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The Portable Antiquities Scheme and the potential of non-metallic finds: A Viking Comb from Shotley, Suffolk

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This article presents a case study in maximising the potential of publicly collected archaeological finds, through collaboration between finder, recorder, curating institution and the research community. It focuses on an object reported to the Portable Antiquities Scheme, of a type not usually well represented among metal-detected finds: an early-medieval antler hair comb. Typological and biomolecular analysis of the comb - found on the shores of the river Orwell, Suffolk - shows that it was manufactured in Scandinavia in the mid-10th century, before being brought to south-east England. This is the first comb found in England to be identified as Scandinavian via biomolecular means, and represents an important, scientifically-verified demonstration of contact between the regions in the period following initial settlement.

The Shotley comb. Image credit: Suffolk County Council, CC-BY-SA

1. Introduction

This article presents a case study in the use of publicly collected data; more particularly, it explores the potential contribution that can be made through collaboration between metal-detectorists, museums, and archaeologists. Unusually, the focus here is on a non-metallic object, an antler hair comb of early-medieval date, highlighting the value that can be drawn from the Portable Antiquities Scheme data beyond the study of personal metalwork.

Following an introduction to the Portable Antiquities Scheme and non-metal finds, a consideration of the circumstances and context of the object's discovery is given, before presenting the comb itself, through typological and morphological analyses, digital representation, and raw material analyses. The closing section provides a context for the comb's presence in 10th-century East Anglia.

1.1 The Portable Antiquities Scheme and non-metallic finds

Since its inception in 1997, the Portable Antiquities Scheme (PAS) has recorded over 1 million archaeological objects across England and Wales. Although a large proportion of these are metallic artefacts discovered by metal detectorists, important discoveries of non-metal finds have also been made. These usually manifest in the form of ceramics or lithics encountered coincidentally by detectorists on terrestrial sites, although objects manufactured from organic materials are also represented. It is often the case that the latter are encountered in riverine, marine or foreshore locales, where the potential for preservation in wet, anaerobic environments is much higher. The Thames foreshore is a key contributor to finds from this category, though not by any means the sole provider.

The PAS annual report for 2019, the last 'normal', pre-COVID year of finds recording , gives a total of 81,602 objects recorded across the entire scheme. Of these, only 1311 qualified as Treasure (finds which due to a combination of their age, precious metal content, number and association are legally required to be reported by their finders, so that local or national museums can ascertain acquiring interest (see Lewis 2016)). Although attention in the popular press is often focused on these Treasure finds, significant objects which do not qualify as Treasure (and thus lack the legal obligation to be declared) are no less important, and have at least as much, if not more potential to alter our archaeological understanding of the past. Key examples of PAS-recorded finds which are not Treasure, yet which have contributed enormously in this regard include the iconic Happisburgh handaxe from Norfolk (NMS-ECAA52), a Roman curse tablet from Ratcliff, Leicestershire (LEIC-6874E9) and a Gallic Late-Iron-Age coin die used to manufacture potins from Steventon, Hampshire (SUR-08FD05). Moreover, the PAS has recorded innumerable finds less headline-grabbing than these unusual objects, yet which hold important interpretative potential.

Hand-in-hand with the voluntary reporting of significant non-Treasure finds is the preservation of these objects for the future by their donation to an institution for further study. Scenarios such as these exemplify best practice by finders after initial discovery and reporting; donation not only allows finds of importance to be conserved, preserved, curated and displayed for the public, but also facilitates access for research and analysis, including the application of leading-edge analytical and imaging techniques from digital heritage and the natural sciences. In recent years, finds acquired by this mechanism have seen some attention, such as the early-medieval hanging bowl mount from Patching, West Sussex (SUSS-F9E7AA) which was donated to Littlehampton Museum and subsequently featured in the British Museum's nationally acclaimed 2016 'Celts' exhibition.

In this article, we present a find which encompasses the above principle perfectly: an incomplete Viking-age comb discovered on the Orwell foreshore near Shotley, Suffolk. The comb is an everyday object made of organic materials, but is of a form rarely found in England. Through the generosity of the finder in donating it to SCC Archaeological Service, it has been possible to undertake typological and biomolecular analyses that allow the comb to be recognised as an object not manufactured locally, but rather reaching the area from Scandinavia via travel or trade. Though one might not be surprised to find such objects in East Anglia, this is the first time that a comb from England has been scientifically confirmed as a Scandinavian product (compare von Holstein *et al*. 2014; Ashby *et al*. 2015; Muñoz-Rodriguez *et al*. 2023), and thus represents an important step forward in attempts to further our understanding of long-range contact and mobility in the North Sea area.

In addition to its particular contribution to our understanding of culture contact in Viking-Age Britain, this article serves to remind us of three key points. First, the PAS should not be seen solely as a repository for records on metallic finds: lithic, ceramic and organic objects found by members of the public make equally important contributions to our understanding of the past, and must be accorded similar attention. Second, the importance of archaeological objects recorded by the scheme is determined neither by their precious metal content, nor by their legal status as 'Treasure'. Third, that cooperation between responsible members of the public, Finds Liaison Officers and academic researchers can pay dividends in furthering our understanding of the past through best practice procedures, allowing detailed and focused analyses of individual artefacts to be undertaken.

2. Find Circumstances

Figure 1: Map showing the approximate location of the comb's findspot. Image credit: Aleks McClain

On 5th July 2018, Mr Ian Saunders recovered an antler object from the banks of the River Orwell on the Shotley peninsula in coastal Suffolk (Figure 1), and reported it to the Suffolk Finds Liaison Officer at the time, Alex Bliss. Though unstratified, this stretch of shoreline had been walked repeatedly by the finder in the past, and a number of sherds of medieval ceramics and CBM had been recorded by Suffolk County Council Archaeological Service, including some Ipswich and Thetford wares. Interestingly, in studying Viking-Age metalwork from across England, Jane Kershaw has drawn attention to a brooch in the Urnes style found at Shotley (Kershaw 2009, 307). Together, these finds grant us some confidence that though the comb was not found *in situ*, its presence is indicative of nearby Late-Saxon period activity, rather than having been washed downstream from far inland.

Measuring 156.8mm long, with maximum widths and thicknesses of 12.83mm and 4.06mm respectively, and made of bone/antler, the object was identified by Bliss as the connecting plate of an early-medieval composite comb (Figure 2).

Figure 2: (a) Image of the comb. Image credit: Suffolk County Council, CC-BY-SA and (b) Drawing of the comb. Image credit: Donna Wreathall

Following consultation with Ian Riddler and Steve Ashby, the object was recorded with the Portable Antiquities Scheme (PAS database number: SF-F4B784). The comb was generously donated by the finder to Suffolk County Council Archaeological Service. This allowed the authors to study the comb more carefully, to undertake biomolecular analyses, and to make digital visual records of the item. This article presents this work.

3. Form and Ornament

The piece is well-preserved, and represents the complete connecting plate of a single-sided comb (see Figure 3 for a terminological overview of basic comb morphology). It is plano-convex in profile, with a shallow plano-convex cross section. Under magnification, the reverse of the plate reveals porous tissue that is consistent with antler, rather than bone.

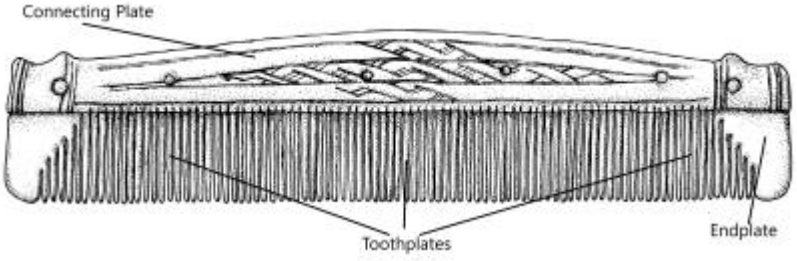

Figure 3: The key elements of a single-sided composite comb. Image credit: Pat Walsh

Though no toothplates remain, the presence of eight perforations (two of which retain remnants of the original iron rivets) confirm the identification of the object as one of two original connecting plates from a composite comb. The basal edge of the plate is marked with sawcuts from the cutting of teeth, at a gauge of 5-6 teeth per cm (a fairly typical tooth value for an early-medieval comb). The cuts are of an even, symmetrical form that suggests care and skill in manufacture; these are deliberate, aesthetically pleasing incisions, rather than the haphazard results of over-enthusiastic sawing.

The reverse of the plate is unmarked except for some residual traces of finishing with a file, but the obverse features quite unusual decoration, consisting of a relatively crudely-cut marginal border, enclosing a large inner panel. Within this, the central decorative field is not well-defined (as it commonly is on Viking-Age combs from across northern Europe), but rather features coarse but well-executed interlace motifs situated above and below a pair of simple ribbons that extend longitudinally along the centre line of the connecting plate.

The overall form, ornament and technology are consistent with a comb produced in the 9th- to mid-10th centuries. The above description would find close parallel in the combs commonly referred to as 'A'-combs (Ambrosiani 1981). However, the dimensions are not in accord with most such combs. 'A'-combs are generally over 180mm in length, yet this example is a diminutive 156mm long, and (even more starkly) only 12mm wide at the centre. Moreover, perhaps the closest UK parallel for the ornament on this comb in fact comes from an Ambrosiani 'B' comb and associated case from a 10th-century grave at Skaill Bay, Orkney (Watt 1888).

Combs featuring these decorative motifs and schemes are better known in Scandinavia, however, and in terms of ornament this example compares well with Callmer's type 32 (Callmer 2020, 158–60, fig. 7.10, 32B and 32C) i.e. small combs with a large central metope (although the Shotley example remains rather narrow, and lacks the decorative terminals of Callmer's example). Callmer dates the emergence of this form to the second half of the 9th century (Callmer 2020, 158), but while his published classification only runs to around 900CE, he confirms that Type 32 persists into the 10th century, and that this comb represents a good example of this type, featuring the same decorative motifs, but arranged into two fields, and crucially featuring recognised morphological developments of the 10th century such as the narrowing of the connecting plates, loss of zoomorphic terminals, and closer spacing of rivets (Callmer pers comm.). Close parallels are known only from the harbour excavations at Hedeby, where Callmer has identified six examples (including two cases) that fit the description (B 79; b 100 Sch II; C 66 (case); D 53 Sch IV (case); E 26 Sch I; E 42 Sch III). The contexts for all these finds are layers II-IV, and an early/ mid-10th century date is likely, particularly given their absence in Hedeby's settlement excavations, where the uppermost layers have been lost to agriculture. The Shotley example then seems likely to have been produced in Scandinavia or northern Europe around this time, arriving in Suffolk by means of trade or, perhaps more likely given the form's rarity in Britain and Ireland, personal travel.

4. RTI and 3D Modelling

4.1 RTI

Reflectance Transformation Imaging (RTI) is an image-based relighting technique, employed with the aim of visualising the appearance of a surface under a spatially variable source of illumination (see Malzbender *et al*. 2001; MacDonald 2011). Using camera images taken from a fixed position, but each lit by a point source with known coordinates, the object can be virtually illuminated using algorithmic software. This allows the user to move the light source across the surface of interest, supporting close inspection of texture and fine details of manufacture, ornament, and wear.

This technique is now well-established as a method in the 2-D representation of an object's 3-dimensional reflectance properties. It has been effectively applied to the study of sculpture (e.g. MacDonald 2011; Andreeff and Potter 2014; Jones and Smith 2017; Smith *et al*. 2018), inscriptions (e.g. Jones and Smith 2017; Smith *et al*. 2018), and artefacts (MacDonald 2011; Andreeff and Potter 2014).

ONLINE ONLY

Figure 4a: RTI Image of the Shotley comb (Comb_Obverse_cropped_4502)
View reverse RTI Image of the Shotley comb (Comb-Reverse1_cropped_4501. Opens new window)

Here, we present the comb plate via an RTI viewer (Figure 4), allowing the viewer to remotely inspect the detail of the object's manufacture, ornament and wear including features not visible with the naked eye. Close inspection of the incised decoration, for instance, shows that the unevenness of definition is a result of wear and post-depositional taphonomy; where it is well-preserved, the ornament is clearly laid out and carefully finished.

4.2 3D Modelling

3D modelling is a well-established tool used in the visualisation, presentation and analysis of archaeological artefacts, and may be undertaken using photogrammetry, laser or CT-scanning (see Wyatt-Spratt 2022 for a recent review). Here (Figure 5) we apply structure from motion (SfM) photogrammetry, in order to preserve the object in an openly-accessible, digital format, with a view to future research. Whilst the term photogrammetry may be used as a broad term referring to any process by which measurements are obtained through photographic images, SfM refers specifically to the process of estimating the 3D structure of a subject from a collection of multiple 2D images.

ONLINE ONLY

Figure 5: Viking-Age Comb from Shotley, Suffolk by University of York Archaeology on Sketchfab

RTI and 3D modelling offer different opportunities for the recording and visualisation of data, and here we offer both, by way of comparison. For this particular form of artefact, it appears that RTI provides a more satisfactory result, as the size of the object confounded attempts to precisely render small details such as tooth cuts and perforations in the 3D model.

5. Biomolecular Analysis

In recent years it has become possible to indirectly provenance antler combs via the biogeographical sourcing of raw materials. Using a process known as ZooMS, minimally destructive sampling of bone collagen makes it possible to distinguish red deer (*Cervus elaphus*) and reindeer (*Rangifer tarandus*) antler (Buckley 2018; Hendy 2021). A number of important archaeological applications have been found (e.g. von Holstein *et al*. 2014; Ashby *et al*. 2015; Luik *et al*. 2020). The proteomic protocol was applied to this comb by Lewis Tomlinson, supported by Jessica Hendy and Samantha Presslee.

5.1 Method

The comb was sampled by one of us (SPA), with powder scraped off with a scalpel from the reverse of the connecting plate before being prepared using the bone sample preparation protocol outlined in Presslee *et al*. (2020). In brief, the bone powder was demineralised in 0.6 M hydrochloric acid (HCl) for 72 hours, washed in 0.1 M sodium hydroxide to remove any humic contaminants and three times in 50 mM ammonium bicarbonate (Ambic). The sample was heated at 65°C for 1 hour to allow any available collagen to solubilise into solution, followed by digestion overnight using 1 µL of 0.5 µg/µL porcine trypsin in trypsin resuspension buffer (Promega, UK) at 37°C. The digestion was stopped by the addition of 1 µL trifluoroacetic acid (TFA) at a concentration of 5%. The sample was desalted using C18 zip-tips and eluted using 100 µL of 50% acetonitrile (ACN)/0.1% TFA (v/v). The zip-tipped sample was spotted in triplicate onto a MTP384 Bruker ground steel MALDI target plate. 1 µL of sample was pipetted onto the sample spots before being mixed with 1 µL of α-cyano-4-hydroxycinnamic acid matrix solution (1% in 50% acetonitrile / 0.1% trifluoroacetic acid (v/v/v)). The sample was analysed on a Bruker Ultraflex III MALDI-ToF mass spectrometer. The resulting spectra was analysed using mMass, an Open Source mass spectrometry interpretation tool (Strohalm *et al*. 2010). The three spectra for the sample were averaged, followed by peak picking (signal/noise set at 6) and cropping (800-3500 m/z). Further details are provided in Tomlinson (2020).

5.2 Results

The comb was found to be made of reindeer (*R. tarandus*) antler. This is consistent with acquisition of raw materials in central or northern Scandinavia, and perhaps western Scandinavia (present-day Norway) is most likely.

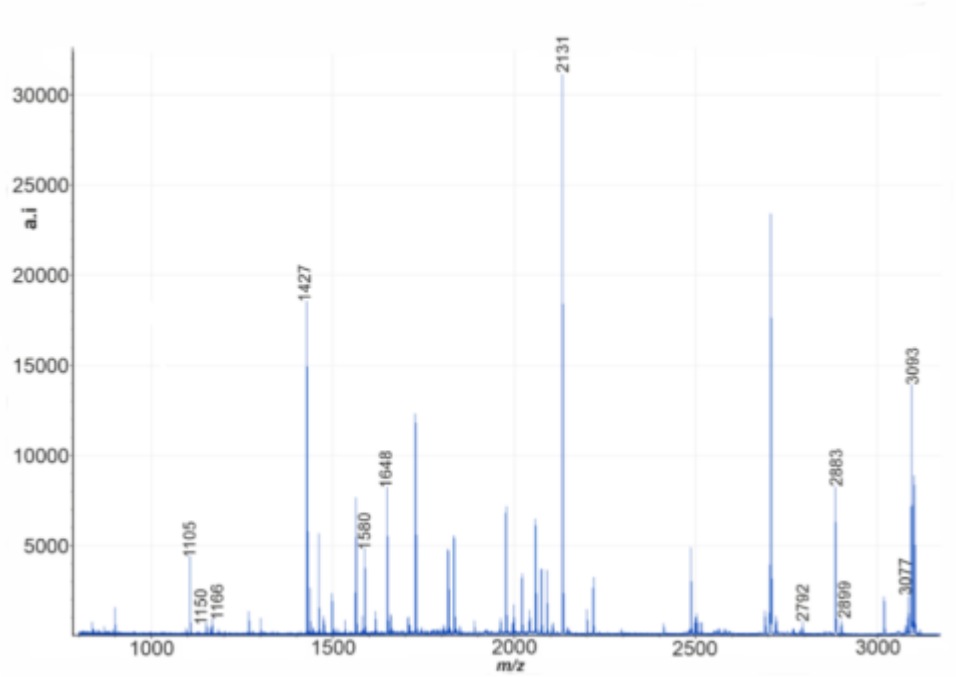

Figure 6: The MALDI-ToF spectrum of the comb. The *m/z* values used to make the identification of Reindeer are annotated on the spectrum (Buckley and Collins 2011; Welker *et al*. 2016). Image credit: Sam Presslee

6. Discussion

The comb is of Scandinavian material, form and ornament, and most likely dates to the early/mid-10th century (what we might broadly define as the Middle Viking Age). Found on the Shotley peninsula, close to Felixstowe (a gateway to East Anglia from the North Sea), it constitutes an important piece of evidence for contact between Scandinavia and this part of East Anglia, and one of a small number of non-metallic finds from the area.

It is conceivable that the comb was the property of a visitor to the region, or of one of its settlers. The Great Army landed in East Anglia in 865 CE, and the area continued to be a theatre for conflict through the 9th century, with the Anglo-Saxon Chronicle even making reference to a maritime confrontation at the mouth of the Stour, as Alfred's fleet engaged a large number of Scandinavian 'pirate' vessels (Giles 1912, entry for AD 885). The comb's distinctly Scandinavian form, ornament and material might lead one to draw upon these events to provide a backdrop for the comb's loss, but its typological date suggests a different, later context. Rather, the comb brings us tangible evidence of contact with Scandinavia - or at least with individuals who had been in Scandinavia - in the mid-10th century. Evidencing the persistence of Viking-Age contact and communication between Scandinavia and Britain and Ireland has proven difficult (see Abrams 2012; Jesch 2015 on the concept of diaspora), even given the existence of a significant corpus of metal-detected finds from eastern England (all of which is provenanced on stylistic, rather than scientific grounds). Moreover, although Kershaw (2013) has identified large numbers of Scandinavian

and Anglo-Scandinavian finds in East Anglia, relatively few 9th- and 10th-century Scandinavian objects are known from Suffolk, with pieces decorated in the Borre- (late-9th to late 10th-century) and Terslev (early 10th- to 11th century) styles being rare in this coastal area. The find thus holds some considerable significance for the archaeology of the region.

On a national level, this study is important in providing the first biomolecular evidence for the use of Scandinavian combs in England. If one were to take the source of material as the provenance of the comb itself, then the recognition of antler only naturally available in upland Norway and Sweden might mean that the comb arrived in the region - whether via trade or as the property of an individual traveller - from Scandinavia. Western Scandinavia would probably be most likely on geographic grounds, and this would be consistent with recent human genetic studies that have argued for the existence of a Norwegian component to the late-9th-century settlement of England (Margaryan *et al*. 2020). This is of course difficult to demonstrate unequivocally, as the degree to which raw materials were circulating between urban production centres remains unclear (see Ashby *et al*. 2015), and the fact that the comb's morphology and ornament are best paralleled in southern Scandinavia might suggest that the comb was manufactured at a site such as Ribe using imported reindeer antler. However, whatever the early details of its biography, this comb tells an important story of connections and mobility across the North Sea in the Middle Viking Age.

Acknowledgements

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ZooMS data are archived with Zenodo - https://doi.org/10.5281/zenodo.8321862

The full PAS record for the comb can be found at: https://finds.org.uk/database/artefacts/record/id/909057

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