of change with different depositional rules coming into practice and with changing relationships with the Continent. Perhaps it is best summed up by Warmembol (1988), who wrote 'One may note it is fairly easy to observe change, but a very difficult one to explain it', and Thomas (1989) who stated 'The Bronze-Iron transition in north-western Europe resulted from a social transformation, not a technological one'.

CATALOGUE OF THE HOARD

1 Socketed axes

L = Maximum length, WBE = Width at blade edge, MDI = Mouth diameter internal, MDE = Mouth diameter external, SD = Depth of socket: all dimensions in mm, WTg = Weight in grammes

1.1 Complete axes

1 AXE: Fig. 11.1
Complete, as straight from the mould with casting flashes still present around the blade edge and with no discernible hammer marks on the blade. There are casting flaws present, and the double mouth mouldings are well defined. Both faces are decorated, one face with five ribs with pellets at either end, and the other face with five ribs with pellets only at the lower end, but with the central rib joined to the ribs either side by short sloping ribs, giving an m-shaped configuration, although this decoration is obscure in places, especially towards the moulding. There is slight spurring at the bottom of the loop. The axe shows the larger back to front mouth opening. The patina is milky-dark green with bronze patches in places.
L 127.5, WBE 65.07, MDI 36.12 × 27.24, MDE 48.3 × 40.29, SD 110.82, WT 375 g

2 AXE: Fig. 11.1
Complete, with the casting webs still present and there are hammer marks clearly visible on the blade which follow the curve of the blade. The blade is still sharp with slightly rounded corners. The double mouth mouldings are clearly visible and the top one is rather bulbous. On one face only, between the mouldings is a slight centrally placed depression with a raised central pimple, this may be a casting flaw, however it does appear on other axes in the hoard. The mouth has the back to front pattern. The surface is rather pitted and the patina is dark green with small areas of light green and with traces of bronze showing through.
L129.9, WBE 66.5, MDI 31.58×28.3, MDE 44×40.2, SD 103.4, WT 426 g

3 AXE: Fig. 11.2
Complete with casting webs still present, and there are traces of hammer marks on the blade which is still sharp and has only slight traces of wear. The axe has a double mouth moulding with the top one rather bulbous. On one face between the mouldings is a centrally placed slight circular depression with a central pimple. There is slight spurring to the bottom of the loop, and the socket has the back to front pattern the patina is green/brown with slight traces of bronze showing through, and the surface is rather pitted.
L127.7, WBE 67.1, MDI 32.4×27.6, MDE 43.6×39.4, SD 101.1, WT 383 g

4 AXE: Fig. 11.2
Complete with casting webs still present. The blade edge is still fairly sharp with only slight traces of wear, and traces of hammer marks on the blade. There are two prominent mouth mouldings with the top one rather bulbous. On one face only between the mouldings is a centrally placed depression with a central pimple. The socket has the back to front pattern. The surface of the axe is pitted and the patina is dark green with traces of bronze showing through in places.
L124.9, WBE 68.2, MDI 31.27×25.9, MDE 43.8×37.8, SD 97.5, WT 406 g

5 AXE: Fig. 11.3
Complete as from the mould with casting webs present along the blade edge. There are hammer marks on the blade so there has been some post-casting treatment. There is a casting fault on the loop, which is not complete. Clear double mouth moulding with the top one rather bulbous. The mouth has the back to front pattern. Pitted surface with dark green patina, although large areas of bronze show through.
L 126.4, WBE 63.4, MDI 30.8 × 27.94, MDE 43.12 × 37.82, SD102.1, WT 406 g

6 AXE: Fig. 11.3
Complete with casting webs still present. There are hammer marks on the blade and the blade edge is still sharp but it does bear traces of wear. On one face there is a large hole on the surface near the blade edge. There is a prominent bulbous top mouth moulding but the second one is only slight. The mouth has the back to front pattern.

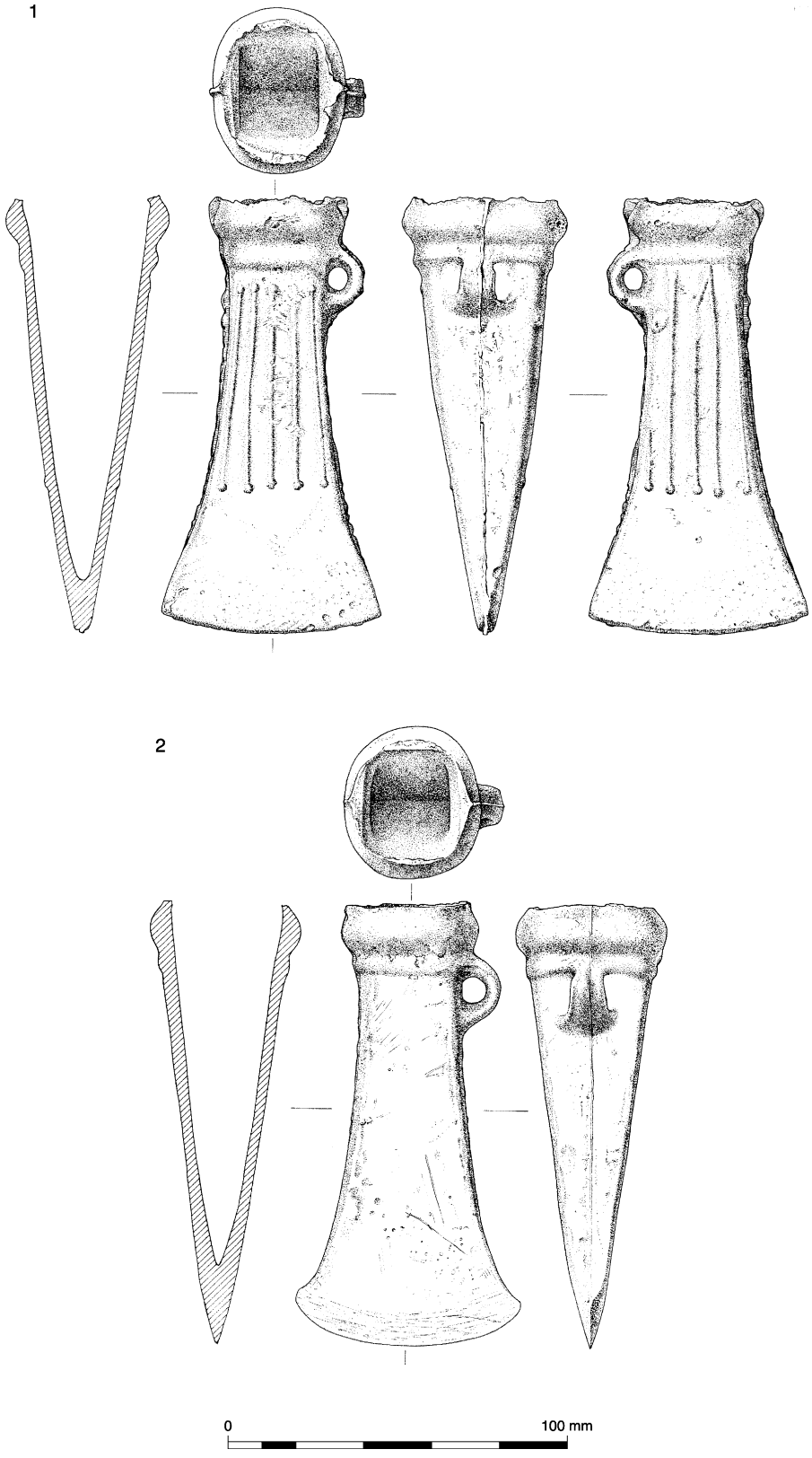


Figure 11.1 Bronze Age socketed axes 1 and 2.

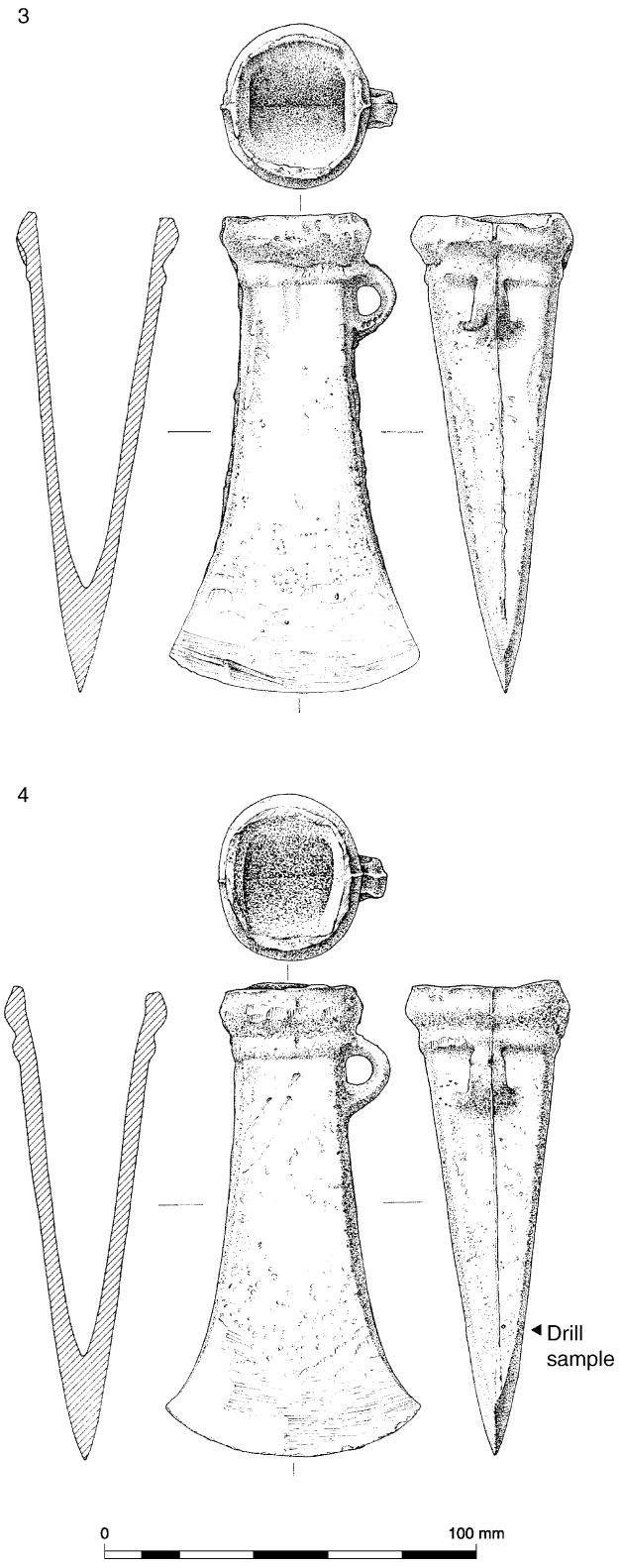


Figure 11.2 Bronze Age socketed axes 3 and 4.

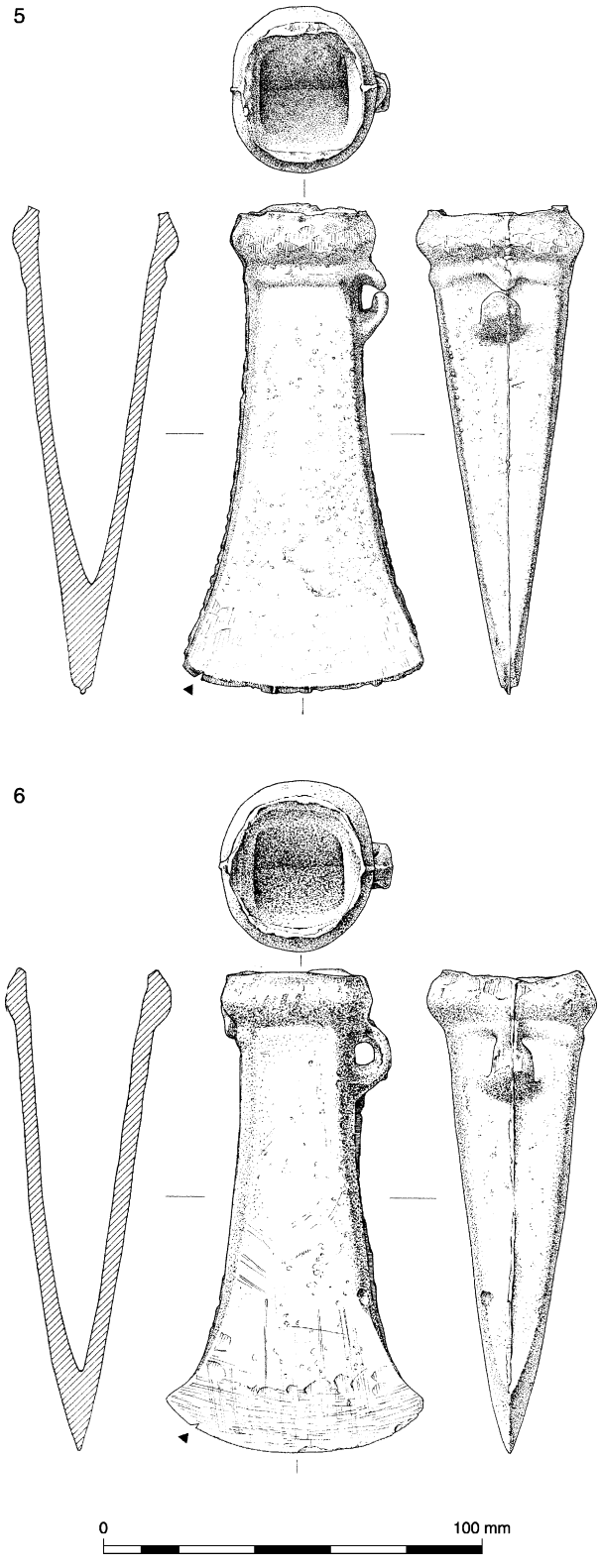


Figure 11.3 Bronze Age socketed axes 5 and 6.

The surface is pitted and the patina is dark green with traces of bronze showing through.
L 127.2, WBE 67.8, MDI 32.8×30.4, MDE 44.1×40.06, SD 107.5, WT 407 g

7 AXE: Fig. 11.4
Complete with casting webs still present and with traces of hammering on the blade. The blade is still sharp but there are clear traces of wear along its edge. The axe has a

well-defined double mouth moulding with the top one rather bulbous. The socket has the back to front pattern. The surface is pitted and the patina is dark green with bronze showing through in places.
L128.0, WBE 66.6, MDI 32.8×28.7, MDE 43.8×40.9, SD112.4, WT 378 g

8 AXE: Fig. 11.4
Complete with double mouth moulding and casting webs still present and hammer marks on the blade. There is a small hole on one face. The blade is still fairly sharp and it shows only slight traces of wear. There are three horizontal pellets on either face below the second moulding and there is a slight indication of ribs along the edges of the axe. The patina is dark green and brown with bronze showing through in places.
L 130.9, WBE 67.0, MDI 26.3×28.0, MDE 39.1×45.3, SD 94.92, WT 434 g

9 AXE: Fig. 11.5
Complete with double mouth moulding, the top one being bulbous. It is in good condition and has hammer marks on the blade. The blade is still sharp but shows traces of wear. The casting webs are still present. The patina is black/dark green with no bronze showing through at all.
L 127.7, WBE 65.0, MDI 26.9 × 29.63, MDE 40.14 × 39.7, SD 100.4, WT 459 g

10 AXE: Fig. 11.5
Complete with double mouth moulding. The condition is good, the side casting webs have been hammered in places but not flat. There are hammer marks on the blade, which is still sharp, and with little traces of wear. The patina is dark green/brown with bronze showing through in places.
L 118.6, WBE 68.6, MDI 29.0×32.29, MDE 41×42.2, SD 96.9, WT 412 g

11 AXE: Fig. 11.6
Complete with double mouth moulding, on one face only there is a blob of metal between the mouldings. The condition is as from the mould with casting webs present on the blade edge. There are hammer marks present on the blade, there are also hammer marks on the casting webs at the sides. The patina is dark green with areas of bronze.
L125.6, WBE 62.7, MDI 29.1×31.56, MDE 43.6×39.2, SD 102.2, WT 416 g

12 AXE: Fig. 11.6
Complete with double mouth moulding. The top moulding is extremely bulbous. The axe is in fine condition: the blade is still sharp and shows little signs of damage. The casting webs at the side are complete and prominent, and there are hammer marks on the surface. The patina is dark green in places, almost black and lighter green elsewhere. There are small areas of bronze showing through.
L 126.6, WBE 71.7, MDI 31.9×33, MDE 43.7×47.1, SD 107.04, WT 442 g

13 AXE: Fig. 11.7
Complete with double mouth moulding, on one face only there is a blob of metal between the mouldings. It is in fine condition with the blade edge still sharp and with little sign of use. The casting webs at the sides are prominent, and there are hammer marks on the blade. There are areas of green and dark brown patina with traces of bronze showing through.
L 130.01, WBE 68.08, MDI 26.24 × 34.13, MDE 37.24 × 44.44, SD 99.96, WT 430 g

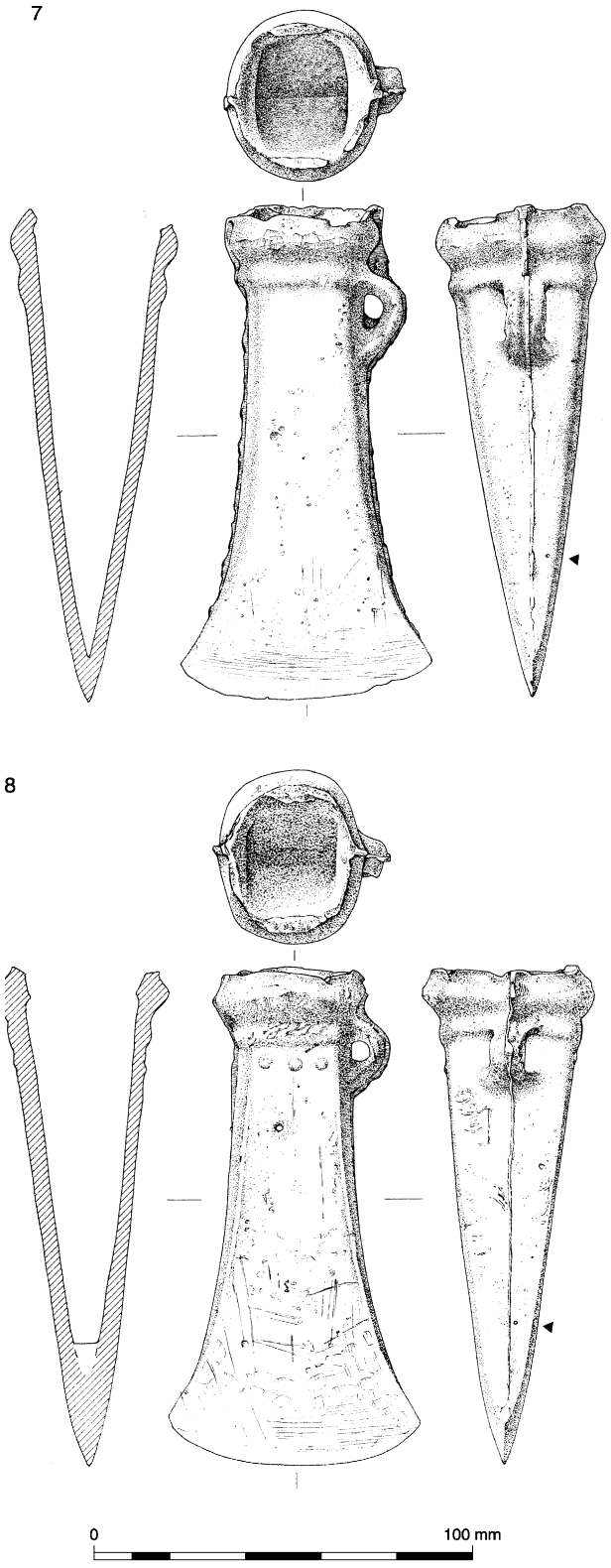


Figure 11.4 Bronze Age socketed axes 7 and 8.

14 AXE: Fig. 11.7
Complete with double mouth moulding and in fine condition. The blade edge has never been sharpened and still retains its casting web. There are hammer marks on

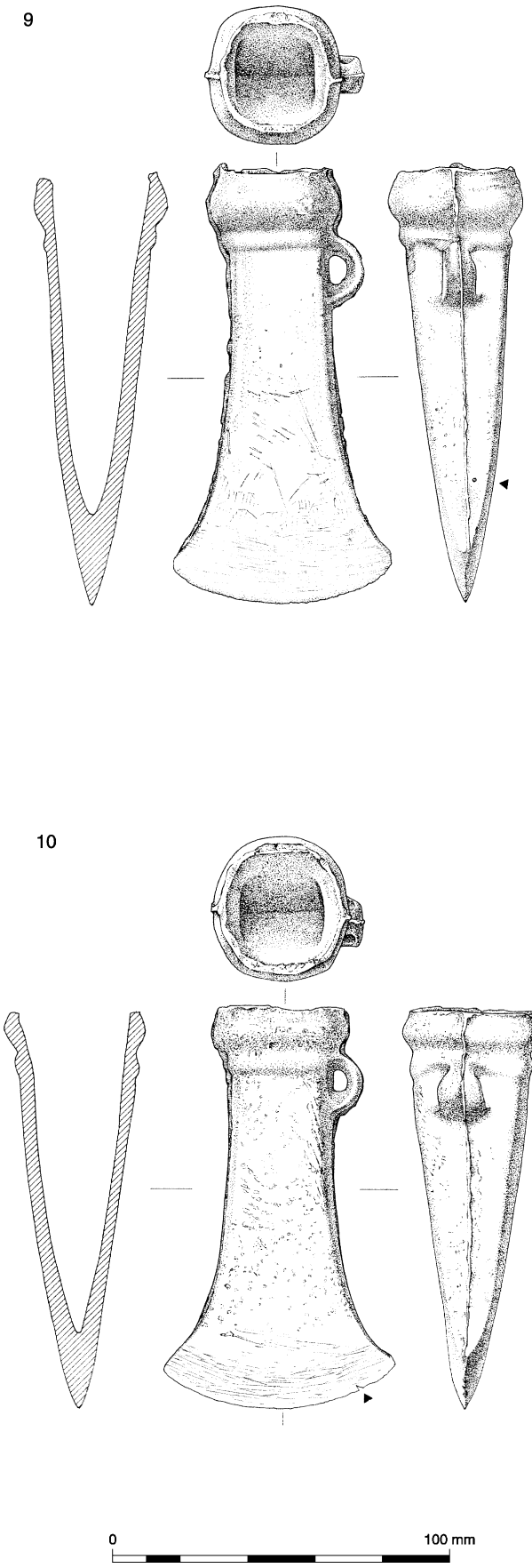


Figure 11.5 Bronze Age socketed axes 9 and 10.

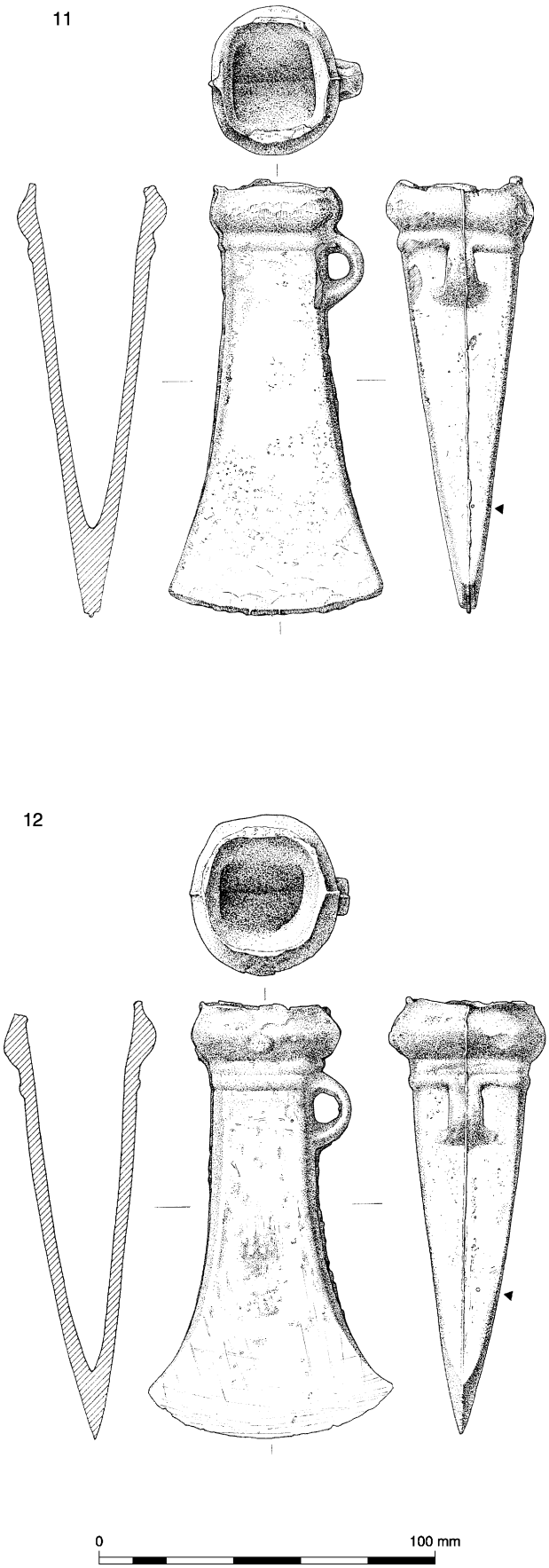


Figure 11.6 Bronze Age socketed axes 11 and 12.

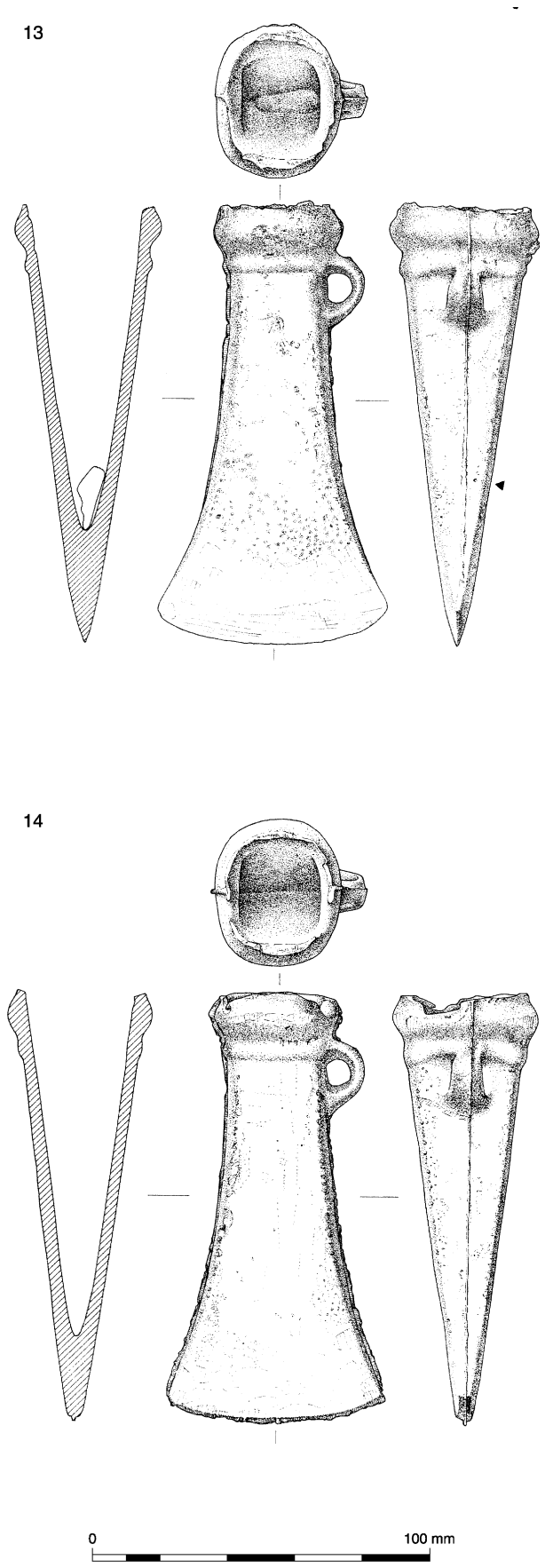


Figure 11.7 Bronze Age socketed axes 13 and 14.

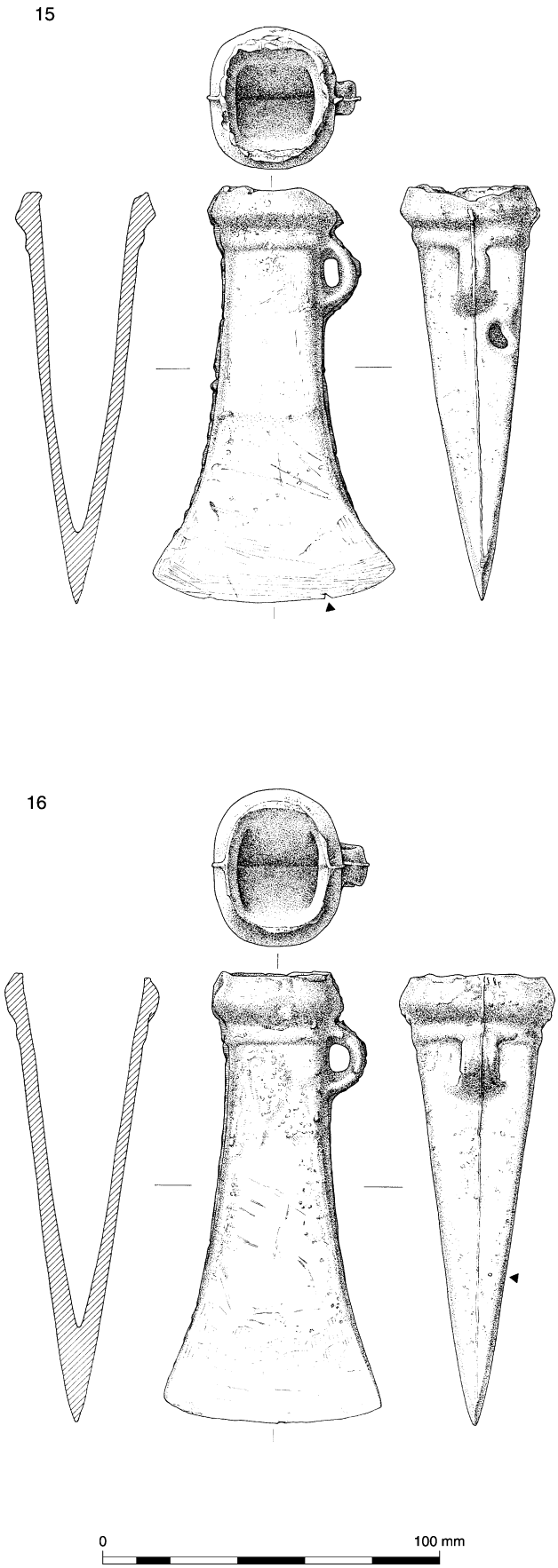


Figure 11.8 Bronze Age socketed axes 15 and 16.

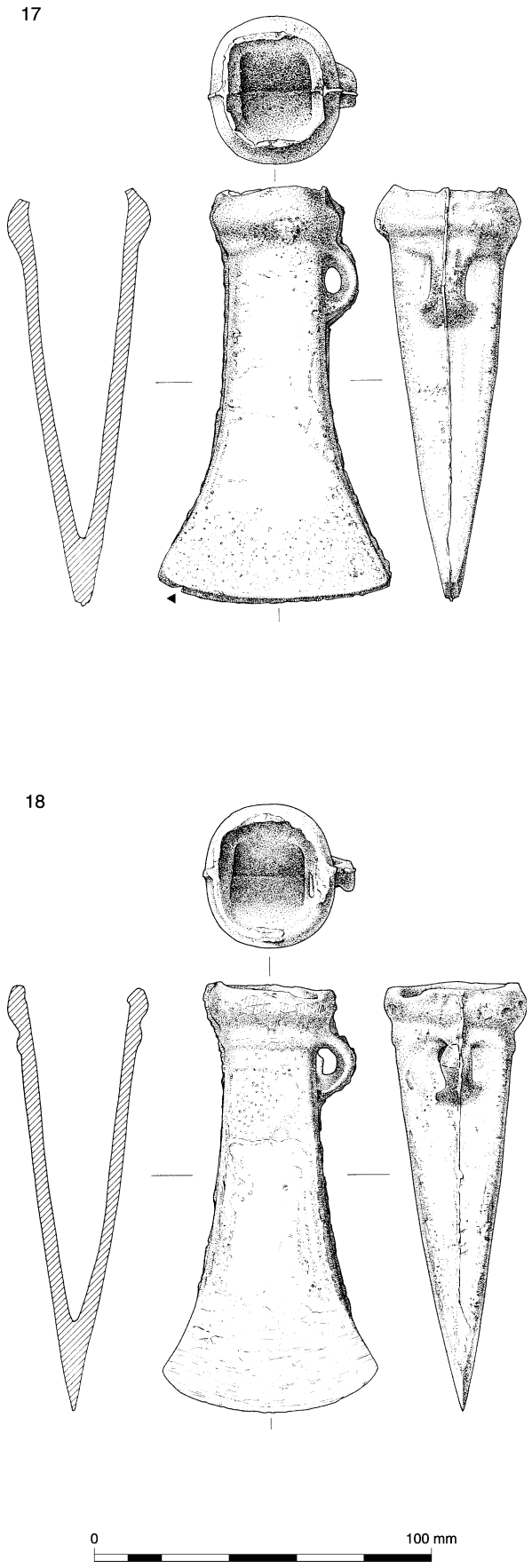


Figure 11.9 Bronze Age socketed axes 17 and 18.

the blade. The patina is dark green and brown with traces of bronze showing through in places. The loop tapers towards the top.
L125.04, WBE 65.02, MDI 31.7×26.4, MDE 38.9×44, SD 100.14, WT 404 g

15 AXE: Fig. 11.8
Complete with double mouth moulding in fine condition. The casting webs on the sides are prominent, and there are hammer marks on the blade, which is still sharp; there are only slight traces of damage along the blade edge. There is a casting flaw (hole) on one face. The patina is dark green/brown and in places there are traces of bronze showing through in places.
L 122.02, WBE 71.06, MDI 27.21 × 29.94, MDE 39.39 × 41.79, SD 99.05, WT 357 g

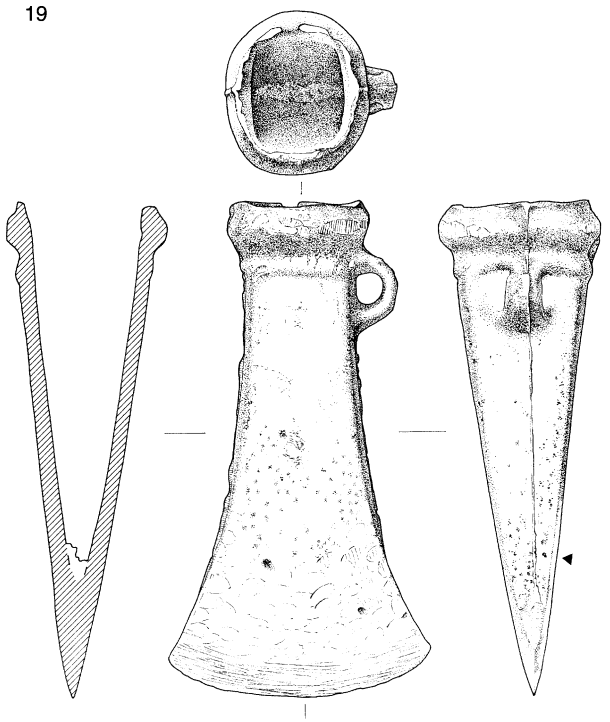
16 AXE: Fig. 11.8
Complete with double mouth moulding. It is in fine condition with casting webs still prominent, and the blade is still sharp with only slight traces of damage along the edge. There are hammer marks on the blade. The patina is dark green/brown with extensive areas of bronze showing through.
L 133.03, WBE 64.02, MDI 26.25 × 34.5, MDE 38.6 × 45.9, SD 106.44, WT 428 g

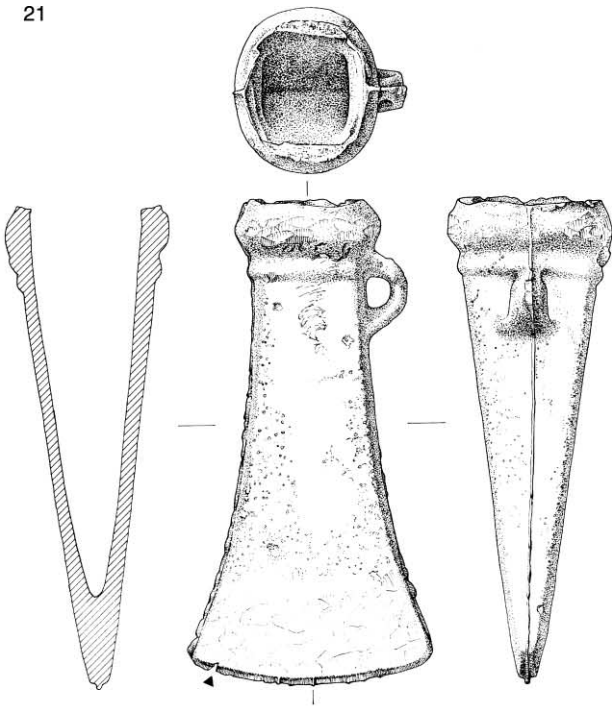
17 AXE: Fig. 11.9
Complete with single mouth moulding, and under the moulding on one face is a small blob of metal. The axe is fine and unused, the casting web is present along the blade edge which has not been sharpened, and along the sides. There appear to be no hammer marks on the blade. There are only slight traces of patina, most of the axe is bronze.
L 122.15, WBE 69.05, MDI 27.05 × 29.37, MDE 39.28 × 44.27, SD 101.33, WT 428 g

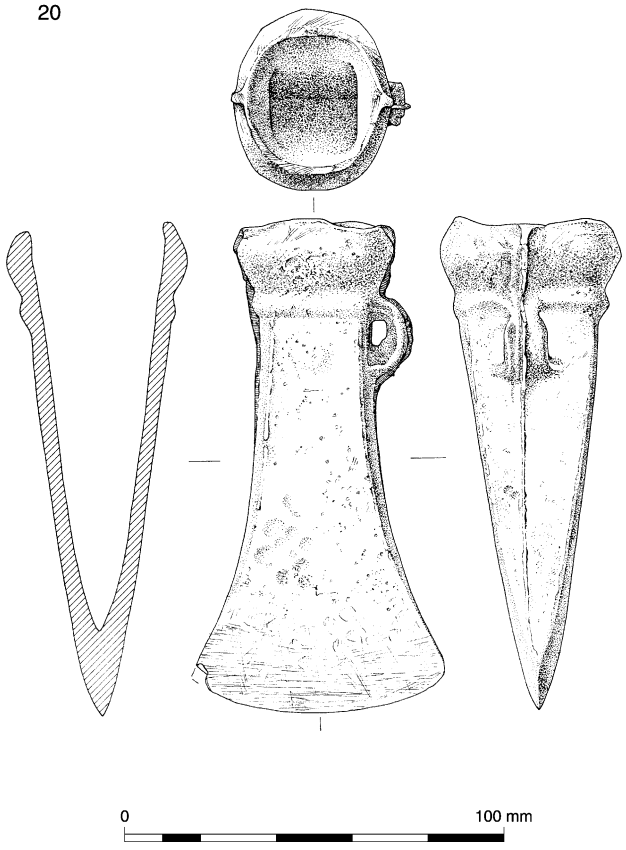
18 AXE: Fig. 11.9
Complete with double mouth moulding, and in good condition. The casting webs are present at the sides though there are traces of hammer marks along them. The blade is still fairly sharp and there are hammer marks on the blade. There is a small hole as a casting flaw under the loop. The patina is dark green/brown all over.
L 125.2, WBE 63.9, MDI 27.25 × 31.19, MDE 39.40 × 42.57, SD 97.68, WT 403 g

19 AXE: Fig. 11.10
Complete with double mouth moulding, and in fine condition with casting webs still prominent along the sides. On one face there is a blob of metal between the mouldings. The blade is still sharp with only little trace of damage, and the loop tapers towards the top. The patina is dark green/brown with bronze showing through in places.
L 130.05, WBE 69.2, MDI 26.67 × 30.62, MDE 38.37 × 43.26, SD 96.62, WT 397 g

20 AXE: Fig. 11.10
Complete with double mouth moulding, the top one being large and bulbous. The edges appear to be slightly raised giving the impression of thin ribs. The surface is rather pitted and the casting webs are present. There are hammer marks on the blade which is still sharp though is chipped on the edge and there is one corner missing. The patina is dark green/black with bronze showing through in places.







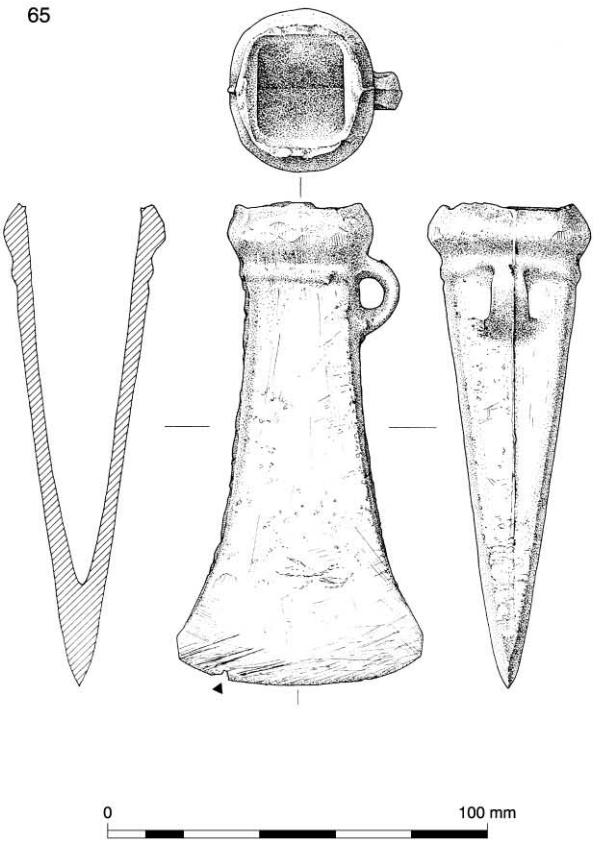


Figure 11.10 Bronze Age socketed axes 19 and 20.

Figure 11.11 Bronze Age socketed axes 21 and 65.

L127.8, WBE 65.8, MDI 30.7×35.1, MDE 41.4×46.7, SD 106.37, WT 409 g

21 AXE: Fig. 11.11
Complete with double mouth moulding, and has never been used, casting webs still present along the blade edge and along the sides. On one face there is a blob of metal between the mouldings, and there are hammer marks on the blade. The patina is dark green/brown with areas of bronze showing through.
L 126.42, WBE 64.32, MDI 25.5 × 30.06, MDE 37.61 × 43.32, SD 99.60, WT 424 g

65 AXE: Fig. 11.11
Complete and in good condition with double mouth moulding. The blade shows signs of use and is blunted and chipped along the edge. There are hammer marks on the blade. The patina is dark green/brown with bronze showing through.
L 125.4, WBE 64.5, MDI 26.9×29.9, MDE 42.1×38.13, SD 99, WT 430 g

1.2 Axe fragments

(L = surviving length, W = surviving width: all dimensions in mm)

Figure 11.12

33 Fragment with green/black patina, L 34.5, WT 12 g
34 Fragment showing part of the single mouth moulding, L 38.6, WT 40 g
44 Corner fragment from a socketed axe showing one groove along the edge, L 22, W 14, WT 4 g
45 Fragment, probably from the body of a socketed axe, with decoration in the form of convergent or divergent parallel grooves, L 11.0, WT 5 g
46 Fragment showing the corner of the axe, L 6.0, WT 4 g
48 Corner fragment from a socketed axe showing the presence of a vertical rib, on one face with black/dark green patina, L 1.3, W 3.7, WT 2 g
49 Fragment from the corner of a socketed axe, green/black patina, L 19, W 3.2, WT 2 g
50 Corner of a socketed axe, with remains of a lattice work pattern in ribs. Green/black patina, L 43.3, W 4.39, WT 18 g
51 Fragment showing part of the mouth showing a single moulding, which has two vertical incisions, dark green/black patina, L 54.42, W 16.02, WT 26 g
52 Fragment of a socketed axe showing the corner, and one side shows hammering, green patina. L 40.7, W 4.5, WT 18 g
53 Fragment from the mouth of a socketed axe, showing single mouth moulding with signs of hammering. One face shows decoration, with thin ribs which curve towards the top, dark green patina, bronze in places, L 31.4, W 3.9, WT 13 g
54 Fragment from the mouth of a socketed axe showing a single mouth moulding, L 26, W 18.0, WT 9 g
55 Fragment from the corner of a socketed axe, dark green patina, L 26, W 4.1, WT 11 g
56 Corner from a socketed axe showing hammer marks on one face. Green patina with bronze showing in places, L 23.1, W 6.73, WT 12 g
57 Fragment from the side of a socketed axe which shows the casting edge, with dark green patina, L 36.8, W 3.02, WT 8 g

Figure 11.13

59 Mouth fragment from a socketed axe with single mouth moulding, possibility of faint second moulding, with dark green patina, L 17.5, W 2.7, WT 5 g
66 Body fragment from a socketed axe showing a small part of the corner. Dark green patina, L 24, W 5.3, WT 12 g
67 Corner fragment from a socketed axe. The fragment shows three ribs on the face, with dark green patina, L 29.2, W 2.8, WT 11 g
68 Fragment of socketed axe showing part of the face and the side. The side shows the casting web, with dark green patina, L 41, W 4.7, WT 24 g
69 Body fragment from a socketed axe. The face shows either a casting web or a rib. L 22, W 2.7, WT 3 g
70 Corner fragment of socketed axe. On one face are the remains of a rib and roundel ornament. Dark green patina, L 32.8, W 5.9, WT 16 g
72 Body fragment from a socketed axe, with dark green patina, L 18.42, W 6, WT 6 g

Not illustrated

58 Fragment of axe, WT 5 g
93 Corner from an axe, with dark green patina. L 17.8, W 4.41, WT 10 g

2 Ornaments

(D = Diameter, ID = Internal diameter, ED = External diameter, ML = Maximum length: all dimensions in mm)

Figure 11.14

22 Bronze ring, very fine and complete. One part is slightly expanded and perforated by a rectangular slot. Decorated on the exterior by vertical lines at right angles to the ring, but decoration is absent in area of the slot. No decoration is present on the interior of the ring. The ring is too large to have been a bracelet and the rectangular hole suggests that it was meant for suspension. ID 88.83, ED 101.47, WT 61 g
23 Bronze ring in fine condition, although now misshapen and oval in shape. It has a dark green bronze patina. It appears to be too big to have been as bracelet. ID 94.9×87.1, ED 95.5×104.7, WT 41 g
24 Bronze ring in good condition. On the exterior are three grooves following the line of the ring, and in places the grooves are not well executed, with green patina in places but largely bronze. ID 68.5, ED 81.4, WT 57 g
25 Complex ring surmounted by a semi-circular loop. A flat ring with a deep groove along its outer edge and deep grooves in both surfaces, with sides perforated by eight rectangular slots. The groove along the edge of the ring also has eight perforations, in the same positions, which do not pierce the interior. ID 56.04, ED 77.1, WT 67 g
26 Broken and bent bronze ring, with one expanded terminal and one terminal missing. On the outer surface are six grooves following the line of the ring, these terminate at four grooves at right angles. Behind the terminal are four grooves at right angles to the body of the ring. ID 23.1×17.0, ED 28.2×23.5, WT 9 g
27 Coiled bronze strip, with three grooved lines on the outer surface of the strip following the line of the ring.

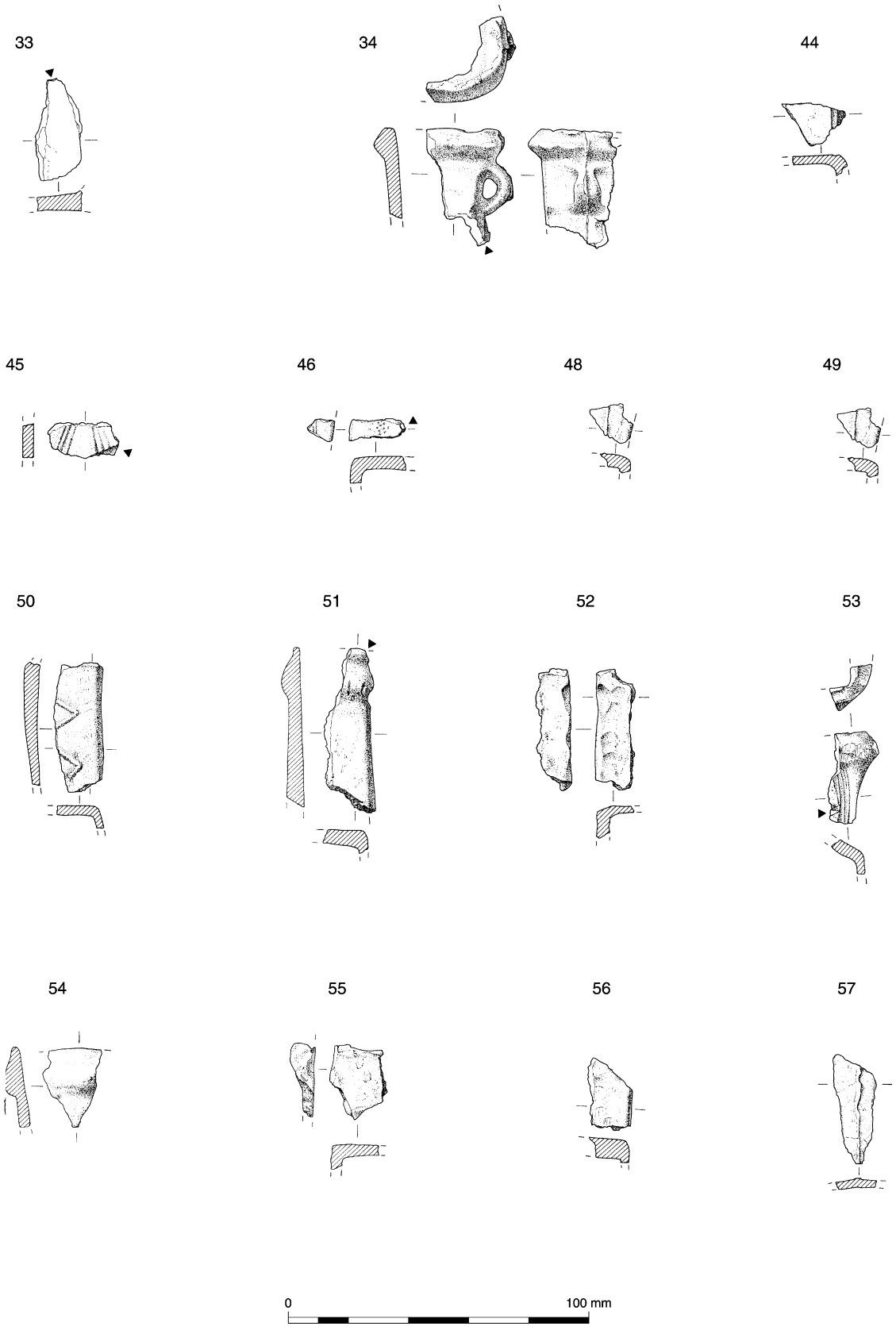


Figure 11.12 Fragments of Bronze Age socketed axes 33, 34, 44, 45, 46, 48, 49, 50, 51, 52, 53, 54, 55, 56 and 57.

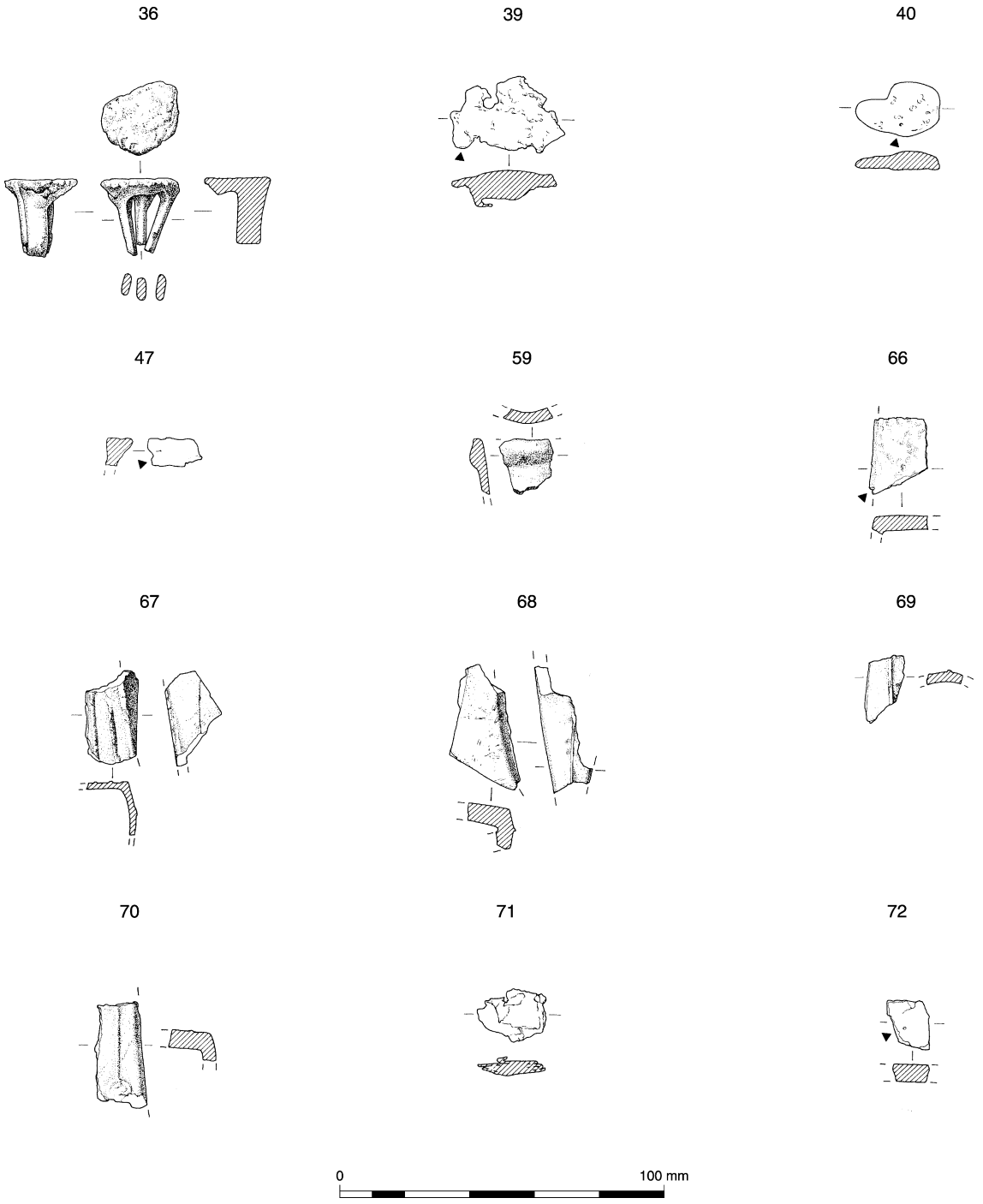


Figure 11.13 Casting jets 36 and 47, scrap pieces 39 and 40, socketed axe fragments 59, 66, 67, 68, 69, 70 and 72, crumpled sheet metal 71.

Near to the end of the strip is a vertical groove, however two of the grooves proceed beyond it. Width at the end of the strip 5.23, WT 6 g

35 Broken disc headed pin with dished head, and part of the shank remaining, with green patina. D of head 30.0, WT 4 g

78 Small bronze ring with oval cross section. This is roughly cast with casting webs still present and dark green patina. ID 7, ED 18.2, WT 6 g

Figure 11.15

28 Bronze ring, badly broken, and now consisting of a fragment of a flat outer ring with edges decorated with short punched lines. The surface of the flat outer ring has three grooves, and is joined by a circular narrow ring with one edge decorated with punched lines, to a similar flat ring of smaller diameter. The reverse of the object is undecorated and has a single loop. Due to its

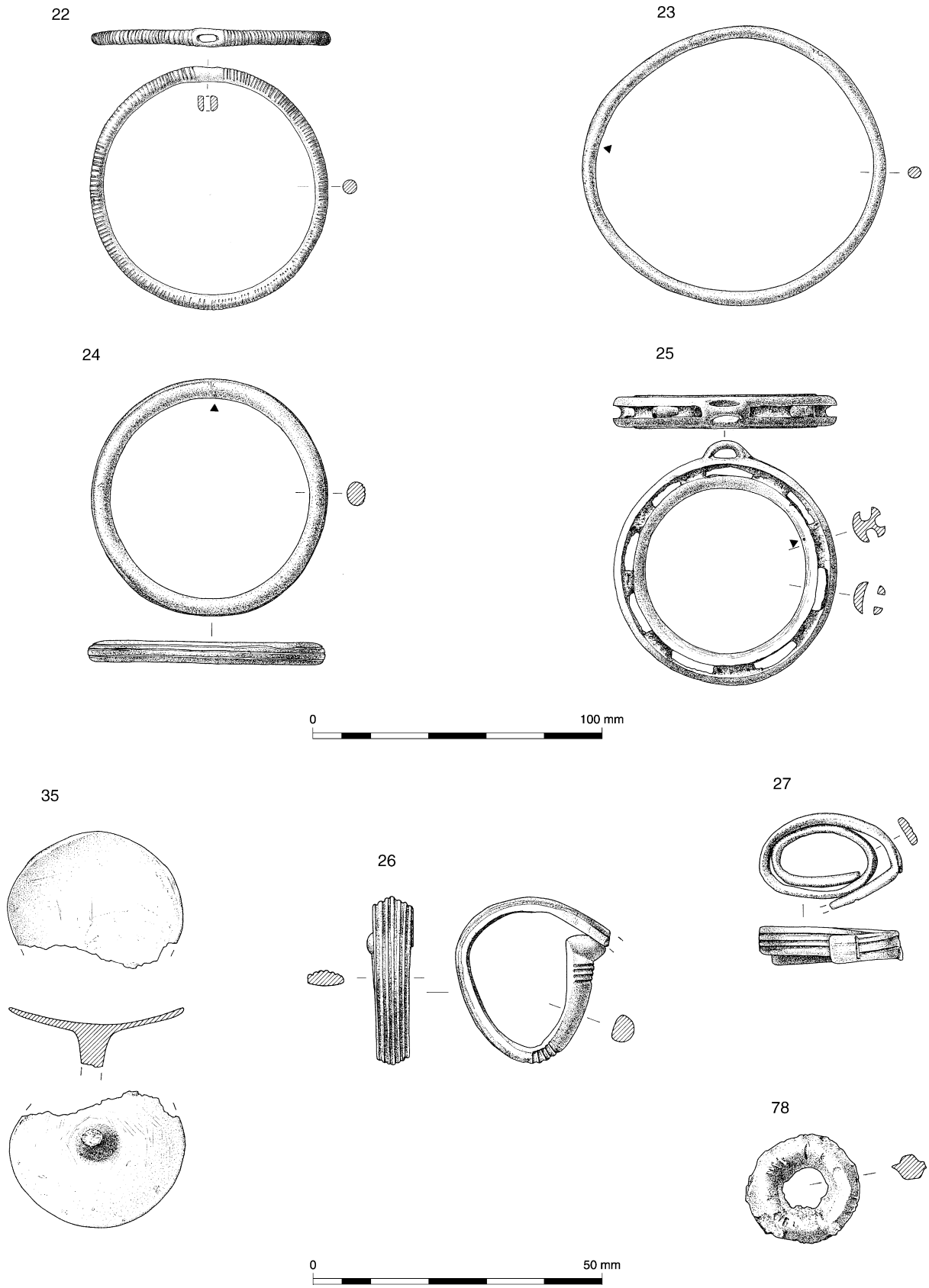


Figure 11.14 Bronze rings 22, 23, 24, 25 and 26, coiled bronze strip 27, disc headed pin 35, and small bronze ring 78.

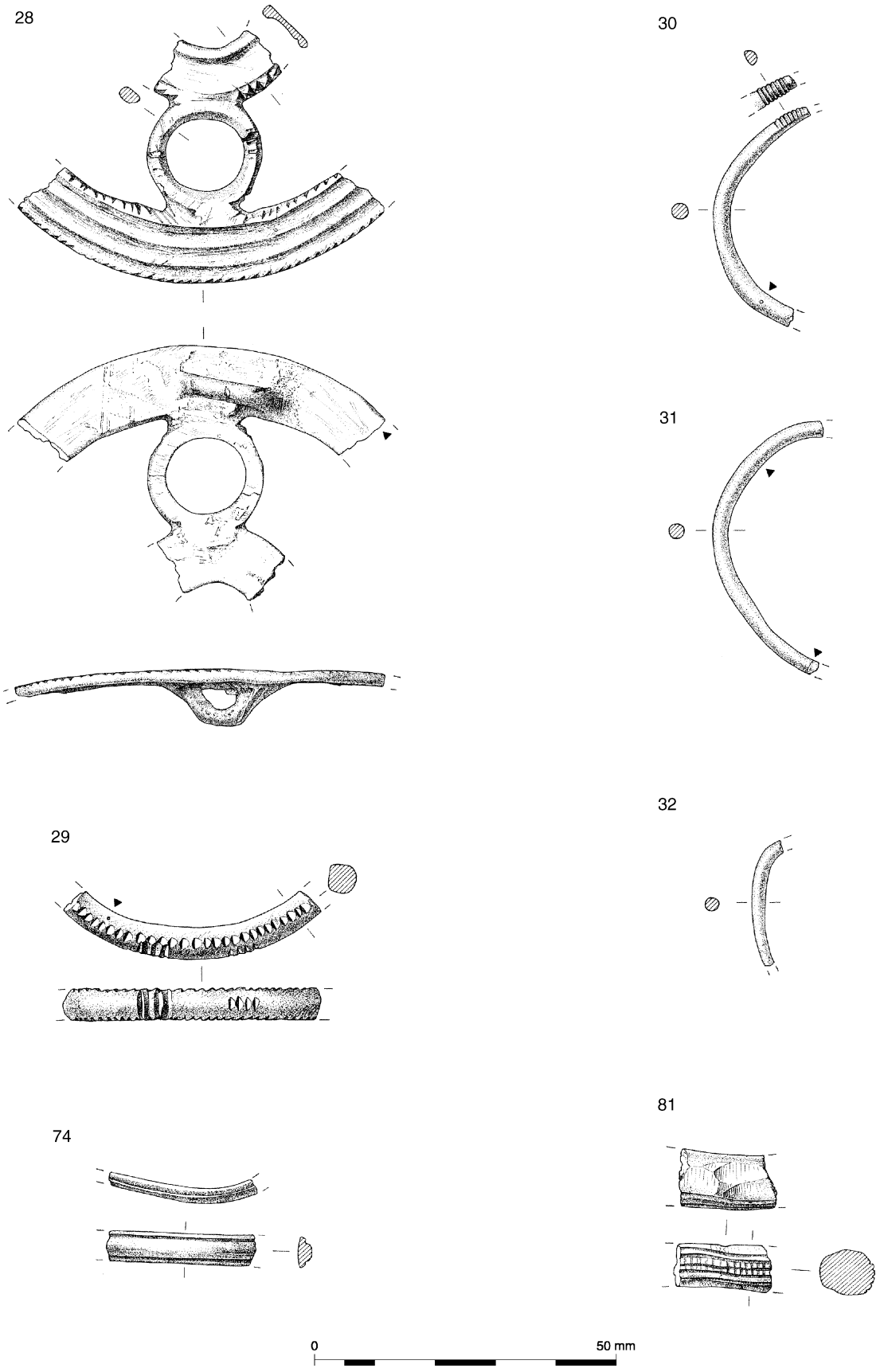


Figure 11.15 Bronze flat ring with loop 28, decorated ring 29, partial rings 30, 31 and 32, bracelet fragments 74 and 81.

damaged condition it is impossible to reconstruct this object. The decoration is not particularly well executed. ML of flat outer ring 62.0 surviving, WT 14 g

29 Fragment of bronze ring, with half moon shaped punch marks on the upper and lower surfaces. Four similar punch marks appear on the edge of the fragment and with another group of four grooved onto the edge. There is little trace of patina. ML 41.6, cross section 5.4×4.76, WT 6 g

30 Fragment of bronze ring with both ends broken, it has a circular cross section. There are six grooves on the upper surface of the ring and are at right angles to the main line of the ring. Only slight traces of dark green patina. The ring thins towards the decoration. Approximate ED 37.0, WT 2 g

31 Fragment of a bronze ring broken at both ends with little patina. Approximate ED 41.5, WT 1 g

32 Fragment of bronze ring, thicker at one end with circular cross section. Approximately 21.0 ML surviving, WT 1 g

74 Small fragment of bracelet of D-shaped section and with bronze colour. There are two grooved lines running along the edges of the bracelet. ML 24.06 surviving, WT 1 g

81 Small fragment, probably of a bracelet, oval cross section. On one face are five incised lines running along the line and there is a centre panel of an incised checkerboard pattern. The other surfaces show extensive hammering. Bronze coloured with slight traces of green patina. ML 16.0 surviving, WT 6 g

Not illustrated

92 Fragment of bronze rod of square section, sub-oval at one end. Dark green patina. Section 3.43×3.50, WT 3 g

94 Fragment of bronze rod, with dark green patina. L 45.6, W 3.45, WT 4 g

3 Waste

Figure 11.13

36 Casting jet showing three inlets into the mould, WT 20 g

39 Bronze scrap, WT 22 g

40 Bronze scrap, WT 9 g

47 Possible casting jet, WT 4 g

71 Fragment of crumpled sheet metal, WT 2 g

Not illustrated (weight in grams in brackets)

41 (6), 42 (9), 43 (2), 75 (16), 76 (15), 77 (1), 80 (8)	Scrap
82 (4), 83 & 84 (2), 85 (2), 96 (2), 97 (4), 98 (4), 99 (3)	Scrap
60 (24), 61 (19), 62 (22), 63 (16), 64 (29) & 79 (11)	Casting jets
73 (2)	Slag
95 (5)	Unidentified

HEAVY METAL ANALYSIS
by John Maskall

Samples of chalk were taken from the top 0.15 m of chalk rock exposed by removal of the ploughsoil, about 0.35 m in depth. The chalk was sampled at ten points using a soil auger of 25 mm diameter. Each sample comprised six sub-samples taken from within a circle of 0.5 m diameter. Sample 1 was taken from the weakly blue-stained chalk (66 on Fig. 8.5), coincident with the group of axes, which rested at the base of the modern ploughsoil. Samples 2–7 were taken from points where other axes were recovered within the ploughsoil, and samples 8–10 were from random points within the spread of axes.

Chalk samples were air dried at 30°C for 72 hours and milled to less than 180 μm. 'Total' concentrations of 25 trace and major elements were determined by digesting the ground rock with a concentrated nitric/perchloric acid mixture and analysing by inductively coupled plasma atomic emission spectrometry (Thompson and Walsh 1983). Data were assessed for accuracy and precision using a quality control system integral to the analytical procedure (Ramsey *et al.* 1987).

With the exception of copper, the concentrations of all the elements determined showed little variation between the ten samples. Copper concentrations in chalk were significantly elevated in sample 1 compared to the background range of 1–5 μg/g (as defined by Newman and Ross 1985). At all other locations sampled copper concentrations fall within this background range. This suggests that the area of weak blue staining 66 was due to the leaching of copper compounds from at least some elements of the hoard. Furthermore, the absence of elevated copper levels in samples 2–7 suggest that the axes found at these sites were moved relatively recently, and possibly originated at the area 66. Results are shown in Table 11.1.

METALLURGICAL ANALYSIS OF THE HOARD
by Peter Northover

Introduction

The metalwork of the end of the conventionally defined late Bronze Age in Britain, the Llyn Fawr period (Burgess 1979) is the least studied technically of any period of the Bronze Age. The number of finds studied is still so small that no overall picture of how bronze was used and worked at that time is known. More particularly, no metalworking debris of that period had been analysed. Previous researches (Northover 1983; Gerloff 1991; Rohl and Needham 1998, esp. 109–10) provide some hints: to some extent at least, there were changes in the use of alloys with lower lead and higher tin contents becoming more common, while surface finish often visibly improved. For the highest status objects, such as cauldrons, there was a great elaboration in their structure, implying a much greater input of labour, while both metal and human resources are diverted to making versions of familiar objects such as axes in forms and alloys that made them impractical for conventional use.

The Tower Hill hoard, with its mix of finished and unfinished axes, ornaments, scrap, and casting

debris in a settlement context, offers an excellent starting point for determining whether our existing sketchy understanding of Llyn Fawr metalwork and metalworking is accurate or not. If not, it is equally a starting point for constructing a more realistic view. However, the quantity of comparative data available is very limited and the sites from which it comes are very different from Tower Hill. It was therefore decided to analyse material from two other Llyn Fawr period hoards from upland sites in southern England – King's Weston Hill, near Bristol (Plowright undated; Grinsell 1988), and the unanalysed part of Figheldean Down, Wiltshire (Coombs 1979b), both sites being closely related to settlements, and both containing axes.

Methods

A total of 86 objects were sampled, two samples ultimately proving too small or too corroded for adequate analysis. Samples were taken either by drilling, with a hand-held modelmaker's electric drill with a 0.9 mm diameter bit, or with a jeweller's piercing saw with a 000 blade; the cut samples were used for optical metallography as well as analysis. A total of 21 samples were cut and 65 drilled; all samples were hot-mounted in a carbon-filled thermosetting resin, ground and polished to a 1 μm diamond finish. All analytical methods and the results, including details of the alloys, impurity patterns and metallography, are given in Appendix 5.

COMPARATIVE DATA

Prior to the discovery of this hoard and its analysis comparative data available from Britain were limited to the Llyn Fawr and Cardiff hoards from south Wales, certain contemporaneous parts of the Salisbury hoard (Northover 1987a; Stead 1998), part of the Figheldean Down hoard (Rohl and Needham 1998), Class 'B' cauldrons (Gerloff 1991), and some non-utilitarian axes of Blandford (high tin) and Armorican (high lead) types. From Ireland there is a review of the compositions of contemporary swords (Ó Faoláin and Northover 1999) plus the compositions of the Irish cauldrons (Gerloff 1991). What was lacking was data from any comparable group of finds and the opportunity was taken to examine two hoards. That from King's Weston Hill near Bristol has a rather similar structure of axes, axe fragments, waste and other fragments, while that from Figheldean Down is of axes only. The analyses from these two hoards, together with those from objects in the Cardiff and Llyn Fawr finds, are presented in Table A5.4. The analyses of the other material cited are less relevant to Tower Hill and are not listed.

To parallel the method used to compare the different components of the Tower Hill metalwork the alloy contents of the four hoards are plotted with Tower Hill in Figure A5.5. The result is a remarkable separation between Tower Hill and the four other groups, and a degree of separation within those groups. With very few exceptions the Tower Hill objects have lower tin contents than the rest, while there is a tendency to higher lead contents except in comparison with Figheldean Down. A similar degree of separation is seen in the impurity patterns. Combining the elements in a principal components analysis these results are confirmed with a demonstration of three basic clusters: Tower Hill; Figheldean Down; King's Weston Hill/Llyn Fawr/Cardiff.

In the preceding Ewart Park period of the late Bronze Age the types of alloy produced were subject to both regional traditions and selection for specific purposes. For example, certain industries, such as those producing south Welsh and Yorkshire socketed axes used much more highly leaded alloys than the others did. Even within those areas, though, other choices were made when required, with harder, higher tin bronzes being used for specialist tools such as faceted socketed axes which could function as chisels. A further differentiation was that between the sheet and cast parts of cauldrons, the sheet being unleaded and the cast parts leaded bronze, a selection having sound technical and practical reasons. Modifying this picture was the large-scale recycling of scrap bronze, both locally collected and imported, either from neighbouring regions or even as far as the Continent. Where a hoard reflects the whole spectrum of local composition patterns it is likely to be locally collected or manufactured from locally recycled bronze, while a hoard that is made largely of a single composition type will reflect one of the external inputs into the metal circulation of that area. The hoards under discussion here allow us to test whether the same picture of metal circulation applies in the Llyn Fawr period.

One strand of metalworking in the Llyn Fawr period that can be discounted in relation to Tower Hill, but is relevant to at least Figheldean Down, is the production of non-utilitarian axes. The heavily leaded axe forms that occur in Armorica in such large numbers have rather few occurrences in Britain; they are occasionally reused for other purposes (Northover 1988) but do not contribute significantly to the metal supply in southern Britain. The southern British equivalent, the Blandford type linear faceted axe is smaller and cast in a white bronze, often with 20% tin (Northover 1987a). With alloy contents up to 19% tin and almost 30% lead it would appear that both these types have contributed to the manufacture of all but one of the axes at Figheldean Down, with the Blandford component making the more significant contribution. The exception is one very low alloy example comparable with Tower Hill. In contrast such scrap can only have made a small contribution to the other finds, the high tin contents measured at Llyn Fawr being influenced by corrosion.

Excepting those few high tin values, and bearing in mind that Llyn Fawr and Cardiff objects were

analysed with older generations of both instrument and software, it can be seen that there is very considerable similarity between those finds and King's Weston Hill. This is primarily in the choice of alloys since there are sufficient differences in impurity pattern to say that the copper used in the bronzes at the latter site has a different origin. With only three assemblages the similarity might be put down to coincidence but, equally, there may have been some degree of uniformity of metal use in a province round the Bristol Channel.

Within the mainstream of metalworking in the Llyn Fawr period as a whole the idea of regional traditions in metallurgy (as opposed to artefact design) is beginning to be recognised. A very clear differentiation has been observed in Irish swords of this period where (probably) imported Gündlingen swords have approximately twice the tin content and half the lead of contemporary locally made weapons, derived from late Ewart park swords (Ó Faoláin and Northover 1999). When the alloys from Tower Hill are compared with those of this 'Bristol Channel' group very much the same split is observed, and it is worth reminding ourselves that the Tower Hill group itself contains some important splits between object types and different generations of castings. This in turn implies that the hoards are snapshots of particular instants in chronological as well as regional variations in alloy choice and production. Much more work, though, needs to be done on this neglected period to determine whether this preliminary portrait is representative of the whole.

METALWORKING AND METAL USE AT TOWER HILL

The Tower Hill finds contain evidence associated with the process of metalworking in the form of unfinished objects, scrap, sprue, and waste such as residues from crucibles. There are however no moulds or no crucibles although there was some possible fuel ash slag (C Salter, pers. comm.). The metalwork itself must be examined to determine whether metalworking was an activity carried on at the settlement at Tower Hill, however briefly.

The best evidence may well be the casting waste, that is the drips, runlets, crucible residues and, especially the oxidised bronze (Ox 253). In earlier periods of the late Bronze Age this type of material is almost never included in hoards. The major exception is the Isleham, Cambridgeshire, hoard of the Wilburton period of, perhaps, the 11th century BC (Northover 1982), which is a large collection intimately associated with a workshop, literally down to the floor-sweepings. In later periods sprue does appear in hoards such as the casts of runner bushes found in hoards of south Welsh socketed axes (Savory 1980) but other forms of waste generally do not. In the Llyn Fawr period finds with the scrap and waste content of Tower Hill are very scarce, the nearest parallel probably being King's Weston Hill (Plowright nd). This hoard, discovered outside the rampart of a hillfort in a context where metalworking might have occurred, consists mainly of fragmentary objects (22 out of 28) with only two complete axes, but with three pieces of sprue and only one of waste. Thus it seems the collection of waste at Tower Hill is unusual for the period and certainly would not all have been collected up for reuse, and some would not even have been noticed. This applies in particular to the oxidised bronze, a waste product probably left in the hearth or removed with the ash, and certainly not recovered.

If the waste is accepted as evidence of metalworking actually at Tower Hill then the discrepancy has to be explained between the composition of the waste and what might be presumed to be the product of the casting process, the unfinished and part finished axes and the sprue which is connected with them. One prime difference is the lead content, with the waste having the lowest levels. One plausible model, then, is that the waste represents one component of a typical crucible charge to which was added lead or leaded bronze. A mixture of two sorts of bronze might be supported by the differences in both alloy content and impurity pattern between the waste and the axe fragments. If this notion is accepted then the nature of the axe fragments must be considered, pointing out that cutting edges are not present among the unused fragments (see also Coombs this report). A further component may be ingot copper, residual from the end of the Ewart Park period which would tend to depress tin and lead contents as well as the nickel and antimony concentrations.

Two useful further indications about the nature of possible alloying additions of lead are now available. A piece of fused bronze trapped in a small mass of mixed copper alloy and ironworking debris from a hilltop site near Sturminster Newton, Dorset, has recently been studied in a post-excavation project (Northover in prep). The date range of the site established by associated ceramics spans the Llyn Fawr period and the beginnings of the early Iron Age. The metal proved to be a low tin, low lead alloy, while analysis of the associated slaggy material discounted the loss of tin and lead by oxidation. Thus, low tin alloys could be a component of metalworking over a wider area than Tower Hill, alloys that would require the addition of lead to match the Tower Hill compositions. The only Llyn Fawr assemblage to have undergone lead isotope analysis is that portion of the Figheldean Down hoard held by the British Museum (Rohl and Needham 1998, nos 400–410). The data were very tightly grouped indeed, suggesting a single source of lead. A significant contribution of recycled lead in the alloys would be expected to give a wider spread so it is reasonable to suppose that lead metal was an input into the crucible charges from which these axes were cast.

The original source of the metal is unclear. The discussion of the impurity patterns has hinted at a continental origin for at least some, but so little

continental metal of this period has been analysed that it is difficult to be certain. There are some similarities with metal used in northern France (Blanchet 1984) but not with metal further afield, for example Period VI bronze in Denmark. As in the Ewart Park period the further away from the Atlantic coast of Europe the lower lead contents tend to be and, to some extent, the higher the levels of impurities. In future analyses parallels in the coastal regions of the Continent from the Low Countries to the Pyrenees should be sought.

From this strong indication that bronze casting was being carried out at Tower Hill the output must be considered. Socketed axes of Sompting type were undoubtedly being made despite the absence of mould evidence, and two factors support this conclusion. The first is the presence of so many unfinished, or part finished, axes. The evidence for rapid cooling rates identified metallographically in the form of narrow dendrite arm-spacings, points to the use of bronze moulds, as in the Roseberry Topping hoard. Careful mould preparation would minimise flash but there would inevitably be some sprue, most of which was probably promptly recycled. That which remains matches some of the axes in composition very well. Of course, the possibility cannot be ruled out that Tower Hill was only one of several locations served by the founder and that some of the axes might have been cast elsewhere. Equally the axes with worked cutting edges could have been worked on elsewhere. The extent of cold hammering and annealing round the blade, together with the finished structure, make it most probable that the axes were designed for use despite the low tin contents of some.

Beside the metal itself the resources required to produce a series of axes would have been the mould, a refractory for the core, sprue cup, crucible, clay for a hearth lining, fuel, and tools for removing the sprue and flash and working the cutting edge, and abrasives for grinding and polishing. While all this material survives for the Ewart Park period in Britain there is almost nothing from the Llyn Fawr period. It is only known in northern France with sites such as Choisy-au-Bac at the confluence of the Aisne and the Oise (Blanchet 1984), where the metalworking evidence suggested a fairly simple workshop, but one that could produce pieces of quality.