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## Late Medieval Bone and Antler Working at the Residence of the Archbishop of Esztergom (Northern Hungary)

Kaulo ir rago apdirbimas Esztergomo (šiaurinė Vengrija) arkivyskupo rezidencijoje vėlyvaisiais viduramžiais

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**Abstract:** A relatively small worked bone and antler assemblage including 28 finished objects and 104 remains representing blanks and waste material was identified during the zooarchaeological analysis of the bone material found at the recently excavated site of Esztergom-Várhegy-Kőbánya (Esztergom-Castle Hill-Quarry). According to archaeological investigations, the complete animal bone assemblage deposited in several successive layers on the Castle Hill of Esztergom represents the kitchen refuse of the bishopric residence. Despite the religious context of the settlement, rosary beads or other artefacts usually produced in greater numbers are missing in our material. Common objects such as pins, handles and toys as well as the fine worked decorative items were poorly represented. Contrary, the details for crossbow and the antler debris dominated the assemblage linked to manufacturing. All these would suggest the presence of a workshop in the archbishop's palace specialised for the quick production and reparation of details for crossbow. Although the small quantity of both the finished objects and production waste point to a small – maybe only seasonally operating – workshop, the involvement of a skilled bone-worker and possibly a lathe is suggested.

**Keywords:** bone and antler manufacture, workshop, lathe, bishopric residence, Late Medieval, Esztergom-Várhegy-Kőbánya, Hungary.

**Summary:** Atliekant buvusios Esztergomo pilies kalno zooarcheologinės medžiagos tyrimus, buvo surinkta ir negausi kaulo bei rago dirbinių (28 vnt.), jų ruošinių ir gamybos atliekų (104 vnt.) kolekcija. Archeologinių tyrimų duomenimis, keliuose pilies kalno kultūriniuose sluoksniuose surinkti gyvūnų kaulai turėtų būti vertinami kaip vyskupo rezidencijos virtuvės atliekos. Nors tirtas religinio pobūdžio objektas, čia visai nebuvo rasta kaulinių rožinių karoliukų ar kitų religinio pobūdžio kaulinių bei raginių dirbinių, paprastai gausiai randamų panašiuose objektuose. Nedaug aptikta ir kasdienės paskirties dirbinių – smeigtukų, rankenų ar žaislų bei dekoratyvinių, kruopščiai pagamintų dirbinių detalių. Kiek netikėtai šioje kolekcijoje dominavo arbaletų detalės ir rago apdirbimo atliekos. Tokio pobūdžio radiniai rodytų, kad arkivyskupo rezidencijoje veikė specializuotos kauladirbio dirbtuvės, kuriose buvo gaminami ir taisomi arbaletai. Nors nedidelis dirbinių ir jų gamybos atliekų kiekis rodytų, kad dirbtuvės buvusios nedidelės, galbūt gyvavusios vos vieną sezoną, dirbinių pobūdis leidžia teigti, kad jose turėjo darbuotis įgūdęs, tekinimo stakles naudojęs kauladirbys.

**Keywords:** kaulo ir rago apdirbimas, kauladirbio dirbtuvės, tekinimo staklės, vyskupo rezidencija, vėlyvieji viduramžiai, Esztergomas-Várhegy-Kőbánya, Vengrija.

## Introduction

The city of Esztergom is located in Northern Hungary, on the right bank of river Danube, where various geographical regions meet such as the Small Hungarian Plain from West, the Pilis Mountains from South, and the Visegrád Mountains from East (Figure 1). It became a princely/royal and religious centre already by the 10<sup>th</sup>/11<sup>th</sup> century. On 1<sup>st</sup> January 1001, the son of Géza (the Grand Prince of the Hungarians), Stephen I has been enthroned as the King of Hungary, who has established the archbishopric in the same year (Horváth et al., 1979, p. 83).



**Figure 1**

The location of Esztergom and other castle sites mentioned in the article

1 pav. Esztergomo ir kitų tekste minimų vietovių situacijos planas (pagal László Zentai, 1996)  
based on the map by László Zentai 1996

The site of Esztergom-Várhegy-Kőbánya (Esztergom-Castle Hill-Quarry) is situated on the 156 m high Castle Hill. The greatest part of the castle including the formal royal palace became the archbishop's property already by the mid-13<sup>th</sup> century (Horváth et al., 1979, p. 84–85). The bone material under study, recovered during the excavations held at the settlement in 2014–2016, has been deposited in subsequent layers in quarry pits on the southern side of the hill, right below the medieval kitchen of the archbishop. This is the first animal bone deposit recovered from the residence of an archbishop in Hungary.

Another novelty of this assemblage among the few bone materials coming from medieval religious centres is that both wet sieving and dry screening was carried out using 5 mm and 2 mm meshes when recovering the bones (Gál, 2021). As a result, a rather great number of fish (Bartosiewicz, 2021) and bird remains (Gál, 2020), as well as small decorative products could have been collected in addition to the mammalian remains and worked bone and red deer (*Cervus elaphus*) antler items that usually form the greatest part of zooarchaeological assemblages (Gál, 2021).

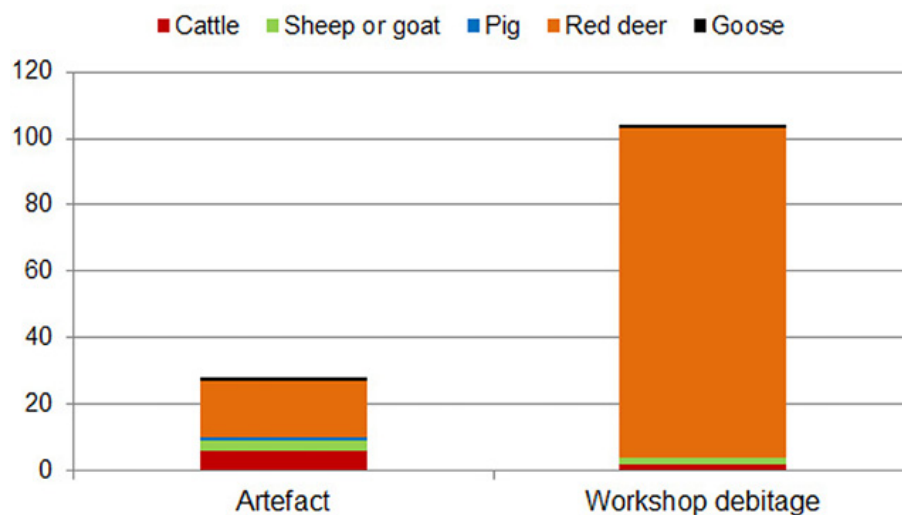
Three radiocarbon dating attempts were carried out on animal bones recovered from the bottom and the top of successive layers, which indicated 1270–1390 cal AD (1 $\sigma$ ; 685; D-AMS 023745), 1285–1400 cal AD (1 $\sigma$ ; 625; D-AMS 020206) and 1330–1445 cal AD (1 $\sigma$ ; 518; D-AMS 020204) respectively. Although the three dates overlap in the interval between 1330–1390 and thus do not exclude the possibility that the bone material had accumulated over a short period, but according to the presence of both migratory and winter visitor bird species in the assemblage, the process of deposition must have been over at least one year. In the lack of a coherent series of radiocarbon dates from the site, however, the accumulation of earlier (end of 13<sup>th</sup> c.–14<sup>th</sup> c.) and later (14<sup>th</sup>–15<sup>th</sup> c.) bone assemblage is also possible.

A total of 9,384 animal bones have been recovered of which nearly 7,000 were identifiable. Their majority (90.9%) belonged to domestic animals, but horse (*Equus caballus*) remains were absent in the assemblage, while dog (*Canis familiaris*) furnished only 8 remains (0.1%). Game animals including wild birds yielded less 8% of the bone material. Interestingly, domestic chicken (*Gallus domesticus*) was the best represented species in the assemblage by 28% (Gál, 2021, Table 1). This would point to the regular consumption of ‘white meat’ provided both by birds and fish on the one hand, and evidence the efficiency of sieving of samples at the excavations on the other hand (Gál, 2020).

Following the publication of fish (Bartosiewicz, 2021) and bird (Gál, 2020) material from Esztergom-Várhegy-Kőbánya, this paper focuses to the detailed presentation of worked bones and antlers found at the settlement, aiming to tincture the environment and facilities in medieval religious centres from a manufacturing point of view.

## Results

Of the several thousands of animal remains unearthed from the medieval layers of Esztergom-Várhegy-Kőbánya, 132 displayed any trace of manufacturing, forming 1.4% of the assemblage. Interestingly, only 28 of them could be identified as finished or at least half-made objects, while the rest of the remains represent a few blanks and mostly workshop debitage. Moreover, the overwhelming majority of the refuse material consists of cut- or sawn-off antler pieces, the bone waste being represented by a small number of cut-off epiphyses from cattle (*Bos taurus*) metapodials and a goose (*Anser* sp.) ulna (Figures 2 and 3).



**Figure 2**

The share of tools 28 pieces and workshop debitage 104 pieces  
by species and the number of identified specimens NISP

2 pav. Kaulinių dirbinių (28 vnt.) ir gamybos atliekų (104 vnt.) pasiskirstymas pagal gyvūnų rūšis



**Figure 3**

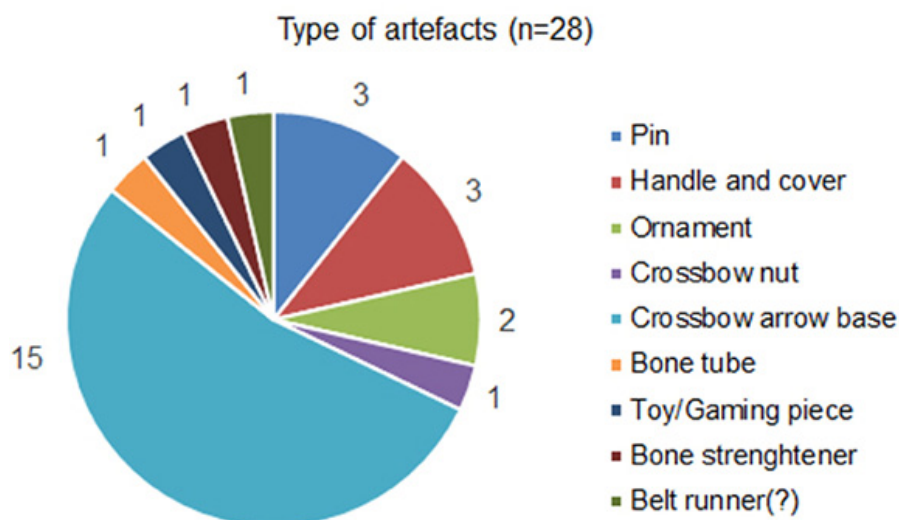
Bone top and antler waste and blanks displaying sawing and cut marks

3 pav. Kaulo (viršuje) ir rago atliekos su kapojimo bei pjovimo žymėmis

Photo by E. Gál

Among the finished products, thin plates representing crossbow arrow bases (or groove for the bolt) were the most frequent objects (15 of 28; Figure 4). They were found both in the 14<sup>th</sup> and 15<sup>th</sup> century layers. The arrow supporting plates were carved from red deer antler, except for a single specimen whose raw material was a cattle long bone diaphysis (Figure 5).





**Figure 4**  
Typological distribution of artefacts  
4 pav. Tipologinis dirbinių pasiskirstymas



**Figure 5**  
Bone and antler arrow supporting plates of crossbow.  
5 pav. Kauliniai ir raginiai arbaletų aptaisai – strėlių nukreipiamieji loveliai arbaletų apšodams  
Photo by E. Gál

When carving them from antler, the first step was removing both the upper layer of the cortex and the spongiosa. The manufacturing included cutting, sawing, polishing, filing, grooving and drilling. First, the plates were cut to size according to the dimensions of the crossbow. The upper side of plates was polished, while the margins and the underside were grooved to facilitate the adhesion of plates to the composite artefact.

According to the many thin and dense – usually longitudinally, but sometimes transversally directed – lines, grooving was made by files. On the upper side of plates, a single wider grooving was cut for the arrow in the midline. The width of this grooving varies in 2.9–9.2 mm. Finally, two slightly slantwise holes were drilled to the proximal end of plates for fixing them to the top of the tiller by rivets. The diameter of holes – including those on the fragmented plates, too – varied in 3.9–5.5 mm. The measurements of the complete or slightly fragmented plates are summarised in Table 1.

**Table 1.** Measurements (mm) of arrow base plates Lentelė. *Arbaletu aptaisų – strėlių nukreipiamųjų lovelių arbaletu apsodams – matmenys (mm)*

**Table 1**  
Measurements mm of arrow base plates

Length of plate	Width of plate	Thickness of plate	Diameter of hole for the rivet	Width of grooving for the arrow	Section	Stratigraphic Unit (SU)	Period
–	22.7	7.1	3.9	9.2	1	18	14th c.
51.0	22.8	5.4	5.5	2.9	1	23	14th c.
44.7	24.2	6.1	5.0	3.0	1	23	14th c.
–	23.3	5.6	3.9	8.5	2	3A	15th c.
–	–	6.3	3.9	8.8	2	3A	15th c.

Lentelė. Arbaletu aptaisų – strėlių nukreipiamųjų lovelių arbaletu apsodams – matmenys (mm)

Besides the number of bolt groove mounts, a fragment of crossbow nut also came to light from the 14<sup>th</sup> century deposit (Figure 6). According to the shape of the hook, it represents the right side part of the nut. Since a small hole of 3 mm diameter was also bored in addition to the central pivot hole, the fragment seems to have been originating from a composite nut (Figure 6:1). Such kind of two-part nuts are rare opposite to common nuts made in one piece and turned on a lathe. They are made from two flat pieces glued and held together by two iron rivets that go all the way through the nut (Holst Booth, 1996, p. 96, Fig. 3). Our fragment represents only a half of such kind of flat piece, and the other half with the second small hole is missing.





**Figure 6**

Fragment of the twopart nut of crossbow shown from various sides

6 pav. Arbaletų riešuto dalis, vaizdas iš įvairių pusių

Photo by E. Gál

The diameter of the nut is 31.9 mm. The hook is rounded and highly polished, suggesting its long term use (Figure 6:2). The opposite part of the cylinder has rough edges. The parallelly running fine horizontal lines on it very much resemble the trace of turning that would suggest that a lathe was also used when preparing the piece of antler for the nut (Figure 6:3).

The next most frequent group of objects is bone needles represented by three specimens that all were found in the older (14<sup>th</sup> century) deposits. Nevertheless, only one of them has entirely preserved in the assemblage. In the case of the other two specimens, only the distal part is present, while the proximal part with the needle eye is missing. All three needles were produced from the long bone diaphysis of sheep (*Ovis aries*) or goat (*Capra hircus*). The first steps in their manufacture included the grooving and splitting of caprine long bones. Then the obtained bone plates were

polished to size and form, an opening was made for the needle eye on the proximal part, while the distal end was sharpened and pointed. According to the well-preserved pin and the other two fragments, the size of needles seems to have been at least 7 cm (Figure 7).



**Figure 7**

Bone needles

7 pav. Kaulinės adatos

Photo by E. Gál

Several other objects may also be assigned to the group of tools used in the household. Two fragments of handles suggested that these articles were carved from cattle long bone diaphysis. It is likely that their manufacturing method also followed the groove and split technique. The bone plates were polished and drilled according to the size of the metal tool to which they had been attached.

The longer (10.1 cm), wide and flat handle was found in the 14<sup>th</sup> century layers. It bears two (broken) holes: a centrally placed larger hole of 5.2 mm diameter, and a marginally placed smaller hole of 3.0 mm. The hand-polish along the handle is also asymmetrical: one of the margins

is polished to white colour including the margin of fragmentation, too (Figure 8:1).



**Figure 8**

Bone and antler artefacts.

1 – handle; 2 – handle decorated with dots; 3 – covering plate; 4 – detail of bag (?); 5 – unfinished artefact (belt driver?). The arrows indicate the broken holes on handles  
Photo by E. Gál

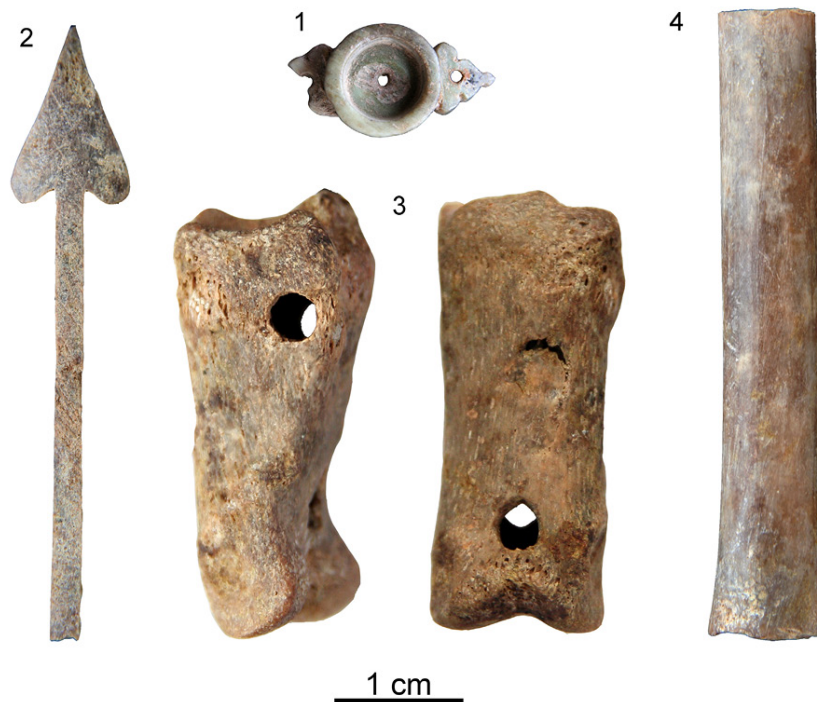
The shorter (83 cm), narrower and convex piece (from the 15<sup>th</sup> century) also presents two (broken) holes of different size (3.0 mm and 2.5 mm diameter, respectively), but both were centrally located. The handle is highly hand-polished, but the dotted decoration is still well notable both along the margins and transversally in double lines across the handle (Figure 8:2).

A 14<sup>th</sup> century handle cover was carved from red deer antler. The short and thick object with a triangle pointed proximal end was fixed to the metal handle by three nails (Figure 8:3). Another bone strip longer and narrower than the previous item was manufactured from cattle long bone diaphysis (Figure 8:4). According to its oblong shape and many small

holes, it may have been a bone detail of a bag or similar object. It was also found in the 14<sup>th</sup> century layers.

The fifth item assigned to this group is a 14<sup>th</sup> century article carved from the cortical section of a red deer antler beam that most probably represents a half-made or unfinished artefact. The size and shape of the 7 cm long and 3 cm wide object seem to have been planned, similarly to the two parallel, vertically cut openings on the antler plate, which, however, slightly differ from each other in size. The rough edges both on the margins and around the openings suggest yet unused object. Its present form resembles a belt driver or similar artefact (Figure 8:5).

The next group of bone objects includes small decorative items and (probable) wind instruments. The smallest (only 19 mm), but most carefully produced object is the 15<sup>th</sup> century belt mount having grey-greenish bronze patina (Figure 9:1). According to its counterparts identified from a medieval workshop placed to the Buda Castle (in present-day Budapest), these small adornments were cut out from the bone plates by sawing. The disk in the middle of plate used to be carved by a bow drill, while the knurling was made by three-edged files (G. Sándor, 1959, p. 115). It is likely that the gracile, 54 mm long bone ornament with a leaf motive, was also produced by sawing and filing (Figure 9:2).



**Figure 9**

**Decorations and toys**

1 – belt mounting; 2 – ornament with a leaf motif; 3 – drilled pig phalanx; 4 – bird bone tube.

9 pav. Puošybos elementai ir žaislai. 1 – diržo detalė; 2 – lapo formos

papuošimas; 3 – pragręžtas kiaulės pirštakaulis; 4 – vamzdelis iš paukščio kaulo

Photo by E. Gál

The modified proximal phalanx from the pig (*Sus domesticus*) most probably represents a toggle or buzzer. The edges both on the proximal

and distal end of the bone were polished. The articulation surface was not bored, but both the proximal and the distal part of the diaphysis bear two symmetrical holes each drilled from latero-medial and dorso-plantar directions, respectively. A fifth, half-made opening was made on the proximal part of the dorsal surface. The diameter of the holes is 4 mm in each case (Figure 9:3).

Finally, the 5 cm long bone tube carved from the ulna of a goose size bird may have been a whistle, but it may also have represented a simple – and maybe unfinished – needle case (Figure 9:4).

## Discussion

Bone and antler remains displaying manufacturing marks as well as workshops have been described from several high-status settlements from all over Hungary (e.g. G. Sándor, 1963; Gróf and Groh, 2001; Kovács, 2005; Kovács, 2005; Gál, 2016). The tool assemblage found at Esztergom-Várhegy-Kőbánya, however, represents the first material that has been published from a religious centre (Gál, 2020a). In this respect, the lack of any evidence for producing rosary beads is noteworthy. These objects were produced in their thousands in a 14<sup>th</sup>–15<sup>th</sup> century workshop at Visegrád when this medieval place was the royal capital of Hungary (Gróf and Groh, 2001). Interestingly, combs – a regularly recovered type of artefact from elite sites including the Hungarian castles mentioned in the paper (Choyke and Kovács, 2010; Gál, 2016, p. 137, Fig. 4) – are also missing in the collection under study.

Common (and finished) objects were generally poorly represented in the assemblage from Esztergom-Várhegy-Kőbánya. According to the very simple handles and covers, the knives (and forks) were produced for everyday use, similarly to the iron knife with antler cover on the handle coming from the 16<sup>th</sup>–17<sup>th</sup> century layers of Visegrád-Fellegvár (Kovács, 2006, p. 187, Fig. 12), or the coeval bone handles originating from the castle of Barcs (Gál, 2016, p. 139, Fig. 7).

The bone plate with a series of small holes (Figure 8:4) may also be assigned to the group of simple objects as it represents a similar artefact to the antler detail of a bag described from the Viljandi Castle located in Southern Estonia (Haak et al., 2012, p. 319–320, Fig. 22).

Buzz bones were usually made from pig metapodials, as several parallels evidence both from Hungary and abroad. Nevertheless, as long as in the case of toggles found in the medieval assemblages of Guetrat Castle near Salzburg (Austria), as well as the Bishop's Castle in Lihula and Otepää hill-fort (Western and Southern Estonia, respectively) both epiphyses were present on metacarpals and metatarsals (Luik, 2002, p. 319, Fig. 13; Maldre, 2001, p. 27, Fig. 6:a–e), the ends of bones were cut off when manufacturing the buzz bones found in the 15<sup>th</sup>–16<sup>th</sup> century assemblage of Visegrád-Fellegvár (Kovács, 2006, p. 188, Figs. 20–21) and the 13<sup>th</sup>–16<sup>th</sup> century layers of Viljandi Castle (Haak et al., 2012, p. 317, Fig. 19:2). Moreover, a radius with cut-off epiphysis also seems to have been



modified into a toggle as a 16<sup>th</sup> century specimen found at the site of Tartu Road 1 in Tallinn indicates (Luik et al., 2015, p. 151, Fig. 6:1).

Nevertheless, it is likely that proximal phalanges were the second most often used pig bones after metapodials for producing sound instruments. The 39 mm long proximal phalanx found in the 10<sup>th</sup>–12<sup>th</sup> century assemblage of Brno-Slatina (a district of Brno in the Czech Republic) bears five holes including the joint surface of the proximal epiphysis and the sides of the diaphysis. Similarly modified phalanges seem to have been discovered in the bone collections of the Polish sites of Giecz, Gniezno and Poznan (Hrubý, 1957, p. 177, Fig. 8:15).

In Estonia, a number of bored cattle phalanges were found in the above mentioned Otepää hill-fort. A few of them were cast with metal, and two presented cross marks carved into the dorsal side of phalanges (Maldre, 2001, p. 26, Fig. 3). Cattle phalanges drilled from the proximal articulation surface and filled with metal as well as decorated with carved cross marks and dots have been described from the 14<sup>th</sup>–16<sup>th</sup> and 17<sup>th</sup> century layers of Tartu Road 1 in Tallinn. Besides, modified phalanges interpreted as gaming pieces were published from many other sites in Estonia as well as Lithuania, Germany and the Netherlands (Luik et al., 2015, p. 151, Fig. 6:5–7). In Hungary, the site of Szent György tér-Királyi istálló in the Buda Castle yielded a proximal cattle phalanx that was bored both from the proximal articulation surface and the dorsal side of the diaphysis, but it was not filled with metal (Csippán, 2007, p. 316, Fig. 3). The specimen found in the manor house of Baj in Northern Hungary was only transversally drilled (Bartosiewicz, 2010, p. 338).

As a consequence, the drilled phalanx from Esztergom seems to better represent a buzz bone – or a similar toy – than a gaming piece. The lack of hole on the proximal epiphysis and filled metal as well as the four symmetrical holes suggests that this object used to be fixed to a string. Nevertheless, the role of the half-made fifth hole on the dorsal surface of diaphysis remains unclear (Figure 9:3).

A similarly enigmatic tool in the assemblage from Esztergom is the bone tube carved in a goose ulna (Figure 9:4). Its counterpart, broadly dated to the 14<sup>th</sup>–15<sup>th</sup> century, was published from Visegrád-Királyi Palota (the Royal Palace at Visegrád) (Gál, 2005, p. 329, Fig. 8; Kovács, 2005, p. 299, Fig. 10). Simple bone tubes without holes may have been employed as plain whistles for emitting sounds when calling animals at the hunting, or as toys for children, for example. They also may have been used as needle cases. Another possible interpretation for the bird bone tubes without holes, based on several bone tubes of varying sizes found in Lihula, is that they formed parts of musical instruments similar to pan pipes (Luik, 2002, p. 318, Fig. 12). Two whistles with one and two holes, respectively, were found on the area of Buda Castle in the present-day Budapest (Kovács, 2005, p. 314, Fig. 4 /3–4).

The role of rounded antler object with two straight openings also raises questions in our material (Figure 8:5). A similar specimen, but with rectangular edges was found in the medieval workshop of the royal palace in Buda. Together with two other simple antler pieces displaying



marks of carving, it has been interpreted as a blank for producing plates (G. Sándor, 1963, p. 110–111, Fig. 3:3). The artefact from Esztergom, however, clearly contradicts this hypothesis, since it seems to have been fashioned to a special form, e.g., a belt cover or driver.

As long as the above-mentioned antler object may only be tentatively linked to clothing, the small detail of belt mount with fragmented verge evidence that fine products representing personal belongings also occurred in the residence of archbishop (Figure 9 :1). A rather great number of parallels for bone belt mountings have been described both from medieval settlements and cemeteries including the Buda Castle (Kovács, 2005, p. 313, Fig. 3/3–4), several sites in the eastern and southern part of the country (G. Sándor, 1959) and on the southern coast of Lake Balaton (Magyar, 2010, p. 148–150, Figs. 5 –6).

Majority of the objects illustrated in the above-listed studies are mounting with rectangular and decorated margins that were fixed by four rivets in addition to the fifth rivet in the middle of the circle. They have been interpreted as bearing Gothic style decorations developed due to western influences and tastes in the Middle Ages (G. Sándor, 1959). Compared to them, our specimen most probably represents a simpler – or merely another type – of mount having only two knurled margins. The mount from Esztergom thus had to be fixed to the belt by three rivets.

The only frequent artefact in the assemblage from Esztergom-Várhegy-Kőbánya was the plates for arrow bases in crossbow, forming more than half of the tool collection (Figure 4). An attempt for grouping the arrow supporting mounts was made by Annette Holts Booth based on 71 plates found in the Archbishop's Palace in Trondheim, Central Norway. She distinguished three groups according to the shape and likely position of plates along the top of the tiller of a crossbow. The front-pieces were recognised by the widening groove in their front end that accommodates the bolt-head. The middle-pieces were determined according to their narrowing end towards the back, while the back-pieces were identified according to their smaller width that corresponded to the narrow part of the middle-pieces (Holts Booth, 1996, p. 97, Fig. 4).

Several well-preserved mounts found in the Vilnius Castle complex, however, evidence that plates with a narrowing end may have also had a widening groove in the front, and even a single such kind of plate would have been enough on a crossbow for driving the bolt (Luik et al., 2019, p. 197, Fig. 8:1; Rackevičius, 2007, p. 61–62, Figs. 2 –3). Moreover, Gintautas Rackevičius in his paper on crossbows states that: “The shape of a crossbow arrow-groove plate would resemble that of a light-weight stock, i.e. those parts of the stock that did not carry additional mechanical load, were narrowed to the maximum” (Rackevičius, 2007, p. 64).

This information and analogues together suggest that some (type of) crossbows – possibly those working with short bolts – may have had a single plate fixed to the tiller only, while the arrow-groove plate may have been composed by more than one piece in others. The shaft of a 14<sup>th</sup>–15<sup>th</sup> century bolt found in the Vilnius Lower Castle was 36 mm long and 10–11 mm in diameter (Rackevičius, 2007, p. 66, Fig. 7:3).

According to the number of entirely preserved, rather short and rectangular-shaped plates in our material, especially taking into account those with the widening carved for the arrowhead (Fig. 5), it is likely that several mounts fixed inline made up the arrow supporting plate in the crossbows used in Esztergom as suggested by Annette Holts Booth (Holts Booth, 1996, p. 97). The size of the two complete plates suggests that they were fashioned to about 4–5 cm in length and 2–2.5 mm in width (Table 1). Most of the arrow-groove plates recovered from Vilnius Castle had a similar size at their widest point (Rackevičius, 2007, p. 66, Fig. 3). As for the groove carved for the arrow, plates for both narrow and wide bolt seem to have been produced in Esztergom (Figure 5, Table 1).

Nevertheless, plates with narrowed end may have also been applied at Esztergom, too, since some of the recovered mounts were fragmented, and the shape of the missing part is unknown in this case. Such kind of narrowed ended, relatively well-preserved plates were identified from Visegrád-Fellegvár (Kováts, 2006, p. 188, Figs. 14–15) and Visegrád-Alsóvár (Kováts, 2009, p. 269, Fig. 10) in Hungary. In addition to the already mentioned analogues from Trondheim and Vilnius, other parallels from abroad were described from Viljandi Castle (Haak et al., 2012, p. 312, Fig. 14:2), and from the region of Bukowsko in South Poland (Hrubý, 1957, p. 119, Fig. 1:1).

The very few pieces known from Serbia (Stalać, 14<sup>th</sup>–15<sup>th</sup> century) and Croatia (Čačvina, mid-14<sup>th</sup> century) seem to have resembled the plates from Esztergom, though one of the Croatian plates was provided with an additional pair of small holes for rivets (Rabovyanov, 2016, p. 15, Fig. 5). Finally, the completely preserved arrow plate recently recovered from Trapezitsa in Veliko Tarnovo (Bulgaria, mid-14<sup>th</sup> century) is unique in this category of artefacts. This mount was carved from the long bone diaphysis of a ruminant, has a triangular pointing front, and was fixed by three rivets at the top and two in the middle (Rabovyanov, 2016, p. 11, Fig. 1).

Not only the number of details for crossbows compared to the other artefacts, but the amount of antler debris mostly consisting of antler bits with sawing marks (pieces of tine, tine-ends, sticks and strips, etc.) is also noteworthy in the material found at Esztergom (Figure 2). The outstanding ratio of antler implements and workshop debitage is especially interesting in the light of archaeozoological results concerning the complete bone assemblage recovered from Esztergom-Várhegy-Kőbánya, since bone evidence for hunting large game animals such as the red deer, roe deer (*Capreolus capreolus*) and wild boar (*Sus scrofa*) – wild species being common in Hungary even today – are almost entirely missing from the assemblage (Gál, 2021; Gál, 2020).

Similar waste materials were found in the workshops of Visegrád-Fellegvár, dated to the 14<sup>th</sup>–16<sup>th</sup> century (Kováts, 2006, p. 187–188, Figs. 2–8) and Visegrád-Alsóvár, dated to the 16<sup>th</sup>–17<sup>th</sup> century that is the period of the Ottoman Empire in Hungary (Kováts, 2009, p. 266–267, Figs. 2–3), as well as in the royal palace of Buda Castle, dated

to the 15<sup>th</sup> century (G. Sándor, 1963, p. 108, Fig. 1) and in Diósgyőr Castle, dated to the 14<sup>th</sup>–15<sup>th</sup> century (Sz. Czeglédy 1966, p. 233–234, Figs. 2–4). The exact number of worked bones and antlers is unknown in the case of two latter settlements, but lots of finds are indicated to have been collected. The abundance and richness of the manufactured material are especially evident in the case of the royal palace at Buda, according to the illustrations and descriptions evidencing the production of workshop settled in the palace for furnishing the regal residence (G. Sándor, 1963). Therefore, the size of assemblage unearthed at Esztergom by its 132 worked bone and antler seems to better resemble the collections from both workshops at Visegrád: 74 pieces in the Citadel and 80 pieces in the Lower Castle. The proportion of antler to bone artefacts as well as the finished objects to blanks and waste material also resemble in these three assemblages. Moreover, both in the castles of Visegrád and Esztergom the crossbow details and household items such as handles, pins and toys dominated. The worked bone materials from Visegrád, however, contained more sophisticated elements such as combs, grooved plates and turned objects. Another important difference between the Esztergom and Visegrád assemblages is that not only the gathered antler served as raw material for the production of antler artefacts at the latter locality, but both red deer and roe deer were hunted at the site according to the antler remains attached to the skull (Kováts, 2006; Kováts, 2009).

Therefore, it seems likely that the workshop placed to the palace of archbishop in Esztergom did not produce a wide range and quantity of bone and antler tools, but was primarily specialised to the production of crossbows, or – taking into account the small number of finished objects – the reparation of damaged details. The periodic manufacturing did not require the successive killing of red deer, but gathered and deposited or transported antler seems to have been supplied to the small workshop.

Parallels for specialised workshops operating in the castle rather than in the town are known from other parts of Europe as well. The worked bone assemblage from the Viljandi Castle in Southern Estonia contained five times as much working debris as artefacts. The latter formed two main categories: details for the weapon (mostly crossbow) and objects for entertainment such as dice, gaming pieces, chessman and flute (Haak et al., 2012).

The castle of Guetrat in Western Austria, built by order of the archbishop of Salzburg and used during the 13<sup>th</sup> century, also yielded a small group of objects such as crossbow nuts and plates, needles and tokens. According to the lack of certain antler parts (e.g. burrs and junctions of beam and tines) in the workshop debitage, it has been suggested that the castle most probably used to be visited by an itinerant bone carver who transported easily movable fragments to the castle only in a certain part of the year to produce the needed artefacts for the settlers of the castle (Lang, 2010).

Crossbow production at an archbishop palace has been described from Trondheim in Central Norway. The preliminary analysis of the 15<sup>th</sup> to

early 16<sup>th</sup> century deposit found during the reconstruction of the palace focuses to the presentation of 19 nuts and 71 arrow base plates, but other animal bones with and without traces of manufacture made also part of this zooarchaeological assemblage. Nevertheless, the rather great number of crossbow details including both finished and unfinished items evidence that a workshop of crossbow makers was located in the archbishop's palace (Holst Booth, 1996).

The equipment of the workshop placed to the castle of Esztergom seems to have included a range of tools such as drawknife, saw and file, as well as a bow drill and a lathe. The period from when the latter implement made part of the utensils, however, is still to be clarified. The full archaeological analysis of the site has not been completed yet. The crossbow nut, dated to the 14<sup>th</sup> century, is not only the single turned artefact coming from a stratigraphically reliable layer, but the sole find in this category, and its condition evidence that it has been used for a long time. Consequently, it may have not necessarily been produced in this workshop, but only discarded in the castle of the archbishop. Three other turned objects including a blank and debris confirm the use of the lathe in the Esztergom workshop (Figure 10), but these finds were found in mixed layers. Therefore, their absolute dating on the one hand, and the study of metal finds on the other may shed light on the beginnings of the manufacture of turned products at the settlement.



**Figure 10**

Turned objects found in mixed layers.

10 pav. Maišytuose sluoksniuose rasti radiniai

Photo by E. Gál

The earliest artefacts displaying marks of turning include the 14<sup>th</sup>–15<sup>th</sup> century handle cover of a tool found at Visegrád–Fellegvár (Kováts, 2006, p. 187, Fig. 13). Although the lathe has been spread over Europe already by the 13<sup>th</sup> century, it seems to have been used to a large extent in the 14<sup>th</sup>–15<sup>th</sup> century workshop of the royal palace in the Buda Castle, from where several dozens of turned products came to light (G. Sándor, 1963). The first charter regarding the lathe guild in Buda dates to the end of the 15<sup>th</sup> century (G. Sándor, 1963, p. 116). Further 15<sup>th</sup> century turned

objects were described from the castles of Diósgyőr (Sz. Czeglédy, 1966) and Nagyvázsony (G. Sándor, 1960).

Nevertheless, as long as workshop debitage and half-made products evidence the presence of bone and antler workshops at Esztergom, Visegrád and Diósgyőr, this needs to be clarified in the case of Nagyvázsony. The three chess figurines made from turned red deer antler (G. Sándor 1960, p. 250, Fig. 68) were found in the castle of Nagyvázsony, but have been linked to the craftsman production of the Pauline cloister located a few hundred meters from the castle (Sz. Czeglédy, 1966, p. 229). The manufactured bone assemblage found at the latter settlement, however, contained only a few high-quality objects such as ivory spoons and decorative antler plates (Éri, 1964, p. 86, Fig. 63:10–15). The lack of any working debris referring to local bone manufacturing makes the presence of a workshop doubtful and raised the question whether this might have so far remained unearthed at the site (Éri, 1964, p. 93).

Concerning the turned artefacts as well as the bone and antler workshops in the castles of Diósgyőr and Visegrád, it has been suggested that qualified craftsmen may have been delegated to royal residences located in the country to produce local workshops during the 15<sup>th</sup> century (Sz. Czeglédy, 1966, p. 229). Although it was the archbishop of Esztergom who owned the castle of Esztergom already by the end of the Early Middle Ages (the second part of the 13<sup>th</sup> century), the settlement seems to have been toeing the line of royal residences in the countryside from the viewpoint of bone working and productions.

## Conclusions

The firstly identified worked bone and antler material from a religious centre in Hungary indicate the presence of a small workshop placed to the palace of the archbishop. The size and composition of the assemblage resemble the collections recovered from the castles of Visegrád (the Citadel and the Lower Castle). In addition to the most frequent antler details for the crossbow, mostly common objects – needles, handles, covering plates and toys – reflecting the everyday life of people were found. Nevertheless, owing to the wet and dry screening of the excavated sediment, very small and fragile finds such as a belt mounting and other carefully carved decorative items also came to light from the settlement.

According to the small number and variety of finished objects, as well as a large amount of antler waste material, it is likely that a small – and maybe seasonal – workshop was settled to the religious residence of the archbishop that has mostly specialised to the production and reparation of weapons and simple household items of personal needs. The lack of evidence for hunted red and roe deer not only in the worked bone assemblage but in the whole zooarchaeological material from Esztergom-Várhegy-Kőbánya would also point to a temporary operating workshop based on gathered and deposited or transported antler stock that might have been functioned mostly in the hunting season. The equipment of the workshop, however, seems to have included a lathe in addition to the



more common utensils, similarly to the workshops of late medieval royal residences.

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## Kaulo ir rago apdirbimas Esztergomo (šiaurinė Vengrija) arkivyskupo rezidencijoje vėlyvaisiais viduramžiais

*Erika Gál*

### Santrauka

Esztergomo miestas yra įsikūręs šiaurinėje Vengrijoje, Dunojaus dešiniajame krante (1 pav.). X–XI a. sandūroje jis tapo valdžios ir religiniu centru, čia 1001 m. sausio 1 d. Vengrijos didžiojo kunigaikščio Gézos sūnus Steponas I tapo pirmuoju Vengrijos karaliumi ir tais pačiais metais mieste įkūrė arkivyskupiją. Esztergomo-Várhegy-Kőbánya pilies kalno gyvenvietė įsikūrusi ant 156 m aukščio Pilies kalno. Didžioji pilies dalis kartu su karališkaisiais rūmais jau XIII a. viduryje tapo arkivyskupijos nuosavybe. Tirta ir šiame straipsnyje pristatoma osteologinė medžiaga buvo rasta 2014–2016 m. archeologinių tyrimų metu duobėse priešais viduramžių arkivyskupijos virtuvę. Tai yra pirmieji arkivyskupo rezidencijoje Vengrijoje rastos zooarcheologinės medžiagos tyrimai. Dar viena naujovė – kasinėjimų metu zooarcheologinė medžiaga buvo surinkta naudojant šlapią ir sausą sijojimą per sietus, kurių akučių dydis 5 mm ir 2 mm. Taikant tokią tyrimų metodiką buvo surinkta daugybė žuvų ir paukščių liekanų (Bartoszewicz, 2021; Gál, 2020), taip pat smulkių, iš elnių ragų pagamintų puošybos detalių. Radiokarboninės gyvūnų kaulų datos parodė, kad sluoksniai, kuriuose surinkta zooarcheologinė kolekcija, formavosi nuo 1270 m. iki 1445 m., tačiau, kadangi trijų  $^{14}\text{C}$  AMS datų intervalai turi sąlyčio taškų, galima manyti, kad tirti kaulai galėjo susikaupti per trumpesnį laikotarpį, tarp 1330 m. ir 1390 m. Tiesa, tirtoje medžiagoje gali būti įsimaišiusių ir kiek ankstyvesnio bei vėlyvesnio laikotarpio kaulų.

Iš viso buvo surinkti 9 384 gyvūnų kaulai, iš jų apie 7 000 pavyko identifikuoti. Dauguma kaulų (90,9 %) buvo naminių gyvulių, tačiau tarp jų visai nerasta arklių kaulų ir vos 8 kaulai (0,1 %) priklausė šunims. Laukinių gyvūnų, skaičiuojant ir paukščius, kaulų aptikta mažiau negu 8 %. Įdomiausia, kad iš visų gyvūnų daugiausia rasta vištų kaulų (28 %). Viena vertus, tai rodytų, kad gausiai vartota balta mėsa – paukštiena ir žuvis, kita vertus, toks rezultatas liudija tyrimų metu taikytos metodikos – sijojimo – efektyvumą (Gál, 2020). Arkivyskupijoje aptiktų žuvų (Bartoszewicz, 2021) ir paukščių (Gál, 2020) liekanų tyrimai jau publikuoti, o šis darbas yra skirtas aptarti rastus kaulo ir rago dirbinius, jų gamybą viduramžių religiniuose centruose ir gamyboje naudotą įrangą.

Tarp tūkstančių Esztergomo-Várhegy-Kőbánya viduramžių sluoksnuose aptiktų gyvūnų kaulų tikrai 132, t. y. 1,4 %, buvo su apdirbimo žymėmis. Iš jų vos 28 buvo daugiau ar mažiau pabaigti dirbiniai. Likusią kolekcijos dalį sudarė keletas ruošinių ir gamybos atliekos, tarp kurių daugiausia aptikta nupjautų arba nukirstų elnių ragų fragmentų, taip pat keletas nukirstų galvijų metapodijų epifizų ir žąsies alkūnkaulio dalis (2 ir 3 pav.). Tarp pabaigtų dirbinių vyravo arbaletų aptaisų plokštelės – strėlių nukreipiamieji loveliai arbaletų apsodams (15 iš 28; 4 pav.). Jie rasti XIV a. ir XV a. sluoksnuose ir visi, išskyrus vieną

(padarytą iš galvijo ilgojo kaulo), yra pagaminti iš elnių ragų (5 pav.). Panašių matmenų arbaletų aptaisų plokštelių rasta Vilniaus žemutinėje pilyje (Rackevičius, 2007; Luik et al., 2019). Be to, XIV a. sluoksnyje aptiktas ir arbaletų riešuto fragmentas (6 pav.). Kiti dirbiniai – XIV a. sluoksnyje rastos iš avių arba ožkų ilgųjų kaulų diafizių pagamintos trys adatos (7 pav.), keletas rankenų (pav. 8: 1–2) ir nepabaigtų dirbinių (pav. 8: 5). Atskira radinių grupė – dekoratyviniai elementai ir apkalai (pav. 9: 1–2), iš kiaulės pirmojo pirštakaulio pagaminta užsynė (9: 3) bei iš žąsies alkūnkaulio gaminta ir neužbaigta švilpynė arba dėtuvė adatoms (pav. 9: 4).

Vengrijos religiniame centre pirmą kartą aptikti su kaulo ir rago apdirbimu siejami radiniai rodo, kad arkivyskupijoje buvo įsikūrusios nedidelės kaulo ir rago apdirbimo dirbtuvės, o Esztergome surinkta radinių kolekcija savo dydžiu ir pobūdžiu labai primena kolekciją, rastą Aukštutinėje ir Žemutinėje Višegrado pilyse. Be itin gausių arbaletų detalių, Esztergome buvo ir kasdienį gyvenimą iliustruojančių radinių, o grunto sijojimas leido surinkti net ir labai smulkius bei trapius dirbinių fragmentus, pavyzdžiui, diržų detales ir kitus puošybinius elementus.

Nedidelis pabaigtų dirbinių kiekis ir jų įvairovė bei didelis rago apdirbimo atliekų kiekis rodytų, kad arkivyskupų rezidencijoje buvo apsistojęs kauladirbys, kurio specializacija buvo ginklų gamyba ir taisymas, nors jis galėjęs gaminti ir paprastus, kasdienėms reikmėms skirtus daiktus. Kadangi visoje Esztergomo-Várhegy-Kőbánya zooarcheologinėje medžiagoje nebuvo aptikta nei stirnų, nei elnių kaulų fragmentų, galima teigti, kad gamyboje buvo naudojami tiktai numesti arba atvežtiniai ragai, o kauladirbys daugiausia darbuotis galėjo medžioklės sezono metu. Nors dirbtuvės galėjo egzistuoti gana trumpai, jose buvo naudojamas ne tiktai paprastas gamybos inventorių, bet ir tekinimo staklės. Tokie įrenginiai buvo naudojami kauladirbių dirbtuvėse, vėlyvaisiais viduramžiais veikusiose karališkosiose rezidencijose.