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Sex identification of a skeleton in a new chamber-grave from Birka

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A chamber-grave was discovered on Björkö in the summer of 1997. The grave was discovered in connection with excavations of the rampart of the hill-fort belonging to the Viking Age proto-town Birka in Lake Mälaren. Due to the state of preservation of the human remains, a molecular sex identification was carried out. Three sets of markers; DYS388, JR25/26 and an X specific alpha satellite were used. The markers revealed the presence of a Y chromosome in the human remains.

Introduction

By Lena Holmquist Olausson

In the summer of 1997, a chamber-grave was discovered beneath the rampart of the hill-fort of the Viking Age proto-town of Birka in Lake Mälaren.

With its early dating and symbolic significance, this grave is essential for the understanding of the genesis of Birka.

The hill-fort of Birka

The hill-fort of Birka is one of the few known monumental architectural structures from the Viking Age in Sweden. Together with the town ramparts and the pile barricade in the harbour outside the town it constitutes the defences of Birka. Previous excavations on Björkö have primarily focused on the town area (Black Earth) and burials. In contrast, the fortification of Birka has been little discussed and the hillfort has never been excavated. In 1996 a 3 m wide and 16 m long trench was excavated through the hillfort ramparts in order to acquire dating material, study the construction and possible rebuilding phases. The excavation showed that the ramparts were robust and well-planned, consisting of an earth/stone structure on which stood a wooden construction, parapet and battlements. The wooden superstructure had been repeatedly burnt down. Dates show that the fort was built at the same time as the town of Birka and that it was in use throughout the whole of the Birka period (Holmquist Olausson 1997).

The excavation

The rampart showed two main phases, an older and a younger rampart. As of now, ten ^{14}C- dates from the investigation are forthcoming. According to values obtained from ^{14}C- and TL, the older rampart was burned down at the beginning of the 9th century. The younger rampart shows evidence of repeated fires towards the end of the 10th century and beginning of the 11th century.

A grave mound was incorporated in the older rampart. Finds of iron cramps and fastenings for restraining timber suggest that the parapet of the older rampart was connected into the large block that stood above the burial mound.

Under the mound a chamber-grave was found dug into the hard moraine. The investigation showed it to contain an middle-aged man buried with a horse. Amongst the large stones forming the superstructure of the grave, the partial remains of yet another skeleton were found, having been placed there but not belonging to the grave proper.

The chamber-grave

The grave is unique for several reasons (fig. 1). Both its impressive size and its early dating (it is assigned to the 8th century) are unusual in Birka. The fact that a horse accompanied the deceased is also unusual. Of the 1100 graves that have been investigated at Birka (all but few which were investigated during the end of the 19th century), 100 are chamber-graves.

"Horses are found in twenty chamber-graves at Birka. Of these, sixteen were men's graves, three double graves (with a man and a woman) and one a woman's grave" (Gräslund 1980:39).

The grave itself consisted of a rectangular pit measuring 3.25×1.20 metres. The 0.6 m deep pit held an individual who had been buried in a coffin, iron nails being the only remaining part of the coffin. Wood remains were found on these nails. The coffin measured 2.2×0.9 metres. The individual lay on his back (the body having an east-western orientation) with its arms placed along the sides of the body. Outside of the foot of the coffin a platform of earth had been constructed on which the horse was placed.

A preliminary osteological assessment was conducted in the field by Dr. Ebba During. The skeleton was estimated to have been 165 cm in length, with a small head and generally slight build. The horse was a mature stallion with an estimated age of 3–4 years with a withers height around 138 cm (During 1997).

The human skeletal remains, being poorly preserved and in worse condition that the horse remains, showed no typical sex indicative features. It was therefore of the utmost importance that a DNA analysis to be performed. This examination is a perfect example of the complementary value of osteological analysis and DNA determination.

In addition to the skeletal remains, personal objects belonging to the deceased were found in the grave. The analysis of these objects is presently in progress, but it can be mentioned here that the grave equipment included a wooden box (?), an iron knife and a pair of bronze tweezers. The artefacts were poorly preserved and the iron objects (items) badly corroded. Parts of the finds were frozen in situ by use of carbon-dioxide ice (H_2CO_3) while the remaining artefacts were frozen directly after excavation. This was necessary to allow inspection of the fragile material in the laboratory.

The metal objects showed textile remains that have been identified as tabby weave and traces of feather and leather have also been identified (Malmius forthcoming).

The constitution of artefacts in the grave differs greatly from other chamber-graves at Birka. Horses occur in all cases save one of the so-called warrior graves, but in this grave no weapons were found.

Birka chamber-graves generally date to the 10th century but this grave must be considerably older, according to the stratigraphy and ^{14}C dates. The ^{14}C dates were obtained through sampling two of the teeth from

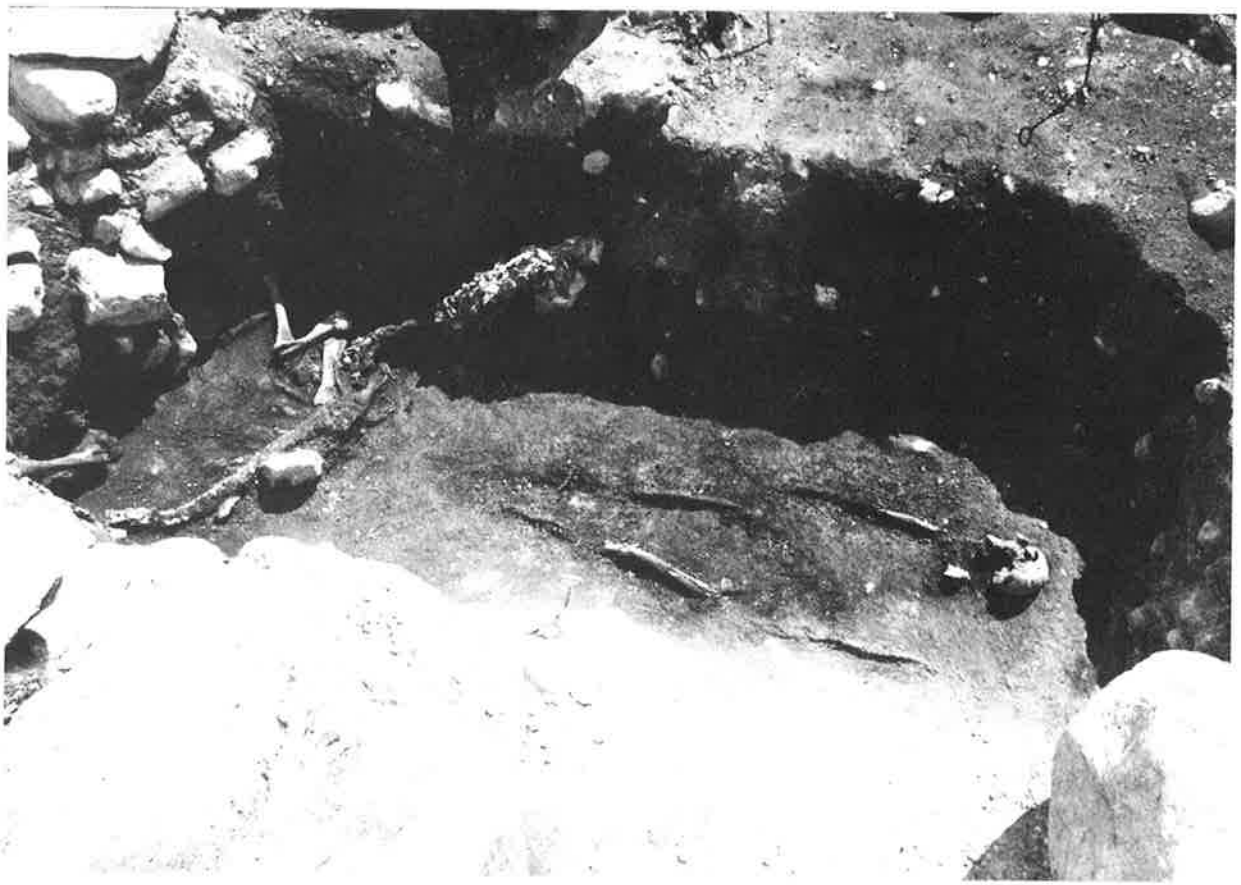

Figure 1. The chamber-grave found beneath the wall of the hill-fort of Birka. Excavated in 1997. Photo by Helena Fennö Muyingo.

the horse. They were dated to the 8th century, Ua-13239 1280±55 BP (calibrated 1 sigma AD 670–790), Ua-13240 1305±55 BP (calibrated 1 sigma AD 670–780). It is probable that it is one of the oldest chamber-graves at Birka. The grave must have been visible quite a distance from the town below and therefore of great symbolic significance when the rampart was erected. It is possible that it was a monument for a person belonging to one of the founding families of Birka.

DNA

By Anders Götherström

Molecular sex identification has been used for archaeological purposes for half a decade now (Hummel & Herrmann, 1991), but they are not frequent in Scandinavia, the first sex identification on Swedish material being published in 1997 Götherström et al. (Götherström et al. 1997), since then they have been applied to a variety of Swedish materials (Lidén, Götherström & Eriksson, 1997), (Götherström, 1997). The advantages with molecular sex identifications is that children and morphologically extreme individuals as well as small bone fragments can be sex identified; the disadvantages are the precautions that have to be taken against contaminations (Götherström & Lidén, 1998) and the fact that it is a destructive method, the bone (approx. 0.5g) that is used is destroyed.

There are a wide range of markers available for molecular sex identifications. Some are repetitive (Hummel & Herrmann, 1991), some are unique (Sullivan et al. 1993), (Götherström et al. 1997), (Kayser et al. 1997). The decision on which one to use depends on the quality of the material and the exact scientific question. It is generally good to use one unique marker and one repetitive, this will provide information on the preservation of the material and the higher certainty a repetition of a result provides. A marker for the X chromosome or one autosome should be used to prove that there is DNA present in the sample. In this case the question was simple and straight forward. Do the bones originate from a male or a female? I.e. is there a Y chromosome or not? The choice of markers in this analysis fell on DYS388 (Kayser et al. 1997), JR25/26 and an alpha satellite on the X chromosome (Hummel & Herrmann, 1991). DYS 388 is unique and short (less than 140bp), JR25/26 is short and highly repetitive and the alphoid is also short and highly repetitive, which is good when working with highly degraded ancient DNA. Thus if the bones belonged to a male and were well preserved all three markers would provide an indication whereas if the bones belonged to a female, still assuming acceptable preservation, only the alphoid would give an indication.

What preservation state the bones are in is crucial for the work, i.e. the results can never be better then the material allows them to be. Not much can be done about this, either there is DNA preserved in the tissue or there is not. The post excavational handling of the bones is of great importance for the preservation of DNA as well. Material taken from one environment to another may experience faster degradation due to new conditions, it may be an increase in oxygen levels or a different temperature. The material may also be treated in different ways that makes further analysis harder, e.g. exposion to X-rays (Götherström et al., 1995). To provide the best conditions possible the material used in this study was frozen directly after excavation, i.e. the reaction speed of the degradation processes was slowed down essentially so when the material was removed from the freezer for analysis it is much in the same condition as when excavated.

Material and methods

Three teeth were used for two extractions, one from a molar and one from a canine plus a incisor. The teeth were drilled from the root as described by Lidén & Götherström (Lidén & Götherström, 1997) and a phosphate based extraction method was used. The material was extracted (Lidén et al., 1997) and amplified with Ampli*taq* gold™ as described earlier (Götherström et al. 1997). However, in the case of DYS388 the sample was heminested and reamplified. Precautions against contamination were taken as described by Götherström & Lidén (Götherström & Lidén, 1998). The PCR products were electrophoresed on a 3.5% agarose gel.

Results and conclusions

Both samples gave positive indications concerning the X chromosomal alphoid and JR25/26 and one sample gave a clear indication on DYS388, the other sample was full of unspecific products so a possible DYS388 indication could not be detected. The blank showed no indications from the Y specific marker or the X specific marker.

The interpretation of the result is rather straight forward just as the question was, the teeth that were sampled belonged to a male individual (at least in a biological sense). The fact that DYS388 could be amplified provides information that the DNA is of good quality. The conclusion is that the chamber-grave excavated in the summer of 1997 at Björkö belonged to a male.

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