

# From Precious Metal to Recycled Scrap

A note on Helgö's workshops in a time of climate catastrophe

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## Abstract

*Helgö, in the Mälaren area of central Sweden, was a centre of metalworking, specifically casting jewellery from copper alloys, in the early centuries of the 1<sup>st</sup> millennium CE (See Excavations at Helgö I – XVIII). In the year 536 CE, however, when manufacturing at Helgö was at its height, Classical sources record the occurrence of a devastating climate event which in Scandinavia became known as the 'Fimbul Winter'.*

*Analyses of the raw materials and cast objects at Helgö have shown that the effects of the climate crisis included the disruption of trade routes and the consequent lack of access to high-quality raw materials for casting. Primary copper-alloys (bronze and brass), which were predominant during the Migration Period, were replaced in the Early Vendel Period by secondary alloys made from scrap-metal (known as gunmetal in English). The raw material used for casting in Uppåkra in the Vendel Period also consisted of secondary alloys. This fundamental change could have resulted from the climate-related collapse of trade routes in the middle of the 6th century.*

## Introduction

The 'Fimbul Winter' was described in the introductory lines of *Ragnarök* (the *Poetic Edda*), as follows:

First is that the winter *called* 'Fimbul Winter' will come. The snow will swirl from all directions, it will be intensely cold with bitter winds. The sun will have no effect. Three winters will come in succession, with no summers in between.

There is no question that the climate catastrophe occurred; it was even mentioned at the climate conference (Cop 26) held in Glasgow in 2021 (Mulholland 2021). It is likely to have been caused by a volcanic eruption in the Pacific area, which spewed ash into the global atmosphere. But its consequences have been the subject of lively debate among many scholars. Morten Axboe and Bo Gräslund stand out in archaeological

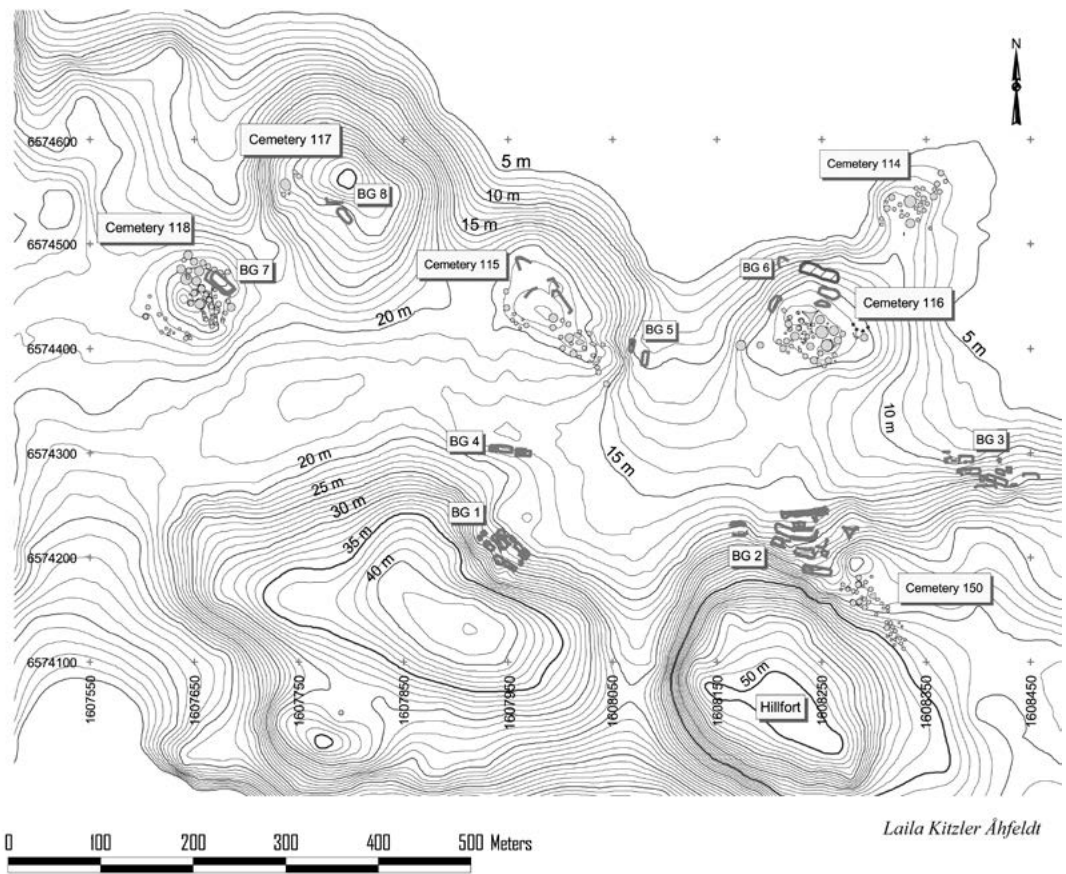


Fig.1 Map of eastern part of Helgö showing building groups and cemeteries.

circles for having written many papers on the topic. Gräslund was the first Swedish archaeologist to equate the climatic events with the legendary 'Fimbul Winter', and then to discuss the archaeological evidence for the profound influence that the crisis had on contemporary society (Gräslund 2007; Gräslund & Price 2012).

A recent paper by Arrhenius (2013) enlarges the debate on the effects of this climate event by suggesting that there was a direct connection between it and the end of Helgö as a jewellery-making centre. The purpose of our current article is to investigate whether Arrhenius's hypothesis is supported by the evidence from the excavations at Helgö.

The archaeological complex on Helgö (Holy Island) consists of eight building groups (BG 1 to 8) and six cemeteries on the eastern part of the island (Fig 1). Helgö was used for ritual activities from the Late Bronze Age to the Viking Age, but is best known for the exotic objects found on site, including a North Indian Buddha statuette, an abundance of imported glass vessels and 26 gold-foil figures. These came to light within BG 2, where there had been a settlement from the 4th century to the 10th century. In the western part of BG 2 there was a smaller workshop area, where bronze casting and iron forging were carried out. A significantly larger workshop area was located in BG 3. Despite the fact that the area has not been fully

investigated 233 kg of crucible fragments and c. 100 kg of fragments of moulds for jewellery, dress accessories, etc. from mainly the first half of the 6th century have been discovered. Iron smithing, bead making and stonework had also been carried out there. BG 4 was a workshop of the same date, which formed part of BG 1, an ordinary farm.

Although the settlement was established as early as the late Roman Iron Age, the oldest graves are from the 6th century (Cemetery 150). These were few in number but the number increased during the late Vendel Period and the Viking Age. Several of the cemeteries overlay an older settlement area. At the beginning of the 11th century habitation ceased but was replaced by a newly occupation area to the north at the Bona Farm, which is mentioned in medieval sources (Clarke & Lamm 2017).

## Arrhenius's hypothesis

Arrhenius's argument for the abrupt termination of jewellery-making rests on her statement that the latest date for casting-moulds found in a single large working area at Helgö (Building Group 3) was c. 530 CE (for chronology see Fischer & Viktor 2011). However, that date refers specifically to the end of the casting of clasp-buttons (*agraffknappar*) decorated in Style I, and other characteristically Migration-period artifacts, even though moulds for later jewellery such as Husby brooches (*Husbyspännen*), bird brooches (*fågelspännen*), small equal-arm brooches (*likarmade spännen*), and dress-pins (*dräktnålar*) with polyhedroid heads, were discovered at Helgö. The objects cast in the moulds were unlikely to date from before 536 CE, even though it must be borne in mind that the moulds and are of an earlier date than the objects which were used and subsequently deposited in graves.

Moulds dating from the Migration Period were discovered over virtually all the excavated workshop area (Building Group 3), with a concentration in the west. Clasps (*agraffer*), known only from the Migration Period, were made in the northern part of the area, whereas moulds for square-headed brooches (*reliefspännen*) were dominant on a terrace to the south at the top of a steep slope. This may indicate specialisation whereby each master craftsman had his own workspace (Clarke & Lamm 2017, 34).

The Vendel-period moulds were discovered only in specific parts of the workshop area. Although casting during this period was less intensive than it had been in the Migration Period, it did not stop completely, with manufacture continuing in both Building Groups 2 and 4 at the same time (Clarke & Lamm 2017, 26f). Arrhenius (2013) claims that objects decorated in Style I were made by skilled craftsmen of Baltic heritage. For evidence she uses the excavated plans of buildings in the workshop area, of 'blockhouse construction' (or *lafted*), a building style which Arrhenius (2011, 34) maintains could have been brought from the East by goldsmiths who wanted to live in their traditional houses. They remained, working in Helgö until the climate crisis hit, when they returned to their homeland (Arrhenius 2013, 3). There is a problem, however: the homeland of these 'highly skilled craftsmen' is by no means certain.

According to Arrhenius, the end of metalworking at Helgö was not the only result of the climate crisis there. Further afield, it certainly resulted in widespread crop failures and famine, with consequent ill effects on many aspects of life. She maintains that the open area in the central building group (Terrace IV in Building Group 2) was no longer used for cult practices, which were transferred to the great hall on Terrace I where the cult could be celebrated indoors

(Arrhenius 2013, 11). Arrhenius provides no references supporting this view; and on the contrary, there are reliable sources indicating that offerings were deposited on Terrace IV right through from the Roman Iron Age to the Viking Age without interruption (Zachrisson 2004, 148; Stolle pers. comm.)

## Results from the metal analyses

There is, however, one factor that shows that the climate crisis had a substantial influence on metalworking at Helgö – that is the change in the raw materials that were used, which took place at the transition from the Migration Period to the Vendel Period. Pure metals such as copper, tin and lead and their alloys such as brass, were dominant before the crisis, but eventually stopped being used. Analyses, first carried out in 1978 but later supplemented and published in Grandin & Hjärthner-Holdar (2008, 65ff) showed that the copper alloys of bronze and brass (at this

time the latter made from copper and zinc mineral) were prevalent in Building Group 3. In the workshops in Building Group 2 and Building Group 4, gunmetal (Sw: *rödmetal*; USA: *red metal*) was the raw material of choice, as the analyses of the finished products also showed. Gunmetal is a mixture, usually of brass and bronze, and is evidence for recycling. In this case, it could have been made by melting down sheet metal (many pieces cut from redundant Roman bowls), rods, remains of ingots, broken objects, miscastings, and smelting debris in the shape of irregular lumps and small droplets. Discoveries from workshops elsewhere show that large, or several smaller, pieces of sheet metal were hammered together into small 'packets' for use as raw material. At Helgö almost all the sheet metal treated in this way was of pure copper (Fig. 2).

The breakdown of trading connections resulting from the climate crisis could have been one reason for diminished access to pure metal, although another reason may have been

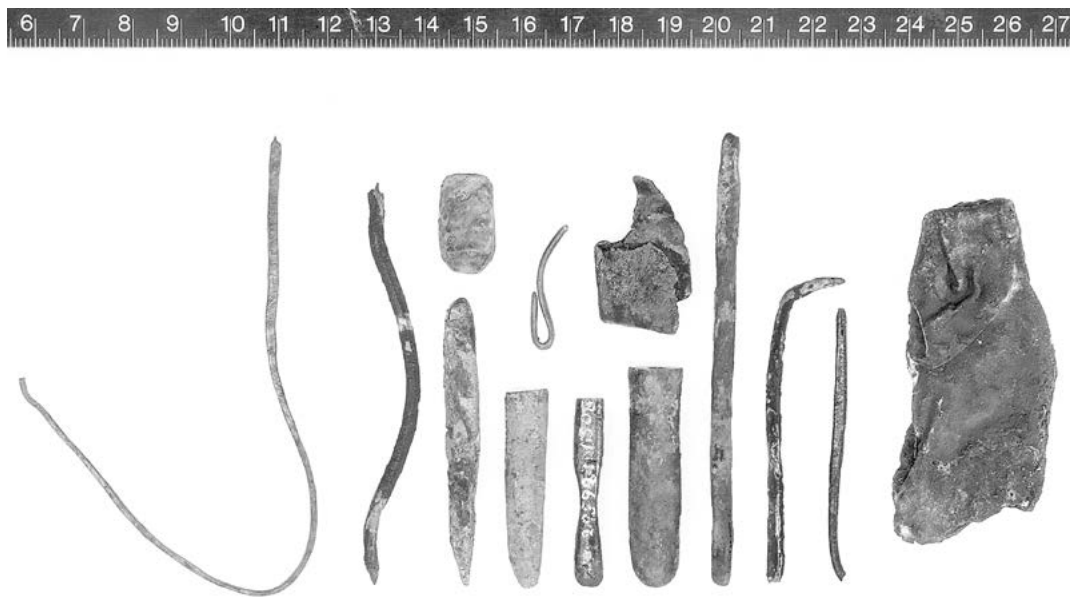


Fig.2 Ingots, rods and folded sheets of copper alloy, Photo Gabriel Hildebrand ATA.

the decline or abandonment of mining in England and on the Continent. The shortage of metal is evident from the modifications in the composition of raw materials, but also from the smaller quantities of metal needed for casting early Vendel-period brooches, such as the Husby, equal-arm and oval types, all of which are considerably smaller and lighter than the square-headed brooches of the Migration Period.

If the supply of pure-metal raw materials really did run out at the end of the Migration Period, one would expect the Helgö craftsmen to have used up everything that could have served as raw material. But a surprisingly large quantity of scrap metal has survived, almost all in Building Group 3. Metal bars were also discovered: seven from Building Group 3 and the same number from the other workshop areas. They were tiny, no more than 1 cm in length, but the very fact that they survived, suggests that other metal was still available. It is surprising that they were not used in casting at the time as they, like the more numerous rods, were made of primary alloys.

Even fewer raw materials have been discovered at other metal-casting centres of the same date. Only four bars and a few small pieces of sheet metal clipped out of larger sheets were discovered in the early Alemannic fortification of Runder Berg (Koch 1984, 186f), and the same paucity of metal objects is true of Dinas Powys in Wales (Alcock 1987, 99, 110), Mote of Mark (Curle 1982, 115f) and Dunadd, both in Scotland (Lane & Campbell 2000, 159).

There are some notable exceptions to the metal shortage. They include the sites of Uppåkra in Scania, Sorte Muld on Bornholm and Gudme on Fünen, all of which were similar to Helgö in being rich in metal artifacts. The quantities are not directly comparable, though, as Helgö was excavated manually whereas many of the discoveries on the other sites were the result of metal detecting.

Comparisons between Uppåkra and Helgö show that the use of pure-metal alloys characterizes metalworking at Helgö, whereas gunmetal is dominant at Uppåkra (Kresten, et al. 2000, 159ff). So far there are no moulds indicating jewellery-manufacture in Migration Period Uppåkra. This contrasts with production in the Vendel Period, shown by great quantities of mould fragments for brooches including *näbbfibulor* (duck-billed brooches; Bengtsson 2005, 19), agreeing with the suggestion that pure metals were not available after the middle of the 6th century CE.

As the Helgö craftsmen employed scrap metal for their raw material when pure-copper alloys were no longer available, they were able to continue working into the early Vendel Period. Two fragmentary moulds found in Building Group 2 exemplify this: they had been used for casting patrices for figural plates, similar to the Vendel-period Torslunda plaques (Clarke & Lamm 2017, 26).

Casting stopped at Helgö towards the end of the 6th century, probably *c.* 570 CE (Fischer & Victor 2011, 89). With one exception (unearthed in Building Group 2), no moulds with a Style II impression have been discovered at Helgö. Some may yet be found, as parts of the workshop area in Building Group 3 have not been investigated because permission to excavate there was not granted.

Other explanations for the cessation of jewellery-making at Helgö at the end of the 6th century include the suggestion that Gamla Uppsala took over Helgö's role as a manufacturing centre, probably when Uppsala became overtly political at the end of the 6th century – its new character being manifested by its great mounds, its hall, and also by its manufacture of jewellery, richly decorated with garnets (Ljungkvist et al. 2017, 91ff). There is as yet no evidence at Gamla Uppsala for jewellery-making in an earlier casting-workshop, acting in parallel

with Helgö, although one could yet be found.

Helgö continued in existence, not as a jewellery-making centre but as a smithy, making tools and weapons of iron and steel, evidence for which has been found through excavations on Helgö's workshop area; the tools and weapons could have been intended for export and not only for local use (Clarke & Lamm 2017, 66).

Gold hoards are other archaeological indications of possible crises and reactions to the 'Fimbul Winter'. They illustrate the populations' perceived need to propitiate the gods. The Migration-period hoards containing solid-gold neck- and arm-rings, and bracteates, could reflect the crisis that followed the climate change of 536 CE, but they can be dated no more precisely than to the first half or the middle of the 6th century (Axboe 1999, 186ff).

In contrast, the gold hoards found at Helgö were made up mainly of coins, which allow a more precise dating. Forty-three of the 47 coins were minted between 431 CE and 513 CE. Two of the four barbaric imitations could have been from as late as the mid-6th century (Fischer 2009, 31ff).

The lengthy crop-failure and famine following the climatic disaster of 536 CE may account for Helgö's most westerly farmstead (Building Groups 1+4) becoming abandoned c. 600 CE. Its site was reoccupied during the 8th century, after which it was inhabited continuously until the 11th century (Reisborg 1994, 76; Clarke & Lamm 2017, 22).

## Conclusion

The Migration- to Vendel-period transition involved a considerable change in the raw materials used at Helgö, as investigated and published by Grandin & Hjärthner-Holder (2008) and K. Lamm (2008). Despite the decline in access to raw materials, there was

definite proof that jewellery continued to be cast during the early Vendel Period.

Thus, the changes in access to the raw material used in Helgö's workshops have a wider significance than for Helgö alone. For example, analyses of cast objects from Vendel-period Uppåkra showed diminishing access to raw materials. This could have been common throughout the whole Nordic area, but this theory still needs to be tested by metallurgical analyses of objects from the early Vendel Period.

The change in raw materials may be explained by the disruption of trading links during the climate crisis. The consequent break in acquiring essential raw materials led to devastating consequences for Helgö's metalworking, which had up to then taken the lead in producing high-quality luxury goods.

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