



The arrow bolt plane from the medieval archepiscopal residence at Esztergom (North Hungary)

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ABSTRACT

This paper presents a previously misidentified antler tool from Esztergom-Várhegy-Kőbánya (North Hungary), which was found in the late medieval kitchen residue of the archbishopric palace. The arrow shaft plane, an implement used together with a knife for smoothing the wooden bolts of (cross)bows, is a rare type of tool whose role was misinterpreted by several authors in the past although its ethnographic parallels made from both antler and wood in Siberia has been described already by the turn of 19th to 20th century. This work aims to summarise all the published arrow shaft planes from Hungary and abroad by presenting their origin, context, and individual features.

1. Introduction

Excavations carried out at the ecclesiastic site of Esztergom-Várhegy-Kőbánya (Esztergom-Castlehill-Quarry; Fig. 1) by Balázs Major and his team in 2014–2016 brought to light a unique zooarchaeological assemblage (Gál, 2021). Owing to the thorough excavation methods including the screening of deposits in addition to hand-collecting of finds, an outstanding number of fish, avian, and other small and fragile bone remains were retrieved, resulting in the so-far known richest bone collection from medieval Hungary (Gál and Bartosiewicz, 2021). The bone accumulation forming the kitchen midden of the archbishopric palace was deposited underneath the kitchen, in many subsequent layers in the quarry on the southern slope of Castle Hill. Nevertheless, remains from undisturbed layers were analysed only. According to three radiocarbon dates made from animal bones, the studied assemblage accumulated between the late 13th and the 15th centuries (Gál, 2021, 423, Fig. 1).

The two-level building attached to the southern side of the palace comprised the kitchens of the archbishop and his personnel alike, and both kitchens had their openings in the same place (Benkő et al., 2021, 2–5, Figs 1–2). Thus, the abundant bone assemblage including a total of 7294 animal bones must have contained the waste of both places (Gál, 2021, 453–454, Table 1). The zooarchaeological analysis of the assemblage revealed that in addition to butchery and food remains, bone and antler artefacts as well as workshop debitage indicating the presence of a bone working workshop also made part of the accumulation. Moreover, the frequency of crossbow details (Fig. 2) among the half-finished and

finished artefacts as well as the amount of antler waste representing raw material and pieces cut to size suggested that this – most probably temporary operating – workshop was mostly specialised in the reparation of crossbows (Gál, 2020a).

The number of antler articles from this material also contained a peculiar object that has been described as an “unfinished artefact (belt driver?)” in the aforementioned paper according to its size, semi-cylindrical shape and two slot-like openings cut across the surface (Gál, 2020a, 86, Fig 8:5). Shortly after this work became public, my attention was drawn to the correct function of the tool that is also linked to the use of (cross)bows. This type of artefact forms a plane together with a narrow knife placed in one of the openings and is used for smoothing the shaft of wooden bolts. The Finnish ethnographer U.T. Sirelius brought ethnographic evidence made from both wood and antler in Siberia already by the turn of the 20th century (Sirelius, 1903, 58–59, Figs 96–99). The use of a medieval antler plane has been also illustrated in the recent work by Garstka and Ginter (2020, 162, Fig. 5).

The present paper aims the detailed description of the antler plane from medieval Esztergom along with a coeval Hungary counterpart from Buda (part of present-day Budapest, the capital of the country) as well as summarising the so far known parallels from medieval Europe for a better understanding of the characteristics and identification of arrow shaft planes made from the hard osseous tissue of animals.

2. The arrow bolt plane from Esztergom

The arrow bolt plane from Esztergom-Várhegy-Kőbánya (Fig. 3) was

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Fig. 1. The location of sites yielding arrow bolt planes on the map of Central-Eastern Europe in the 14th century. Numbers refer to the list of sites in Table 1. The base map was drawn by Béla Nagy.

Table 1
Summary table of arrow shaft planes discussed in the paper.

No.	Site	Type of site	Period	Raw material	Length (mm)	Number of holes	Direction of holes	Reference
1.	Břeclav – Pohansko (Czech Republic)	Fortified settlement	8th–9th c.	Antler	57 (fragment)	2(?)	Opposite	Dostál and Vignatiová (1989); Švecová (2002)
2.	Sarkel – Belaja veža (Russia)	Fortified settlement	9th–11th c.	Bone	cca 45 (fragment)	3(?)	Opposite	Medvedev (1966)
3.	Kyiv – Church of the Tithes (Ukraine)	Church	10th c.	Horn	cca 80	2	Identical	Sergeeva (2010)
4.	Region of the Lower Volga (Russia)	Burial	cca 10th c.	Bone	cca 65	3	Opposite	Fodorov-Davydov (1984)
5.	Kyiv (Ukraine)	?	10th–12th c.	Bone	cca 100	5	Opposite	Medvedev (1966)
6.	Trebišov – ul. Sovietskej armády (Slovakia)	Rectory	11th–13th c.	Antler	89	2	Opposite	Čaplovič (1979); Slivka (1984); Švecová (2002)
7.	Warsaw – Copper-Roof Palace (Poland)	Royal Castle	14th c.	Bone	82	3	Opposite	Mroczek (2007)
8.	Esztergom-Várhegy-Kőbánya (Hungary)	Archbishopric palace	14th c.	Antler	70	2	Opposite	G. Sándor (1963)
9.	Buda-Várpalota (Hungary)	Royal Castle	15th c.	Antler	71	2	Opposite	Garstka and Ginter (2020)
10.	Muszyna (Poland)	Stronghold	15th c.	Antler	41	2	Identical	Sirelius (1903)
	Vasyugan (Russia)	–	19th c.	Antler	107	2	Opposite	Garstka and Ginter (2020)
	Człuchów – Castle (Poland)	?	?	Antler	?	1	–	

found in trench 1, stratigraphic unit 6, at a depth of 167.21 m a.s.l. One of the aforementioned bones providing a radiocarbon date (Sample D-AMS 020206), a tibiotarsus from the domestic hen (*Gallus domesticus* L., 1758), originated from the same stratigraphic unit and indicated the age of 1285–1400 cal AD (Gál, 2021, 423, Fig. 1).

The object was carved out from a segment of antler from the red deer (*Cervus elaphus* L., 1758). First, the piece of antler was longitudinally split, which was followed by the complete removal of the spongy tissue. Overall on this concave side of the semi-cylindrical object, cross lines in Z-shape were carved whose purpose is so far open. The corners of

the tool were rounded, but not in the same manner: one end remained almost straight, while the other end is more rounded. Finally, two opposite directed slant chops were made by a sharp tool crosswise at the middle of the object, resulting in two wedge-like openings on the convex side of the object. The wider groove falls to 23.2 mm from the straight end of the plane, while the narrower slot was cut at 23.5 mm from the rounded end of the artefact. The distance between the two openings is 22.7 mm. The total length of the object is 70.2 mm; the greatest width is 29.0 mm. The diameter is 22.2 mm, while the thickness of the wall varies between 2.7 and 4.1 mm (Fig. 3).

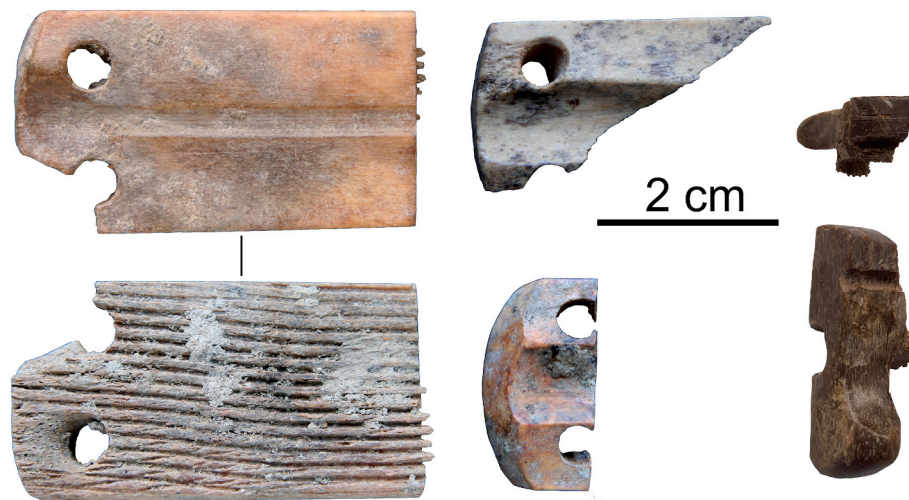


Fig. 2. Arrow supporting plates indicating the use of both narrow (ca 3 mm wide) and wide (8–9 mm broad) bolts, and a fragment of a two-part nut of a crossbow with marks of turning from Esztergom-Várhegy-Kőbánya. Photo by Erika Gál.



Fig. 3. The antler arrow bolt plane from Esztergom-Várhegy-Kőbánya. Photo by Erika Gál.

3. Counterparts from Hungary and abroad

The other arrow shaft plane (Fig. 4) known from medieval Hungary was already published in 1963 but described only as an antler object with carving marks (G. Sándor, 1963, 110–111, Fig. 3:3). The 71 mm long and 3 mm thick artefact with straight ends and two oppositely directed slots was brought to light from the courtyard of the royal palace in Buda by László Nagy in 1951. Since it was found together with a rather great amount of antler pieces and objects displaying traces of sawing, peeling, turning and filing, it has been suggested that the palace

contained a workshop dedicated to bone manufacturing. According to the ceramics and a coin present in the same assemblage, the workshop was dated to the 15th century (G. Sándor, 1963, 113–115).

The closest analogue to the Hungarian finds in the region comes from the site of Trebišov – ul. Sovietskej armády. The small town is located in the south-eastern part of Slovakia but belonged to the Hungarian Kingdom during the Middle Ages (Fig. 1). The artefact was found in an 11th–13th-century waste pit in the garden of the old rectory behind the Greek-Catholic Church of the Assumption of the Blessed Virgin Mary (personal communication by Zora Bielichova and Ján Chovanec). The



Fig. 4. The antler arrow bolt plane from Buda-Várpalota. Photo and courtesy of Ágnes Font.

89 mm long implement is rounded at both ends and bears two openings directed oppositely. Initially, it was described and discussed as a clasp for cloths (Čaplovič, 1979, 156, Fig 15:2; Slivka, 1984, 408, Plate 3, Fig 24).

The so far known oldest antler plane, dated to the turn of the 8th to the 9th century, also came to light broken. The 57 mm long and 20 mm wide fragment, damaged at the second hole, was found at the fortified settlement of Břeclav – Pohansko in Southern Moravia, and first interpreted as a bow cover (Dostál and Vignatiiová, 1989, 52, 170, Fig 23:6; Švecová, 2002). Arrow bolt smootheners dated to the 10th century came from the Church of the Tithes in Kyiv and a Kazar period burial from the region of the Lower Volga. The former was made from a horn and has two identically directed holes (Sergeeva, 2010, 196, Plate 25:1). The latter was made from bone and has three holes directed in an opposite way (Fodorov-Davydov, 1984, 90, Fig 8:6).

A.F. Medvedev also published some early planes by referring to the 19th century decorated specimen from the Vasyugan swamp in Western Siberia (Sirelius, 1903, 59, Fig 98). The older, fragmented object presenting two, identically directed holes originates from the 9th–11th-century fortified settlement of Sarkel – Belaja veža on the present-day territory of Russia (Fig. 1). The other, 12th-century plane with five opposite openings was found in Kyiv (Medvedev, 1966, 50, Plate 11, Figs 19–20, 22).

Two coeval analogies with the Hungarian finds were described from Poland. A 14th-century plane made from bone was found in the main courtyard of the ducal castle in Warsaw. This item bears three, oppositely oriented holes (Mroczek, 2007, 62–63, Plate 10:11). The other site is the stronghold of Muszyna, which functioned as an administrative and military centre during the 14th century. The inner part of the hillfort became an area of craft in the next century when the function of the hillfort is not clear. Nevertheless, the number of crossbow bolts found both at this place and in the castle of Muszyna, built on the initiative of the bishop of Cracow, Zbigniew Oleśnicki, seem to have been linking these two areas of the site (Garstka and Ginter, 2020, 159–160, Fig. 1). The antler plane, initially identified as a part of a musical instrument, is

the shortest among this type of published artefacts, its length being only 41 mm (Table 1). The two holes are oriented in the same direction (Garstka and Ginter, 2020, 162, Fig. 4).

4. Typology and workshops

The summary of the above-listed finds (Table 1) shows that antler (in five exemplars) and bone (in five items) were equally preferred raw materials for carving arrow bolt planes, while only a single plane made from horn was so far published. From the antler planes, which have been documented by photographs, we can see that sometimes the surface was left intact (e.g. the plane from Muszyna; Garstka and Ginter, 2020, 162, Fig. 4), while in other cases the cortical tissue was partially (Esztergom; Fig. 3) or completely removed (Buda; Fig. 4).

Neither chronological nor regional (Fig. 1) patterns seem to have developed, neither in the size of planes nor regarding the number and orientation of holes. Nevertheless, most of the planes' size falls between 65 and 80 mm, and usually, two or three slots were cut. The orientation of holes – except for two cases (the planes from Kyiv – Church of the Tithes and Muszyna, respectively) – is opposite, allowing a fusiform shape for the shaft by whittling from the middle towards both ends. Contrary, a straight shaft was whittled from one end to the other (Garstka and Ginter, 2020, 162).

It is also notable that the arrow bolt planes usually originate from sites representing aristocratic settlements such as royal palaces and religious houses. The context of archaeological finds from where the planes were identified in several cases points to an area connected to handicrafts (e.g. Břeclav – Pohansko and Muszyna) or even to a bone and antler carving workshop (e.g. Warsaw – Copper-Roof Palace, Esztergom-Várhegy-Kőbánya, and Buda-Várpalota). According to the osseous assemblages including cut-to-piece raw material and semi-finished products in addition to various artefacts found at the latter sites, it seems likely that the higher status of settlements involved a developed specialisation and workshops dedicated to bone and antler manufacture (Fig. 5). Turning marks displayed on several objects found in the



Fig. 5. The Crossbow Maker. Woodcut book-illustration by Sigmund Feierabend from 1568. Image from the public domain, courtesy of the British Museum.



Fig. 6. Hunting with a crossbow in the 14th century. Detail from the MS. Bodl. 264, fol 95r. Image from the public domain, courtesy of the Bodleian Library, Oxford.

assemblages from Buda and Esztergom, respectively, would even imply the use of a lathe in these Hungarian ateliers (G. Sándor, 1963; Gál, 2020a).

The Z-shaped lines present on the Esztergom piece so far represent a unique feature as they were not recognised in any of the published analogies. Since nothing is attached to the plane from its concave side, but the artefact runs over the bolt shaft during working, it is suggested that it represents a decoration or sign made as a personal mark.

The workshop placed in the archbishopric residence at Esztergom is not unique. Evidence for crossbow production was also found in the palaces of the archbishops of Salzburg (Austria) and Trondheim (Central Norway), respectively (Lang, 2010; Holst Booth, 1996). Although we do not know the name of the bishop who was settling the palace in Esztergom during the accumulation of the osseous material that formed the subject of our studies, historical documents evidence the use of the crossbow by Ippolito d'Este, archbishop at Esztergom between 1486 and 1497. One of the 33 accounting books under his reign mentions the cost of his crossbow's reparation (Kuffart, 2018, 111), while the legacy inventory of Ippolito's master, Sebastiano da Lugo (who died on 4th October 1490), includes a crossbow from Prague among his belonging (Kuffart, 2018, 47–48).

The zooarchaeological assemblage representing butchery and food remains suggested that small- and medium-size games such as hare and birds living in various environmental conditions were more frequently consumed in the palace (Gál, 2020b, 2021). Although the employment of trained birds and nets in catching these preys can not be excluded, written and iconographic evidence from the Middle Ages prove that the crossbow was a rather widespread weapon used for hunting (Fig. 6).

5. Conclusions

The revision of the 13th–14th century arrow shaft plane from the archbishopric palace at Esztergom together with its 15th-century counterpart from Buda brings additional evidence for the use of this rare type of tool in medieval Europe. Both finds, together with the 11th–13th-century arrow bolt plane from Trebišov, suggest that this kind of implement used to be carved from antler rather than from bone in medieval Hungary. Their size falling between 70 and 90 mm as well as the two openings oriented in opposite directions on each of these artefacts would also confirm their similar character.

Author contributions

Erika Gál: Conceptualization, Investigation, Data curation, Visualization, Writing - Original draft preparation, Writing- Reviewing and Editing.

Data availability

All the data in this study are cited from published literatures.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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