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THE LIFE AND TIMES OF AN ESTONIAN MESOLITHIC SLOTTED BONE 'DAGGER'. EXTENDED OBJECT BIOGRAPHIES FOR LEGACY OBJECTS

All too often archaeological objects are found as stray finds. As such, they have little or no contextual information, which often makes them difficult to handle analytically and in terms of their exhibition appeal. As a consequence, they often languish un-researched in museum storerooms and there is the critical risk that such objects fall victim to the ongoing curation crisis and are deaccessioned due to a perceived lack of value. Therefore, in this paper we aim to illustrate the applicability of an extended biographical approach to such legacy material by studying the changing character of the Ulbi dagger, an Early Mesolithic flint-edged bone dagger, in its both archaeological and modern contexts. By using both a combination of traditional archaeological methods, coupled with a critical analysis of past illustrations, the dagger went from an isolated, undated, and unique object to a tool with a complex life history extending more than 9000 years. Our analysis reveals multiple stages of manufacturing and ornamentation including the presence of possible anthropomorphic figures. Use-wear analysis also allows us to address the object's likely primary function. Finally, we speculate about its deposition and discuss previously overlooked post-recovery episodes of damage and repair.

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Introduction

Over the last few decades, approaches that seek to capture object biographies have been employed extensively to study archaeological artefacts (e.g. Gosden & Marshall 1999; Oras et al. 2017). Objects such as stray finds or those that have come to light through poorly documented or poorly executed excavations – with inspiration from the term legacy data, we here refer to these as legacy objects – have rarely been the focus of object biography studies. Legacy objects fill many a museum storeroom, but rarely contribute more to our understanding of the past than a dot on a map thought to indicate the presence of a specific group, culture, or activity. More commonly, these objects simply languish unstudied in museum collections. Due to the common lack of associated manufacturing debris, a known context of use or a precise depositional context and few associated records, it is hardly surprising that stray finds have rarely been analysed using a biographical perspective; it is usually precisely this evidence that is used to construct the biography of an object. Nonetheless, in this paper, we present the results of a multi-method analysis of an Estonian Mesolithic slotted bone tool, and in doing so illustrate the applicability and usefulness of an extended biographical approach to better understand the complex life-history of such finds.

In the extended biographical approach used in this paper, the biography of an object is seen to derive from cultural context of technology and knowledge to produce the object, the manufacturing sequence, the use and deposition of the object as well as its post-depositional life. In this approach the deposition of an object is not seen as the final stage or death of an object, but the pre-depositional life and post-recovery life are considered of equal importance and form a single, albeit interrupted, biography (Woodward 2002; Joy 2009; Joyce & Gillespie 2015).This extended biography approach used in this paper combines a range of traditional analytical methods with more novel techniques such as the chronological analysis of published illustrations to achieve a more complete understanding of the changing character of an archaeological object in both its prehistoric and contemporary context as well as gaining insights into changing research and curation practices. Focused analysis of published illustrations has rarely been performed on archaeological objects (see also Hanlon & Nilsson 2004), but as will be shown in this paper they can be vital source of biographical information. We argue that detailed analyses of this kind produce significant new knowledge about past material culture and societies, as well as insights into archaeological practice in the recent past. We argue that, in intersecting detailed archaeological analyses with the curatorial history of the object and recent history, the extended biography approach can play a valuable role in rehabilitating such orphaned legacy objects (see also MacFarland & Vokes 2016).

In the extended biography approach used in this paper it is perceived that the cultural biography of an object begins with the mental template for how the object will look, be used and perceived. This mental template partly derives from the larger historical context of pre-existing and co-existing technology and knowledge

(Schiffer 2005; Johannsen 2010). Therefore, in order to more completely understand the extended biography of an object it is important to first look at the historical context to better understand the some of the formation processes behind mental template used to create and use a specific tool.

Slotted bone tools around the Baltic Sea

Slotted bone tool technology is well known from the Mesolithic of the Baltic Sea region. These slotted bone tools are most often interpreted as either arrowheads, spearheads and occasionally as daggers. According to David (2005; Bergsvik & David 2015), the early postglacial slotted bone tools in the region belong to a north-east European technological tradition, differing from technologies used to work bone in other parts of Europe.

The earliest known examples of this type of slotted bone tools in north-eastern Europe derive from the Moscow region. The ten earliest securely dated examples in the Baltic region date to ca 8400–7100 cal BC (Fig. 1, Table 1). It is assumed that the spread of this technology in northern Europe was related to the arrival of so-called post-Swiderian groups from the eastern European plain in the early postglacial (e.g. Sørensen 2012; Bergsvik & David 2015; Damlien 2016; Knutsson et al. 2016; Manninen et al. 2018), while the latest use of slotted bone tool technology in the area is documented from the fifth millennium BC in southern Scandinavia (e.g. Larsson 2005).

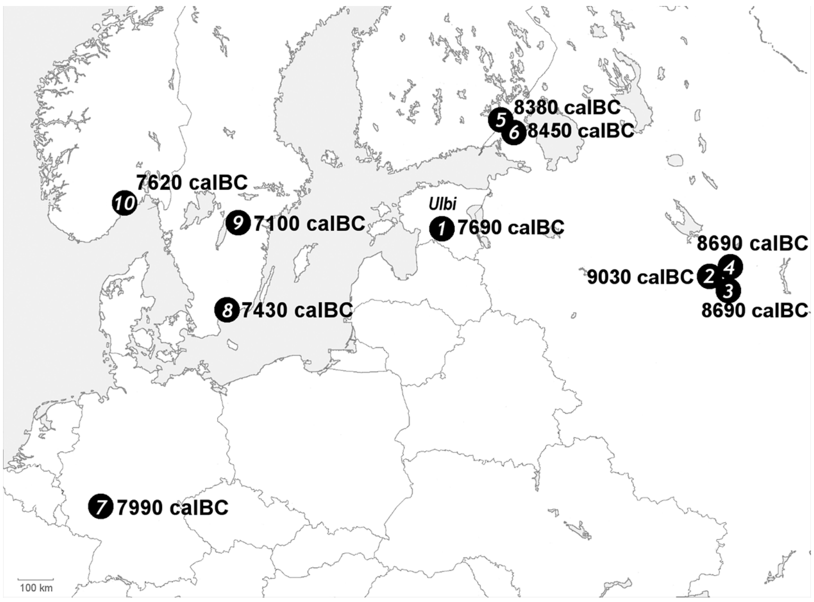

Fig. 1. Slotted bone tools in northern Europe prior to 7000 cal BC. Dates represent mean cal BC. Modified from Persson et al. 2019. See Table 1 for data and calibration details.

Table 1. Radiocarbon dated slotted bone points/daggers in northern Europe prior to 7000 cal BC. See Fig. 1 for locations. Calibrated dates are calculated using OxCal 4.3 and IntCal 13 (Bronk Ramsey 2009; Reimer et al. 2013) on a single direct date or a cluster of dates from the find context (comb*) using the R_combine function of the program. Calibrated dates represent the mean rounded to the nearest ten. Jussila et al. p.c. = personal communication courtesy of Timo Jussila, Aivar Kriiska & Tapani Rostedt

No.	Site	^{14}C age	±	Lab. code	calBC mean	Dated sample	Type of date	Reference
1	Ulbi	8700	40	AAR-23180	7690	Bone collagen	Direct	This paper
2	Ivanovskoje 7	9650	110	GIN-9520		Worked bone	Contextual	Skakun et al. 2011
2	Ivanovskoje 7	9640	60	GIN-9516		Unworked wood	Contextual	Skakun et al. 2011
2	Ivanovskoje 7	comb*			9030		Combined	
3	Sakhtysh 14	9550	60	GIN-11616		Worked wood	Contextual	Zaretskaya et al. 2005
3	Sakhtysh 14	9450	60	GIN-11624		Worked wood	Contextual	Zaretskaya et al. 2005
3	Sakhtysh 14	9420	40	GIN-11621		Worked wood	Contextual	Zaretskaya et al. 2005
3	Sakhtysh 14	comb*			8750		Combined	
4	Stanovoje 4	9413	50	KIA 35154	8690	Bone collagen	Direct	Hartz et al. 2010
5	Saarenoja Muilamäki	9163	55	Hela-2487	8380	Burnt bone	Contextual	Jussila et al. p.c.
6	Antrea Korpilahti	9310	140	Hel-1303		Worked bark	Contextual	Carpelan 2008
6	Antrea Korpilahti	9230	210	Hel-269		Worked bark	Contextual	Carpelan 2008
6	Antrea Korpilahti	9220	210	Hel-269		Worked bark	Contextual	Carpelan 2008
6	Antrea Korpilahti	9140	135	Hela-404		Worked bast	Contextual	Carpelan 2008
6	Antrea Korpilahti	comb*			8450		Combined	
7	Near Wiesbaden	8845	65	Ua-4625	7990	Pitch in slot	Direct	Edgren 1997
8	Norje Sunnansund	8548	121	Ua-30695		Collagen (fish)	Contextual	Kjällquist et al. 2014
8	Norje Sunnansund	8288	76	Ua-30696		Collagen (fish)	Contextual	Kjällquist et al. 2014
8	Norje Sunnansund	comb*			7430		Combined	
9	Motala Strandvägen	8106	46	Ua-30871	7100	Pitch in slot	Direct	Knutsson et al. 2016
10	Prestemoen	8671	45	Ua-45176		Hazelnut shell	Contextual	Persson 2014
10	Prestemoen	8620	45	Ua-45177		Burnt bone	Contextual	Persson 2014
10	Prestemoen	8593	46	Ua-45178		Hazelnut shell	Contextual	Persson 2014
10	Prestemoen	comb*			7620		Combined	

The Ulbi dagger

The object known as the Ulbi dagger has been dated to the first half of the eighth millennium BC (7910–7560 cal BC, cf. Table 1). Made from a split tubular bone of a large mammal, it is currently 285 mm long. Originally the dagger would have been longer but due a large transverse break much of the handle is missing. It is widest (33 mm) at the handle and tapers to the point (Fig. 2). The thickness of the object varies from 10 mm at the handle to 3 mm at the tip of the object. On both sides, a ca 2 mm wide and 5 mm deep continuous groove has been engraved. Only the very tip of the object is without the lateral grooves.

The object has two clearly different sides. The back side is heavily worked, flattened and was left with extensive tool marks that probably derive from the early stage of processing of the bone. The front side of the object is considerably different being convex in shape with a slight central ridge running down much of the object. This side of the object is decorated with a series of eight engraved 'figures' and appears in a more finished state. Altogether five flint inserts made from medial blade fragments are preserved from the original set. A further two, which are currently loose, but stored with the object, most probably derive from this object. Close parallels in shape and form to the Ulbi dagger are known from several sites in north-western Russia including Yuzhnyj Oleni Ostrov, Sukhoe, and Minino 2 (Fig. 3). These are, however, currently undated. The Ulbi find also bears resemblance to the substantially younger object found in Offerdal, Sweden, dated to 7060–6650 cal BC (Ua-17917; Larsson 2005).

Manufacturing procedure

A long tubular bone from a large mammal, possibly an aurochs or elk, was split, probably using the groove and splinter technique. Due to the significant reworking of the bone and an unsuccessful attempt at species identification using

Fig. 2. Photograph of the obverse (top) and reverse (bottom) of the Ulbi dagger including the two now loose flint inserts.

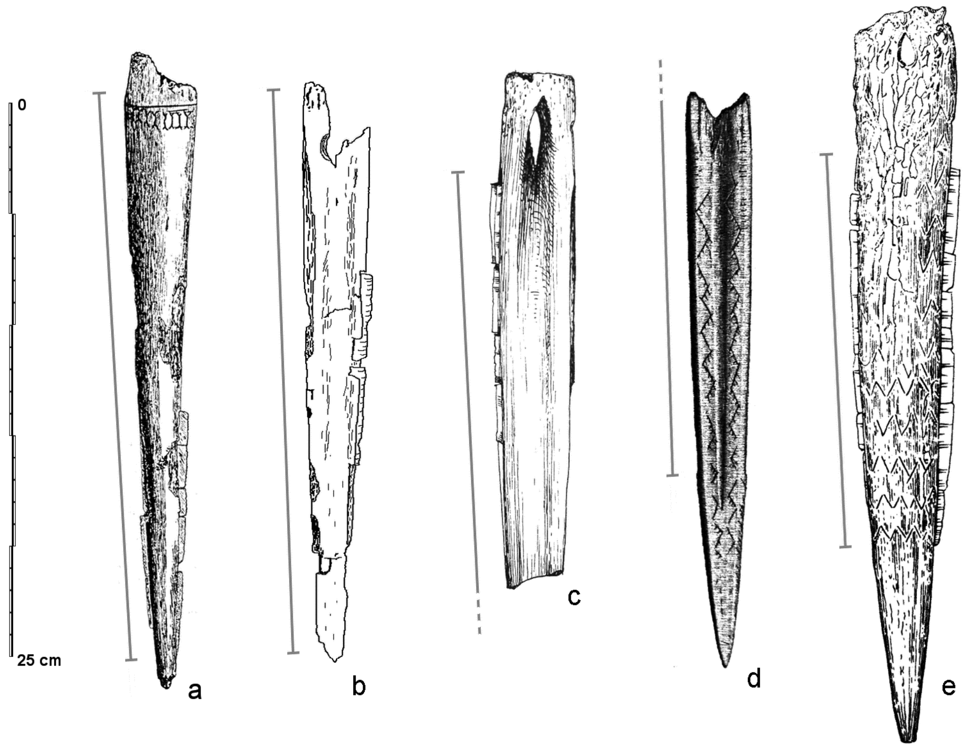

Fig. 3. Double-edged slotted knives/daggers from Mesolithic northern Europe. Grey lines indicate the length of the slots. a – Ulbi (Estonia, Indreko 1931, fig. 30), b – Minino 2 (Moscow region, Sorokin 2013, fig. 273), c – Sukhoe (Lake Lacha, Oshibkina 2006, fig. 117), d – Offerdal (Sweden, Larsson 2005, fig. 1), e – Yuzhnyj Oleni Ostrov (Lake Onega, Gurina 1956, fig. 122).

protein mass spectrometry, it was not possible to determine the species or the exact bone that the dagger is made from. Once the bone was split it was then shaped into the preform using a variety of tools. This initial shaping appears to have consisted of initially roughing out with an axe or adze, indicated by the presence of wide and shallow removals from the ventral side of the dagger, especially around the handle. Based on the presence of longitudinal facets covering much of the bone surface, this preform was further shaped by whittling using a flint burin or blade (cf. Zhilin 2017). On the right dorsal side of the dagger faint traces of roughly parallel lines of very fine 2–3 mm long lateral engravings forming at least three parallel columns overlie these longitudinal whittling facets (Fig. 4). These columns run longitudinally along the dagger extending from ca 13 cm from the tip to 5 cm from the surviving end of the dagger. Based on experiments it is unclear if these faint engravings are just an unintentional result of surface planning using a flint blade held at an obtuse angle causing the blade to vibrate leading to engravings similar to chatter marks. If these do represent chatter marks, then that indicates that at this stage the bone was being worked in a dry state. It is also possible that these

Fig. 4. Close-up photograph of columns of faint lateral engravings on the Ulbi dagger.

were done intentionally as a form of ornamentation, as the engravings are remarkably systematic and regular.

Once the overall form of the object was completed it is likely at this stage when a slot was cut along the entire surviving edge of the object but stops 15 mm from the tip and even continues into the presumed handle. From here on, it appears that the ventral side was no longer tackled. The proximal end of the object was then coarsely scraped using a large-toothed stone tool, maybe a scraper, leaving deep and wide scratches, possibly to increase the grip on the handle (Fig. 5). It is likely at this stage that a ca 3 mm wide hole was drilled into the proximal end of the handle. A wide lateral groove, overlying the coarse scraping, was then cut into the widest part of the object on the dorsal side, probably in order to demarcate the blade from the handle. It is also likely at this stage that the bone surface was polished to give the general macroscopically visible lustring of the surface especially on the dorsal side of the dagger.

Fig. 5. Photograph of engraved 'figures', the handle groove, traces of coarse grinding and the fragmented drilled hole, indicated by grey circle.

Perhaps using a burin a series of eight X-shaped motifs or 'figures' were then engraved laterally across the widest part of the object. These figures clearly overlie the aforementioned lateral groove as well as the coarse scraping indicating that they were engraved at a later stage. Given the fluidity of the engravings we interpret that these were engraved when the bone was relatively soft. Therefore, as these engravings represent some of the final working of the bone, it is likely that bone was soaked on at least one occasion to soften the bone to aid in some stages of the manufacturing and engraving.

The figures on the Ulbi dagger are engraved as two sets of v-shaped engraved short lines (~2 mm long), which are then connected by a central longer line (~3–5 mm; Fig. 6). On the right side of the dagger each motif is further repeatedly engraved in a wide c-type motion leading the central 'body' to become wider and the figure to be less angular. This additional engraving is not present on the figures on the left side of the dagger, which could be due to handedness and dexterity of the engraver.

It is unclear if these engravings are in fact anthropomorphic figures or if they are geometric motifs. However, the two central figures have a very small engraving between the two 'legs' which could represent phalli. These possible phalli have a v-shaped cross-section that does not match the engravings made during the preceding scraping of the bone. Nor are there any tool marks that superimpose these engraved figures, indicating that the possible phalli do not post-date the figures. These observations suggest that the possible phalli were engraved at the same time as the figures. The presence of these possible phalli suggests that these may represent anthropomorphic figures, at least one possibly two of which are biologically male, with their arms and legs outstretched, rather than geometric shapes.

The flint inserts are all medial blade fragments ~10 mm wide and 13–29 mm long, produced from yellowy-grey coarse-grained flint. Due to their similarity, the flint inserts were likely either all produced from the same nodule or at least

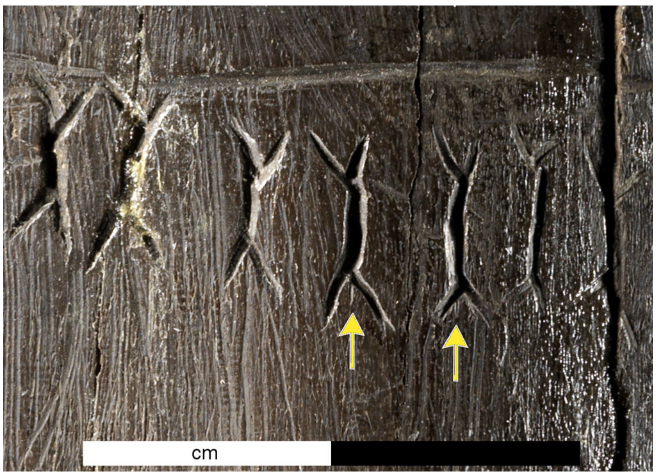

Fig. 6. Close-up photograph of engraved figures with the potential phalli indicated by arrows.

of flint from a single source. Unfortunately, XRF analysis conducted on one of the loose inserts did not match any of the available reference samples from Scandinavia, southern Baltic or central Russia. However, the flint is likely to be non-local as most of the Estonian Silurian flint is of too poor quality or the nodules are too small and irregular to have been used to produce these inserts. Many of the inserts have been unilaterally retouched to varying degrees. The different forms of retouch could suggest that the object had been re-tooled on multiple occasions, or that the retouch was intended to change the shape of the inserts in order to achieve as straight an edge as possible.

Finally, these blade fragments were attached into the slot around the edge of the object using birch bark tar adhesive. This adhesive is still present in many areas of the slot and on one of the loose microliths. The identification that this material is birch bark tar was determined using both gas chromatography-mass-spectrometry (GC-MS) and attenuated total reflectance Fourier transform infrared spectroscopy (ATR-FT-IR) on a sample of material from one of the loose microliths. The methods used for the GC-MS and ATR-FT-IR are further described in the appendix. Different triterpenoids with three major biomolecular components being assigned to betulin, and derivates of lupenolandlupenone characteristic of birch bark tar (Aveling & Heron 1998; Lucquin et al. 2007) were detected with GC-MS (Fig. 7).

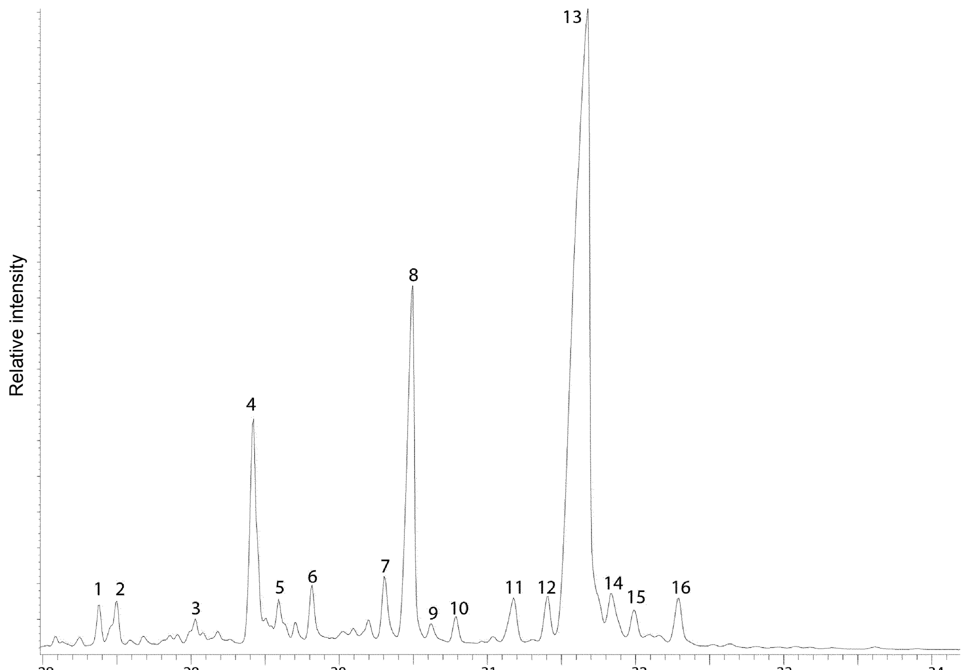

Fig. 7. Partial total ion current chromatogram of the Ulbi adhesive. The presence of 1 – lup-20(29)-en-3-ol, 2–6 – betulin, 7 – lup-20(29)-en-3-one, 8 – lup-20(29)-en-3-ol, 9–16 – betulin indicate that this adhesive is birch bark tar.

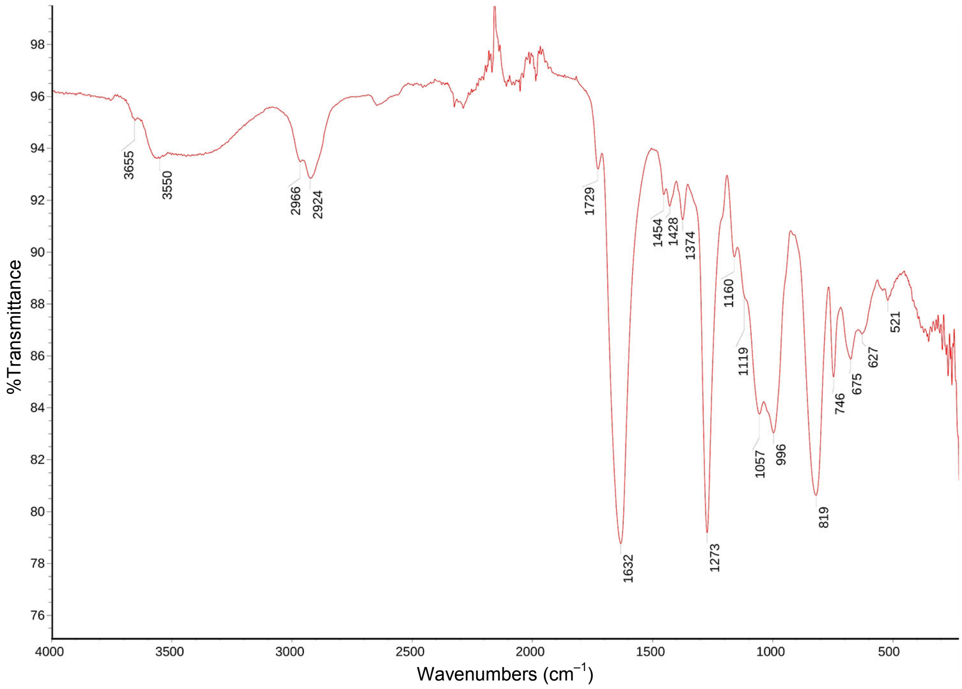

Fig. 8. ATR-FT-IR spectrum of the Ulbi adhesive.

In addition, the ATR-FT-IR spectrum of the analysed adhesive from the Ulbi dagger (Fig. 8) shows similarities with the ATR-FT-IR spectra of Early Mesolithic birch bark tar from Estonia presented in Vahur et al. (2011).

Use of the Ulbi 'dagger'

Based on the use-wear analysis performed on the loose flint inserts it appears that the object was used in a slicing, whittling or planning motion evidenced by the presence of a series of parallel striations that run almost perpendicular to the ventral edge of one of the loose inserts (Fig. 9). See supplementary material for a more detailed overview of the methods used in this analysis. It is worth noting, however, that the striations observed on one of the inserts were the only observable micro-wear traces. The striations suggest that this object was primarily a slicing or whittling tool, i.e. a knife rather than a point or a dagger, but we do not preclude the possibility that the object could have functioned as either a spearhead or as a dagger, given the pointed tip and sharp edge, although evidence of thrusting-type movements is not observed.

Unfortunately, due to the degradation and surface exfoliation of the bone tip, it was not possible to perform any use-wear analysis of the bone itself. It must also be noted that only the two loose inserts were analysed for microwear

Fig. 9. Weakly developed parallel striations, indicated by translucent arrows, on one of the loose inserts. Use-wear analysis was performed by and photograph taken with a Dino-lite AM4815ZT microscope at 200x magnification.

and as these inserts had fallen out of the slot it is possible, however considered unlikely, that such traces could have also formed post-depositionally or in the museum. Given these uncertainties, it cannot also be precluded that these use-wear traces formed during a previous use of the inserts, before they were placed in the Ulbi knife. However, as the striations are so weakly developed, it is likely that any subsequent use would have erased these traces. Thus, based on the use-wear results from in this study, which are suggestive of the whittling or slicing use of the object, it will henceforth be referred to as the Ulbi knife not a dagger.

Deposition

Based on the few details known about the find context and the surrounding area it can be postulated that the knife was deposited off the shores of a small island of Lake Võrtsjärv in southern Estonia. No other Mesolithic finds are known from this location, making it unlikely to have been discarded on a settlement. The closest known Mesolithic sites, Villa and Väluste, are located about 4–8 km southwards (Kriiska & Lõhmus 2004). Numerous other Mesolithic sites are located further away, to the north of the lake, where the local flint was easily accessible (Indreko 1948, 95; Kriiska & Lõhmus 2004). Based on the drawing published in 1931 by Indreko and the current condition of the knife it appears that the artefact was probably broken prior to it being accidentally lost or deposited near to the shore of the small island. It is not possible to determine if the knife accidentally broke or was intentionally fragmented as such a break, especially at a point weakened by the drilled hole, could have occurred through any number of reasons. Furthermore, given that a knife could be used for a wide variety of tasks, any number of which could lead the handle fracturing. Based on the sparse known contextual details it is not possible to determine if the deposition was part of some ritual practice (cf. Larsson 2005) or whether it was accidentally dropped.

Most archaeological object biography studies stop at this stage, thereby implying that the objects' biography ends at its deposition. However, in this study the post-depositional life history is also considered an important part of the object's biography and very informative – especially for legacy objects (e.g. Peers 1999; Joyce & Gillespie 2015).

Discovery

Little is known about the discovery of the object. It was found sometime between 1924 and 1926 during peat extraction at about 1.2–1.5 m depth, and about ten metres from a dry hillock, approximately 1.5 km from the present lake (Indreko 1931). Due to the receding shorelines it is believed that at the time of deposition what is now the hillock was an island and the knife was likely deposited near the shoreline of this island.

Post-discovery life history of the Ulbi knife

After the object was discovered it was first held at the archaeology collection of the University of Tartu but was, following the department's closure, moved to the Institute of History in Tallinn in the 1950s. Since its discovery between 1924 and 1926 the Ulbi knife has frequently been mentioned. Indreko published it for the first time as a 'spear point or a dagger' (Indreko 1931, 56), a label subsequently reproduced by himself (Indreko 1934; 1939) and others (Šturms 1970). The object was later interpreted exclusively as a dagger (Indreko 1948; Jaanits et al. 1982). Although the Ulbi knife has been referred to on multiple occasions, most of these publications in fact reveal very little about the object itself or its post-depositional life-history. Yet, in order to gain insight into this post-depositional life-history, we subjected the published illustrations to close scrutiny.

Apparently, the Ulbi knife was largely intact when discovered, other than the large fracture of the handle. Most of the flint inserts were missing as were a few pieces of the bone surface (Fig. 10). By comparing the various published photos

Fig. 10. Published illustrations of the Ulbi knife. Dates denote when the image was published and are thus termini ante quem, from Indreko (1931), Indreko (1939), Gurina (1956), Jaanits et al. (1982) and this paper.

and drawings and the knife's current condition, it is clear that the artefact had multiple phases of unrecorded damage and repair since its discovery.

Between the drawing published in 1931 by Indreko and the photograph published in 1939 (Indreko 1939, table VII: 1) the condition of the knife does not appear to have changed. However, the flint inserts appear notably straighter, less edge-damaged and more continuously aligned in the 1939 photograph compared to the 1931 drawing and later illustrations (respectively Šturms 1970 and Jaanits et al. 1982). Rather than indicating that these inserts had actually changed between 1931 and 1939, it is interpreted that the photograph from 1939 had been altered with inserts drawn in afterwards. Such early photo-manipulations are difficult to detect but likely more common than generally assumed (cf. Fischer & Kristiansen 2002).

The drawing published in 1956 by Gurina (106, fig. 63: 1) is the only published image where the retouch is clearly visible on the outside edge of all of the inserts and prior to finding this drawing it was unclear if the inserts were originally retouched on the inside or outside edges. In addition, based on the position of the inserts in this drawing it seems that at least one or possibly two inserts fell out from the left side of the objects between the 1939 photograph and when the 1956 drawing was made. It is unclear how much we can rely on the accuracy of this image as there are notable errors in this 1956 drawing including the inserts being drawn too long, the left lowermost insert being drawn too far down, some of the inserts being drawn as a single insert when they are actually two inserts, the handle lateral engraving is drawn incomplete and the figures are drawn incorrectly spaced.

Comparing the drawing published in 1956 by Gurina and the photograph published in 1982 by Jaanits et al. (1982, fig. 31: 1) it is clear that half of the remaining inserts fell out or were removed. As there are no existing records of the falling-out of these inserts it is unclear when or how this occurred. The majority of the original inserts are seemingly lost.

At some point between when the photo published in 1982 was taken and 2015, the knife broke into several large fragments, portions of the outer bone surface flaked off and the remaining flint inserts also seem to have fallen out. The very tip of the object had been broken as well. This ~30 mm long piece was then reattached to the knife incorrectly by changing the dorsal and ventral sides. These bone fragments and large pieces of the outer surface were glued back together using two different glues; ATR-FT-IR spectroscopic analysis points to a cellulose-nitrate and anester-based glue, the former of which was in common use at the Institute of History in Tallinn during the Soviet era and hence points to a repair window of 1980 to the early 1990s. The use of two different glues further suggests at least two discrete episodes of damage and repair.

It is likely that all but three of the inserts were reinserted into the slot at this point and held in place with yellowish glue that is similar to the aforementioned cellulose-nitrate based glue. Many of the re-inserted flint inserts were not placed back in the original positions. Two inserts were even reinserted on the wrong side of the knife (see Fig. 8). The images described above are not the only published illustrations of the Ulbi knife. To our knowledge, the other published images appear to be all either re-drawn from prior publications or were outdated at the time of publication (e.g. Indrenko 1948; Šturms 1970; Płonka 2003). These images hence do not provide any further insights into the post-discovery treatment and condition of the Ulbi knife.

Discussion

The biography of the object under specific scrutiny in this paper, the Ulbi knife, appears closely aligned with that of other slotted bone tools from the wider region (cf. Zhilin 2017). It is dated to the eighth millennium BC, a date that fits with the emerging pattern of a general east-to-west spread of this technology starting out in the early tenth-ninth millennium BC in western Russia. Over a few centuries, in the eighth millennium, this technology appears to have spread across the Baltic and north-eastern Europe, although it remains unclear whether this related to the dispersal of people or of new technologies (Sørensen et al. 2013).

Slotted bone tools are most often interpreted as points or more rarely as daggers. The use-wear results reported in this study indicate that, contrary to such prior interpretations, the Ulbi knife probably did not function as either a point or a dagger. Instead we suggest that it was used to chop, whittle and/or plane; it functioned as a knife.

Although the Ulbi knife was, like so many prehistoric objects, found as a stray find during peat digging and is today associated with limited contextual information, it was possible to put forward some likely depositional scenarios. The remaining uncertainty about the object's eventual deposition, however, is of limited importance in an extended biographical approach. In standard object biography approaches, which end with deposition, significant weight is placed on precisely this stage. In contrast, in an extended biography approach, the deposition is just one more stage in a never-ending life of the object. An additional benefit of this extended biographic analysis is the inclusion of the changing character of the object in recent and contemporary contexts. Studying the changing character of the object in its modern setting can add scientific value to the objects as indices of past economic and political processes, of changing curatorial and exhibition practices, and of archaeological knowledge production (cf. Voss 2012).

One particular and often overlooked source of information is found in drawings and photographs. Such reproductions are part and parcel of knowledge production with changing applications and styles reflecting changing research priorities as well as the preferences of individual workers (Saville 2009). But the epistemological role of drawing and photography in archaeology remains poorly investigated (Lopes 2009; Moser 2012) and actual practice largely implicit. Significant legacy objects are often characterized by the paradoxical combination of obvious aesthetic value and total lack of contextual information, with the result that they are often poorly studied yet commonly reproduced in print. Yet, rarely are these past illustrations subjected to critical investigation. Such illustration analysis may seem moot when the object itself is available for research, but studying the trail of past reproductions can also be vitally informative with regards to any post-discovery alterations, damage or repairs, which in turn affects the authenticity and research value of the object. Archaeological objects are commonly redrawn from earlier drawings or photographs with the potential of also reproducing any errors or manipulations. In addition, the use of re-drawn or outdated illustrations (e.g. Šturms 1970; Płonka 2003) can provide a false chronology for the post-discovery biography of an object which then brings into question the authenticity of that illustration as an accurate representation of the object. Making and curating accurate representations of important objects such as the Ulbi knife is vital as such objects can be lost, stolen, destroyed, damaged, difficult or impossible to access. Indeed, many legacy objects are known *only* from illustrations or photographs. Increasingly, advanced image recognition and analysis methods are applied to drawings and photographs (e.g. morphometrics – see Shott & Trail 2010), making it even more pressing to ascertain the accuracy of object reproductions.

The Ulbi knife underwent several phases of both damage and repair, all of which was unrecorded and previously unrecognized. By combining our illustration analysis with archaeometric analysis of the glues used to repair the damage, it was possible to form a timeline for these alterations, akin to the Barum point where the number and position of the associated flint inserts also changes throughout time (Hanlon & Nilsson 2004). In addition, the early editing of the photograph of the Ulbi knife published in 1939 was only identified during this close comparative analysis of the illustrations. This particularity serves as a cautionary note when relying on older photographs as the only representation of a given object. Cross-checking is strongly advised.

Conclusions

Nearly a century after its discovery, we have presented a first in-depth study of the Ulbi knife, a Mesolithic slotted bone point dating to the eighth millennium BC from Estonia. Our analysis has drawn on the combination of detailed object analysis using macroscopic and microscopic approaches and archaeometric analyses. We have used the Ulbi knife as a first case study for an extended object biography approach.

The extended object biography approach used in this paper provides an adaptable framework for studying prehistoric finds, even legacy objects such as stray finds. Many such stray finds, especially organic artefacts, are of remarkable inherent quality, but lack contextual information and are hence difficult to handle analytically and in terms of their exhibition value. The approach outlined here maximizes information generation under the ever-present constraints of time and funding. Any biography of archaeological objects will be inherently fragmentary and interrupted, but by considering as many aspects of the object as possible such biographies can become more complete, richer. An extended biographical approach places equal weight on the changing character of objects on both archaeological and curatorial timescales. By illuminating past archaeological and museum practices, as well as by providing novel information on the object itself, this approach contributes significantly to our understanding of both the past and its becoming.

Our study illustrates the inherent value of legacy objects when tackled through collaborative approaches that transcend regional or national borders, and that pool competences. Not only have we been able to record the object in detail and to reconstruct a more complete life-history up to deposition, we have also been able to trace the way in which the object itself and its reproductions in publications have changed since discovery. Many of the methods employed in this study are straightforward, accessible and at most minimally destructive. These methods can be readily applied to context-rich archaeological objects, but, critically, also to legacy material. Individual objects, be they stray finds or not, offer intimate entries into the past. By enriching legacy objects with narratives of their use, deposition, discovery and subsequent passage through our own times, they arguably become significantly more valuable aspects of our cultural heritage.

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APPENDIX

GC-MS SAMPLE PREPARATION AND METHOD

The sample was prepared with the following solvent extraction method. 15 mg of sample was suspended in 2 mL of dicholormethane (DCM) and methanol (2:1 v/v) mixture, ultrasonificated for 15 min, centrifuged and solvent soluble fraction removed with Pasteur pipette. The same procedure was repeated three times to obtain the total lipid extract (TLE). The solvent was evaporated under a gentle stream of nitrogen. Silyl derivates were created adding 50 μl of N,O-bis(trimethylsilyl)trifluoroacetamide (BSTFA) with 1% TMCS into the TLE, followed by heating (70 C, 1 hour). The excess BSTFA was removed under a gentle stream of nitrogen and sample was rediluted with DCM.

GC-MS analysis was conducted with Agilent 7890A Series gas chromatography and Agilent 5975C Inert XL mass-selective detector with a DB5-MS (5%-phenyl)-methylpolysiloxane column (30 m × 0.25 mm × 0.25 μm). Injected sample size was 1 ul. The splitless injector and interface were maintained at 300 °C and 280 °C respectively, helium was used as the carrier gas at a constant flow. The GC column was inserted directly into the ion source of the mass spectrometer. The ionization energy was 70 eV and spectra were obtained by scanning between m/z 50 and 800 amu. The temperature program was set as follows: 50 °C for 2 min, thereafter gradient of 10 °C/ min up to 325 °C for 6.5 min. Compounds were identified with Agilent Chemstation software using also NIST mass spectra library.

ANALYSIS WITH ATR-FT-IR SPECTROSCOPY

ATR-FT-IR spectra were acquired on Thermo Scientific Nicolet 6700 FT-IR spectrometer with the "Smart Orbit" diamond (refractive index $n_D = 2.418$) micro-ATR accessory. The spectrometer has DLaTGS Detector, Vectra Aluminum Interferometer and sealed and desiccated optical bench with CsI optics. In order to protect the spectrometer from atmospheric moisture, it is constantly purged with dry air.

The analysed sample was placed on the ATR crystal and the sample was pressed against the ATR crystal. After that the ATR-FT-IR spectrum was scanned.

The following spectrometer parameters were used: spectral range 225–4000 cm^{-1}, resolution 4 cm^{-1}, number of scans: 128, Level of Zero filling: 0, Apodization: Happ-Genzel.

Thermo Electron's OMNIC 9 software for FT-IR spectrometer was used to collect and process IR spectrum.

USE-WEAR ANALYSIS

To gain a better understanding of what the dagger might have been used for, use-wear analysis was employed. This method is conducted with a Dino-lite AM4815ZT USB microscope to enable observations of edge-damage, edge-rounding, polishes and residuals. The sole use of the USB microscope was partially due to time constraints, but also as it was possible to quickly get imagery for further discussion of the object's function. Furthermore, with the aid of the USB microscope it was possible to analyse the loose flint inserts and the bone haft with the built-in polarized lens, which enabled a more dynamic approach in the analysis. In this study, only the loose flint inserts were analysed for use-wear traces, as it was not possible with the microscope set-up to analyse the inserts that are currently attached to the dagger.

Initially, a careful scan of the analysed loose microliths was made at x20 magnification with the microscope to identify if any edge damage, residues or fibres were present. These flint inserts were then cleaned using ethanol, in order to remove any finger grease and other lipids which can obscure use-wear polishes. After a preliminary x20 scan, the clean the flint insets were analysed with the mentioned USB microscope using x200 magnification.

To aid in the interpretation, the observed traces were then compared to use-wear traces on a reference collection of experimental stone tool replicas curated at Moesgaard Museum by Claus Skriver and Dr Helle Juel Jensen and further supplemented by the analyst's (Dr. Peter Bye-Jensen) own collection of experimental replicas.

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EESTI MESOLIITILISE SOONTEGA 'PISTODA' ELULUGU: KULTUURIPÄRANDI LAIENDATUD BIOGRAAFIA

Resümee

Arheoloogilistel juhuleidudel enamasti puudub tõlgendusteks vajalik kontekst ja nii jäävad need tihti aastakümneteks muuseumikogudesse edasist uurimist ootama. Lisaks sellele on ka võimalikud probleemid leidude säilitamisel: on oht, et juhuleidude tõlgendusväärtus pigem kahaneb aja jooksul. Artiklis on näidatud, kuidas pea sajand tagasi leitud külgsoontega teraviku laiendatud biograafia pakub uusi võimalusi eseme meieni säilinud vormi tõlgendamiseks. Laiendatud biograafia järgi ei ole leiu jäämine leiukohta selle biograafia lõpp ja eseme elulukku on kaasatud ka edasised tegevused leidmise ajal, hoidlas jne.

Kirde-Euroopa tehnoloogilisse kultuuripiirkonda kuuluvaid soone ja pistikteradega teravikke on mesoliitikumist teada üle kogu Läänemere piirkonna. Neid on tõlgendatud nii noole- kui ka odaotstena, samuti pistodadena. Vanimad seda tüüpi esemed on pärit Moskva ümbrusest, Läänemere-äärsed näited on dateeritud 8400–7100 cal BC (jn 1, tabel 1). Ulbi teravik (jn 2) on dateeritud AMS-i radiosüsinikumeetodil 8700 ± 40 aastat tagasi (7690 ± kal eKr). Ulbi leiule lähimad paralleelid pärinevad Loode-Venemaalt (jn 3). See on valmistatud suure imetaja lõhestatud toruluust ja on näha mitmeid valmistusetappe (jn 4–6). Mõlemal küljel on 2 mm laiused ja 5 mm sügavused sooned, milles on säilinud mõned mikroliitidest pistikterad. Teraviku küljed on selgelt erinevad: üks pool on üksnes silutud, kuid jäetud ilma edasise viimistluseta, teine külg on korralikult viimistletud ja selle käepidemepoolsel osal, mis on ülejäänud terast sügavalt sisselõigatud soonega eraldatud, on kaheksa X-kujulist sisselõiget, mida võib tõlgendada kui stiliseeritud inimfiguure. Käepidemepoolne tipp on murdunud ja murdekohal võib näha umbes 3 mm läbimõõduga sissepuuritud augu serva. Pistikterade kinnitamiseks kasutatud kiti keemilised analüüsid ATR-FT-IR- ja GC-MS-meetodil viitavad, et tegemist oli kasetõrvaga (jn 7–8).

Külgsoontesse kasetõrvaga kinnitatud tulekivi ei ole Eesti päritolu, kuid selle täpset päritolu ei olnud võimalik määrata. Ehkki tulekivi kasutusjälgedel ei ole selgeid viiteid torkamisele, ei saa välistada, et eset on kasutatud ka oda või pistodana. Selged kasutusjäljed pistikteradel (jn 9) aga osutavad sellele, et eset on kasutatud lõikamiseks, seega noana.

Ulbi "nuga" oli ladestunud Võrtsjärve läänekaldal ilmselt toona seal olnud väikesele rannalähedasele saarele, kust mesoliitilisele asustusele viitavaid leide pole praeguseni rohkem teada. Küll aga on mesoliitilisi asulaid leitud mõne kilomeetri kauguselt, eriti Võrtsjärve hästi uuritud põhjakaldalt. Kuna täpsed leiuandmed puuduvad, ei ole ka võimalik spekuleerida, kas ese jäeti maha tahtlikult või kaotati kogemata.

Pärast leiu jõudmist arheoloogiakogusse (jn 10) on seda teaduskirjanduses mitmel korral avaldatud, muuhulgas ka koos fotode või joonistega. See lubab uurida Ulbi "noa" edasist biograafiat leiuhoidlas. Hoiustamise ajast ei ole säilinud dokumentatsiooni, mis viitaks eseme konserveerimisele või restaureerimisele. Avaldatud fotode ja jooniste põhjal võib aga jälgida, kuidas pistikterad on soontest välja kukkunud ning sinna tagasi kinnitatud. Pärast 1982. aastal avaldatud foto tegemist purunes Ulbi nuga kolmeks tükiks ja see liimiti uuesti kokku, kusjuures teraviku tipp on tagurpidi külge liimitud. Infrapunaspektroskoobiga (ATR-FT-IR) tuvastati ka vähemalt kahe erineva liimi (ilmselt PVA- ja tselluloosnitraadil põhinevad) kasutamine. Samal ajal on välja kukkunud ka enamik pistikterasid ja need on tagasi liimitud, kusjuures asetatud valedesse kohtadesse, kaks tera on ka valet pidi.

Selline laiendatud esemebiograafia kasutamine ja avaldatud jooniste kriitiline analüüs lubab meieni säilinud leide uurida hoopis teise pilguga. Ühtlasi on see ka hea näide, et näiliselt tervena säilinud ese võib olla märkimisväärselt muudetud, mida tuleb arvestada just kasutusviiside ja -jälgede analüüsis.