Mervi Suhonen

A LEAD-BRONZE INGOT FROM MULLI AT IHALA IN RAISIO

Abstract

In 1997 a lead-bronze ingot was found in excavations of the dwelling site of Mulli at Ihala in Raisio in Southwest Finland. The ingot was found in an undisturbed context under wooden remains interpreted as the corner of a building. Three corresponding finds are known from the Baltic area: two from Latvia and one from Gotland. The possible use of the ingots is linked to metalworking. At the Mulli site, however, no clear evidence of metalworking has been discovered.

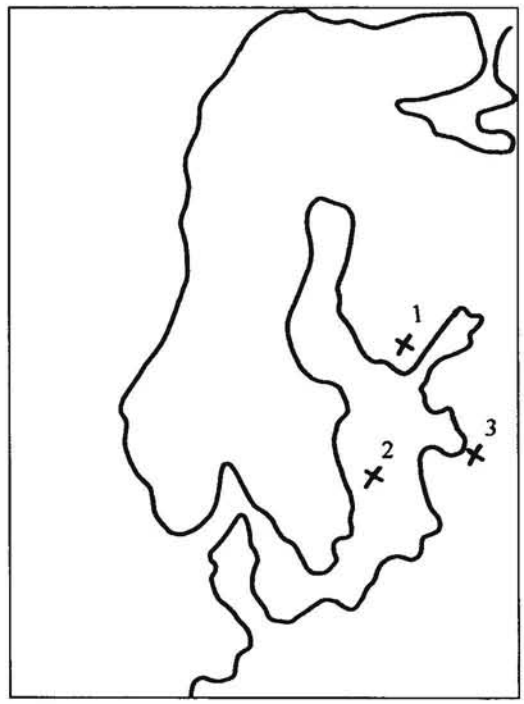
Keywords: Finland, Iron Age, Middle Ages, ingots, bronze, metalworking.

Mervi Suhonen, Department of Archaeology, FIN-20014 University of Turku, Finland.

The dwelling site of Mulli at Ihala in Raisio, dating back to the Late Iron Age / early Middle Ages is located in Southwest Finland about five kilometres from the centre of Turku (Fig. 1). In September 1996 a lead-bronze ingot was found at the site (TYA 642:949; Pietikäinen 1997b, App. 4). So far no counterparts to the Mulli ingot are known in Finland.

The ingot is cup-shaped. Seen from above it is a flattened oval object resembling the letter D in shape (Fig. 2). It measures 54 cm x 35.5 cm and its weight is 16 kg 250 g. Its maximum height as measured from a horizontal base is 7 cm. It has a "bottom" which is less than 1 cm thick of metal ("metal plate") curving outwards into a convex shape. On the concave side there is a 2.5 to 5-cm wide inwardly curving thickened edge of solid metal. The underside of this edge is flat and parallel with the bottom of the "bowl" (Fig. 3). On the grounds of the shape of the edge it seems possible that the object was cast in two stages: the upper part of the edge separately from rest of the ingot.

Fig. 1. Location of the Mulli dwelling site at Ihala in Raisio and sites where the counterparts to the Mulli ingot have been found. 1. Mulli, 2. Kvarna, 3. Rauši.



RESULTS OF METAL ALLOY ANALYSIS

For metal alloy analysis a test core was drilled through the layer of corrosion and a 1 x 2 mm piece was broken off the metal surface. Samples were examined by

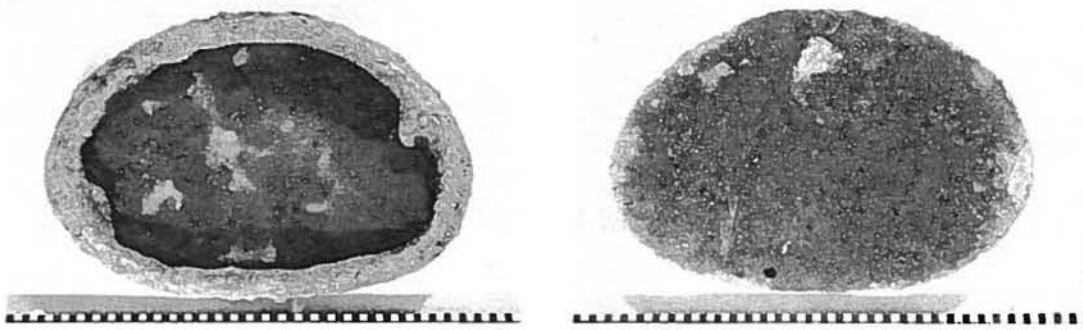


Fig.2. The Mulli ingot seen from (a) the concave and (b) the convex side. Photos Leena Tomanterä.

Seppo Hornytzkyj of the Mikrofokus company. For the excamination a energy-dispersive ex-ray microanalyser attached to a scanning electron microscope (SEM-EDS) was used. The results are semi-quantitative but satisfactorily accurate when compared with standards. The metal alloy consists of 86% copper, 14% lead and a small amount (0.36%) of antimony (Fig. 4).

As the lead in a copper alloy slowly cools, it forms granules of unequal size. In the analysis method used here the metal surface yields the results. Since lead appears in the alloy as granules the results of the analyses clearly depend on the SEM picture area chosen for examination. It is thus not surprising if parallel analy-

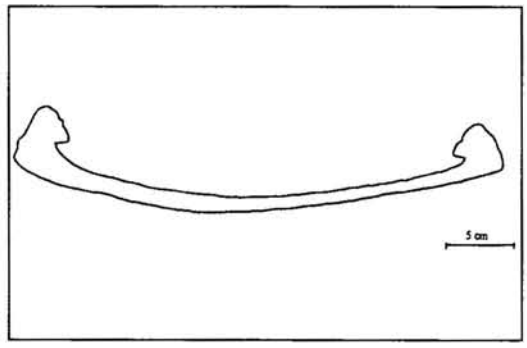
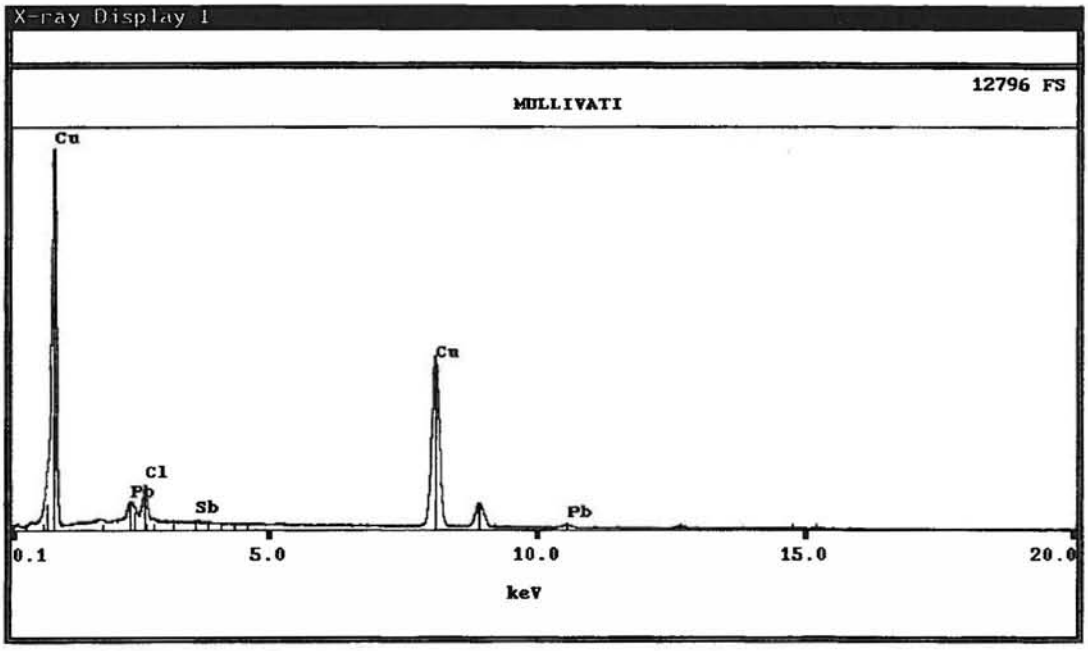


Fig.3. Cross section of the Mulli ingot. Drawing Silja Salminen.

Fig.4. Results of the SEM-EDS analysis of the metal alloy. Middlemost of three samples. Mikrofokus Oy.



ses contain differences of several percentage points in terms of lead content. Since lead does not, to our knowledge, occur with copper in nature, it would have been intentionally added to the alloy.[1]

During the laborative investigation of the Mulli ingot the thick layer of corrosion covering the ingot was left in place. The X-ray (Fig. 5) shows that the object is not surface-treated and thus it is freely solidified crude bronze stock. Soil has fastened to both the solidified metal surface and the corroded surface and it contains remains of both decomposed and charred plant parts.

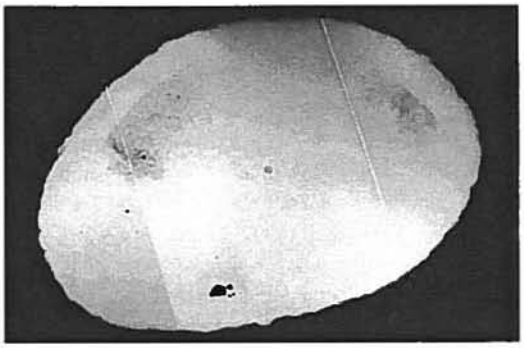


Fig.5. X-ray of the Mulli ingot. Photo Leena Tomanterä.

THE CONTEXT OF THE FIND

The Mulli dwelling site is located at the mouth of the Raisionjoki River, about 3 km from the present coastline. The dwelling site is radiocarbon-dated to cal A.D. 980 – 1220 (Su-2708 – Su-2716; Su-2861 – Su-2870; Stuiver & Pearson 1993). During the 1980s the site was located at the bottom part of an uncultivated field. Unbroken structures had been preserved under the ploughed surface over an area of some 400 m^2. Mulli served as a research excavation site for the Department of Archaeology of the University of Turku in 1994 – 1997 (Pietikäinen 1995, 1997a, 1997b). Examinations of the site are still in progress. A research project was launched in assosiation with the Medial Laboratory of the University of Art and Design Helsinki and several MA thesis and two doctoral theses based on material from the excavations at the site are under preparation.

The lead-bronze ingot was found in an undisturbed context in the bottom part of the cultural layer (Pietikäinen 1997b: 56 and map 68). The soil material around the ingot contained large amounts of decomposed wood waste. Macro fossils in the soil under the ingot were extremely well preserved because of the dissolution of copper salts from the ingot into the soil. A bird's egg was also found in the soil material. The macrofossil material at Mulli is generally diverse and well preserved.[2]

The ingot lay in a gully which crossed the preserved part of the dwelling site in a north-south -direction and measured about half a metre in width and depth. In and above the gully were wooden structures as well as burnt clay and fine sand. The gully is thought to have been a ditch between the buildings.[3] The southwest corner of the clay floor of one of the buildings was evidently situated about one metre northeast of the location of the ingot. The blockwork structure of the corner lay some 20 cm higher than the ingot, indicating that the ingot had been intentionally concealed here (Pietikäinen 1997b: 56-58, 69-71). The wooden framework of the corner is stratigraphically above the find context of the ingot and has a radiocarbon dating of cal A.D. 1040 – 1170 (Su-2864; Stuiver & Pearson 1993).

CORRESPONDING FINDS

Three known finds in the Baltic area correspond to the Mulli lead-bronze ingot (Svarāne 1996: 104- 106). Two have been found in Latvia in the village of Rauši at the mouth of the Daugava river. The Rauši ingots are of the same shape as the Mulli ingot. One of them is also the same size (51.2 cm x 31.2 cm; maximum height 7.3 cm, weight 18 kg) and the other is slightly smaller and much lighter (46.2 cm x 31.3 cm, maximum height 2.4 cm, weight 7 kg) (Urtāns 1977: 206; Svarāne 1996: 105). Compared to the Mulli ingot, both Latvian finds are of purer copper (Cu content 96.7 % and 92.5 %), and the alloy is mainly lead (Pb 2.4 % and 7.4 %). The larger of the Rauši ingots also contains some iron (Fe 0.9 %). The method of analysis was the same as for the Mulli ingot (Svarāne 1996: 106).

The only previously known counterpart to the Rauši ingots was found in Gotland (Kvarna, Eskelhem Sn) (Šnore 1991: 82; Svarāne 1996: 105). The diameter of the Gotland ingot is 42.5 cm and the height 3.4 cm. Its shape is similar to the Rauši and Mulli specimens (Oldeberg 1942: 51 Fig. 46, 52). Its material is not completely pure lead bronze; in addition to copper and lead the alloy contains tin (Cu 90.0 % – 92.3 %, Pb 6.3 – 7.1 %, Sn 0.5 – 1.9 %). The SEM-EDS method was also used for the analysis of this ingot, and other elements found

in the analysis were antimony (0.4%), silver, zinc, gold and iron (Forshell 1992: 88; Svarāne 1996: 106).

A copper ingot found in Västmanland (Norrbo, Haraker Sn) in Sweden is also flattened and oval in shape (measurements 39 cm x 20 cm x 3.6 cm) (Oldeberg 1966: 48, Fig. 33). In addition to copper, however, it contains 1.5 – 1.7 % tin and only 1.2 – 2.4 % lead. According to Forshell (1992: 76, 82, 154, 158), it is a crude copper ingot, whose raw material may have originated from the Falun copper mine. Bronze has been cast into large ingots in Central Europe as early as the Bronze Age (see e.g. Tylecote 1986: 22-23).

Svarāne (1996: 105-106) has suggested that the shape of the Rauši ingots is a result of the copper alloy being able to solidify freely on the bottom of the smelting furnace (see also Tylecote 1986). However, the inside of the thickened edge of the ingot found at Mulli has 2-5 mm wide "eaves", and the suggestion that the molten metal alloy would have run into the bottom part of the furnace does not seem sufficient as an explanation for the detailed shape of the ingot. The bottom of the Rauši ingots is straighter than that of the Mulli ingot, and the cross section of the Gotland ingot as seen from the side is similar to the Rauši ingots (Svarāne 1996: 105).

The convex outer surface of both of the Rauši ingots has a notch resembling the letter K or the Roman numeral V, which Svarāne suggests might be the mark of the maker of the ingot. The Västmanland copper ingot also has notches on its convex surface (Forshell 1992: 81). Svarāne also mentions a notch with the shape of the Roman numeral V on the convex surface of the Gotland bronze ingot but in the photo it is hard to notice any notches at all (see Forshell 1992: 89). The convex surface of the Mulli ingot is covered by a strong layer of corrosion and any notches or other marks cannot be seen.

The village-type center of Rauši is located at the mouth of the river Daugava, on the island of Dole. Rauši has been investigated by excavations in 1968 – 1974. The Rauši village is thought to have been a significant metalworking centre between the 10th and 12th centuries. Iron and bronze artifacts have been manufactured there, the bronze articles suggesting the work of Livonian jewellers. Approximately one third of the finds have been found at hearths. Both of the Rauši lead-bronze ingots were found at the same hearth (Šnore 1991). The ingot find is one of the three major metal deposits in Rauši (Urtāns 1977: 194-196, 206). There appears to be a clear connection between the Rauši metal artifacts and the finds in Southwest Finland: for instance a round concave-convex brooch of Finnish type was found there (Šnore 1991: 80, 84-85; on p. 86 the Maaria Saramäki cemetery, Turku, Finland is mentioned).

The total weight of the other bronze artefacts – the lead-bronze ingot excluded – found at Mulli amounts to only less than 700 grammes (TYA 619, TYA 631, TYA 642: bronze artefacts and fragments of such; see also Pietikäinen 1997a, App. 3). To our knowledge, nothing has been found at Mulli which would provide clear evidence of metalworking. Together with the ingot was some unburnt bone and burnt clay, both of which are common finds at the site.

The exact find context of the Gotland Eskelhem ingot is not known. Oldeberg (1942: 52) dates the ingot to the Middle Ages or later, basing his opinion on the large amount of copper. According to Serning (1987: 51) it is possible that the find dates from prehistoric times (see Svarāne 1996: 105).

Published finds of bronze raw material dating from prehistoric times and close to Raisio are the Köyliö bronze bar cache (Salmo 1953) and the bronze bars found recently at Kyrksundet in Hiittinen (Edgren 1995). The Köyliö find contains bronze totalling 4 kg 770 g and it is dated to the 10th century. Bronze bars from the same time period with a similar segment shape cross section as the Köyliö bronze bars have been found in both Latvia and Gotland (Svarāne 1996: 107; Edgren 1995: 56 refers to the same corresponding find in Gotland). The shape of the bronze bar depends on the method of production as well as on how they would be used. The Köyliö bronze bars are not lead-bronze; they are zinc-bronze, but they do not contain any tin. A corresponding composition has been found in the chemical analyses of some ingots of Latvian bronze bars (Salmo 1953: 11-12; Svarāne 1986: 108). The massive lead-bronze ingots of Rauši, Eskelhem and Mulli may have been intended for a different use than that of the regular shaped zinc-bronze bars.

ON THE POSSIBLE USE OF THE INGOTS AND ORIGIN OF THE RAW MATERIAL

The lead content of the Mulli lead-bronze ingot is rather high. The addition of lead improves the workability of copper. In Iron Age bronze, depending on the time and area, the alloy usually contained, in addition to tin (or instead of it), zinc and nearly always lead. The alloy containing generous amounts of lead in the copper appears as bronze in jewellery in the late Iron Age in Finland[4] and for instance in Gotland (see Forshell 1992:

25, 59-60, 62-63). Lead may also have been added to copper alloys used for bell casting, but there is not sufficient evidence to link bell casting and the Rauši ingots (Svarāne 1996: 106; Svarāne refers to Forshell (1992: 23) but see also Forshell 1992: 110-111, Tylecote 1986: 39-40 and Drescher 1984: 41-42).

There is no certainty as to a common origin of the Rauši and Gotland lead-bronze ingots (Šnore1991: 86). Svarāne (1996: 107) thinks it probable that the raw material of all three ingots is from the same area. Investigating the origins of the raw material, however, contains many elements of uncertainty and the lack of adequate reference material is a restricting factor. According to Forshell (1992: 98, 158), the lead isotope analysis of the Gotland ingot shows a similarity with central European reference material. A lead isotope analysis of the Mulli ingot has not been carried out.

If the Mulli lead-bronze ingot is thought to have been raw material for making ornaments and jewellery, the material would have been enough for more than one hundred brooches. However, it has not been proved for sure that the ingot has been intended to serve for raw material of any kind and its connection to jewellers' work is uncertain. It is quite possible that the Mulli ingot is the intermediate product of a metallurgical process and that is was taken to Raisio as a treasure.

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NOTES

1 As Jüri Peets (Ajaloo Instituut, Tallinn) has pointed out, the metal alloy of the Mulli ingot differs from all natural copper ores. According to Forshell (1992: 11, 75-76), no alloy with lead and / or tin percentage higher than 2% can be classified as raw copper.

2 The macrofossil samples from Mulli site are analysed by docent Terttu Lempiäinen (Turku University, Laboratory of Biodiversity).

3 A preliminary interpretation of the constructions of Mulli dwelling site has been made by Juha-Matti Vuorinen, *MA* (see Vuorinen 1997).

4 Seppo Hornytzkyj and Leena Tomanterä: unpublished analyses of Finnish brooches.

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