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Korta meddelanden

A silver-coated copper axe from Late Neolithic Scania: initial analyses

Late Neolithic metal axes are rarely found during archaeological excavations. In the autumn of 2015, however, it did happen. Metal detecting at Eskilstorp in south-west Scania (fig. 1) revealed a Late Neolithic axe of the Pile type (figs 2–3). The Eskilstorp axe turned out to be unique. It is a silver-coated copper axe. In this note we present the results of the initial analyses performed on the axe.

Location and find circumstances

The archaeological investigation concerned the eastern outskirts of the Medieval village of Eskilstorp, of which nothing is today visible above ground (Brink & Ohlsson 2016). Observations made in the field by co-author KB suggest that the axe was found in ploughed topsoil at the edge of a small drained bog. No sunken features or finds from the Late Neolithic were found together with the axe. The area around the excavation site is however rich in remains from several prehistoric and historic periods. A cluster of Stone Age and Bronze Age grave monuments is located on a

north-south ridge c. 500 m east of the excavation site. Excavations in 1992 revealed the postholes of two Late Neolithic houses about a kilometre south of the Eskilstorp axe's find spot (Brink & Ohlsson 2016).

The Eskilstorp axe

The axe (Brink & Ohlsson 2016, p. 43, fig. 26, LUHM 32527:1) is a well-preserved specimen of the Pile type (Larsson 1986, p. 45 ff, fig. 22a; Karsten 1994, p. 89), named after the Pile hoard found in Tygelsjö parish c. 5 km north-west of Eskilstorp (Oldeberg 1974, p. 125, #832).

In her comprehensive analysis of Late Neolithic metalwork, Helle Vandkilde has dated axes of the Pile type to the Late Neolithic II, c. 1950–1700 cal BC (1996, pp. 140, 147 ff). The Eskilstorp axe belongs to Vandkilde's class A, "primitive low-flanged axes", and subgroup type A3, "parallel-sided-curved flanged axe of Gallelose type". Vandkilde suggests that these axes were made locally or regionally in south Scandinavia. According to her, no type A3 axes are decorated (1996, pp. 66 ff, 74 ff). No decoration is indeed visible to the naked eye on the Eskilstorp axe (but see below). Consequently, we interpret the Eskilstorp axe as having been manufactured in south-west Scandinavia within the same craft tradition as the axes in the Pile hoard.

The axe is complete and symmetrical: length 115 mm, edge width 48 mm, butt width 20 mm, thickness excluding flanges 11 mm, thickness including flanges 14 mm. The butt is rounded. The edge is convex and damaged. It looks as if the axe was struck against something hard which pressed the edge inwards (fig. 4). A small piece, a few millimetres in size, seems to have been lost from the edge on this occasion. This has been interpreted as possible combat damage (Horn 2016).

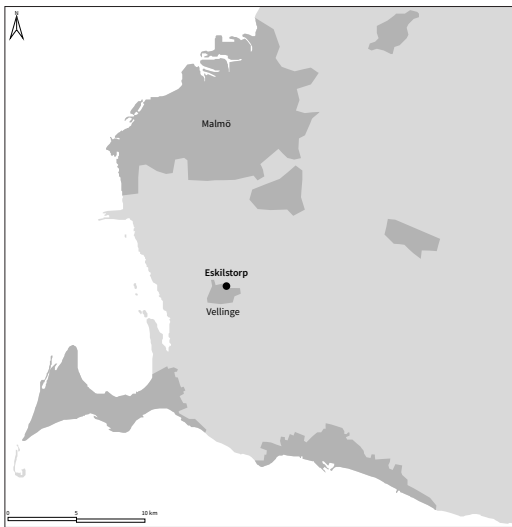


Fig. 1. The find location near Vellinge in Scania.

Fig. 2. The Eskilstorp axe, drawn from three sides. Note the differences between the two broad sides. On the one to the right the unusual surface discussed in the text is prominent, whereas it is absent on the broad side to the left. LUHM 32527:1. Drawing Erika Rosengren.

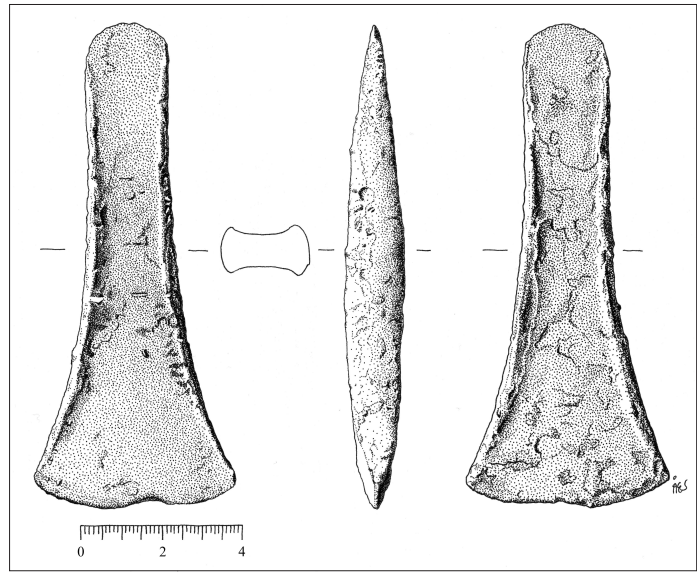


Fig. 3. Photographs of the axe's broad sides. On the right, note the unusual surface discussed in the text. Photo AH.



Fig. 4. Close-up of the axe's edge with damage interpreted as a result of combat. Photo Ingmar Franz.



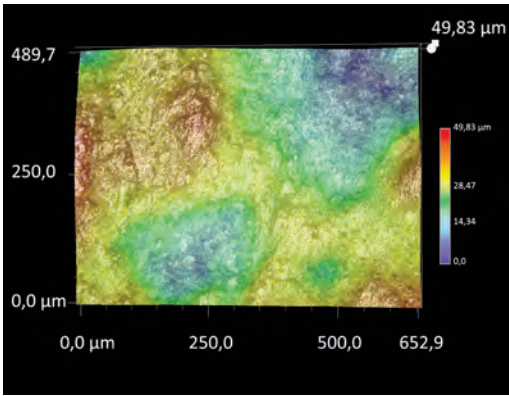


Fig. 5. Height model of the broad side with the unusual surface. Parts where the surface has flaked away are all on a similar level. This suggests the formation of an even corrosion layer underneath the original surface. Photo from Keyence VHX-5000 by CH.



Fig. 6. Decoration visible as brighter reflections, indicated by the white arrows top right. The axe's edge faces upwards in this image. Photo from Keyence VHX-5000 by CH.

Contrasting sides

One broad side has the distinct greenish tint of oxidised copper or copper alloy. However, the other broad side, one narrow side and to a lesser extent the other narrow side share an area whose colour and texture contrast from the rest of the axe. Where it is preserved, this surface is polished and smooth. It consists of two layers.

This area might be a result of oxidation, that is to say, a secondary chemical alteration that arose during 4000 years in the ground. During a detailed visual low-magnification examination co-author AH had the idea that this surface might be the remains of a treatment given to the axe after it was cast. This might be a metal coating or some form of chemical and mechanical treatment that altered the surface structure of the axe. Based on these observations, two questions were formulated. 1) Was this surface part of the axe from the time it was made or is it a result of post-depositional processes? 2) If this surface is an original part of the axe, what does it consist of?

To investigate this, the axe has been analysed microscopically by co-author CH and with the aid of metallographic analyses and chemical analyses with electron microprobe by co-author LG. We are not aware of any other Late Neolithic metalwork with a similar surface, and so we have not been able to make any comparative analyses.

Microscopy

A Keyence VHX-5000 digital microscope, allowing for magnification up to 5000x, and a Lumos XLoupe G20 microscopic camera capable of magnifications up to 300x were used to investigate the entire surface of the axe. At high magnification the contrasting surfaces on the axe give the impression of being the original surface and the original patination layer of the axe. The places where they are preserved are in direct contact with the axe. On the parts of the axe where these contrasting surfaces are not found, it appears that it has been lifted by the build-up of another, underlying corrosion layer that subsequently led to the loss of some areas that flaked off due to internal tension in the microstructure. This is supported by the lower but even height of areas where the original patina is missing (fig. 5). Overall, the surface of the unusual broad side is erratic in colour and structure. The other broad side's surface structure is rough, but overall more regular (Horn 2016).

Near the right-hand flange in the frontal third of the side with the unusual surface, differences in coloration, corrosion, and reflection indicate five ribs (fig. 6). Inspection with the XLoupe camera and the 300x lens revealed an almost imperceptible height difference between the ribs and the intermediate channels they define (fig. 7). The



Fig. 7. Flat depressions between ribs, at the white arrows left. Photo from XLoupe 60x magnification by CH.

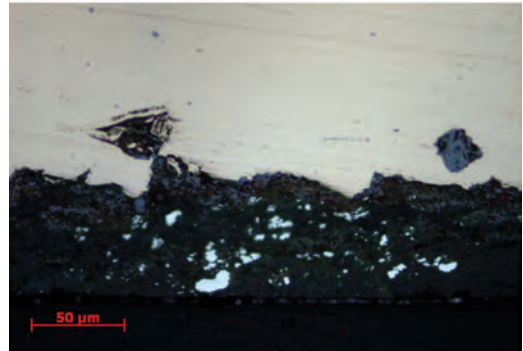


Fig. 8. Microscope survey of the cross-section of a sample taken from the butt of the axe, showing a mostly homogeneous metal (pinkish beige). The outer edge of the metal is irregular and covered by an oxidized layer (darker). The bright patches in this layer, most prominent in high magnification, are silver. The enlargement below covers the area above the scale bar in the upper picture. Photo from Zeiss Axioskop 40A polarization microscope by LG.

depth of these channels cannot have been greater than the original surface layer. Otherwise, the ribs and channels would have been discernible in the copper, i.e. on the lefthand side where the original patina has flaked away. We interpret these ribs and channels as part of the original surface ornamentation of the axe. Such decoration is found on some of the axes in the Pile hoard. No other decorative features could be observed.

Metallography and chemical analyses

We performed metallographic and chemical analyses for two purposes: to characterise the metal in the axe and to find out the surface cover's composition. Therefore we sampled two different areas with two different methods. One sample, to characterise the cast metal, was cut from the butt. The cut was done to attain a cross section of the whole thickness of the axe, yet to minimize destruction. For the other sample, small flakes of

the surface layer were carefully removed from areas where they were already partly in the process of flaking off. Both samples were mounted, individually, in epoxy resin, and then ground and polished.

The metallographic analysis was done in a Zeiss Axioskop 40A polarization microscope (up to 500x magnification) equipped with an integrated camera connected to a computer for digital documentation. The same samples were later used for elemental analysis with a field electron microprobe (EPMA) using the JEOL JXA-8530 F at the Centre for Experimental Mineralogy, Petrology and Geochemistry at Uppsala University. Mainly WDS (wave length dispersive) analyses were done, applying an analytical routine specially designed for copper-based alloys, comprising major, minor and trace elements. A few complementary measurements were also made with EDS (energy dispersive) methods. EDS cannot

detect or distinguish low concentrations of some of the important minor or trace elements, but has the benefit of measuring lighter elements, such as oxygen, that are not measured by WDS.

These metallographic and chemical analyses showed that the surface flakes consists of secondary formed copper minerals (oxides etc., not analysed in detail). However, within this oxidized layer, small patches (c. 10 micrometres in size) of another metal can be detected, in microscope as well as with microprobe (fig. 8). A combination of WDS and EDS analyses demonstrates that this metal is mainly silver.

This is unexpected since silver is not previously known to have been used in Late Neolithic Scandinavia (Kristiansen & Larsson 2005). However, whether it is originally from the making of the axe, or derives from secondary processes from millennia in the ground, cannot be determined by a sample of non-oriented flakes. The second sample though, initially selected to characterise the cast copper itself, proved more informative than expected. During sampling, this part of the axe butt appeared to be homogeneous, i.e. lacking any surface coating. But, already at low magnification in the polarization microscope, a contrasting rim was seen in cross-section.

We will return to this rim, but first we must comment briefly on the cast copper itself. The metallographic analysis reveals a homogeneous reddish metal, further demonstrated by chemical analyses to be copper. This is in accordance with the majority of coeval axes, although bronze is also known from Late Neolithic artefacts (Vandkilde 1996). Although not a bronze, the copper is not pure but contains several impurities (up to c. 1% each): silver, antimony, arsenic and minor nickel, a combination typical of Fahlore copper ores. Such ores were commonly used during the Late Neolithic and Per. I of the Early Bronze Age, as reflected in other Scandinavian artefacts (Vandkilde 1998; Liversage 2000; Ling et al 2014; Melheim 2015).

But back to the silver. The sample from the butt showed a faint, non-continuous rim of this metal. The core of copper in any axe generally becomes covered by various oxidation products, as copper begins to oxidise as soon as it is cast. This is also true for the Eskilstorp axe. At the rim,

there is a continuous zone of oxidation from the copper core and outwards, and within this zone the silver is present as irregular patches. These seems to be part of the artefact, although oxidation in general may have a tendency to incorporate material in its vicinity while forming. Since there is a very low concentration of silver in the copper metal itself, one might argue that the silver layer is due to surface enrichment (primary or secondary) of the copper metal. However, due to the large discrepancy in concentration, this is not very probable.

We suggest that the silver covering layer is a primary part of the copper axe. Further analyses is however needed to understand how the silver was applied to the axe, and to estimate its original thickness. These may include detailed analyses across the contact with the cast copper, also including other elements to see whether chemical and/or mechanical evidence can be found.

Summary conclusions

Our interpretation is that the Eskilstorp axe is a silver-coated copper axe manufactured locally during the Late Neolithic II. This makes it unique. No similar south Scandinavian Late Neolithic artefact is known. The traces of decoration in the thin silver layer makes the classification as a “parallel-sided-curved flanged axe of Galle-mose type” slightly incorrect, as according to Vandkilde (1996, pp. 66 ff, 74 ff) these axes are never decorated. But, since the decoration on the Eskilstorp axe is on the silver layer and not in the copper, and only visible in a microscope, we do not see the classification of the axe as type A3 Galle-mose as a problem.

Discussion

Kristian Kristiansen and Thomas B. Larsson (2005) assert that the time just before 2000 BC saw an opening of systematic trade between the Eastern Mediterranean and Central Europe, and soon after that it also included the shores of the English Channel. From around 1900 BC south Scandinavia also became a part of this trade network (Kristiansen & Larsson 2005, p. 120).

Centres for metal production and distribution in the Black Sea area, the Eastern Mediterranean, Eastern Europe, Central Germany and

Britain and Ireland functioned as nodes of contact routes and exchange across great distances. These early metal centres appear to have been in contact with each other through the exchange of metals, objects and knowledge (Kristiansen & Larsson 2005).

Areas where silver was produced and used at the time of the southern Scandinavia Late Neolithic II are South-Eastern and Central Europe (Gimbutas 1965), the Mediterranean area (Heyd 2013; Hansen 2014; Helwing 2014) and parts of the Iberian peninsula (Contreras-Cortés et al. 2014). Which of these areas the silver for the Eskilstorp axe came from, and how the contact routes and forms of exchange were organised so that the silver could reach Scania, are questions for future research and further analyses.

There is one previous record of a silver find in Scandinavia from this period. The documentation from the discovery of the Pile hoard in 1864 mentions that the hoard included five pieces of thin silver wire. Unfortunately, these pieces have disappeared from the collections. Nor are they mentioned in later descriptions of the find (Oldeberg 1974). Vandkilde (2005, p. 276) highlights the silver wire from the Pile hoard as an outstanding object for its time: “In Scandinavia such unique objects continued their life as inalienable objects of very personal character . . . with . . . preserved memory of their previous life history and function.”

The Eskilstorp Axe takes this materiality one step further. The outstanding feature – the unusual metal – has been materialised in the form of a thin silver layer on a copper axe. The exotic and alien has been made comprehensible through local craft. The history and function of different metals were blended with the smith’s craft skill. The result was a unique social manifestation.

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