Archaeologia Historica Polona
vol. 31, 2023, pp. 197–216, ISSN 1425–3534, DOI: 10.12775/AHP.2023.007

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Craftsmanship in early modern Gdańsk: insights from bone and antler artefacts from the excavations at 1 Sadowa Street

Abstract. This paper investigates 22 modern (17^{th}/18^{th}-century) bone and antler objects unearthed during archaeological excavations carried out in 2009–2010 at 1 Sadowa Street in Gdańsk, Poland. The artefacts were found in a layer of manure in a wood-and-brick outbuilding. The collection was subjected to typological, functional, raw material and traseological studies, which contributed to the evaluation of crafts that were developing in modern Gdańsk. Some finished products were identified, including a needle case, a fragment of a musical instrument, a lace block, a bone folder, a bead, a lid or a pawn, a needle case cap, and a button, as well as semi-finished products and production waste. The objects were made of long bones, including bones of the metapodial segment of cattle or, less frequently, sheep or goats, and of deer antlers. Traces of technological processing such as sawing, drilling, chopping, and grinding were observed on the artefacts, as well as traces of use, mainly disordered linear marks and polish.

Keywords: Pomerania, crafts, raw bone, needlework, lace-making, archaeozoology, traseology.

Introduction

From prehistory to the present day, the use of natural raw materials found in the vicinity of human habitation has been widespread (Bradley, Crabtree 2012, p. 426). People employed raw materials of both plant (e.g., wood, plant shoots, roots) and animal origin (e.g. fleece, hair cover, bones, antlers), skilfully selecting those with specific properties. In the case of raw bone, sufficient strength was particularly desirable, which was guaranteed by the right proportions, density, and structure of the cortical and cancellous bone composed of a large number of osteons. Craftsmen often used metacarpal and metatarsal bones because of their morphology – a long shaft and a thick cortex – along with other long bones that split into thin plates, thus facilitating further processing. Deer antler was also an important and frequently used raw material, as evidenced by numerous finds of objects dating back to the Middle Ages (Jaworski 2012, p. 166). However, it seems that the preferences concerning raw materials changed over time. From the late Middle Ages and early modern times, livestock-derived raw materials started to gain more importance, which is also linked to a change in the economic situation. In that period, the role of hunting declined, and the significance of cattle in the livestock structure grew notably, while the role of pigs and small ruminants diminished (Gręzak, Kurach 1996, pp. 139–167).

Traseological research, i.e. observation of the surface of artefacts for the presence of traces related to their production and use, is an increasingly common method employed in archaeology and archaeozoology to identify production techniques and/or technologies, utilitarian features, and post-depositional traces, including conservation activities. Due to the impermanence of organic source materials, the identification of these processes is extremely time-consuming (Wilczyński 2021, p. 202, Fig. 2), especially since, according to Arkadiusz Marciniak (1996, p. 502), in archaeological interpretations, we only have "illusions of certainty" and can record only single traces of a causal factor affecting the artefact.

Due to a lack of traseological studies of modern bone artefacts, this group of artefacts is almost excluded from the cognitive space. For this reason, we have analysed 22 artefacts recovered from a modern archaeological layer (layer no. 130 – manure, ca. 150 cm bgl), dated to the turn of the18th century, discovered at 1 Sadowa Street in Gdańsk, at an archaeological site investigated in 2009–2010 (Fig. 1). According to previous publications on the excavations in the so-called Lower Town, which includes Sadowa Street, "the origins of the settlement in this area date back to the 14th century, when a hospital for infectious patients with Saint Barbara's chapel was built at Długie Ogrody Street. In the 1420s, English settlers arrived in the Lower Town and settled north of Długie Ogrody Street, as well as Scots, who settled south […]. Settlement did not intensify until the early 17th century, when urban plots were delimited and extensive levelling activities were commenced

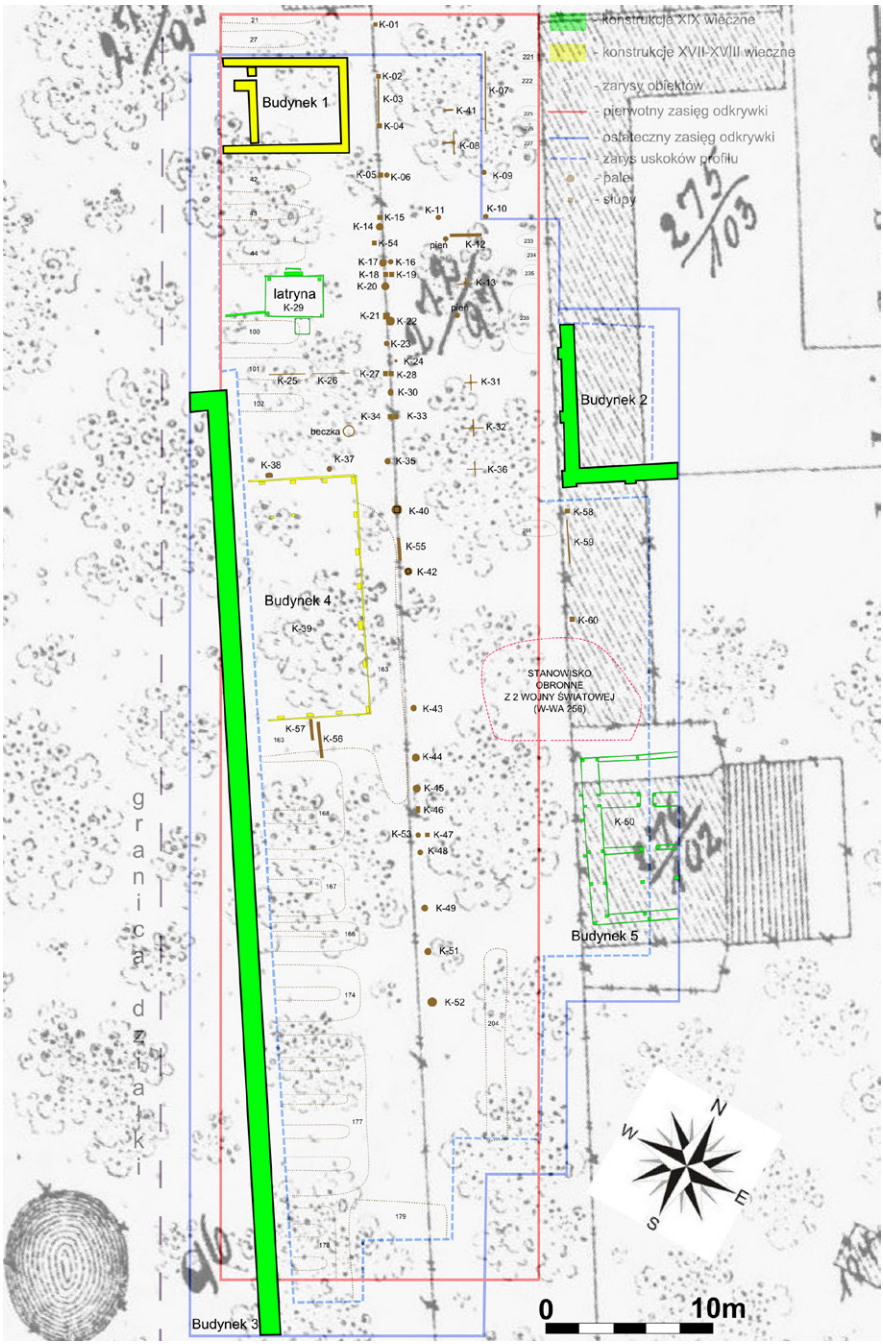

Fig. 1. Gdańsk, 1 Sadowa Street. Situational plan based on 19th cent. Buhse plan of Gdańsk, with the yellow building marked as no. 4 in the central part, where the analysed collection was found (developed by A. Ginter)

to prepare the ground for gardening" (Majorek, Ginter 2021, pp. 253–264). During the rescue archaeological excavations directed by Artur Ginter and Aleksander Andrzejewski (Andrzejewski, Ginter 2010), bone objects aside, numerous fragments of ceramic vessels, metal objects, and textiles were found in the exposed wood-and-brick outbuildings (Ginter 2020; Majorek, Ginter 2021, pp. 253–264).

The aim of this study is to perform a functional, raw material, and traseological analyses of the bone and antler artefacts with a particular focus on the raw material used, and to identify the manufacturing techniques applied for making items of various categories, as well as the functions and purposes they were used for against the background of many different crafts that were developing in modern urban centres.

Material and methods

The study material consisted of 22 bone and antler artefacts distinguished by their good state of preservation. This is largely due to the site where they were found, namely, a layer of compressed manure, which is affected by taphonomic factors to a much smaller degree compared to sand layers (Majorek 2017, p. 193).

In the course of the analysis, macroscopic and microscopic visual observation methods commonly used in archaeozoology[1] were applied. In this way, the species and anatomical affiliation of the raw material were determined and the traces visible on the bone surfaces were assessed. The species and body parts were identified based on distinctive features of bones of specific animal species, as described in anatomy textbooks and atlases (Akajewski 1994; Krysiak *et al.* 2007, pp. 107–118; Lasota-Moskalewska 2008; Reitz, Wing 2008), with the use of a comparative collection held at the Faculty of Archaeology of the University of Warsaw[2]. The raw materials used and the functions of the objects were identified in several stages. During stage one, the phase of production of an item was determined. As a result, the items were divided into three groups: finished products, semi-finished products, and production waste (Figs. 2–4). Stage two was devoted to typological, functional, and raw material identification (e.g., Jaworski 2012, pp. 165–204; 2024, pp. 511–525; Rybarczyk 2012, pp. 617–626; Eeltink, Rompelman 2015, pp. 395–405; Łyszkowicz

[1] In Western European countries, the term "zooarchaeology" is used, highlighting the cultural attitudes and behaviour of human societies towards animals over time (Albarella 2017, pp. 2–5).

[2] The valuable comparative material was provided by slides of production waste and semi-finished antler products made available by a PhD student at the University of Warsaw, Maciej Miścicki, whose contribution we sincerely appreciate. We would also like to thank Anna Gręzak, PhD, for offering us her guidance and consulting in the course of our work with the material, and Katarzyna Pyżewicz, PhD, for her assistance in using the Keyence VH-7000 microscope and advice during the evaluation of technological traces and traces of use on the analysed artefacts.

2017, pp. 215–220; Miścicki 2017, pp. 373–384; 2022, pp. 457–471). The raw material assessment was supplemented by macroscopic and microscopic observations of the surface and morphological characteristics on bones and antlers, which undergo individual transformations during the life cycle of different animal species (Lasota-Moskalewska 2008, p. 135; Rijkelijkhuizen 2008, pp. 40–42). Previous findings made in experimental archaeology were also taken into consideration (Osipowicz 2005; Diakowski 2014, pp. 17–140; Orłowska, Osipowicz 2017, pp. 103–121).

Traseological investigations were carried out using three microscopes: a Keyence VHX-7000 series digital microscope, a Nikon Eclipse LV150N metallographic microscope, and a Zeiss Stemi 305 stereoscopic microscope. The methodology for investigating traces on the osseous material was based on the models proposed by Alexandra Legrand and Isabelle Sidéra (2007, pp. 67–79). During the analysis, the influence of anthropogenic, post-depositional, and natural factors on the state of preservation of the material was also taken into account (Lyman 1994, pp. 294–396).

The microscopic investigations began with observations of the surface of the artefacts using the Zeiss microscope at magnifications ranging from x8 to x40. Next, the Keyence digital microscope was used and magnifications ranging from x20 to x150 were applied. Among others, it was used for creating and analysing a 3-D model of the surface of artefact no. 13 in order to determine the tool that the visible cuts were made with. The Nikon Eclipse LV150N metallographic microscope was used for observing natural structures at the magnification range of x50 to x200, especially the structure of the cortex in the form of Volkmann's and Haversian canals, which are different in the long bones and antler. Archaeological artefacts often become contaminated and filled with soil or other sediments. The contaminated structures allow the raw material to be tentatively identified as bone, as contaminants penetrating the canals cause a discoloration in that area, rendering them easier to see. It should be noted, however, that the research on the differentiation of nutrient canals in wild and domesticated animals is scarce and insufficient for comprehensive comparative analyses (Lasota-Moskalewska 2008, pp. 112–116), especially given the absence of reference collections. Comparative analyses were performed using the available fragments of red deer antlers, domestic cattle horns, and sheep/goat long bones.

In the case of an item (no. 24) with a complex material composition (bone with a metal alloy), an analysis of the composition of the metal elements was carried out using an XRF spectrometer prior to conservation treatments[3].

[3] The measurements were taken with a POLON-IZOT XRF spectrometer PI-MKON 0.1.XRF 01, which belongs to the Laboratory of Dating and Conservation of Artifacts, Institute of Archaeology, of the University of Lodz, using dedicated Spc and SpcArcheo software. The device is equipped with a 4W X-ray tube with a voltage of 50 kV and a current of 132 μA, and a tungsten anode.

Results

Of the 22 analysed objects, six pieces were identified as production waste (Fig. 2), six as semi-finished products (Fig. 3), and ten were identified as finished products (Fig. 4), nine of which were made of bones of cattle and sheep/goats, and one was made of deer antler (Table 1). The macroscopic and microscopic observations confirmed the presence of traces of lathe work, grinding, sawing, and polishing caused by use-wear or post-depositional factors.

Production waste

The artefacts classified as waste are made of long bone shafts – metapodial sections of the hind limbs of domestic cattle (Table 1: 1–6). This is confirmed by their morphological features, mainly the size and thickness of the cortex, as well as the linear shape of the artefacts. Traces of circumferential truncation of the lateral surfaces, most likely with a metal tool, were observed on most items. The visible traces of oblique cutting in the upper and lower parts confirm the classification of these objects as production waste rejected by the maker. The cortex of the bone plate no. 6, unevenly sawn off along the metapodial bone shaft, shows circular holes that are evidence of bead- or button-making (Fig. 2: 1–6).

Semi-finished products

The artefacts classified as semi-finished products were produced using bones of the metapodial segment of the hind limb of cattle (Table 1: 7–12). The surface structure indicates a bone raw material with a characteristic porous interior, with partially preserved cancellous bone. These are objects at different stages of production and, in most cases, their purpose remains unknown. Objects no. 11 and no. 12 display common features in the form of technological traces – one-sided sawing and drilling in the upper part. The next two semi-finished items, no. 9 and no. 10, are probably the result of an unsuccessful attempt at making tools and accessories used for textile production or dress making – parts of a spinning wheel or needle cases. An unfinished toolholder marked with no. 12, made of cattle metapodium, bears traces of sawing and lateral hewing on the upper side. Items marked with no. 7 and no. 8 were interpreted as semi-finished products created in a lid-making process. There are traces of oblique cutting on the lower part and threading on the upper surface (Fig. 3: 7–12).

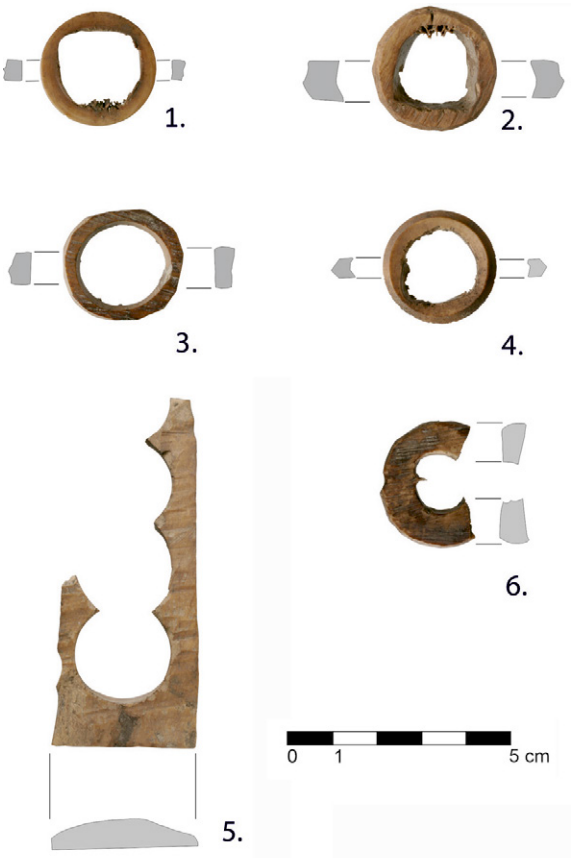

Fig. 2.
Gdańsk, 1 Sadowa Street. Production waste: 1–5 – waste of undetermined function; 6 – waste from bead or button production (developed by O. Synkovska)

Finished products

The group of 10 finished products included the following objects: a needle case, two needle case plugs, a musical instrument, a lace block, lining, a bone folder, a threaded lid or pawn, a two-piece button, and one object whose function is unknown. The finished products were characterised by varying degrees of polish caused by contact with leather or textiles, and the passage of time during use and deposition in soil layers (Fig. 4: 13–22).

A tubular bone artefact (Table 1: 13) included in this group consisted of two parts: a tube decorated (profiled) on the outer side and a plate attached to the wider, preserved end. It was made of the shaft of a long bone of a small ruminant (a sheep or a goat). The fracture visible at the end was likely caused by the joining of components, intensive use or changing environmental conditions. Based on the

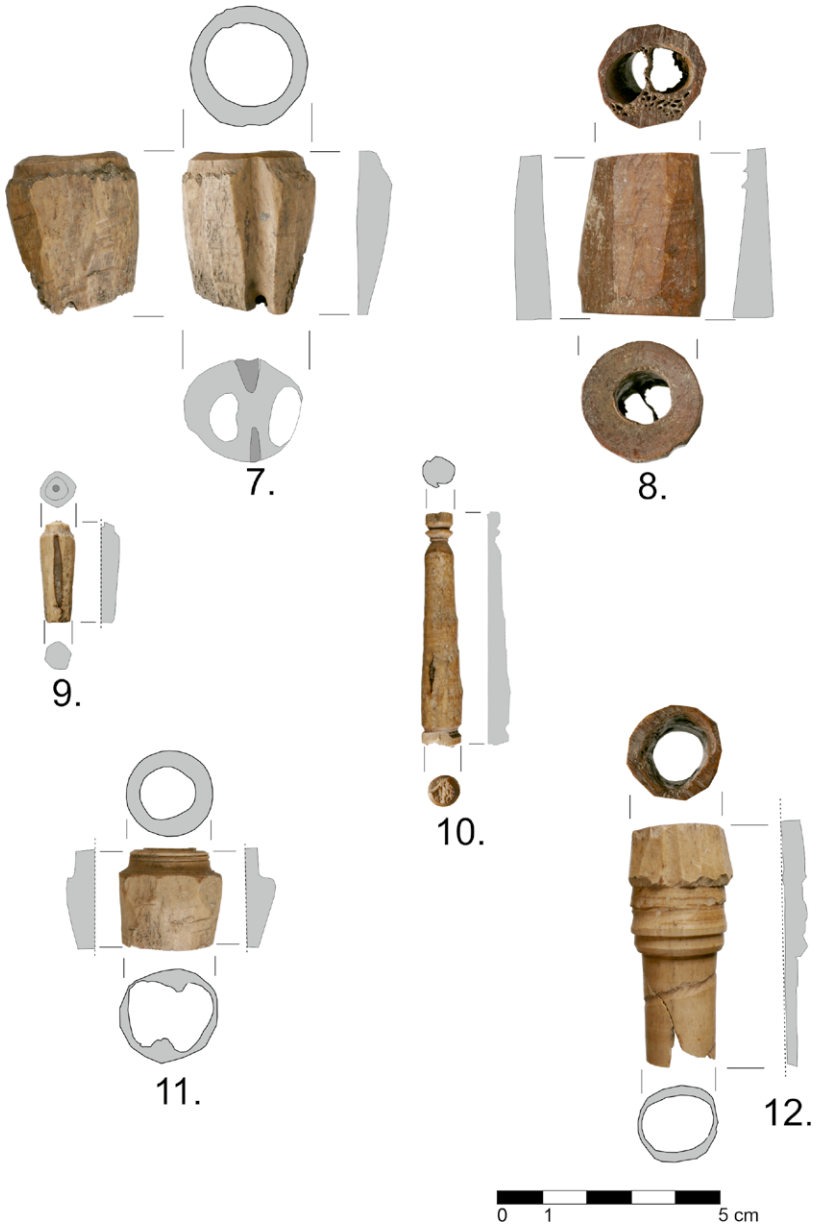

Fig. 3. Gdańsk, 1 Sadowa Street. Semi-finished products: 7–8 – fragments of a lid; 9–10 – parts of a spinning wheel or needle cases; 11–12 – tool holders (developed by O. Synkovska)

Fig. 4. Gdańsk, 1 Sadowa Street. Finished products: 13 – needle case; 14 – fragment of a musical instrument; 15 – lace-making block; 16 – lining; 17 – bone folder; 18 – bead; 19 – lid; 20 – lid/pawn; 21 – lid (of a needle case); 22 – button (drawing by O. Synkovska)

microscopic analysis and the 3-D model of the surface, it was determined that the item had been worked on a lathe and further honed with a file or another precision tool, leaving shallow grooves.

Another object (Table 1: 14) was made of a metapodial bone of cattle. It has the shape of a toroid with narrower upper and lower planes, and three brass[4] bells symmetrically placed around the perimeter, connected to one another with thin wires hidden inside. It bears traces of lathe drilling, forming a multi-coiled thread that makes it possible to screw other objects (or parts of the same object) in on both the top and the bottom. The microscopic observations at x20 magnification showed the presence of nutrient holes in the natural structure arranged along the bone. A more precise identification of this raw material was impossible due to an extensive polish. It was only determined that it was a fragment of a long bone shaft that the object interpreted as a piece of a musical instrument was made of.

An elongated artefact (Table 1: 15) with its cut end and decorated head had been turned on a lathe and substantially polished, thus hindering the classification of the material in terms of species and anatomy. The length of the block may suggest that the raw material was a long bone whose dimensions corresponded to the product in question, e.g., a metatarsal bone or another long bone of cattle. Most likely, it is a lace-making block.

Artefact no. 16 (Table 1: 16) is half-preserved. It is lining of a tool for daily use, curved on one side and straight on the other (probably such a shape was created by sawing off). The microscopic examination revealed the presence of binder (glue) residues on the surface of the sawn-off part. In the upper part, a significant degree of polish can be observed. There is one preserved and another half-preserved hole inside, in which glue residues are also present. The surface of the item is heavily obliterated, and therefore the arrangement of the osteons could not be determined. The chaotic arrangement of the double incision visible on the surface, probably made with a blunt instrument, suggests that the lining was made by an unskilled craftsman. The irregularity of the incisions seems to rule out their ornamental nature.

A thin, elongated artefact (Table 1: 17) was made of a long bone, most likely the metatarsus of cattle. It has a diamond-shaped ornament on one side. On both ends, the object shows traces of damage in the form of broken fragments. Diagonal scratches on the back side are evidence of intensive use and post-depositional processes. It was identified as a bone folder – a blunt tool used for folding or creasing paper, or for separating pages in books.

A round-shaped artefact (Table 1: 18) was made of long bone of an unidentified species. The raw material was identified as bone based on the image of osteons

[4] Based on the spectrometric (XRF) analysis, it was determined that the bells were made of brass (Table 2).

Table 1. Gdańsk, 1 Sadowa Street. Summary of bone and antler artefacts found (compiled by J. Piątkowska-Małecka)

No.	Inv. no.	Type of object	Species identification	Anatomical identification	Dimensions							Technological and usage traces	Figure
					lenght	width	height	thickness	hole	outer diam.	inner diam.		
1	44/10	waste	cattle	metatarsus	–	–	0.4	0.4	2.4	2.5	1.8	sawing, drilling	2: 1
2	66/10 (1)	waste	cattle	metatarsus	–	–	0.8	0.5	2.8	2.8	2.0	sawing, drilling	2: 2
3	66/10 (2)	waste	cattle	metatarsus	–	–	0.3	0.4	2.4	2.4	1.5	sawing, drilling	2: 3
4	45/10	waste	cattle	metatarsus	–	–	0.6–0.8	0.4	–	2.7	2.1	sawing, drilling	2: 4
5	54/10	waste	cattle	metatarsus	-	–	0.5–0.7	0.7–0.8	–	2.8	1.2	sawing, drilling	2: 5
6	18/10	waste	cattle	metatarsus	–	–	8.25	0.7	2.2	3.3	–	sawing, chopping	2: 6
7	291/297/10	semi-finished product	cattle	metatarsus	–	–	3.8	0.7	–	3.2	–	sawing, drilling, chopping	3: 7
8	82/10	semi-finished product	cattle	metatarsus	–	–	3.8	–	1,2	2.8	–	sawing, chopping	3: 8
9	38/10	semi-finished product	cattle	metatarsus	2.4	–	–	–	–	0.8	–	sawing, drilling, chopping	3: 9
10	63/10	semi-finished product	cattle	metatarsus	5.2	–	–	–	–	0.9	–	drilling, chopping	3: 10
11	53/10	semi-finished product	cattle	metatarsus	–	–	2.3	0.7	–	2.4	1.2	sawing, chopping, threading	3: 11
12	93/10	semi-finished product	cattle	metatarsus	5.4	–	–	0,6	–	2.2	–	sawing, drilling, chopping	3: 12
13	197/10	needle case	sheep/goat	metatarsus	6.5	–	–	0.2	–	1.3	–	drilling, grinding/burnishing, cracking	4: 13
14	24/10	fragment of instrument (?)	unspec.	long bone	–	–	2.1	0.6	–	2.7	1.5	drilling, grinding/burnishing	4: 14
15	180/190/10 (1)	block	unspec.	long bone	8.1	–	–	–	–	8.8	–	drilling, grinding/burnishing	4: 15
16	308/10	lining	unspec.	long bone	5.6	1,5	–	0.3	–	–	–	sawing, drilling, grinding/burnishing, notches, polishing	4: 16
17	73/10	cube	unspec.	long bone	9.2	1,5	–	0.1	–	–	–	grinding/burnishing, decoration, cracking, linear traces	4: 17
18	202/208/10	bead	unspec.	long bone	–	–	–	0.3	0,7	1.7	–	sawing, drilling, grinding/burnishing, threading, polishing	4: 18
19	76/10	lid (of the needle case)	cattle	metatarsus	2.7	–	–	0.2	–	0.9	–	drilling, grinding/burnishing, threading, polishing	4: 19
20	39/10	lid/pawn (?)	cattle	metatarsus	–	–	2.3	0.3	–	2.5	–	drilling, sawing, threading	4: 20
21	126/10	lid (of the needle case)	cattle	metatarsus	2.0	–	–	–	–	1.1	–	drilling, grinding/burnishing, polishing	4: 21
22	180/190/10 (2)	button	feer	fragment of antlers	–	–	1.6	–	–	1.7	–	drilling, sawing, grinding/burnishing	4 :22

Abbreviations: diam. – diameter, unspec. – unspecified.

arranged along the shaft. The object bears visible technological traces in the form of drilling, sawing and grinding, as well as traces of intensive use, evidenced by the heavily polished surface of this item. It was probably used as a bead.

Other bone artefacts include two plugs in the form of threaded screws, probably representing elements of needle cases (Table 1: 19, 21), made using the shafts of metatarsal bones of cattle. They were threaded on one side and decoratively shaped on the other. Microscopic observations at x20 magnification revealed a high-degree polish and a natural structure in the form of nutrient canals, which confirmed that these objects were made of bone.

Object no. 20 (Table 1: 20), tentatively identified as a threaded lid or a pawn used for party games, stands out in terms of size and form. It consists of two connected elements with a preserved thread in the lower part. At the stage of macroscopic observations, the presence of longitudinally arranged osteons was noted, confirming the fact that the raw material used was bone, specifically, the shaft of a long bone of unidentified species.

A two-piece button (Table 1: 22) with a convex head, single-layer profile, with a fused flat ear was made of a different material. Microscopic observations at x200 magnification showed soiled, chaotically arranged structures on the surface of the button head, exhibiting similarity to the Volkmann and Haversian nutrient canals found on the surface of deer antlers.

Bone artefacts from Gdańsk against a comparative background

The rich variety of the bone artefacts found in the area of Gdańsk is evident, since it was a port and a trading centre with a significant share of immigrants, including craftsmen. Horn workers probably used the same workshop as lathe workers due to the availability of the necessary tools for production and a lack of workshops of their own. In addition to analysing the issues involved in the making of bone products, Axel Christophersen (1980) distinguished three stages in the development of this branch of manufacturing based on data from medieval Lund (southwest Sweden). The first stage was domestic craftsmanship (up to 1020) carried out for one's own needs, while at the same time, the first "professional" products made in workshops, such as combs, became available. The second stage (from 1020 to 1150) was directly associated with the development of the city, when advanced craftsmanship and the phenomenon of itinerant craftsmen was growing.

The third stage of development (from 1150 to 1350) saw the emergence of more or less specialised workshops, concentrated in the commercial part of the city and focused on the needs of the market (Christophersen 1980, pp. 203–212). No remnants of modern horn workshops are known in Gdańsk. Nevertheless, historical accounts indicate that they existed and focused on the production of needle cases,

linings and handles. They also made eyeglass frames and lamp shades. Probably, such workshops operated on Olejarna Street and Podwale Staromiejskie since the 12th century (Ceynowa 2018, p. 460)[5].

With the development of the manufacturing of bone products, the preferences of the customers/buyers also changed. In the late Middle Ages and in the early modern period, cattle served as an important source of food, while hunting did not play an important role in the economy (Gręzak, Kurach 1996, pp. 139–167). It cannot be ruled out that in the modern period, the community of Gdańsk, including craftsmen, was not collecting shed antler. The fact that cattle bones were much simpler and quicker to obtain had a direct impact on the number of functionally diverse items made of them.

The small quantity of waste and semi-finished products retrieved from 1 Sadowa Street in Gdańsk does not confirm the existence of a horn workshop at this site (Fig. 2: 1–6 and Table 1: 1–6, Fig. 3: 7–12 and Table 1: 7–12). Backyard production seems more likely. Nevertheless, the rich variety of items confirms the fact that various crafts were developing in modern Gdańsk. In the case of semi-finished products and waste, the state of preservation of the natural bone structure and the low degree of processing made it possible to identify the material used in terms of species and anatomy. These objects were usually made of the metatarsal bones of cattle. Only one of them was identified with a high degree of probability as button-making waste (Fig. 2: 6, Table 1: 6). In addition to the metapodium of cattle, ribs were also used for this purpose in modern times (Bikić, Vitezović 2016, pp. 58–62), while in the Middle Ages, scapulas of this species (MacGregor *et al*. 1999, p. 1999; Jaworski 2012, pp. 165–204; Luik 2016, pp. 180–182), and sometimes elk antlers were employed to this end (Rijkelijkhuizen 2008, p. 47).

As far as the finished products are concerned, the collection includes bone parts of several different needle cases, a lace-making block, a needle case lid, a needle case, a piece of a musical instrument, a lid or a pawn, a fragment of lining, a bead, a bone folder, and a button (Fig. 4: 13–22, Tab. 1: 13–22).

Numerous finds of needle cases confirm that the production of needles developed in Gdańsk from the mid-16th century. Needle makers were active in the suburbs of Gdańsk and on Długie Ogrody Street (Bogucka 1962, p. 85). Workshops that made needles were also established and operated in Kraków, Warsaw, Bydgoszcz and Toruń. Needle containers were common until the 20th century (MacGregor *et al*. 1999, p. 1969; Bradley, Crabtree 2012, p. 425). In modern times, needle holders were often made of the upper parts of antlers (Kuczkowski 2010, pp. 107–109) or long bones of mammals (Eeltnik, Rompelman 2015, pp. 400–401). Needles were used extensively in tailoring, leatherworking and other fields related to textile manufacturing.

[5] The cited work does not specify the categories of objects that were produced in those workshops.

A bone block for making lace is associated with the textile crafts (Fig. 4: 15, Table 1: 15). Lace-making started to develop in the modern period. The oldest lace products dating back to the turn of the 16th century come from Italy – the homeland of lace (Clifford 1913; Turnau 1987; Rybarczyk 2012, p. 617; Grupa, Drążkowska 2014, pp. 325–334). The artefact from 1 Sadowa Street in Gdańsk is very similar to the wooden Belgian-type block with a moulded belly found in Elbląg (Rybarczyk 2012, p. 621, Fig. 4: b). Although wooden lace blocks are better known, individual specimens made of bone, e.g., sheep bones (Kohlsaat 1910, p. 25), have also been identified (Michałowska 2006, p. 142). Bone blocks were more expensive than wooden ones and had to be made in a craftsman's workshop (Durbridge 2012, p. 5). The aim of the intricate construction (head, neck, collar, shaft – spool, belly, and end) of the lace-making block (Rybarczyk 2012, p. 620, Fig. 3) was to ensure proper tension on the thread and prevent entanglement.

A tubular artefact was identified as a container for storing needles. However, this does not rule out that it could have been used as a flute-type musical instrument (Fig. 4: 13, Table 1: 13). Examples of wooden and bone flutes are known from early medieval Wrocław and eastern parts of Germany (Borkowski 2004, pp. 275–276, Figs. 12–13). The analysed object does not have a mouthpiece or holes on the shaft; nevertheless, it is known that the musical instruments used in the Middle Ages as toys for children were usually simplified and did not require significant musical skills. The range of such objects is quite wide – from simple whistles through pipes or *hetki* to more complex ones such as flutes and bells (Gomułka 2017, pp. 16–17).

Bone artefacts resembling threaded screws/nuts (Fig. 4: 19, 21, Table 1: 19, 21) are probably associated with tailoring and may have functioned as plugs for needle cases, although no equivalents have been found in archaeological literature. Alternatively, they could have been parts of a spinning wheel or spool (MacGregor *et al.* 1999, pp. 1968–1969).

A barrel-shaped object with a constriction in the central part (Fig. 4: 14, Table 1: 14) was the most problematic one in terms of species identification and functional analysis. The circumferentially placed bells suggest that it was an instrument known as *janczary* (*turliki*), a type of harness bells for horses. It may also have been a part of a musical instrument with *janczary* (a wooden baton with bells) of the "Sleigh Bells" type. In the 18th century Wolfgang Amadeus Mozart was the first to use such instruments in his music (Holland 2005, p. 43).

Similar bells may also have been a part of women's clothing. They are known from Lithuanian and Latvian sites from the 5th–9th century (Bednarczuk 1981, p. 115). A bone artefact from Długi Targ 19 in Gdańsk, which is similar in shape though it lacks bells, is interpreted as a flea trap (Miścicki 2022, p. 464).

Another example of a bone object made in modern Gdańsk is bone lining (Fig. 4: 16, Tabl 1: 16). It is similar to other finds of this type, such as knife handle linings

dating back to the late medieval and early modern period, from urban excavations at 4 Katedralna Street in Wrocław (Jaworski 2012, p. 183) and the castle in Puck (Miścicki 2017, p. 375, Fig. XIV.1: 25–28). Other examples of bone knife linings were found, e.g., in the medieval stronghold at Ledniczka (Górecki *et al.* 1996, pp. 206–209).

A "bone folder" is another interesting find (Fig. 4: 17, Table 1: 17). In Poland, bookbinding began to emerge in the late Middle Ages and was mainly developed by monks in monasteries. The 15th century is the time of development of this craft, and factories dealing with it professionally were established in that period. Gdańsk was one of the main centres. Bone folders were used for crimping uncut paper and then for tearing it precisely and delicately. Bone folders were available in a variety of sizes to match the size of sheets, books, and magazines (Magdzik 1992, pp. 105–108). The shape, size, decoration, and material used for making bone folders may vary with their intended use. A bone folder was also found in Gdańsk in the collection of Eduard Ludwig Garbeg from the 19th century (Łopuski 2020, p. 153).

Single beads made of long bones in the Middle Ages and in the modern times (Fig. 4: 18, Table 1: 18) are commonly found in Poland. Beads come in various shapes and sizes. They were manufactured, among others, in Ostrów Tumski in Wrocław, where a bead-making workshop operated in the 16th and 17th century (Jaworski 2012, pp. 165–204).

An artefact identified as a lid may have served as a simple pawn for a party game (Fig. 4: 20, Table 1: 20). Among pawns found at medieval sites, chess pieces are the most common. Examples of similar bone pawns (e.g., for playing checkers) have been discovered at sites in various cities, such as, e.g., Puck, Wrocław, Vilnius, and Elbląg (Borkowski 2004, p. 272, Fig. 5; Blaževičius 2011, p. 109, Fig. 128: 1, 2; Stempin 2012, p. 80, Fig. 65; Gawor 2022, pp. 22, 89, Fig. 74).

The only product made of deer antler – a button with an ear – has no ornamentation, and its shape is similar to numerous finds from the 16th–18th century (Fig. 4: 22, Table 1: 22). A complete typology of buttons serving as elements of clothing and footwear has not been prepared yet due to their large number and variety. Such buttons first appeared in Europe in the 12th–13th century, when bone, antler, and wood were the main materials. Mass production of metal buttons began in the 18th century (Jaworski 2012, pp. 165–204; Janowski 2016, pp. 283–292).

Analyses of modern bone and antler artefacts are hampered by the high degree of processing and significant transformation of the natural surface, as well as the wide range of tools used by craftsmen. Moreover, the number of scientific publications on objects made of animal raw materials in the modern period is insufficient. Traseological research should be supported by the achievements of experimental archaeology. The bone identification technique known as ZooMS (Zooarcheology by Mass Spectrometry), based on the study of collagen molecules (the building protein of all living organisms), appears to be extremely helpful. This method is not

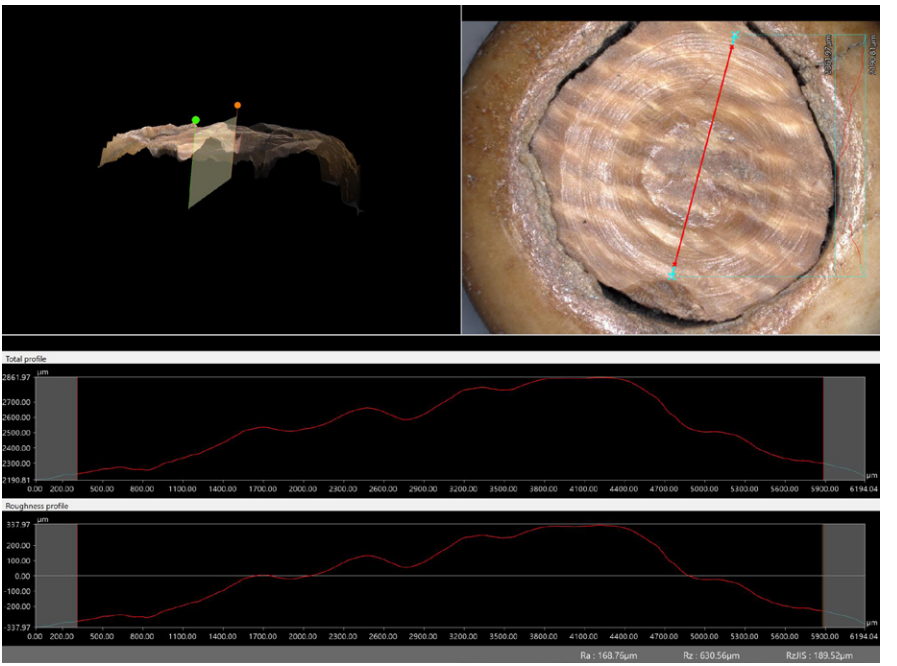

Fig. 5. Gdańsk, 1 Sadowa Street. 3-D cross-section of a bone artefact no. 13 (photo by O. Synkovska)

Table 2. Elemental composition of bell (XRF made by A. Ginter)

Element	%
S	0,43
Ar	0,32
Ca	0,27
Fe	16,12
Sn	0,1
Cu	65,02
Zn	17,47
Ni	0,26

perfect for finished products, though. The invasive sampling technique used as part of this method can damage the artefact. However, a non-invasive method is also available. It allows one to conduct an assessment without damaging the artefact (Martisius *et al.* 2020, pp. 1–12). It is based on computed tomography that can identify inter-canal spaces, distinguish the natural features from intentional processing features, and produce 3-D visualisations to help determine the function of the studied object (Bradfield 2016, pp. 71–79).

Conclusions

The study of the artefacts from the modern archaeological stratum at 1 Sadowa Street, Gdańsk, provided data that was used for identifying the raw material (species and anatomy) and function of these objects. Six items classified as production

waste, six semi-finished products and ten finished products (including needle case fragments, a fragment of lining, a lace-making block, a part of a musical instrument, a lid, a bone folder, a bead, and a button) were identified. These objects were mostly made of the bones of the metapodial segment of cattle or, for a lower number of specimens, of sheep/goat bones and deer antler. The traseological analysis revealed the presence of technological traces – mainly drilling. Traces of sawing, chopping, grinding, and threading also occur. The tools employed in the manufacturing process involve files, knives, and lathes. The artefacts bear traces of use-wear, such as polish, linear marks, and various damage marks. The data obtained supplements the picture of modern crafts developing in Gdańsk, which was one of the most important ports and commercial centres. Horn-processing and bookbinding workshops had already been operating there from the Middle Ages, with craftsmen working for the local market – butchers, tanners, leather makers, textile makers, and coopers–who also developed their trade.

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