



# Metalcraft within the Nordic Bronze Age: Combined metallographic and superficial imaging reveals the technical repertoire in crafting bronze ornaments



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## ABSTRACT

The study presents two major approaches in the analysis of metal working techniques in the Nordic Bronze Age; a comparison of experimentally-crafted ornaments as a means of defining characteristic traces of known crafting techniques, and a scientific analysis (metallographic imaging) used to explain recognisable superficial crafting traces. This analysis results in a definitive explanation of superficial crafting traces through their specific microstructure and will thus be of significant interest for further research concerning prehistoric crafting. The metallographic investigation of 24 artefacts, which date to the early period of the Middle Bronze Age (around 1470–1290 BC) and originate in the central Lower Saxony region, revealed a much more varied technical repertoire in metalcraft than has previously been presumed. Superficial traces related to the crafting process and tested on experimentally-crafted bronzes indicated a mixture of cast technology and cold working. Thus, several samples indicated that the lost-wax technique was favoured within the Lüneburg group but, in addition, that intensive post-casting reworking was common. The high skill of Bronze Age metalworkers can be highlighted through the assessment of localized techniques applied to the artefacts, such as annealing or intensive cold working, without causing damage to the object. This knowledge of the technical possibilities of metalcraft in the Nordic Bronze Age allows for further research to concentrate on regional peculiarities using the traces of the crafting process presented here as a facilitating tool.

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## 1. Introduction

The Bronze Age in northern Europe is characterised by magnificent decorated bronze ornaments, swords and other weapons, deposited in elaborately constructed burial mounds or in rich depositions (e.g. Kristiansen and Larsson, 2005; Vandkilde, 2007, 65ff.; Holst and Rasmussen, 2013). This cultural unity, known as Nordic Bronze Age, shows a great variety of object forms and ornamentations between 1470 and 1290 BC, and, especially, a rich repertoire of female ornaments. Particularly of interest concerning the Scandinavian style, which was established around the NBA IB period (1600–1480 BC) (see Vandkilde, 1996, 264; Hornstrup et al., 2012) is the very early, putative use of a casting technique known as the lost-wax-method, or *cire perdue* (see also Herner, 1989, 129; Oldeberg, 1942, 1943). However, the development of the local Scandinavian as well as North German metal traditions are to be seen as a gradual process with a stage-by-stage

establishment of forms (Klassen, 2000, 271–294; Vandkilde, 1996, 1998, 2004/05).

Through intensive research and various experiments we have today a very accurate insight into the different possibilities within the techniques used for the crafting of bronze artefacts. The work of Hans Drescher (Drescher, 1953a, b, 1954, 1958) and Barbara Armbruster (Armbruster, 2012, 2010, 2000, 2003, 2001) is in this regard seen as a foundation of metalcraft research, as they offer explicit explanations of possible techniques and related documentable traces on the material. More specific research, such as studies regarding the application of decorative elements (Herner, 1989; Rønne, 2010, 1991, 1989; Rønne and Bredsdorff, 2008; Levy, 1991; Lowery et al., 1971; Savage et al., 1982), studies concerning casting technology (Armbruster, 1990; Goldmann, 1981; Uhlig, 2004; Mödlinger and Ntaflos, 2009; Born and Hansen, 2001, 189–191; Jantzen, 1991) and the distinctive reconstruction of the crafting of specific artefacts (Holdermann and Trommer, 2010; Meeks et al., 2001) has contributed important knowledge and extended our understanding of the technical possibilities of

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metalcraft in prehistory. In this respect, the generally accepted idea that the spirals on the Nordic belt-plates were often applied via a spiral-shaped stamp that was pressed into the soft wax-model of the plate (Rønne, 1989, 2010), or the characteristics of tool wear traces of decoration applied post-casting (Drescher, 1955, 133), should be considered amongst others as fundamental results within analyses of metalcrafting techniques.

Although the methods of crafting used in the Bronze Age have been extensively discussed (e.g. Sprockhoff, 1941; Rønne, 2010; Schwab et al., 2007), our knowledge concerning the organisation, structure and possibilities of Bronze Age metalcraft has developed in the last two decades to its present state by studying Bronze Age metalwork from a theoretical point of view, and thus allowed for consideration of the sensual and implicit part of craft (e.g. Nørgaard, 2014; Kuijpers, 2013, 2012; Ingold, 2000).

However, studies that unite scientific and archaeological methods on a large scale are rare, especially in northern Europe. Nonetheless, within the combination of macroscopic and microscopic crafting residues (including debris) lies the key to the understanding of metalcraft in prehistoric times (as shown for example by Berger, 2011; Bunnefeld and Schwenzer, 2011; Drescher, 1958, 116ff.; Northover, 1996, 321ff.; Jantzen, 2008; Kienlin, 2006, 2008). Thus, within this investigation, the basics for identifying the method of crafting Bronze Age metal artefacts are presented through two approaches; a juxtaposition of superficial traces of the applied techniques, and the imaging of their specific microstructures, in order to identify the techniques used within the Bronze Age of Northern Europe. Such an archive of traces can be used to make an important contribution to discussion around the socio-technical possibilities within the metalcraft of the Nordic Bronze Age. Embedded in a theoretical approach based on the *craftsman's habitus* it should be demonstrated that the knowledge of crafting techniques and related traces can reveal regional and individual differences, which here are presented with a focus on the Lüneburg region in Niedersachsen.

## 2. The crafting of Nordic Bronze Age ornaments

The ornaments under investigation are all of Nordic origin, dating between 1470 and 1290 BC, and have been found in burials and depositions, commonly accompanied by a high volume of other well-crafted artefacts. The source material was critically examined based on dissemination within the study area and its chronological as well as typological classification (Nørgaard, 2011; Aner and Kersten, 1973, 1978, 1979, 1991, 1993) in order to secure that the identified technical repertoire used to craft these artefacts derives from local knowledge and, therefore, that specific traces can be related to each other. As such, deviations in techniques should be considered to have been due to specific regional technical traditions (see Nørgaard, 2014). The theoretical basis for this assumption is rooted in the fundamental idea by E. Panofsky (1951) and M. Mauss (1979, 101) concerning the concept of *habitus*. Further developments in regard to understanding of the craftsman's *habitus* (e.g. Wendrich, 2012, 3; Dobres, 2000, 138) allows the argument that when *habitus* is seen as a combination of the craftsman's capabilities with experiences and the imprinting (absorption of all kinds of influences) - which happens to every craftsman - this concept is suitable for the explanation of underlying behaviours in craft. Consequently, the *habitus* of a craftsman can be seen as a mirror of the technological knowledge of a group due to the fact that through the learning process and the direct transfer of gestures and steps the traditions and ideologies were handed on. Accordingly, this technological knowledge creates the frame of the *habitus*, the individual aspect is given by the craftsman's skills and his ability to receive and process knowledge (Fig. 1).

However, first and foremost, residues of the crafting process should be interpreted correctly as only then can the technical repertoire of a specific region be defined and inferences concerning the technical knowledge of social units be compared.

### 2.1. Superficial crafting traces

To distinguish between traces derived from cold working and traces which occurred while making models and casting bronzes, the study compared two kinds of experimentally-produced spiral-decorated belt plates similar to the plates found around 1430 BC in the Scandinavian burial mounds (Nørgaard, 2011). Of particular interest for this visual analysis was the belt plate probably made by the goldsmith Boas in the 1890s, which was crafted using only bronze tools with a similar alloy as that of the plate (see Müller, 1897, 257–258; Rønne, 1989, 129), as well as another plate with a similar pattern made via *cire perdue* casting. Both plates are in the custody of the *National Museum in Copenhagen* (Fig. 2). Due to the fact that the basic physical properties of the material (for example the melting point of the copper alloy) are consistent regardless of chronology, it was possible, using these two items, to directly compare the two most widely-used metal working techniques of the Middle Bronze Age in order to create an inventory of crafting traces (see Fig. 3) which will facilitate the craft technical investigation of Bronze Age metal artefacts. The method used here was a visual documentation via macroscopic images of specific details using a Canon EOS 450D SLR camera and a Sigma EX 105 mm 1: 2.8 DG Macro lens, and in which the metal-technical background of the author was crucial for the interpretation.

#### 2.1.1. Results: superficial differences between cast and cold worked ornaments

The comparative study of the belt plates yielded several differences related to crafting techniques which are shown in Fig. 3.

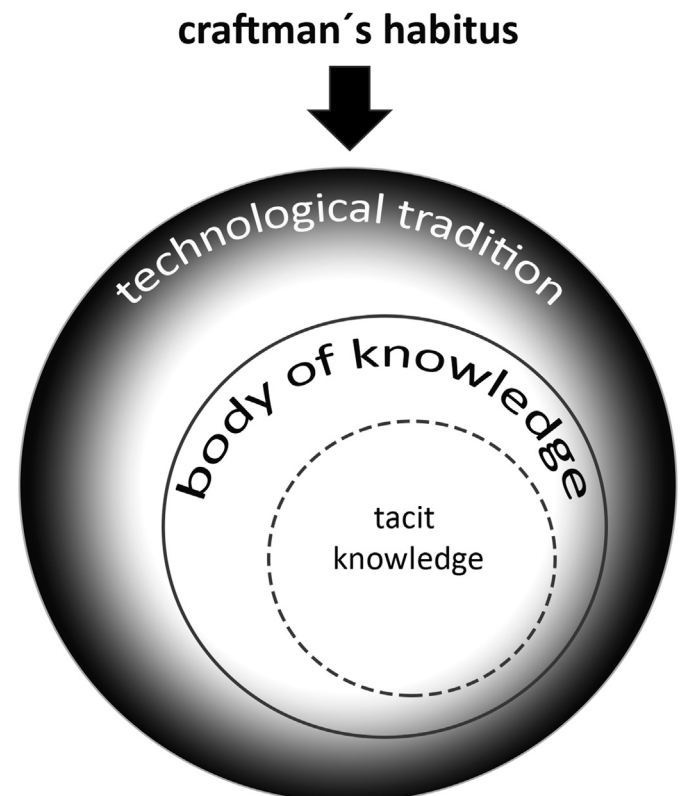


Fig. 1. The scheme visualises the single components of the craftsman's habitus.

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