**Combs and Contacts: past and future work on society and economy via worked-bone artefacts and craft**

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**ABSTRACT**

This paper reflects upon the author’s work on Viking-Age combs and combmaking, and proposes an agenda for future study. Previous work has considered practical problems such as the development of typochronology (Ashby 2011a), as well as issues relating to trade and culture contact, by way of studies of form and ornament (Ashby in press-a, Ashby 2009), methods of manufacture (Ashby 2013b), and raw materials ([Ashby 2009](#_ENREF_1); von Holstein et al. 2013). The latter holds especial potential, particularly given the development of high-throughput, low-cost biomolecular methods. Having identified the utility of these methods, it remains to highlight the issues on which this approach may be brought to bear. This is the aim of this paper, and in laying out an agenda for research, it introduces the incipient SAAGa project.

**COMBS: from chronologies to communities**

The hair comb is one of the most frequently recorded bone artefacts found on early-medieval sites in northern Europe. Thanks to a long period of study, it is now well understood in chronological terms (see Ashby 2011a for a review). Moreover, it is central to discussions about trade and urbanism, particularly in Scandinavia (e.g. Christophersen 1980; Hansen 2005). Its manufacture is thought to be well understood (e.g. Galloway and Newcomer 1981; Ambrosiani 1981), but few synthetic, multi-site studies have been undertaken: fewer still studies in which waste material is considered (see Ashby 2013b). A coherent approach that searches for variations not only in form, but in technological process and raw material exploitation, will allow differences in manufacturing practice, rather than just aesthetic fashion to be identified. This clearly has implications for the organisation of craft and trade across Europe and the North Atlantic, and has been the focus of my work over the last decade.

This paper reflects on the work undertaken to date, and sets an agenda for future study. Previous work has: considered methodological problems (Ashby 2005; Ashby 2013c); surveyed temporal and spatial variation across Europe in order to present a typochronology (Ashby 2011a); problematised the organisation of comb production and trade in England (Ashby 2012) and Scotland (Ashby in press-a); investigated the logistics of securing access to raw materials (Ashby 2013a); and proposed new interpretative frameworks for the study of combmaking, as models for research into a wider range of crafts and industries (Ashby 2011b; Ashby 2013b; Ashby in press-b). Research has also moved beyond combmaking itself, and considered the lives of combs as biographies, involving interactions with various people, places, and things (Ashby 2014). As a result, it is now clear that a single generalising model for the organisation of the comb trade cannot be applied to the entire ‘viking world’. While some level of mobility may be inferred to explain the production of combs at the early Viking-Age entrepots or ‘nodal points’ of the Baltic, it is clear that the Anglo-Scandinavian combmakers of the Danelaw were not part of the same system. Moreover, the situation seems to have undergone fundamental change in the 10th and 11th centuries, at which point local variation becomes more easily apparent in form and technology. Indeed, the technological and aesthetic differences between the manufacturing traditions of central and northern Scandinavia on the one hand, and the southern Baltic and British Isles on the other, are striking (Ashby in press-a). These insights are significant not only in the study of combmaking, but also have implications for our broader understanding of trade, urbanism, and economics in the Viking Age.

Moreover, there are ways in which research into combs may allow us to more directly address the big questions of Viking-Age archaeology, particularly where these key into debates about the nature of culture contact in the early Viking Age (*cf* Myhre 1993)*.* For instance, work in Orkney has allowed recharacterisation of the nature and chronology of Norse contact in Atlantic Scotland (Ashby 2009; von Holstein et al. 2013), while ongoing research has implications for the nature of Baltic exchange networks (Ashby et al. in prep, and see below). These latter studies have come to incorporate an important suite of analytical tools taken from biomolecular research. Indeed, it is in the use of these techniques alongside more traditional morphological studies, and the technological approaches I have outlined elsewhere (e.g. Ashby 2011b; Making Ashby 2013b), that the greatest contribution to Viking archaeology is to be made. The developments are new, and there is a pressing need for the development of research questions that may be cogently addressed by application of the approach, but having identified antler as a material with sufficiently high biogeographical resolution for sourcing, for the first time in several decades we are in a position to use comb data to address long-standing problems relating to trade, mobility, and culture contact. In what follows, I will outline some of the ways in which I believe this will be possible.

**Sourcing Antler and Artefact Geographies**

One particular biomolecular method holds significant potential: a proteomic technique for the identification of raw materials, known as Zooarchaeology by Mass Spectrometry (ZooMS) (Van Doorn et al. 2011, Buckley et al. 2009). This method uses Time of Flight Mass Spectrometry to analyse collagen extracted from a tiny (1mg) sample of powdered bone or antler, and to produce a ‘peptide fingerprint’. This fingerprint may be distinctive to family level, species, or groups of species. In short, the technique allows the raw materials of an object to be identified much more efficiently, and with a higher success rate, than with ancient DNA, though at a lower resolution. Having established the right questions, then, ZooMS will open up genuinely new areas of research.

The approach holds particular potential in the study of Viking-Age combs. Such combs are usually manufactured in deer antler, which means that the range of species that may be present in a collection is tightly constrained. The presence then of red deer (*Cervus elaphus*), reindeer (*Rangifer tarandus*) or elk (Alces alces) - all of which have discrete biogeographic distributions -has important implications for the movement of artefacts, or of the raw materials used in their manufacture. This method has been well tested on finished objects (von Holstein et al 2013) and on working waste (Ashby et al. forthcoming), but has yet to be applied on coherent collections of both types of material. This is the aim of the Sourcing Antler: Artefact Geographies (SAAGa) project.

**METHODS**

Sampling for ZooMS analysis is minimally destructive, furnishing the approach with great utility in the study of finished objects (even museum display pieces). Sampling may be undertaken by soaking the target object in an ammonium bicarbonate buffer solution (Fig 1), or by gentle surface abrasion, but for worked bone our preference is for sensitive use of a drill. After first removing any surface contamination, a small quantity (~10 milligrams) of powder is extracted, using a handheld diamond-tipped drill. The sample size is sufficiently small that samples may be taken from rear surfaces, comb teeth, or broken edges as is appropriate, in order to minimise intrusive damage. It is possible to sample loose fragments of comb, but this should only be undertaken when the association can be demonstrated (through, for example, cross-mending), while for some combs it may be necessary to take samples from both the connecting plate and the teeth (if there is as suggestion that different material may have been used in each). The powder from each comb is collected in sterile 500ml centrifuge tubes, and couriered to the BioArCh laboratories at the University of York, UK for ZooMS analysis.

Analysis targets the protein (collagen) element of the powdered antler, which is sequenced using MALDI-Time of Fight mass spectrometry. through laser absorption??, it is possible to measure the peptide masses that characterise the sample, and produce a ‘fingerprint’ spectrum that may be unique to a species or group of species, and which may be compared against a reference library.

As a safeguard, items are also identified by eye. In many cases it is impossible to make a reliable species-level identification by macroscopic techniques alone (see Ashby 2009; Ashby 2013), but bone and antler are often more easily distinguished, particularly when areas of cancellous tissue are preserved (see Penniman 1952; O’Connor 1987). Thus, where a ZooMS identification gives us a result of (for example ) ‘reindeer/ goat’, a macroscopic idetnification may be undertaken to determine whether the material is postcranial bone or antler.

**WORK UNDERTAKEN TO DATE**
To date, the ZooMS methodology has been applied in a number of pilot studies, each with significant implications. The approach was initially trialled on a large collection of worked bone from the early-medieval site of Burdale, Yorkshire (fig 2; see also Hounslow et al. 2013: 204). This demonstrated the overwhelming use of local materials (particularly postcranial bone from domestic mammals), but more importantly it provided a proof of method. The method has since been blind tested against macroscopic genetic techniques; it was demonstrated that ZooMS outperformed macroscopic analysis, and directly replicated the results of aDNA, while producing useful spectra in a larger number of cases (von Holstein et al. 2013). This study was also the first meaningful application of ZooMS to an important archaeological question: we addressed the debate surrounding the chronology of Scandinavian contact with Atlantic Scotland, and demonstrated the misidentification in previous analyses of a significant number of objects. Ongoing work includes the study of combs and combmaking waste from the sites of Aggersborg, Aarhus, and Ribe, which is allowing us to date the onset of maritime expansion in the early Viking Age, and to characterise movement and culture contact throughout the period (Ashby et al. in prep.).

To provide a little more detail, a brief case study from this research will be outlined. The work has been undertaken as part of the *Entrepot* project directed by Søren Sindbaek, and has allowed us to investigate the idea of reindeer antler as a northern commodity arriving in the markets of central and southern Scandinavia, from where it will have been used in the manufacture of objects such as hair combs**.** Applying the ZooMS methodology, analyses undertaken by Ashley Coutu, Soren Sindbaek, and myself allowed us to identify the species of a significant number of samples taken from well-stratified workshop material in 8th- and 9th- century phases at Ribe’s *Posthuset* site (see Feveile 2006; Feveile and Jensen 2000). The results will be published in due course, but it is possible to say that from over 200 samples tested, little of the material from the early phases appears to constitute imported antler. However, reindeer antler does appear to make its presence felt in workshop debris from the late 8th century onwards.

This influx appears to predate the arrival of other imports from the Scandinavian north, but coincides broadly with the traditional start of the Viking Age, defined on criteria such as the Anglo-Saxon Chronicles’ records of the first monastic raids, and (slightly earlier) the arrival in northern Europe of large quantities of Arabic silver coinage and oriental glass beads. This arguably suggests that Ribe was an important nodal point from the very outset of the Viking Age (however defined), and that parts of the Norwegian outfield were keyed into the otherwise ‘urban’ exchange network that characterised the Viking-Age Baltic. This research, then, clearly has implications for how we might model the development of the North European economy. Together with the work undertaken elsewhere in Denmark, England, and Scotland, is sufficient to demonstrate the approach’s feasibility, reliability, and transformative potential. The next task is to identify further questions that may be addressed using this methodology. Below, I introduce a number of projects on which I am currently undertaking scoping work.

**PLANNED WORK AND POTENTIAL**

In detail, the SAAGa project aims to address 4 important questions:

*Pre-Viking Comb Dynamics*

The first question addresses the centuries leading up to the Viking Age; a context whose discussion is dominated by debates about culture contact between various north Germanic tribes. In traditional culture historical terms, these groups are represented by suites of distinctive artefacts, among which combs are central. Distinctive artefact forms are taken to be representative of particular groups, but we know that there is no 1:1 relationship between material culture and ethnicity. Careful consideration of species (which will tell us from where an object’s materials were sourced) and technological process (which will tell us under what tradition it was manufactured) will add clarity to a narrative that at present is painted in very broad brushstrokes.

*The Arrival of Early Viking-Age Combs*

Moving into the Viking Age itself, a key concern is the origin of the earliest ‘viking’ combs in northern Europe. The Ambrosiani A (Ashby Type 5) comb is central to understanding the growth of trade and urbanism in the late 8th and 9th centuries. The origins of the type are variously believed to lie in Frisia (coastal continental Europe; Callmer 1998) and Scandinavia (particularly the north; Ambrosiani 1981). Close comparative analysis of technology and raw material will allow this question to be definitively answered. Well-dated material from key early urban sites such as Kaupang, Ribe, and Dorestad will allow us to track the dynamics of production and export, and the resultant model will have important implications for how early Viking-Age trade is conceived of more generally. This is a key argument in early-medieval scholarship: it amounts to a question about what caused the Viking Age, and from whence came its impetus.

*Viking-Age Comb Dynamics in the British Isles and Southern Baltic*

In the 10th century, there is a particular need to characterise the trade dynamics of what has been referred to as an urban and craft revolution. Certain comb forms (Ashby type 8) are common in Ireland (particularly Dublin), while also being recorded in England, as well as in the southern Baltic region, where they appear in some numbers (Ashby 2011a; Dunlevy 1988; Cnotliwy 1970). Contemporary forms in northern Scandinavia are different in both form and technology, but the types must be related. Nonetheless, there is something of a schism across the Baltic, which if verifiable in material terms has important implications for the nature of contact and trade in the Viking Age. ZooMS will help us to address this problem.

*Combs and the Colonisation of the North Atlantic*

The end of the Viking Age also has its own discrete questions: most notably regarding characterisation of the networks of export and population movement that tied together Scandinavia and the islands of the North Atlantic. In the late Viking Age and medieval period, combs began to be produced on an unprecedented scale, in the towns of western Scandinavia in particular. These combs were intended not just for home, but for export to the colonies in northern Scotland, the Faroes, Iceland, Greenland, and (to a lesser extent) England and Ireland (*e.g.* Amorosi 1992: 117-21; Ashby and Batey 2012; Batey 1987; Clarke and Heald 2002; Dunlevy 1988: 367-9). Morphologically there is much variation in these combs, though the collective outputs of Scandinavia’s medieval towns all tend to look very similar. Some writers have seen close similarities in objects far removed from on another in space, and have explained these as ‘twin products’, ostensibly made by the same hand (e.g. Hansen 2005: 180-184). Material and technological analysis will allow us to verify this assertion. It will be informative to determine the degree to which Scandinavian crafted objects were really brought to the colonies: were they actively imported, or do smaller quantities suggest that most examples constitute the possessions of individual travellers? Is there evidence of local imitation? Collections from Scandinavia, the British Isles, Ireland, the Faroes, Iceland, and Greenland will be interrogated in order to address these questions.

In all of this, it is important that traditional artefact skills are utilised alongside biomolecular techniques, and that the focus is not just on the artefacts themselves, but also on the debitage associated with manufacture. In studying both finished product and waste product, in drawing on approaches more commonly applied to prehistoric assemblages, in uniting traditional typological method with novel approaches to the study of ancient technology (developed by Ashby 2006), and in applying leading edge biomolecular techniques, the project’s methodology is innovative and potentially transformative. Coupled with sophisticated theoretical approaches to the social content of technology (see Ashby 2013), this focus will allow the analysts to address a number of previously unanswered questions that are central to key themes in Viking-Age archaeology.

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