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CANNONBALLS FROM THE OLSZTYN TURRET

Abstract: This paper discusses an assemblage of artillery projectiles discovered in 2012 in the course of archaeological works in the basement of remains of the Medieval High Turret in Olsztyn (Masuria – north-eastern Poland). 113 cannonballs were found altogether, out of which 89 were made from erratic boulders, while the remaining ones were made from well-fired clay. Apart from a discussion on these finds, a analysis of stone raw material used for their manufacture was carried out. Furthermore, it was attempted at identifying types of cannons stored in this part of Olsztyn's fortifications.

Keywords: cannonballs, Middle Ages, Olsztyn, artillery, ceramic projectiles, rocks used in the production of ammunition

Introduction

Archaeological examinations carried out in the centre of Olsztyn (Allenstein), the Warmińsko-Mazurskie Voivodeship, in 2011-2012 resulted in documenting of remains of the High Turret, situated in the northern part of the Old Town. This site, provided with No. XXIV, was part of the Main Gate complex. This area was of strategic importance in the defensive system of the town's masonry walls. It was originally composed of the gate (the Main Gate) and its neck. They came into existence in the 2nd half of the 14th c., by virtue of a privilege issued by the Warmian Chapter in 1378¹. In the 2nd half of the 15th c. this complex was enlarged with a defensive turret (the High Turret), which flanked the eastern corner of the premise. It is difficult now to precisely assess the time of construction of this turret. It is possible that it happened only after 1480². In Trench 110 at the examined site of the High Turret, 113 cannonballs were found at the depth of c. 5 m. This assemblage included both stone and clay projectiles³. The assemblage from Olsztyn is exceptional for two reasons. First of all, it is one of few assemblages of projectiles in Poland which were found in the context of the room in which they were originally stored⁴. The other reason is a very rare and unique raw material – clay⁵.

Stone cannonballs

The group of stone cannonballs includes 89 finds altogether. It is significant that it can be divided into four calibre groups only (Tab. 1). Diameters between 12.9 and 14.0 cm are the most numerous. There are 75 such finds, which is nearly 85% of the assemblage. Their weight is about 3.0-3.25 kg; however, due to a considerable degree of weathering of rocks or mechanical damage, lighter finds are also found. Other sizes are represented in a much more modest manner. Thus, there are only two missiles with calibres of 15.5-16.2 cm (their weight is 4.58-5.1 kg), and six finds are within the range of 10.5-11.6 cm (their weight is 1.77-2.01 kg). The last group are projectiles with diameters between 9.0 and 9.3 cm. It also includes six projectiles and their weight is from 0.94 to 1.09 kg.

Based on our hitherto research it can be said that in the territory of northern Poland (including the former State of the Teutonic Order) local erratic boulders were mainly used for the manufacture of cannonballs. Such rocks were selected which were most useful both with regard to their hardness and weight, possibilities of processing and expected ballistic properties. For this purpose, fine- and medium-grained granitoids were most often used, while granite-gneisses and limestones were less common. Coarse-grained rocks were less often used, and chiefly for the manufacture of large-calibre cannonballs. However, in periods of difficult availability of raw materials, these less useful rock types were also made use of⁶.

¹ Kaczyński and Mackiewicz 2014, 5.

² Wojciechowska-Grygo 2014, 38; Lewicka 2014, 51, Fig. 3B.

³ This paper discusses 113 stone and clay finds altogether. However, preliminary press reports mentioned about 120 stone and 20 clay projectiles.

⁴ The following assemblages are of similar nature: 88 stone cannonballs found in the cellar at the castle of Bishops of Warmia in Reszel, as well as 80 projectiles from the ruins of the Town Hall in Elbląg, cf. Strzyż 2007; Strzyż 2011, 115-117.

⁵ So far, the only reasonably certain finds of Medieval clay ammunition for artillery in Poland have been known from

Jemiołowo, the Warmińsko-Mazurskie Voivodeship, and from Chojnice, the Kujawsko-Pomorskie Voivodeship, cf. Strzyż 2011, 55, 95-96, 100, Pls. XLII: 5-7.

⁶ Cf. Czubla and Strzyż 2013; Czubla and Strzyż, forthcoming.

Calibre	Granitoids	Syenitoids	Granite-gneisses	Gneisses	Pegmatites*	Porphyries	Diabases	Sedimentary rocks	Fired clay	Total
9,0-9,3 cm	5	-	-	-	1	-	-	-	-	6
10,5-11,6 cm	4	-	2	-	-	-	-	-	5	11
12,9-14,0 cm	64	1	2	2	5	-	1	-	19	94
15,5-16,2 cm	1	-	1	-	-	-	-	-	-	2
Total	74	1	5	2	6	0	1	0	24	113

*This category includes cannonballs made from granitoids with pegmatite veins. It was nearly impossible to make a cannonball solely from pegmatite, as pegmatite veins very hardly form erratic boulders. Their technological properties (resulting from coarse-grained and often miarolitic texture) render intentional processing very difficult.

Tab. 1. Raw materials used for the manufacture of the cannonballs found at Olsztyn. By P. Czubla.

In the assemblage from Olsztyn there is a preponderance of granitoids as a raw material for the manufacture of cannonballs. Out of the total number of 89 stone projectiles, 74 cannonballs were made from such rocks (Tab. 1). They represent all four calibres which were identified. Within this group, it was possible to identify a number of typical granitoids of Scandinavian provenance, e.g., Aland rapakivi granites, Sala, Uppsala, or Siljan granites (Fig. 1:f; 2:a, e). On the other hand, these rocks were probably gathered in Olsztyn or in its closest neighbourhood as erratics brought from Scandinavia by the latest glaciation. It is not entirely clear why in the manufacture of cannonballs preserved at Olsztyn coarse-grained rocks were used relatively often. Such rocks – both granitoids (Fig. 1:e; 2:b-d, f) and pegmatites (Fig. 1: e; 2:c, g) were not very useful raw materials. Their share is as much as 17% in the group of stone projectiles with calibres of 12.9-14.0 cm. Coarse-grained raw material was used even for the manufacture of the smallest projectiles in the assemblage (9.0-9.3 cm), but a very low number of cannonballs of this calibre does not allow for drawing credible conclusions. Coarse-grained texture, and in the case of pegmatites also miarolitic (porous) texture, renders precise processing very difficult. In the course of work it often occurred that bits of raw material flaked off along cleavage planes of minerals, most frequently micas or feldspars. Falling away of part of a crystal with the total size of a few millimetres (in medium-grained texture the average size of grains does not exceed 5 mm⁷) had virtually no influence on the shape of the final product. However, in the case of crystals with the size of one centimetre or more, it could come to considerable and undesirable subsidence on the surface of the processed cannonball. Processing of rocks with miarolitic texture is even more difficult. It is because in the course of work cavities in the rock lead to cracking and falling of material into pieces. There was also a risk that even if a properly shaped product was formed from such raw material, it would fall into pieces after firing the gunpowder charge. Until present day pegmatites with miarolitic texture which occur in

granitoid massifs are treated as waste during extraction of ashlar stone. An exceptional case is a cannonball cut from pegmatite containing spangles of biotite which are a few centimetres long (Fig. 2:c). It was possible to manufacture a reasonably processed cannonball from such rock only due to the fact that large crystals of biotite were distributed in a chaotic manner and there were no cavities in the compact (massive) structure.

In the analysed assemblage cannonballs which were made from raw materials with evident directional structure (granite-gneisses and gneisses) were also identified (Fig. 1:b, c). They occur rarely, which seems to be obvious, as such rocks easily decompose into pieces along foliation planes. It is easy to manufacture flat, plate-like artefacts from them. On the other hand, it is possible to make a ball only if the directional structure is feebly pronounced and the rock contains few micas (these are usually biotite and muscovite). A granite-gneiss boulder was used to cut a partially preserved cannonball with the diameter of 13.5 cm (Fig. 1:b). In spite of the low content of biotite, one can anyway see cracks in it, along which it will come to further decomposition of the artefact.

A fragment of a cannonball made from syenitoid is a single find. On the one hand, it is not as hard as granitoids (this results from a much lower content of quartz in syenitoids). On the other hand, it is certainly much more mechanically resistant than sandstones and limestones. This means that it was not technological properties which prevented this rock from being used for the manufacture of artillery projectiles. The reason is much simpler – syenitoids occupy only small areas in Fennoscandia and mainly in western Sweden and Norway⁸. Due to this, they are rather rarely found as erratics in the territory of the Central European Plain, with special reference to its eastern part, where raw materials for the manufacture of the cannonballs from the discussed assemblage were gathered. It must be also remembered that syenitoids weather at a faster pace than granitoids. Therefore, in a majority of cases they may have been rejected by stone-cutters already at the stage of

⁷ Czubla et al. 2009, 67.

⁸ Smed 2002, 152-155.



Fig. 1. Olsztyn, the High Turret, stone cannonballs: a. diabase; b. gneiss with layers of biotite, evident directional texture and cracks appearing along laminas with biotite; c. fine-grained (phaneritic) granite-gneiss, rich in biotite; d. coarse-grained Uthammar granite with large potassium feldspars; e. leucocratic granitoid with feldspar pegmatite, strongly weathered; f. strongly weathered Sala granite. A-f Photo P. Czubla and P. Strzyż.

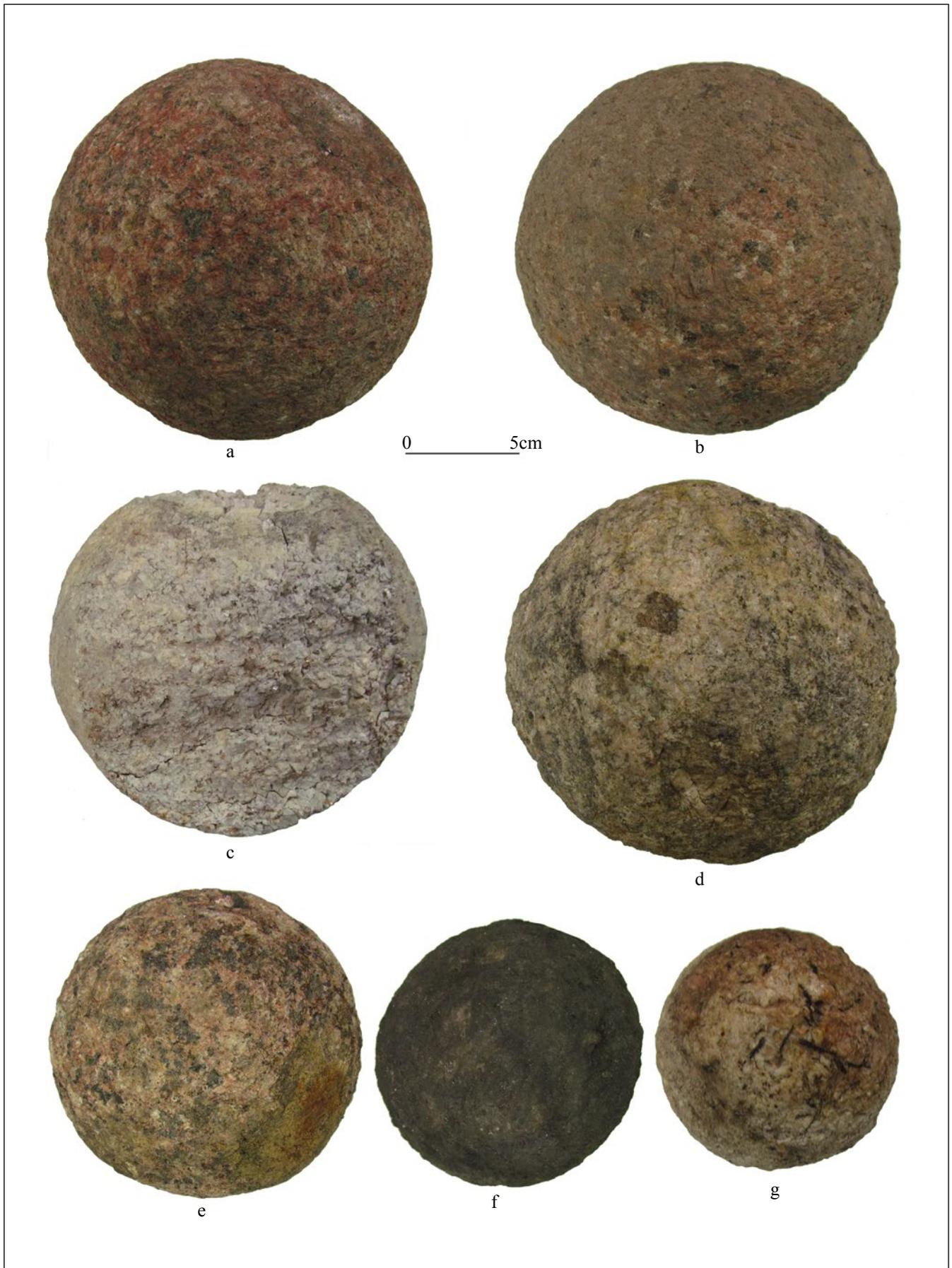


Fig. 2. Olsztyn, the High Turret, stone cannonballs: a. Aland rapakivi granite b. red Scandinavian granitoid; c. weathered granitoid with pegmatite (almost only feldspars and biotite); d. fine-grained (phaneritic) granitoid; e. Siljan rapakivi granite; f. fine-grained (phaneritic) granitoid; g. pegmatite with large sheet-shaped crystals of biotite. A-f Photo P. Czubla and P. Strzyż.

preliminary selection of material as completely useless for further processing.

Diabase, which is heavy and very hard rock, seems to be an ideal raw material for making of projectiles. In spite of potentially very good technological properties, diabasites were rarely used for the manufacture of ammunition. The most probable reason behind it is their sporadic occurrence in Pleistocene sediments⁹ and generally small sizes of erratics composed of this rock. It must be also remembered that it was certainly worth spending a couple of working days in order to make a high-quality diabase axe which would be used for many years. However, using the same raw material for labour-consuming manufacture of a projectile which would in all probability be used only once was hardly rational. In the assemblage from Olsztyn there was only one projectile made from the discussed rock (Fig. 1:a). It is worth stressing that its diameter is 13.5 cm and it weighs as much as 3.81 kg. In comparison with the same artefacts made from granitoid (which weight up to 3.25 kg), the difference is nearly 20%.

In contrast to many assemblages of stone projectiles from Northern Poland¹⁰, in the course of examinations of the High Turret in Olsztyn no cannonballs made from sedimentary rocks were found. It is especially astonishing in the context of confirmed manufacture of clay ammunition, which had much worse combat properties than artefacts made from limestones or sandstones. Even if not the town itself, its closest neighbourhood was certainly abundant in various kinds of erratic rocks – not only granitoids, syenitoids, granite-gneisses and gneisses, but also sandstones, dolomites and limestones. This means that sedimentary rocks must have been intentionally rejected by stone-cutters in Olsztyn. A question should therefore be asked whether stone projectiles and fired clay projectiles were manufactured at the same time. The manufacture of projectiles from sedimentary rocks was much less time- and labour-consuming than from igneous rocks, and ballistic properties of such projectiles were much better than those made from clay. It seems that if clay projectiles had been a cheaper substitute of stone projectiles, sedimentary rocks would have been used first, and then one would have made use of clay. However, it was not done so, which is evidenced by a complete absence of sedimentary rock projectiles in the discussed assemblage.

Clay cannonballs

The assemblage of clay ammunition is 24 cannonballs altogether. They survived either in whole or in smaller or larger fragments (Fig. 3:a-j). What is important here is that also in this case there are small differences with regard to

their size. Finds with diameters between 13.1 and 13.5 cm dominate within the assemblage (Fig. 3:a-g). There are 13 intact projectiles of this kind and a few which partially survived. Their weight oscillates between 2.15 and 2.42 kg. This means that the difference in weight between clay and granite projectiles of similar calibre is about 0.8-1.0 kg in favour of the latter (clay cannonballs are approximately 30% lighter than those made from igneous rocks). Regrettably, among clay cannonballs of smaller calibre only one survived intact, while the remaining ones are preserved in fragments. In a majority of cases their diameters are 10.5-10.7 cm (Fig. 3:h-j). The weight of these remains oscillates between 0.53 and 0.63 kg. Therefore, the weight of complete artefacts may have been about 1.2-1.3 kg. Comparing the weight of stone and clay cannonballs within this calibre group, we find a difference of about 0.57-0.71 kg.

While analysing the technology of manufacture of these clay projectiles, their high quality and careful manufacture must be underlined. The cannonballs are ideally regular and their surfaces are smooth. It is probable that before firing their surfaces were smoothed or covered with clay mass mixed with water. Based on surviving fractures it can be said that the clay was leaned in the same way as for pottery manufacture. In this case, admixture of sand with 1-2 mm fraction was used. Projectiles made in this way were fired in oxidising atmosphere, which is evidenced by fractures which have intensive brick colour (Fig. 3:b, e). The final result were artefacts of excellent quality and high hardness. It must be stressed that clay cannonballs are the best indicator of calibres of municipal artillery, as they were probably best adjusted to bore diameters and it was hardly possible to use them more than once.

A purposefulness of manufacturing of cannonballs from such raw material as clay should also be discussed. There is no doubt that financial savings were a significant advantage, as such projectiles were cheaper than their stone equivalents. As such cannonballs were lighter than those made from stone, it is probable that smaller (weaker) gunpowder charge was needed to launch them, which caused further savings. The fact that clay ammunition caused less damage to the bore of the barrel than stone projectiles did may have also been taken into consideration. On the other hand, the range of applications of clay ammunition was limited. Apart from fighting the adversary's manpower, clay projectiles could be only used to practice shooting. Due to their fragility they were certainly useless against fortifications or residential buildings.

It should also be noted that both calibre groups of clay cannonballs match the size of stone projectiles. A conclusion can therefore be drawn that both kinds of stored cannonballs were meant to be used for the same cannons. Based on the diameters of surviving projectiles only four calibre groups can be isolated. The first one would encompass barrels designed for ammunition with the calibre of about 16 cm. There are only two finds of that kind.

⁹ Cf. Schulz 2003, 176-186; Rudolph 2008, 120-123; Chachlikowski 2013, 25-27; Czubla 2015, 147, 154, 206, 207.

¹⁰ Cf. Czubla and Strzyż 2013, 103-105; Woźniak 2014, 387-389.

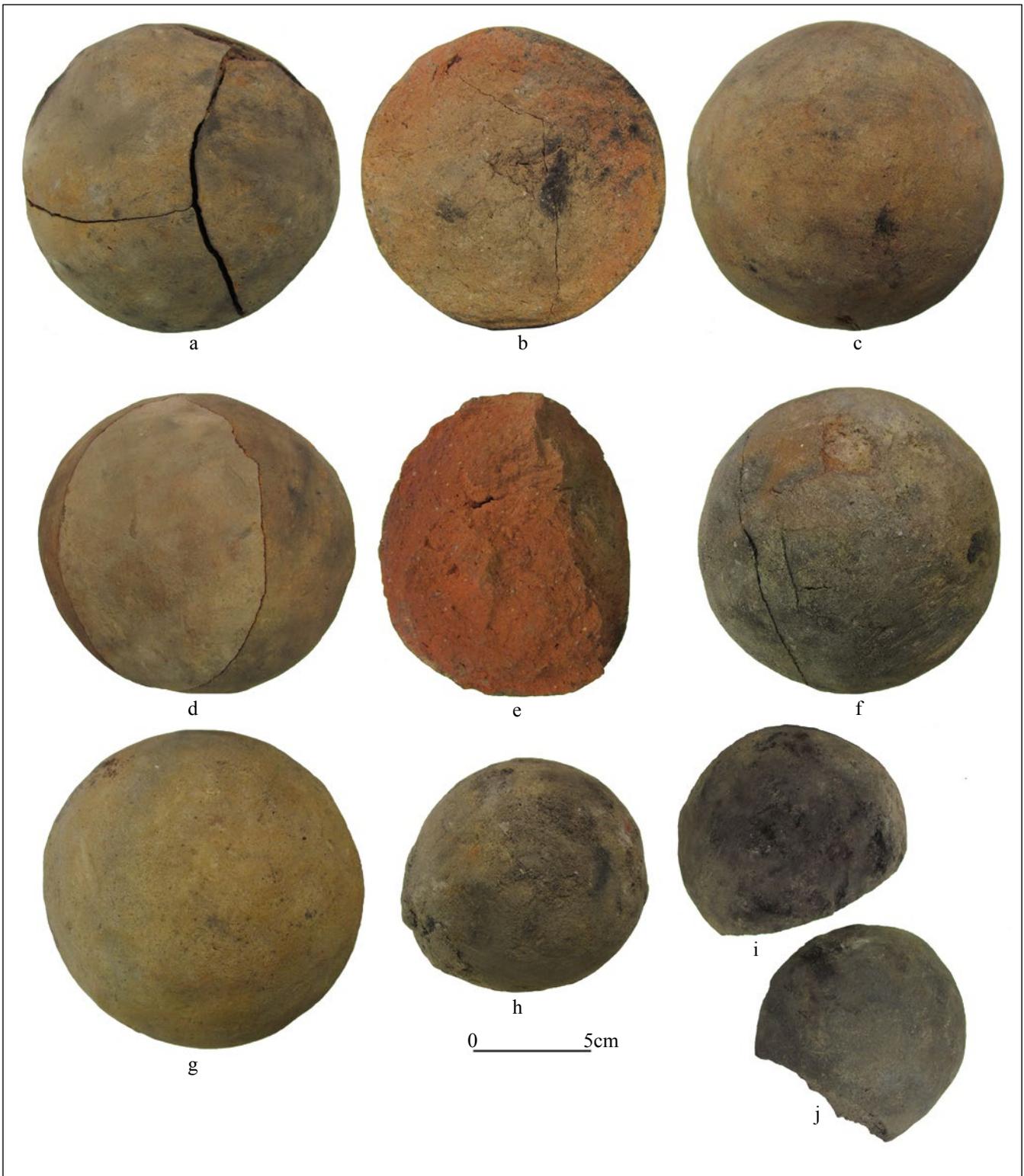


Fig. 3. Olsztyn, the High Turret, a-j: clay cannonballs and their fractures/cross-sections. Photo P. Strzyż.

With regard to its numerical strength, the best represented group is the ammunition with calibres between 12.9 and 14 cm. It can be assumed that it was designed to be used for several different cannons. This group includes as much as 85% of the entire assemblage. The next group, represented by both types of raw materials, was designed for barrels with calibres of 11.5-12 cm. Finally, the last group encompasses projectiles for the lightest cannons with calibres of

9.5-10 cm. However, discovered projectiles for such cannons were made from stone only. Both the circumstances of the discovery and the calibre assortment itself demonstrate that it was a municipal arsenal and it was probably prepared in advance in the times of peace. The closest vicinity of the Old Town in Olsztyn and the town itself were erected mainly on glacial tills of the Pomeranian Phase of the Vistulian Glaciation and only in a small part on outwash sands

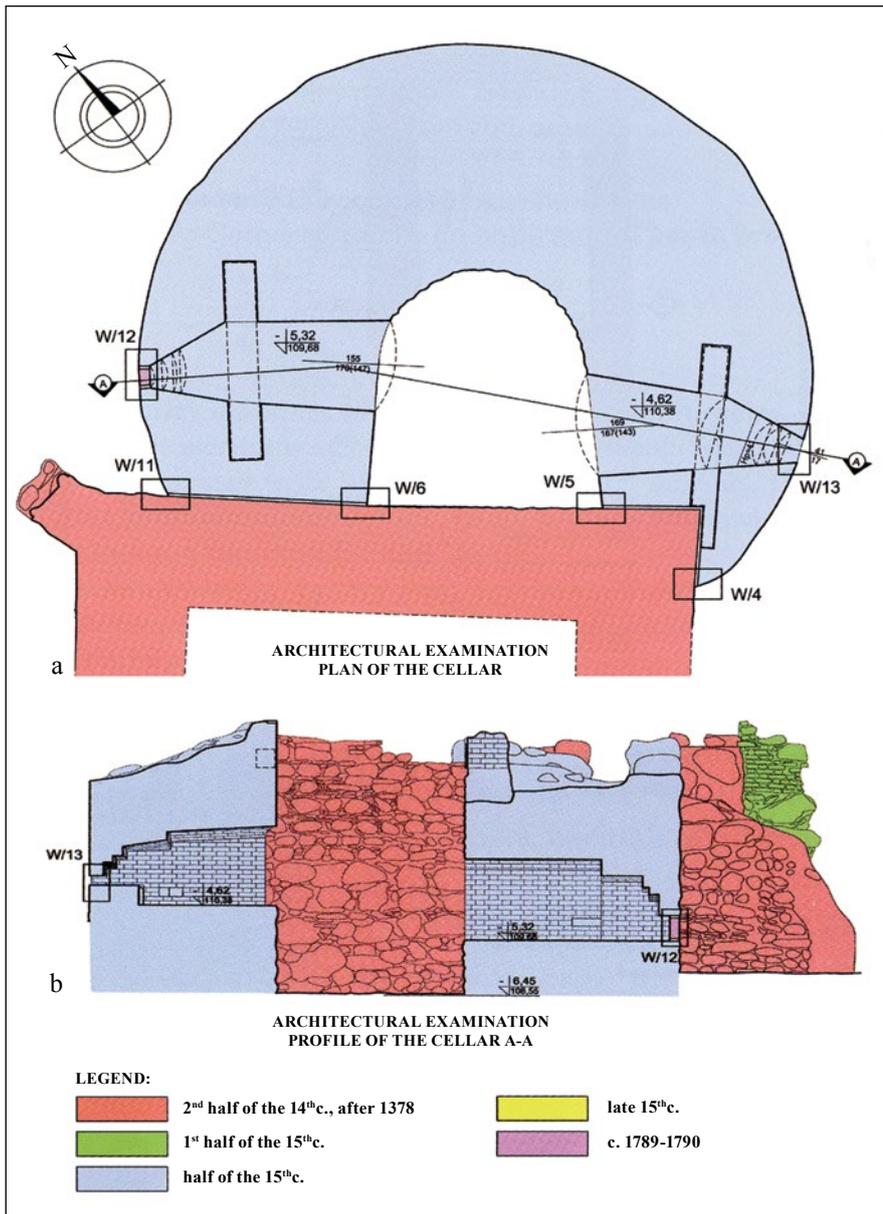


Fig. 4. Olsztyn, the High Turret: a. projection of the remains of the turret with marked embrasures, b. cross-section through the remains of the turret and the embrasures. After Wojciechowska-Grygo 2014, Fig. 11, 14.

and gravels¹¹. This means that there should be no problems here with access to granitoid erratic boulders for cannonball manufacture. As a matter of fact, it cannot be excluded that all boulders had been picked and used for construction of fortifications, foundations and masonry walls before artillery went into use. On the other hand, this hypothesis does not seem to be very probable.

Artillery in the High Turret

After the removal of rubble, two embrasures were discovered in the remains of the High Turret. Their loopholes were bricked up in a later period (Fig. 4). A niche situated on the S-E side is 1.6 m wide and 1.8 m high. On the N-W side the embrasure was 1.6 m wide and 1.7 m high. Loopholes of both posts have the same dimensions: their width is 0.3 m and their height is 0.5 m. What is worth

stressing is the presence of anti-ricochet walls and openings used to fix beams which supported barrels of cannons or hand-held siege defense firearms (Fig. 5). Obviously, we cannot be certain for what cannons the embrasures discovered in the basement were intended. It seems that in this case, due to their narrow openings, one can take into consideration either heavy siege defense hackbuts (with the calibre of 2-3 cm) or lighter cannons, such as terrace-guns or veuglaires¹². In this particular case, due to the fact that the basement of the turret was situated below the foreground, these embrasures could be used only to conduct fire on the level of moats¹³. It is anyway obvious that the discovered assemblage of ammunition was a stock for firearms deployed in the entire turret. On the basis of archaeological-architectural research the original structure of the High

¹¹ Rumiński 1996.

¹² Cf. Szymczak 2004; Strzyż 2014.

¹³ Lewicka 2014, 51; Wojciechowska-Grygo 2014, 33..



Fig. 5. Olsztyn, the High Turret. Shooting niche, arrows mark openings for beams supporting firearms. After Kaczyński and Mackiewicz 2014, Fig. 20.

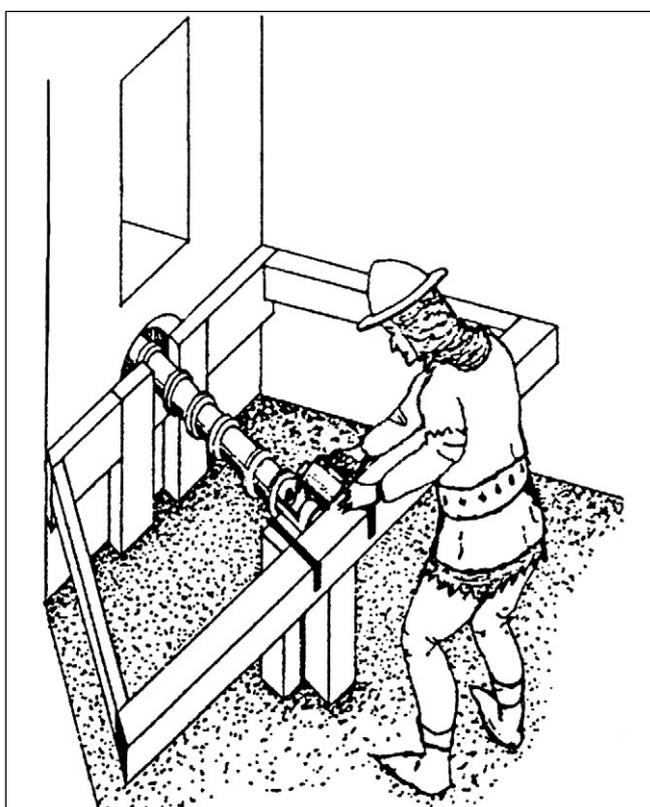


Fig. 6. Veuglaire post at the castle, re-construction. After Varhaník 2002, Fig. 9.

Turret is re-constructed as composed of a basement with a cellar, a ground floor and four utility storeys¹⁴.

On each such level there may have been other embrasures, where cannons protecting the area of the High Gate were deployed. In all probability, projectiles were originally stored on subsequent usage levels, or, what is more doubtful, they were all kept in the basement. Clear traces of smoke-blackening, which are especially notable on smaller clay projectiles (Fig. 3:h-j), but also on some finds of stone

cannonballs (Fig. 2:f), allow to suppose that their joint deposition may have been a result of fire, which caused loaded ceilings to collapse into the cellar. However, we are not able to offer a more precise chronology of these events. On account of the fact of long storing of stone ammunition¹⁵, it cannot be excluded that these may have even been events from 1622 or 1657¹⁶. Dismantlement of the turret in the late 18th c. may have been another circumstance of their deposition into the ceiling¹⁷.

It can be also discussed to what kind of artillery the projectiles found in the ruins of the turret were designed. There is no data on stores of hand-held firearms and no find of ammunition could be classified in this way. The calibres of the cannonballs fitting into the range between 9.5-10 and 15.5-16 cm allow to say that this was generally light artillery. Terrace-guns and veuglaires are especially relevant here. The former are defined in the literature as slender, rather long (up to c. 1 m) barrels with calibres from 4 to 10 cm. They were usually deployed in terraces, where they were fixed on wooden trestles. This did not exclude a possibility to use them inside rooms¹⁸. Another kind of light artillery which deserves a more detailed discussion here are veuglaires, or cannons with interchangeable powder chambers. With regard to their construction and parameters they were very similar to terrace-guns, but their calibre was often 15 cm or more. The mentioned interchangeable chambers significantly facilitated the use of such cannons, especially bearing in mind the lack of space in embrasures in turrets and towers (Fig. 6). This was chiefly influenced by the fact that after firing it was not necessary to withdraw the entire cannon in order to charge it again. Instead of it, it was only necessary to replace the powder chamber and load the projectile¹⁹.

Conclusions

The projectiles from the High Turret in Olsztyn are one of few assemblages of ammunition in Poland which can be considered as remains of municipal artillery. In the discussed case there were four calibre groups of cannons which protected this part of Olsztyn's fortifications. It is especially worth underlining that the projectiles of such cannons were made both from stone and from clay. In the case of stone cannonballs stone-cutters preferred igneous equal-grained (medium- and fine-grained) rocks, mainly granitoids. Syenitoids and diabases were used sporadically. There are no clear reasons behind the use

¹⁵ Cf. Strzyż 2011, 63-64.

¹⁶ Wojciechowska-Grygo 2014, 26. It came to a deposition of projectiles in the tower of the castle in Reszel in a similar way, when loaded ceilings collapsed into the cellar, cf. Strzyż 2007, 461-462.

¹⁷ Wojciechowska-Grygo 2014, 30.

¹⁸ Szymczak 2004, 53-54; Strzyż 2014, 72.

¹⁹ Szymczak 2004, 55-56; Strzyż 2014, 92-93.

¹⁴ Wojciechowska-Grygo 2014, 34, Fig. 7.

of coarse-grained rocks, including pegmatites with much worse technological properties, for the manufacture of cannonballs in Olsztyn. Furthermore, all sedimentary rocks were completely omitted, in spite of the fact that the manufacture of fired clay projectiles (perhaps in a later period) was undertaken. The latter are remarkable for their very high quality and they are the most homogeneous with regard to their calibres. It is also the first

assemblage in Poland which contains such a great number of cannonballs of this kind.

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Streszczenie

Kule z olsztyńskiej baszty

Podczas badań reliktyw Baszty Wysokiej, położonej w północnej części Starego Miasta w Olsztynie (Mazury), w jej piwnicy znaleziono 113 kul kamiennych i glinianych do dział. Amunicję kamienną stanowi łącznie 89 egzemplarzy. Najliczniej reprezentowane są średnice od 12,9 do 14,0 cm. Łącznie jest ich 75 sztuk. Ich waga mieści się w granicach 3,0-3,25 kg. Mniej jest pocisków innej wielkości: dwa mają kaliber 15,5-16,2 cm (waga 4,58-5,1 kg), a w przedziale 10,5-11,6 cm znalazło się sześć egzemplarzy o ciężarze 1,77-2,01 kg; odkryto także sześć kul o średnicy 9,0-9,3 cm, o wadze od 0,94 do 1,09 kg.

Jako surowca do wyrobu kul kamiennych użyto przede wszystkim granitoidów (74 pociski spośród ogółem 89 kamiennych). W tej grupie udało się oznaczyć szereg typowych granitoidów pochodzenia skandynawskiego, np. alandzkie granity rapakiwi, granity Sala, Uppsala czy Siljan. Skały te zostały zapewne zebrane w Olsztynie lub okolicach jako eratyki przywleczone przez ostatnie zlodowacenie ze Skandynawii. Dość często korzystano także ze stosunkowo mało przydatnych skał grubokrystalicznych: granitoidów i pegmatytów. Ich grubokrystaliczna tekstura, a w przypadku pegmatytów często również miarolityczna (porowata), bardzo utrudniała precyzyjną obróbkę. W analizowanym zbiorze rozpoznano również

kule wykonane z surowców o wyraźnej teksturze kierunkowej – granitognejsów i gnejsów. Jednostkowe znaleziska stanowią kule zrobione z diabazu oraz syenitoidu.

Amunicja gliniana to łącznie 24 kule zachowane w całości oraz w mniejszych lub większych fragmentach. Dominują wśród nich egzemplarze o średnicy mieszczącej się w przedziale 13,1-13,5 cm i wadze od 2,15 do 2,42 kg. Mniejsze kalibrowo fragmenty kul glinianych mają średnicę 10,5-10,7 cm, a w całości mogły osiągać ciężar do 1,2-1,3 kg. Należy podkreślić wysoką jakość i staranność ich produkcji: są one idealnie foremne, a ich powierzchnia jest gładka.

Kule z Baszty Wysokiej w Olsztynie są jednym z nielicznych w Polsce zespołów amunicji, które można uznać za pozostałości artylerii miejskiej. Na szczególną uwagę zasługuje odkrycie amunicji wykonanej z wypalanej gliny – jest to pierwszy w Polsce tak liczny zbiór tego rodzaju pocisków do dział.