In the workshop of the Viking age goldsmith: gold- and silverwork at Borgeby in Scania, southern Sweden
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Gold- and silverwork at Borgeby in Scania, southern Sweden

By Torbjörn Brorsson


During the 1970's it was suggested that Borgeby was the location of a royal Viking Age fortress (trelleborg). There is no archaeological evidence thereof, except a possible mintage from early 11th century. An excavation in the courtyard 1993 yielded a small number of artefacts. Despite their paucity, careful and detailed registration and scientific analyses produced a unique discovery. The presence of inter alia a goldsmith's workshop with several kinds of metal craft was confirmed. This article contains all of the Viking Age find material from the excavation in the courtyard during 1993.

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Löddeköpinge is today a small community beside the river Lödde å, only two kilometres away from the Sound. Place-names in Scania which end in köpinge indicate a Viking Age-Early Medieval Scandinavian market place. This fact together with the nearness to the Sound and the river has intrigued many researchers who have tried to locate a market at Löddeköpinge.

In the 1970's archaeologists discovered fairly strong evidence in favour of such a hypothesis (Ohlsson 1976). Löddeköpinge probably flourished in the 9th century, but the prosperity of the market town decreased towards the end of the Viking Age. Interest shifted to Borgeby, a town farther away from the Sound, on the other side of the Lödde å River.

Borgeby nowadays bears witness to a long history with, e.g. a 13th century church and a great estate which is mentioned in the written sources from the 14th century. Borgeby was an important town in the Middle Ages but its most prosperous period may well have been much earlier than today's visible remains would suggest (Fig. 1).

In 1993 the courtyard at Borgeby was excavated by archaeologists from the Cultural Museum in Lund (Kulturen). This paper reports on the artefacts, particularly the ceramics, from the layers belonging to the Viking Age and Early Medieval period. Apart from EDS, the registration and the analyses, were performed at the Laboratory for Ceramic Research, Department of Quaternary Geology, University of Lund. The EDS-analysis was carried out by Monica Carlsson at the R & D department, Höganas AB, Höganas.

In order to trace and visualise the histories of Borgeby and Löddeköpinge it is essential to study the artefacts carefully. The results will be placed in a social and chronological framework in order to try to answer four main questions: (1) Was Borgeby socially connected to Löddeköpinge during the Viking Age? (2) Are the ceramics homogeneous as regards the ware and the manufacturing technique? (3) Are the
ceramics imported or locally made? (4) Which different types of craft are represented among the artefacts?

**Material**

The find material from layers 50, 51 and 52 consists of ceramics, bone, artefacts of metal and flint. The ceramic artefacts comprise sherds, crucibles, moulds and soldering plates with a weigh of 314 g. The osteological material is limited to an equine bone weighing 35 g. The metal artefacts are iron rivets, a bronze rod, a metal wire, metal drops and several unidentified fragments. The metal pieces have a total weight of about 34 g. Only one flint artefact was found, the weight of which is 21 g.

**Methods**

In order to extract as much information as possible from the ceramic material several parameters were recorded. Weight, number, sherd thickness, firing effects (inside, outside and core), temper (kind, amount, largest grain), surface treatment, vessel-shaping technique, shape of sherds, part of vessel and, when appropriate, decoration. The original diameters of rims and bases were calculated and recorded. The ceramics were grouped by function and vessel type, e.g. black earthenware, AIV-ceramics, stoneware, redware and technical ceramics.

Other artefacts were subjected only to a general examination. The weight, size and type of material were registered.

All the artefacts were scrutinized in a stereo microscope with up to 40 x magnification. In the case of the ceramics, the ware quality, the presence of pattern on the moulds and a fortuitously introduced material were examined. Ceramic thin sections (thickness 30 μm) were analysed under a polarising microscope, at magnifications from 25 to 1000 x, in both parallel and transverse light. The clay structure, the proportion of the coarse fractions (sand, silt), the kind and amount of temper and the presence of accessory minerals were analysed.

EDS-analyses were made on the metal drops on soldering plates, on the glaze of a crucible, on the coating of a silver wire and on a bronze rod. These analyses give the chemical composition of the material.

**The history of Borgeby**

The oldest historical record to mention Borgeby is a coin, struck during the reign of the Danish King Swein Estridsen. Its inscription reads “LIFVIN I BORB”. Estridsen ruled Denmark between 1047 and 1074 AD. Another coin marked “BVRHI” which was minted during the reign of Saint Canute (1080–1086) was presumably struck at Borgeby. It cannot be excluded, however, that the coin was struck at Borrby in south-eastern Scania (Holmberg 1977 p. 41).

There are strong indications that Borgeby was an important place at the beginning of the eleventh century. Although the archaeological material is limited, it supports the hypothesis that the place was closely connected with Löddeköpinge. Two coin balances were found at Borgeby, one of which is from the eleventh century and the other probably somewhat older (Strömberg 1961 p. 61).

Using older maps, written sources and aerial photos, R. Holmberg has interpreted the topography of Borgeby (Fig. 2). He discerned an O-shaped construction, with an inner diameter of about 156 m. The ring-rampart may
have been open toward the Lödde å River where a bridge may have been built. On the other side of the River is a place called Lilleborgen (Minor earthwork) named by the people who live nearby. A map printed in the 19th century marks the field as an old earthwork. Holmberg believes that Lilleborgen was an outer earthwork to the O-shaped construction. It is about 10 meters higher than the surrounding terrain (Holmberg 1977 p. 42).

The castle complex of Borgeby bears witness that the place had a special significance. The fortress by the river may have served as a control point for the bridge. The road may have been important, since the highway from Dalby and Lund probably passed close to Borgeby, maybe even alongside it. The ring-rampart could also have been used as an obvious power indicator at the bridge. An administrative, or even royal, centre may have been located within the protection of the rampart.

There has been little archaeological activity at Borgeby, despite the site's potential. In 1983 an excavation was carried out 300 meters south of the barn on the Borgeby Estate (Lindeblad & Wihl 1984 p. 10). Three pit houses and a few other structures were found. The ceramics were presented and interpreted at a research-seminar at the Department of Archaeology at Lund University (ibid.). Sixty-four per cent of the ceramics were black earthenware and 36 per cent AIV-ceramics (based on the number of units). The black earthenware was classified according to D. Selling's system from 1955 (Selling 1955). The shapes are AII:2a, AII:2b, and AII:3a1 which indicate a date in the first half of the 11th century. Lindeblad and Wihl mention that a lid was found in the excavation (Lindeblad & Wihl 1984 p. 3). The lid probably belongs to the Bobzin-group defined by E. Schuldt (Schuldt 1956 pp. 30 ff.). Bobzin is dated to the late 10th through late 12th century. AIV-ceramics are represented by the shape AIV:3a1, common in southern Scandinavia. This vessel type is dated by Selling to 800–1200 (Selling 1955 p. 226).

The material from the 1993 excavation

Pottery. The pottery consists of AIV-ceramics and black earthenware showing a Slavonic influence. According to the number of units, 69 per cent are AIV-ceramics. The medium sherd thickness for the black earthenware is 7.4 mm and for AIV 7.9 mm. AIV-ceramics and black earthenware represent two different craft traditions.

The AIV-ceramics cover a wide range of dates, normally 800–1200 AD (Selling 1955 p. 226). In southern Sweden most of the pottery type dates from 700 to 1025 AD. The type was found in large quantities (Ohlsson 1976, 1980; Brorsson 1996) at the sites Löddeköpinge I and II, and at Löddeköpinge 90:1. The pottery has characteristic thick walls and rough temper (Fig. 3). A typical protruding edge was observed on the base of sherds from Borgeby.

The black earthenware is, in its extent, a sign of contacts with Slavonic territory. Slavonic ceramics manufactured outside Löddeköpinge were found at Löddeköpinge I (Vikhögsvägen), although there are strong indications also of locally made black earthenware (Hulthén 1976 pp. 135 ff.). Moreover extensive material came to light at Löddeköpinge II.
Western vessel shapes such as Badorf and Kugellopf (AI-ceramics) and others are poorly represented at Löddeköpinge. It seems likely that Borgeby tended to use the same pattern of ceramics as at Löddeköpinge.

The material from Borgeby is limited to the remains of five distinguishable vessels of black earthenware. Only in one case was it possible to reconstruct the shape of a vessel. This is a Garzer-type (Schuldt 1956 pp. 49 ff.), found in layer 14 (Fig. 4). Garzer-ceramics consist of bowls which are rare in Scania, except in Early Medieval cities. They occur with and without decoration. The decoration often consists of oblique lines on, and parallel lines below the rim. The vessel from Borgeby does not have the oblique lines, but, as far as can be seen, has parallel lines on the body. Garzer bowls are normally dated to between 1000 and 1200. In Oldenburg they appeared sporadically in layers from 975–1000 (Kempke 1988 pp. 90 ff.). The type has also been found fairly frequently on the Isle of Rügen (Schuldt 1956 Karte 12). The dating of the bowl from Borgeby is uncertain because it was found in a Medieval layer. The Slavonic Garzer-bowl differs from the Early Medieval bowls from Lund in that the latter sometimes have stands. The Lund bowls with stands are interpreted as oil lamps. Unfortunately, the bowl from Borgeby is too fragmented to allow a decision on whether or not it had a stand.

Layer 50, which contained mainly Viking Age ceramics, yielded fragments of a vessel, the ware of which is similar to stoneware. A sherd of redware is also present. The stoneware-like sherds are not completely sintered and match C1 according to Selling. The thickness varies between 2.5 and 5 mm, and the vessel was probably globular. The stoneware-like pottery which first reached Scandinavia from the manufacturing sites in Germany consisted chiefly of Pingsdorf, Paffrath and Siegburg vessels. It is most likely that the sherds from Borgeby may be interpreted as Pingsdorf ware. Selling dates the Pingsdorf ware to the centuries between 900 and 1200 (Selling 1968 pp. 262 ff.).

The redware sherd was thin, approx. 5 mm. The sherd, which can only be described as a BII-type is glazed both inside and outside. The

Fig. 3. Scandinavian AIV vessel found at Kosel-West in Schleswig, Germany. Scale 1:6 (Meier 1994, Taf. 10:4). The same vessel type occurs at Borgeby and Löddeköpinge in Scania. — Ett kärl av typ AIV påträffat i den vikingatida boplatsen Kosel-West i Schleswig, Tyskland. Samma kärltyp har påträffats i Borgeby och Löddeköpinge i Skåne.

Fig. 4. (A) Garzer bowl found at Kowall, Germany. Scale 1:3. (Schuldt 1956, Abb. 91b). (B) Sherd from a Garzer bowl found in layer 14 at Borgeby. Scale 1:2. (Drawing F. Svanberg.) — (A) Garzer-skål påträffad i Kowall, Tyskland. Skala 1:3. (B) Skärva av Garzer-skål påträffad i Borgeby, lager 14.

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early glazed ceramics from Lund are mostly glazed on the outside, but patches of glaze can be seen on the inside. Early redware is dated to the latest part of the 11th century. The sherd from Borgeby is smaller than 1 cm², which makes it impossible to determine vessel shape.

**Crucible fragments.** Layer 50 yielded a total of 11 fragments of crucibles. It was not possible to reconstruct the shape of any. The fragments could easily be mistaken for soldering plates, but due to the high temperature and the long time in the fire, the crucible is sintered throughout. A soldering plate is usually sintered only on the upper side. Fragments of slag which, due to the manufacturing technique, will not occur on the soldering plates, were found on the crucible. Some of the crucibles were coated with a red glaze, which has been analysed by EDS. The results show that in all probability the bronze had been melted in the crucible and thus caused the glaze.

**Moulds.** Layer 50 yielded three fragments from at least two different moulds. After macroscopic analysis, one of them is determined with certainty to be Hiddensee style (Svanberg 1998). The second fragment may also come from a mould of the same style. The third fragment could only be generally described as a mould.

Not only the decoration, but also the quality of the ware are important for the classification. Mould No. 1 has a two-layer ware and was probably a matrix. The inner layer is made of fine clay to give a smooth surface, and the outer is coarser to prevent tensions in the mould. The melt has affected the inner layer, which has been heated at a higher temperature than the outer layer. Moulds No. 2 and No. 3 are heated up to the limit of sintering (high temperature over a long period).

The casting of a piece of jewellery is a complicated process, performed through several steps. At first, the jeweller produced a matrix of the jewellery and then a matrix of clay. Then a patrrix, a positive model of the artefact, was fashioned within the matrix. Around the patrrix the matrix of clay was built up. The matrix is the mould. In prehistory there were two kinds of patrices and matrices, which could be merged in the casting process.

The older method of casting is known from the Bronze Age, à cire perdue—lost wax. The jeweller created a patrrix of wax. This patrrix was coated with clay and the mould took shape. One problem was that the matrix was closed except for a small channel. The mould was fired, the wax melted and could be poured out. The metal was heated and poured into the mould. To prevent segregation it was essential that the mould was warm when the melt was poured in. If the temperature gradient is too steep there is a risk that the moulds will crack. The moulds could be kept warm during the casting process by means of an ember vessel. The moulds were placed in the vessel and surrounded by glowing charcoal. When the metal had been poured into the mould it left to cool; finally the jeweller gently broke the mould to remove the object.

The jeweller also used another method which had its origin in the Bronze Age, but was most common during the Viking Age. The patrrix was formed of wax or metal, but the mould was made in two halves and could easily be separated and re-used. The metal patrrix too could be used several times. This mould had another advantage: the inside of the mould could be lined with a thin piece of cloth to prevent adhesion.

The third method using patrices and matrices did not pertain to casting. Instead of casting a thin sheet of gold, silver or bronze was fixed on the matrix and punched into position. The sheet thereby assumed the shape and pattern of the matrix. This method was primarily used for exclusive jewellery such as ring-shaped buckles. The fine jewellery made by means of matrix No. 1 were probably produced in this way. The hardness of moulds Nos. 2 and 3 suggest that the artefacts made therein were also produced by this means. However, the other methods cannot be excluded. When the coiner minted coins he also used the punching-method.

As shown in Figs. 5 and 7 the jeweller had several different types of tool. B. Lonborg remarks that they were probably made by the
gold- and silversmith himself (Lønborg 1982 p. 38). The skill of such smiths must have been very great.

The archaeological finds showing the incidence of casting are patrices, moulds and crucibles. The fact that patrices were sometimes made of metal enables their identification. The most famous find is from Hedeby, where a jeweller lost 42 patrices in the sea sometime during the Viking Age (Schietzel & Crumlin-Pedersen 1980).

It was possible, with difficulty, to use an already existing artefact as a matrix. Depending on the casting method the new artefact would be approximately 6 per cent smaller than the original, because the wax used, beeswax, shrinks about 4 to 5 per cent when it dries and the wet clay will also shrink, about 0.2 to 0.4 per cent (Lønborg 1994 p. 154).

Soldering plates. The material from layer 50 included fragments of several soldering plates. The ware is poriferous and in some areas has red and blue glazed layers. Some of the fragments could be fitted together into small concave plates with approx. 6 cm diameter. The convex underside is surrounded by a straight strip (Fig. 6). Twenty fragments were found, but only two are definitely from the same soldering plate.

This artefact is relatively rare among archaeological materials. The artefact is so inconspicuous that many soldering plates have probably escaped notice. It is confined to a single category of craftsmen, viz., the gold- and silversmith. The ware in the soldering plate should be fairly soft. One of the plates from Borbeby was exposed to high temperatures during the soldering, which has caused the surface to sinter. Semiparabolic open pores may be seen on the surface; these appeared when drops of melted metal were spilt onto the plate. The soft surface thus served as a trap for the precious metal, which could later be collected and re-used. When the soldering plate had sintered (hardened) it could no longer fulfil this important task and was therefore replaced by a new, soft plate.

The glazed surface ensued from a chemical reaction between the metal and elements in the clay. Red colour, such as emperor red, could for instance have resulted from solder-
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Fig. 6. (a) Soldering plate from Fyrkat, Jutland, Denmark. Scale 1:2. (Roesdahl 1977, Fig. 52b). (b) Soldering plate from Borgerby. Scale 1:2. (Drawing T. Brors­son.) — (Ö) Lödningskavalett från Fyrkat på Jylland. Skala 1:2. (b) Lödningskavalett från Borgerby. Skala 1:2.

ing with gold, or copper. A chemical analysis is necessary for identification. As silver alloys often contain copper one such could have caused the red colour.

A chemical analysis was performed on soldering plates with the same red colour from Fyrkat in Denmark. The colour was caused by copper protoxide and aluminium silicates in the clay. The copper protoxide can derive from a bronze melt. The analysed plates had been exposed to temperatures between 800° and 900°C on the upper side while the base which had no contact with the hot flame had only been heated to 500°C (Hulthén 1977 p. 52). Analyses of metal drops found on four other soldering plates at Fyrkat show that silver soldering actually had taken place. The drops were mainly silver, but copper too was found (Roesdahl 1977 p. 53).

Several drops of gold (max Ø = 0.33 mm) found on two of the soldering plates from Borgerby were studied in a stereoscopic microscope at a magnification of 16 to 40 ×. The gold was spilled on the surface of the plate during the soldering process. Another plate showed small spheres (Ø 1–2 mm) of a substance which could not be determined in the microscope. An EDS-analysis was performed. The spheres were slag particles which probably resulted from iron soldering with silver solder.

The Borgerby material also included a silver coated wire. The wire had probably been used for soldering. Thus both gold- and silver-smithing and iron soldering were practiced at Borgerby by the end of the 10th century.

Soldering was used for filigree or granulation, in gold, silver or bronze. The principle of soldering is still more or less the same. A soldering wire of gold or silver is heated beyond its melting point. The melting point of gold is 1063°C and of silver 961°C, but the temperature can be lowered by using another metal as an alloy or a flux. In view of the high temperatures, these smiths have been masters of their craft and possessed excellent tools.

Besides the soldering plate the smith used blowpipes of bone with mountings of thin bronze, pewter or tin plate, metal wire, the object which was to be soldered, and finally charcoal (Fig. 7). Such a collection of tools was found at Högom (Hulthén 1995 pp. 21 f.). A soldering experiment was performed by silversmith H. Ottoson and Professor B. Hulthén at the Laboratory for Ceramic Research.

A copy was made of one of the soldering plates from the Högom finds. The plate was dried but not fired. A bone from a bird was used as a blowpipe (length 5 cm). Several pipe-shaped bones with burnt ends came to light at Högom. To prevent burning cornet-shaped mounts were made from triangular brass tinplates and fastened on to the pipe. The mounts also concentrate the air flow which creates a very narrow flame with a high temperature.

The object was placed on the soldering plate, with small pieces of glowing charcoal round the edge. The smith blew into the pipe and concentrated the flame from the charcoal to the object on the soldering plate. A sufficiently high temperature was attained and sol-
Fig. 7. Tools used for soldering. Most of the artefacts were found in a richly endowed Migration Period grave at Högom. The Viking Age goldsmith may have used the same type of tools. — Verktyg använda för lödning. De flesta föremålen påträffade i den rikt utrustade folkvandringstida graven i Högom, Medelpad. Den vikingatida guldsmeden har sannolikt använt samma typ av verktyg.

Soldering with the metal wire was possible. The rounded base made it easy to rotate the soldering plate, and the jeweller could sit to work. The result of the experiment showed that a temperature of 300°C was reached in the soldering plate itself, and that small drops of metal ended up in the ware.

Soldering plates are usually dated to the Viking Age but also to the Migration period (Holmquist 1970; Hulthén 1995). No soldering plates from the Vendel Age have yet been found.

Apart from the finds at Borgeby, Viking Age soldering plates came to light elsewhere in Scandinavia, at Hedeby, Ribe, Trelleborg (Denmark), Fyrkat and Birka (Fig. 8). Soldering plates have also been found in Holstein, in Ireland and in England (Roesdahl 1977 p. 54; Brinch Madsen 1984 p. 27).

Osteological material. The osteological material consists of a sawn-off fragment of a distal methapod of a horse (pers. comm. Dr. J. Ekström). The bone was found in layer 50 and is an indication of some craft, perhaps comb-making. This craft is closely connected with that of the jeweller. The small rivets used to fit the different parts of the Viking Age combs together were most probably made by a jeweller. Evidence of a connection between these two crafts was found at Högom (Hulthén 1995 p. 23).

Silver wire with coating. The find material from layer 50 included a silver wire (silver wire $\varnothing = 0.7$ mm, with coating $\varnothing = 1.8$ mm) weighing 0.75 g. The microscopic analysis established that the wire was silver. The coating was analysed by the EDS-technique. The silver wire was found in the same layer as were the other smith’s tools, and was most probably used for soldering. The tip of the wire was heated and the metal dropped on the object to be soldered.

Bronze rod. Layer 51 yielded a 20 mm bronze rod. It comprised two halves ($2.8 \times 3.4$ mm) which were probably soldered together. It possibly functioned as a rivet for a comb. The bronze in the rod contains a high proportion of lead, which, according to Professor B. Arrhenius, is typical for Viking Age bronze. (Pers. comm. Prof. B. Arrhenius.)

Rivets. Four iron rivets with square heads were found in layer 50. Their length varied between 4 and 5 cm. Rivets normally occur in house construction, but the context may suggest a somewhat different usage. Some of them were found among the jeweller’s tools; they appear unused and could be newly made. At least one of the rivets has been used, because the tip is bent. The blacksmith, who usually made horse-
shoes, weapons and various household artefacts, probably also made the rivets.

Other metal objects. Several small iron fragments from layer 50 are not definable, but two of them may be. One of these is long, narrow and almost cylindrical. The sides have been folded in on a rectangular piece of iron with flaps, and the shape is more or less cylindrical. The piece could have been used as a key or a handle. The other object was U-shaped and may be part of a buckle. Buckles were accessoires of dress and of equine equipment.

The find material includes a piece of firestone with a length of 74 mm. It was found in layer 52.

Analyses
Ceramic thin sections. Microscopic analyses were made on seven ceramic thin sections from two vessels of black earthenware-type, two AIV-ve-

sels, two soldering plates and one mould. The results are presented in Fig. 9.

The analyses show that several types of craft are represented in the ceramics material. Apart from the crucibles and the other technical artefacts, moulds and soldering plates are made of a sorted, silty, coarse clay, which is untempered. They were probably produced by a different craftsman from the one who made the vessels, perhaps even by the jeweller himself. Considering that this was a specialised, precision craft with high requirements for ware quality it is logical to assume that the jeweller made his own tools for casting and soldering. Previous examinations of raw clay, loom weights and daub-clay have shown that most of the clays in the Løddeköpinge area are coarse and unsorted (Brorsson 1996). Thus it is likely that the ceramic artefacts needed for soldering and casting at Borgeby were manufactured locally.

The ordinary pottery represents at least
three different vessel productions and the technical ceramics constitute a separate group (Fig. 10). The AII, black earthenware, is made of sorted medium-coarse, silty, micaceous clay, rich in iron oxide. Conglomerates of ferro-oxihydroxide occur. Zircon and ore as accessory minerals were observed. The clay was tempered with between 15 and 18 per cent crushed pegmatitic rock with a maximum grain size of 2.5 mm.

The AIV pottery (in all probability locally made) occurs in two qualities. One (No. 13) is made of a sorted, coarse, sandy and silty clay, very rich in iron oxide and mica. Zircon and ore occur as accessory minerals. Crushed granitic rock, 13 per cent, was used for tempering. The maximum grain size is 3 mm.

AIV pottery sample No. 20 is of another quality. The raw materials consist of a sorted, fine silty clay, rich in iron oxide and mica. It is tempered with 21 per cent crushed sericitized granite with a maximum grain size of 6 mm. It is not likely that the AIV-vessels were made by the same potter. The two AII-vessels on the other hand, would seem to originate from the same pottery production.

Slag and metal. Four of the artefacts have been subjected to spectroscopic and chemical analyses in order to determine their constituents. Concerning the analytical methods reference is made to M. Carlsson (in this paper).

1. Red glazing on the surface of a crucible. The main constituents of the glaze are silicon and aluminium (42.5%). Iron, lead, copper and a small proportion of silver amount to 29%. The percentages of calcium and phosphorus are relatively high (11% each). The red colour of the glaze is most probably due to the presence of iron or copper. The comparatively high percentage of lead (11%) is a typical property of a Viking Age bronze. Although the occurrence of tin is not proven the crucible was probably used for bronze melting.

2. The above findings should be compared with the result of the investigation of a bronze rod with a length of 20 mm. The latter analysis showed that the rod was made of an alloy consisting of copper, tin, iron, aluminium and lead (24%). Like the glaze the alloy also contained a fairly high percentage of phosphorus and of calcium (20%).

There is substantial evidence of a connection between the glaze on the crucible and the bronze rod and consequently also in support of a bronze-casting craft at the location.

3. The silver wire with coating was in all probability an essential part of the silver soldering procedure. This coating had two plausible functions. Firstly it had an insulating effect which enabled the jeweller to handle the hot wire with his bare hands during the soldering. The second, no less important function was fluxing. The coating contained a flux, which may indeed have lowered the melting-point of the silver wire but was chiefly intended to remove oxides and adjust the surface tension of the molten solder and the metals to be sol-

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**Fig. 9. Results of petrographic microscopy of ceramic artefacts from Borgeby, Borgeby parish, Scania. Symbols: S = Sorted, C = Coarse, M = Medium, F = Fine, X = Occurrence, N.O = Not observed, ++ = Rich, + = Abundant, o = Medium occurrence, - = Scarce, Zi = Zircon, O = Ore.**

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Ware type I: Soldering plates and a mould.

Ware type II: One AlIV vessel (No. 13)

Ware type III: Both AlIV vessels

Ware type IV: One AlIV vessel (No. 20)

Coarse clay □ Medium coarse clay □ Fine clay △ Added granitic or pegmatitic rock

Fig. 10. Four different types of ware were distinguished through thin sections. The technical ceramics (soldering plates, moulds) are untempered. — Genom tunnslip har fyra helt olika keramiktyper kunnat konstateras. Den tekniska keramiken (lödningskavaletter, gjutformar) är helt omagrad.

dered. This is a fairly sophisticated technique which is also used by the silversmith of today (pers. comm. H. Åström). The coating of modern silver wire consists of a complex potassium-fluorine-borate compound and silver. The coating on the Viking Age wire was produced in two phases. The elements are mainly bromine, chlorine, calcium and silver.

4. Spherical drops ($\varnothing = 1-2$ mm) of slag were found on one of the soldering plates. The EDS analysis detected, besides silicon and aluminium (10%), which may originate from the clay of the soldering plate, the following components among others: potassium c. 2%; iron c. 40%; nickel c. 2%; calcium c. 6%; phosphorus c. 4%; silver c. 5%. This composition corresponds fairly well with the content of slag, which is normally formed when iron is soldered by silver solder. Thus, the silversmith most probably soldered also e.g. the iron buckles etc.

The outcome of the analyses gives a glimpse of the activities inside a workshop for gold-, silver- and bronze-melting and casting, and for joining together iron artefacts. They also bear witness to the special skills of the master of such a workshop.

The excavations at Borgeby

What was found below the courtyard at Borgeby is unique and constitutes the remains of a goldsmith's workshop from the late Viking Age. Both the raw materials and the tools are preserved in the find material.

At least two different moulds were identified. One of them was interpreted as Hiddensee-style. This jewellery probably denote high rank in the Viking Age society. The techniques of producing jewellery in moulds varied at Borgeby. For example the casting method is known to be the same as for minting. The goldsmith probably had the technical knowledge to produce coins. It is of great importance however to observe that the workshop is dated to the late 10th century, while the possible mintage during Swein Estridsen's reign occurred in the mid 11th century. Despite the latest metal finds in Borgeby, mintage cannot be confirmed.

Soldering plates for gold, silver and iron have been identified in the material. A silver wire with coating was analysed with the EDS-technique, which gave an amazing result. The actual wire was used for soldering, while the coating acted as a flux and insulation which allowed soldering without hand protection. This is a sophisticated technique also used today. Thanks to EDS-analyses of a bronze rod and a crucible it was possible to confirm bronze moulding at Borgeby. The chemical composition of the bronzes is roughly the same, which implies a local product. In view of the discovery of a piece of an equine metaphor, it is possible that the rod and the bone were used to produce combs. The metal finds from Viking Age Borgeby are matched only by finds from important centres such as Hedeby, Birka, Fyrkat and in Trelleborg (Denmark). This indicates that Borgeby held a unique position in western
Scania during the late Viking Age.

The composition of the ceramic vessels is also interesting. Four different types of ceramics have been recognised. The presence of Garzer ceramic at Borgeby suggests special status. No other examples of this vessel type have been found anywhere outside the Medieval towns in Scania.

The distribution of AIV-ceramics and black earthenware which came to light at the two excavations at Borgeby do not correspond (Fig. 11). This discrepancy may depend on the fact that the investigations dealt with two different periods—albeit only 25 years apart. It may also spring from different needs. Besides the technical ceramics, the jeweller also required vessels for water to cool his artefacts. These vessels may have been of AIV-type. If we accept the hypothesis that the jeweller used the local type of ceramics, this indicates that he too was a native.

According to Selling’s classification the AIV-ceramics from the excavation in 1983 date from the early 11th century. It is mainly the type A1I:2a, dated by Selling from 1020 onward, which determines the dating. The amount and presence of AIV-ceramics (rarely occurring after 1000 AD) indicates a dating to the end of the 10th century, which is also supported by a find of a bead which is determined as no older than 950 (Lindeblad & Wihl 1984 p. 11). The relative distribution of black earthenware and AIV respectively at Löddeköpinge would confirm such a dating. Sometime between 960 and 980 a radical change occurred within the pottery craft: the AIV-ceramics was replaced by the black earthenware.

Most of the ceramics from the excavation in 1993 date from the end of the 10th century. The relationship between black earthenware and AIV-ceramics provides the chief evidence for this dating. Layer 50, which mostly contains Viking Age finds, also yielded sherds of the western Pingsdorf ware and glazed red earthenware. This combination may be due to a later mixture, or indicate that the layer was accumulated into the 11th century. This is one of the very first sites where early glazed ceramics and stoneware-like pottery have been found outside Lund.

The ceramics which were examined in thin sections showed that the technical ceramics and the AIV-ceramics were most probably produced locally. The two sherds of black earthenware which were analysed, are similar to each other but differ from the rest. This may mean that they are imported, but could as well indicate another craft tradition.

Borgeby – the site of a trelleborg fort in the Danish empire?

Considering the rich find material at Borgeby and the local topography, there is a strong probability that Borgeby was the site of a Danish trelleborg fortress. Harald Bluetooth initiated the construction of these ring-shaped fortifications in 950–975. The dating of the finds from the courtyard at Borgeby support this hypothesis.

A trelleborg fortress at Borgeby (Holmberg
1977 p. 41) enabled the Danish king to control the area around the Lödde å river, as well as the roads and the seaways going north-south. The trade routes between what are now Poland, Eastern Germany and Norway may also have passed through the Sound. The main highway from the continent to northern Scandinavia, however, generally went through Hedeby (ibid. p. 17).

The Viking Age market place at Löddeköpinge made Borgeby even more interesting. By placing a trelleborg fortress in Borgeby, the king could control the market place. While Löddeköpinge’s main function was trade and other civilian pursuits, Borgeby was probably an administrative centre for the king’s men. The relation between the two places could be considered as dualistic.

If we accept that Borgeby was the site of a Danish trelleborg fortress some interesting results emerge from the find material. The different craft traditions in the Danish Empire show that east and west were influenced by different cultures. The moulds and the soldering plates point to a jeweller’s workshop which in turn indicate a power centre, while the pottery shows more far-reaching connections.

The artefacts made of the technical ceramics were mainly Western in style. On the other hand, the pottery is of local origin. Both Borgeby and Löddeköpinge seem to have been influenced by Slavonic culture. In the 10th century the local AIV-ceramics were replaced by the Slavonic-inspired black earthenware, which was in turn superseded by Western redware and stoneware. The pottery at Hedeby has its origins in Jutland, the western part of continental Europe and the Slavonic area. The same is true for Fyrkat, the ceramic tradition of which is different from that of Scania. The ceramics are mainly Jutlandic with some Scandinavian and Slavonic features. Trelleborg on Zealand, on the other hand, has a stock of pottery which resembles that of Borgeby-Löddeköpinge (Roesdahl 1977 p. 20).

The pottery from the different regions of early Denmark suggests the presence of two different cultures, a western and an eastern. Status objects on the other hand show a more uniform origin. It is probably not correct to say that the western imports out-classed the eastern during the late Viking Age since the Slavonic-inspired black earthenware existed into the Middle Ages. Status objects of Western origin on the other hand indicate that the elite were in close touch with the Frankish empire.

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Appendix. Electron Diffraction Spectroscopy (EDS) on Viking Age artefacts from Borgeby, Scania, performed at the R & D Department at Höganas AB, Sweden
When using EDS for element analysis a complete X-ray spectrum (mostly 0-10 KeV) is obtained within a very limited time since the X-ray quanta stemming from the entire energy range can be analysed simultaneously.

In practice the elements are determined quantitatively by comparing the energy levels reflected by the recorded peaks with the known (tabulated) values. This compilation is today carried out by means of fully automated computer-based systems for X-ray analysis.

The Scanning Electron Microscope (SEM) is combined with the EDS-system, thus allowing the analysis of the X-rays generated when the electron beam reaches the targeted sample.

Two different set-ups were deployed for the EDS-analyses of the archaeological artefact samples. A slag and a glaze of a soldering plate and a bronze rod were analysed using a Philips SEM 515 with an EDAX-EDS-system, whereas the silver thread (Ø = 1.8 mm) was analysed by means of a JEOL 5800 SEM with a LINK ISIS-EDS-system. In contrast to the old EDAX EDS-system the LINK EDS represents the latest state-of-the-art technology where a germanium
detector offers a far better statistical foundation than the EDAX Si-detector. The samples were coated with a very thin layer of carbon (C) to achieve the correct surface conductivity—a crucial property on which the entire analytical method rests.

Monica Carlsson

References


geby har klensmeden dessutom använt sig av s.k. punsteknik. En teknik där ett metallbleck punsas ut till ett smycke.


De keramiska tunnslipen visar att det sannolikt inte var samma person som framställde de olika keramiska föremålen. Troligen tillverkade smeden sina egna föremål, medan kärlen framställdes av en keramiker.

Deglar och lödningskavaletter kan med lättet förväxlas. Skillnaden är att höga temperaturer och förhållandevis långa stunder i elden medför att degeln blir helt genomsinrad. En lödningskavalett är normalt endast sinrad på ovansidan.

Fyndmaterialet från Borgeby indikerar en alldeles speciell miljö, en miljö som förmodligen kan kopplas till det högsta samhällsskiktet i det dåvarande danska riket. Utifrån de tolkningar som lagts fram av forskare under 1970-talet och den nu påträffade guldsmedjan är sannolikheten stor att det under slutet av vikingatiden låg en trelleborg i Borgeby.