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CHARACTERISTICS OF MEDIEVAL ARTILLERY IN THE LIGHT OF WRITTEN SOURCES FROM BOHEMIA AND POLAND

Artillery appears in Central Europe at the end of the 14th c.¹ and it starts playing a more significant role only in the next century. In the Kingdom of Bohemia it became more widespread as early as during the Hussite Wars of 1419-1436, while in the territory of the Kingdom of Poland and its northern neighbour, i.e., the Teutonic Order, an increase in popularity of firearms can be rather dated to the Thirteen Years War of 1454-1466. On the other hand, earlier conflicts, from the Great War of 1409-1411 onwards, witness a steady growth in significance of the new weapon. In this context, it is comprehensible that the use of both gunpowder artillery and hand-held firearms in the mentioned states found its place in numerous originating chronicles which described current or past events. Among a great deal of data concerning the new weapon, in this paper we decided to concentrate on the characteristics of effectiveness and accuracy of fire, as well as the range

and infallibility of artillery of that time. An attempt at such an assessment is possible based on the analysis of available written sources.

Effectiveness and accuracy

From the very beginning of the existence of firearms, they were used in two main areas – during sieges and battles in the open field. Effectiveness of early artillery in the bombardment of fortified sites, such as castles or towns, cannot be assessed unequivocally. There are numerous examples which inform us that during a bombardment considerable damages were inflicted both concerning buildings, property of inhabitants as well as people themselves. However, sources also contain data on bombardments which proved completely ineffective, in spite of the fact that considerable means were made use of.

Already in one of the first mentions, referring to the siege of Hradčany in 1420, the Czech chronicler Vavřinec of Březová said: “At that time, the Prague troops and the Taborites inflicted a lot of damages to houses in Hradčany, shooting from throwing engines deployed in Pohořelci. The defenders, however, firing from cannons from Hrad and Hradčany, destroyed those throwing engines”². We do not know the rate of fire of throwing engines shooting at the posts. However, a considerable accuracy of deployed cannons must be underlined, as it was necessary to hit the target with the surface of a dozen or so square meters only³.

¹ In Central Europe the new weapon appears in the 2nd half of the 14th c. For the territory of the Teutonic Order in Prussia, the first mention in the Order's inventories comes from the castle of Lipienek in 1374 and it informs about “3 buchsen” stored there, cf. *Das Grosse Ämterbuch des Deutschen Ordens*, ed. E. Ziesemer, Danzig 1921, p. 524; V. Schmidtchen, *Die Feuerwaffen des Deutschen Ritterordens bis zur Schlacht bei Tannenberg 1410. Bestände, Funktion und Kosten, Dargestellt Anhalt der Wirtschaftsbücher des Ordens von 1374 bis 1410*, Lüneburg 1977, pp. 8, 26; A. Nowakowski, *O wojskach Zakonu Szpitala Najświętszej Marii Panny Domu Niemieckiego w Jerozolimie zwanego krzyżackim*, Olsztyn 1988, p. 92. It cannot be excluded, however, that already a decade before that the Teutonic Knights made use of gunpowder artillery during the siege of Kowno in 1362, cf. also V. Schmidtchen, *Die Feuerwaffen...*, p. 24; A. Nowakowski, *O wojskach...*, p. 92; J. Szymczak, *Początki broni palnej w Polsce (1383-1533)*, Łódź 2004, p. 12. The first record from the territory of Bohemia comes from 1373 and mentions a Prague master gunner “magister Heinrichus,” cf. W. Iwańczak, *Broń palna w wojsku czeskim późnego średniowiecza*, [in:] *Heraldyka i okolice*, eds. A. Rachuba, S. Górzyński, H. Manikowska, Warszawa 2002, p. 279; J. Szymczak, *Początki...*, p. 12. For the territory of the Kingdom of Poland it was 1383 and the siege of Pyzdry (J. Szymczak, *Początki...*, pp. 12-14, with previous scholarship). Analogously, the appearance of cannons in Hungary, Lithuania and the Grand Duchy of Muscovy is dated to the 1380s (J. Kalmár, *Régi magyar fegyverek*, Budapest 1971, p. 158; J. Szymczak, *Początki...*, p. 12).

² Vavřinec of Březová, *Husitská kronika*, ed. and transl. by F. Heřmanský, M. Bláhová, Praha 1979, p. 71.

³ We think so based on the results of research in the territory of the Crimean (Genovese) fortress of Chembalo from the late 14th c. In the course of archaeological research both remains of a post and stone cannonballs for a trebuchet were discovered. The post's dimensions at the base were 5.1 x 2.6 m, i.e., about 13 m²; see H. A. Алексеенко, С. В. Дьячков, *Раскопки “консульского замка” генуэзской крепости Чембало в 2006 в.*, Археологічні дослідження в Україні 2005-2007, pp. 81-87; S. Dyachkov, *The 15 century brigandine of a crossbowman from the Genoese fortress of Cembalo*, Acta Militaria Mediaevalia, Vol. 7, 2011, p. 175. Similar sizes of posts of throwing engines were recorded during the research at castles in Bohemia: Bechyně and Lopata, cf. J. Kypta, J. Richterová, *Tábor obláhatelů z doby husitských válek u Bechyně*, Dějiny staveb, Sborník příspěvků z konference Dějiny staveb 2003, Plzeň 2003, pp. 177-192;

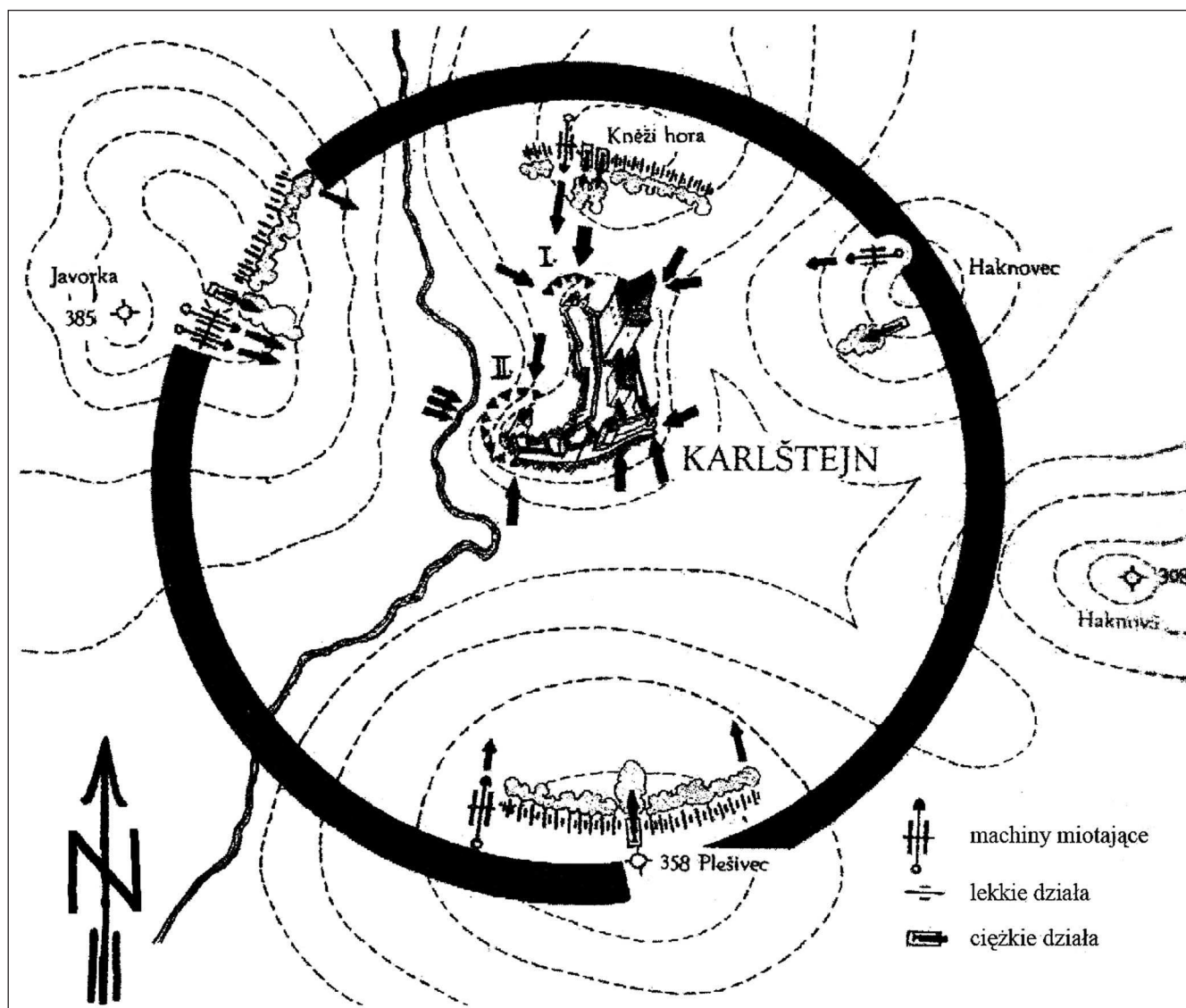


Fig. 1. The siege of Karlštejn in 1422-1423 (after E. Wagner).

In August of the same year it came to hostilities in the vicinity of Vyšehrad, and the chronicler Vavřinec of Březová remarked: “On the other side of the town they deployed two machines, i.e., throwing engines, behind the choir of the Holy Virgin church on the Botič. These, however, were destroyed by a skilful Vyšehrad master gunner, who fired from the round chapel of St Margaret towards the Botič. On the other hand, with a large cannon which they deployed in the little church ‘on Grass,’ having demolished its wall, they inflicted a lot of damage to the Vyšehrad people”⁴. Also in this case the accuracy was excellent, as the posts of heavy cannons were not larger than those for throwing engines.

One of more spectacular descriptions of siege works with the use of artillery, both gunpowder and neuroballistic (throwing engines) refers to activities at Karlštejn (Fig. 1),

surrounded by joint forces of Czech revolutionary troops and Polish auxiliary detachments: “In that year [1422] shortly thereafter, on Tuesday after the Pentecost [2 June] Duke Sigismund [Korybutovič] with Prague troops and Poles besieged the castle of Karlštejn. However, they did not capture it, although they attacked it with great strength and force and with throwing engines they threw many stinking barrels to the castle. (...) With throwing engines they threw 932 stones to the castle, apart from barrels with stinking refuse, which they carried from Prague, filled with carcass and excrements. 822 such barrels were thrown with throwing engines. They fired seven times a day with the “Pražka” cannon, seven times a day with the “Jaroměřka” and thirty times a day with the “Rychlica” cannon, but they did not inflict any damage to the castle. – There, the Poles were eating donkey meat instead of game”⁵. As it can be

M. Novobilský, *Obléhání hradu Lopaty. Rekonstrukce obléhání hradu z roku 1432-1433*, Plzeň 2008, pp. 61-71.

⁴ Vavřinec of Březová, *Husitská...*, p. 151.

⁵ *Ze starých latopisů českých*, ed. J. Porák, J. Kašpar, Praha 1980, p. 90. On this issue see also J. Dolejší, L. Křížek, *Husité. Vrchol válečného umění v Čechách 1419-1434*, Praha 2009, p. 299.

seen, in spite of heavy bombardment from several neighbouring hills and attempts at causing disease between the defenders by means of throwing carcass of dead animals, the siege failed and one of more important castles of Sigismund of Luxembourg remained unconquered.

Low effectiveness of artillery is also testified to by data on the siege of Plzeň at the turn of 1433 and 1434: "In that year [1433] on Monday after St Bartholomew's day [31 August], Prague lords from both towns, the Old and the New one, departed for Plzeň to lay siege to the town. (...) But because of this, God permitted that wherever they went, they were defeated everywhere, as they did not spare anyone, either those with whom they besieged Plzeň. Because of this, their last supporters were abandoning them"⁶. Therefore, practically no-one suffered harm during the entire siege and no major damage was done to the town buildings. Damage was repaired on an ongoing basis during the hostilities⁷.

We are unable, either, to provide an unequivocal answer for the question concerning the scale of damage inflicted by the fire of bombards. It seems, however, that accuracy prevailed over ineffectiveness. During the siege of Most in Bohemia it was remarked that: "Having deployed two throwing engines and the same number of large Prague cannons, they inflicted huge harm to the castle..."⁸. Furthermore, during the siege of the town of Žatec in 1421 by forces of the anti-Hussite coalition, the town was daily bombarded by 600 to 800 cannonballs, fired by 30-40 cannons.

These authors, however, offer a different interpretation of this record. They say after F. Palacký that these cannons burst during the siege: Pražka after six, Jaroměřka after seven, and Rychnice after thirty shots, cf. F. Palacký, *Dějiny národu českého v Čechách a na Moravě*, Part III, 3rd ed., Praha 1940, pp. 733-734. Similar opinion was expressed by W. Iwańczak, *Broń palna w wojsku czeskim...*, p. 383 and J. Szymczak, *Początki...*, s. 64. These data are based on the compiled chronicle of Václav Hájek of Libočany, which originated as late as the mid-16th c. It is hard to say whether these earlier records are completely trustworthy. Here we agree with the opinion of J. Durdík (*Husitské vojenství*, Praha 1954, pp. 88-89) and assume that these are numbers of shots per day delivered from the mentioned cannons. On these events see also *Kronika Bartoška z Drahonice*, [in:] *Ze správ a kronik doby husitské*, transl. by E. Kamínková, Praha 1981, p. 233: "In that year on Wednesday before St Urban's day [20 May 1422] Prague troops with men of the mentioned voivode besieged the castle of Karlštejn and strenuously attempted to take it by force with heavy cannons and five throwing engines".

⁶ *Ze starých...*, pp. 115-116. There are no mentions of damages in the town during the siege (which lasted for almost 43 weeks) in the *Kronika Bartoška z Drahonice...*, p. 262, 265, 266.

⁷ J. Hejnic, M. Polívka, *Plzeň v husitské revoluci*. *Hilaria Litoměřického "Historie města Plzně"*, její edice a historický rozbor, Praha 1987, p. 106: "Dicam est, quid apud nostros cives fortune legalitatisque fuit. Illi ex bombardis lapides ferrumque mittebant, sed unicus ex mango lapide ob sui incuriam excusso cerebro cecidit. Alii vero lapides nunc in plateam, nunc in tecta, si quando inter homines ceciderunt, minime nocuerunt", see also W. Iwańczak, *Broń palna w wojsku czeskim...*, p. 386, footnote 44.

⁸ Vavřinec of Březová, *Husitská...*, p. 251.

We do not know the effect of this bombardment; however, it must have been insignificant, as it is known that the town was not captured and the besiegers had to terminate the siege. The defenders, on their part, also used firearms and their volleys caused the death of 100 to 150 men per day among the besiegers⁹.

During the siege of the castle of Bechyně: "In that year before St Gall's day [before 16 October 1428] Duke Prokop the Bald, the commander of the Taborites, together with those who were subject to him, besieged the castle of Bechyně. They brought there all the cannons and deployed them in a crosswise manner. And because of great hardship the castle surrendered to them"¹⁰. In this particular case it is worth noting that part of fortifications related to these events was discovered by archaeologists¹¹. It is a low promontory situated in the bifurcation of the Rivers Lužnica and Smutná, to the south of the castle. Its distance from the castle's centre is about 250 m (Fig. 2, 3). Its location was convenient, both due to protection offered by steep banks of the mentioned rivers and the elevation of about 20 m higher than the posts of the defenders¹².

⁹ *Deutsche Reichstagsakten unter Kaiser Sigismund*, Bd. 8, 1421-1426, ed. D. Kerler, Gotha 1883, pp. 100, 101: "(...) wisse ouch das kein tag zergat, sie tügend 6 7 oder 800 buchsen-schutze under uns, und land etwo dik 30 oder 40 búhsen zúmal uss (...)"; "(...) dann wenig kein tag zergat, es belibent hundert oder 150 der unseren todt von geschütze und ouch uf fúterunge;" on this issue see also J. Durdík, *Husitské vojenství...*, pp. 18, 20, 71, 90; J. Szymczak, *Początki...*, p. 160.

¹⁰ *Ze starých...*, p. 106. An almost identical description is offered by *Staré latopisy české z rukopisu Křižovnického*, eds. F. Šimek, M. Kaňák, Praha 1959, p. 92: "In that year before St Gall's day Prokop the Bald with his supporters besieged the castle of Bechyně. And all the cannons were brought there and they were deployed in a crosswise manner. And the defenders had to surrender the castle because of great hardship". On this issue see also *Kronika Bartoška z Drahonice...*, p. 240: "On Thursday in the week before St Margaret's day [8 July 1428] the Taborites laid siege to the castle and the town called Bechyně and they put up their camp around it from four sides. (...) They set up their wagons and remained there for about 15 weeks and attempted at taking the castle and the town by force, with the help of numerous large and smaller cannons and throwing engines".

¹¹ It the territory of the present-day Czech Republic at least a dozen or so archaeological sites with remains of siege posts are known, cf. e.g., T. Durdík, *Povrchový průzkum zaniklého středověkého sídlištního komplexu Stará Dubá*, Sborník vlastivědných prací z Podblanicka, Vol. 21, 1980, pp. 141-168; P. Meduna, *Pozůstatky středověké militární činnosti u hradu Kostence nad Sáravou*, Sborník vlastivědných prací z Podblanicka, Vol. 25, 1984, pp. 119-128; id., *Povrchový průzkum kompletu obláček prací v Konopiště z let 1467-1468*, "Castellologica Bohemica", Vol. 4, 1994, pp. 243-250; J. Kypka, J. Richterová, *Tábor obláček u hradu Velkého Vřešťova*, Hláška, Vol. 14, fasc. 3, 2003, pp. 37-40; id., *Opevněné postavení obláček hradu Grabštejna*, "Castellologica Bohemica", Vol. 9, 2004, pp. 285-290; M. Novobilský, *Obléhání hradu Lopaty...*, pp. 41-72.

¹² In the northern part of the promontory there are large rectangular pits, interpreted as trenches for battering cannons. These are four ditches, with the first one being situated to the west and

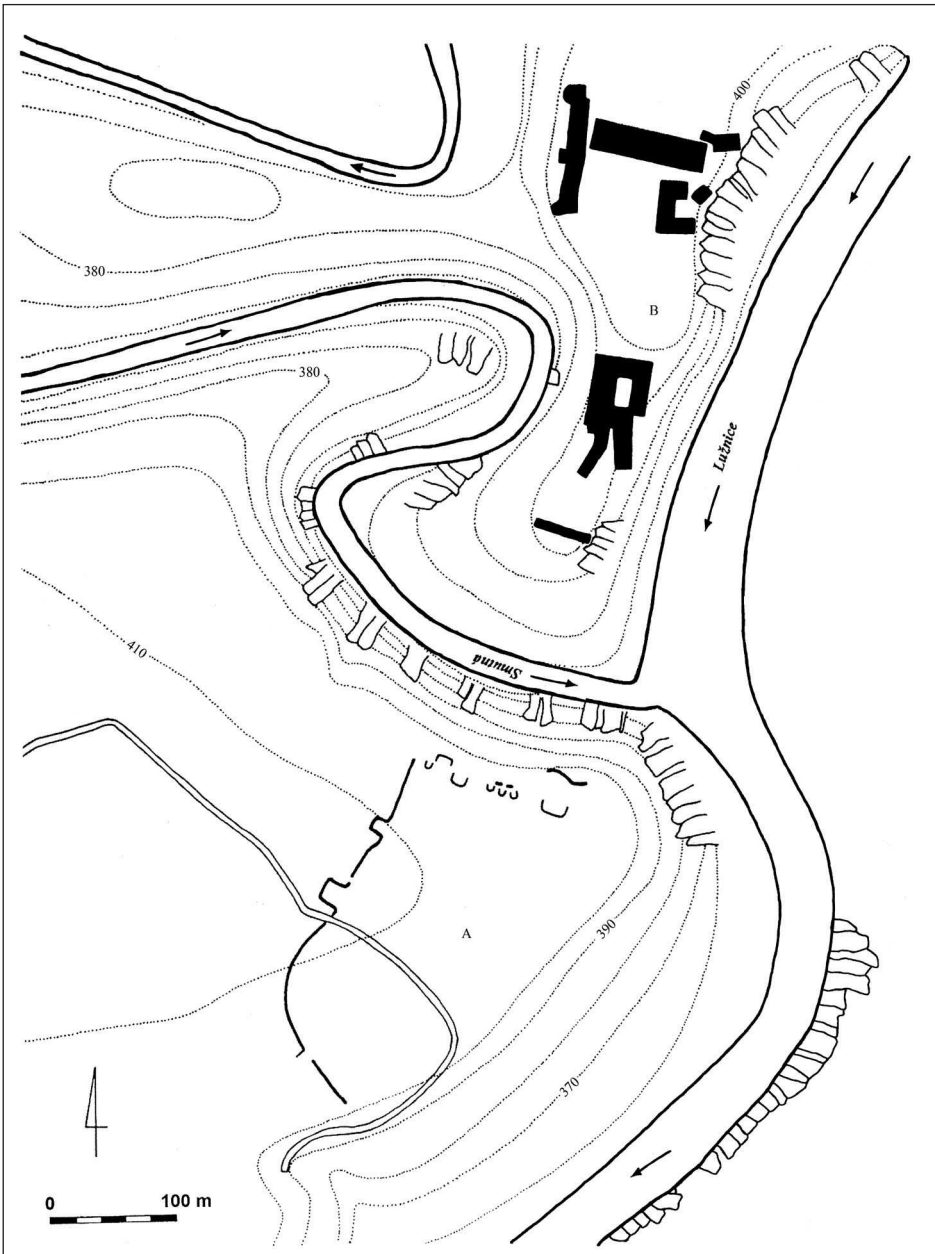


Fig. 2. Bechyně castle; A – castle; B – fire position (after Kypta, Richterová 2003, fig. 1).

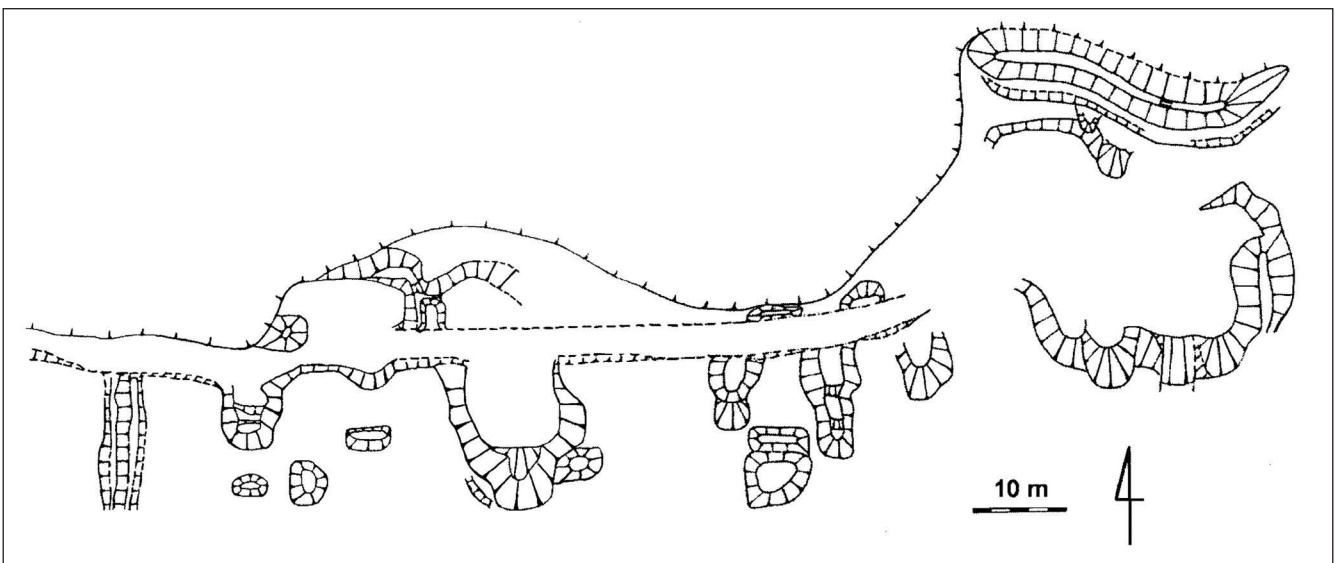


Fig. 3. Bechyně – fire position (after Kypta, Richterová 2003, fig. 6).

Good accuracy in destroying fortifications is underlined by Jan Długosz in the description of hostilities at Łuck in 1431: "Large cannons, which were also moved close to the castle, fired at the wall, destroyed it and demolished numerous towers and a considerable part of the wall. It was in spite of the fact that King Władysław reprimanded the destruction of walls and admonished some men to refrain from firing cannons". In result of heavy bombardment "fortifications were scattered and empty, and the wall was pulled down in many places"¹³. Łuck would have no question surrendered if it had not been for the delay of the Polish commanders, for which Długosz consequently blamed first of all King Władysław Jagiełło.

Among military activities which are of use for research on effectiveness of medieval firearms a prominent place is taken by the siege of Malbork by joint Polish-Lithuanian forces between 26 July and 19 September 1410. The capital of the Order was surrounded with a number of artillery posts (Fig. 4). Jan Długosz says that "...Władysław Jagiełło King of Poland, having ordered to deploy heavy cannons in the town church on the same night [26/27 July], incessantly bombards the castle with them. Other cannons were deployed in the Lithuanian army: some near the outer wall, others at the abutment of the burnt bridge on the other side of the River Nogat. And all these cannons strongly bombarded the castle from four sides..."¹⁴. In this place the description offered by the chronicler is to be corrected, as it is certain that heavy cannons were not lifted to the church tower. These were rather lighter bombards which launched cannonballs with the diameter of a dozen or so cm. The record also testifies to a variety of cannons that were used and it gives the location of the most important artillery posts, which were situated on the other bank of the River Nogat

being 8.5 m long and 5.5 m wide. Further three features are situated in the eastern part of the site. The first one is 7.5 m long and 5.5 m wide. A couple of metres next to it there is another ditch which is 12 m long and 6 m wide. Preserved dimensions of the last pit are 7.5 (length) x 6 m (width). To the south of them there is also an oval hollow with its dimensions being 6 x 7 m. On the north it terminated with a 0.5 m high earthwork. The function of these large and sunken features and smaller earthworks was perhaps related to the use of artillery and its personnel (Fig. 2, 3), see J. Kypta, J. Richterová, *Tábor obléhatelů...*, pp. 117, 121, Figs. 1, 2, 6.

¹³ Joannis Dlugossi, *Annales seu cronicae incliti Regni Poloniae*, liber XI et XII, Warszawa 2001, p. 31: "Bombarde quoque maiores castro admote, quaciebant et rumpebant murum et plures turre et spacium notabile muri disiecerant, Wladislaw rege improbante murorum concusionem et exhortante aliquos, ut a proieccione bombardarum abstinereetur;" p. 32: "... menibus disiectis et nudatis muroque in frequentibus locis disupto..."

¹⁴ Jan Długosz, *Roczniki...*, Books 10 and 11, Warszawa 1982, pp. 153-154; Joannis Dlugossii, *Annales...*, liber X et XI, Warszawa 1997, p. 132: "Sed et Polonie rex Wladislaus nocte eadem bombardis maioribus in ecclesiam opidi introductis continua percussione ex illis castrum quatit. Locate et alie bombarde fuere in exercitu Lithuanico, alie circa pomerium, alie in pede pontis ex altera parte Wisle exusti et ex omnibus illis cum quaciebatur castrum fortissimo in quadrum."

directly in front of the High Castle and on the side of the Fore-Castle, i.e., from the north and the east. The latter were in all probability posts of Lithuanian artillery, which bombarded the walls, including the Buttermilk, the Clock and the Szarysz Towers, as well as household buildings of the Fore-Castle from a close distance of c. 50 m¹⁵. Another cannon (or cannons) was deployed directly to the east of the Priest Tower and the castle church (Fig. 4). The fire was conducted in the direction of the High Castle from the foreground of the New Gate. In result of that, the Priest Tower was completely pulled down¹⁶.

On the southern side (Fig. 4) cannons were deployed behind the walls of burnt town houses and in the parish church. With the use of these cannons i. a. the Sparrow Tower, Dietrich's Tower and the Gate Tower were demolished. In all probability, in this zone of siege works an exchange of fire was conducted. It is known that a shot from a castle cannon "demolished the wall of one of burnt houses in the town. With its weight the collapsing wall crushed twenty knights, who were standing behind it"¹⁷. The Teutonic cannon may have been posted on defensive galleries of the High Castle. The presence of artillery in this location is mentioned in inventories from 1412, when the demolition of a structure called *bolenwerk* was testified to. This was perhaps a construction on which a small calibre barrel was posted¹⁸.

The firepower of the besieging troops and the scale of damage caused by it¹⁹ are also testified to by letters sent

¹⁵ M. Haftka, *Wielka wojna Polski i Litwy z Zakonem Krzyżackim 1409-1411. Batalia o Malbork lato 1410*, Malbork 2000, pp. 10-11; id., *Pod murami Malborka. Lato 1410*, Gdańsk 2010, p. 109; M. Kuc, *Oblężenie twierdzy malborskiej w 1410 roku – aspekty militarne*, „Zapiski Historyczne”, 2000, Vol. 65, fasc. 1, pp. 38-39; S. Józwiak, K. Kwiatkowski, A. Szweđa, S. Szybkowski, *Wojna Polski i Litwy z Zakonem Krzyżackim w latach 1409-1411*, Malbork 2010, pp. 500-505.

¹⁶ M. Haftka, *Pod murami...*, pp. 93-94, 107.

¹⁷ Jan Długosz, *Roczniki...*, Books 10 and 11, p. 161; Joannis Dlugossii, *Annales...*, liber X et XI, p. 138: „(...) impetu suo bombardata murum unius exuste in oppido lapidee collidens viginti milites, qui subter murum consistenter, sua mole oppressit.”

¹⁸ M. Haftka, *Pod murami...*, p. 107.

¹⁹ Important data for the assessment of the use of artillery in the siege of the Malbork castle are also provided by the bombardment of the Grand Masters' Palace at the Middle Castle from the other bank of the River Nogat. The artillery post was in all probability situated directly opposite its walls and it was slightly elevated above the surrounding terrain. It was in all probability situated on the flood embankment. The bombardment damaged not only the Palace itself, but also the roofs of the Infirmary, the Great Granary and the Bath Tower. The main target of the bombardment were representative halls of the Summer Refectory, which was the place of councils of the government of the Order's state. Its western façade was hit by at least 6-8 large stone cannonballs. The concentration of projectiles fired in this direction must be stressed, as the dimensions of the hall are 14 x 9 m. The point of reference for aiming was perhaps the large window of the Summer Refectory. A granite cannonball, which went through the window and stuck above the fireplace in the opposite wall is

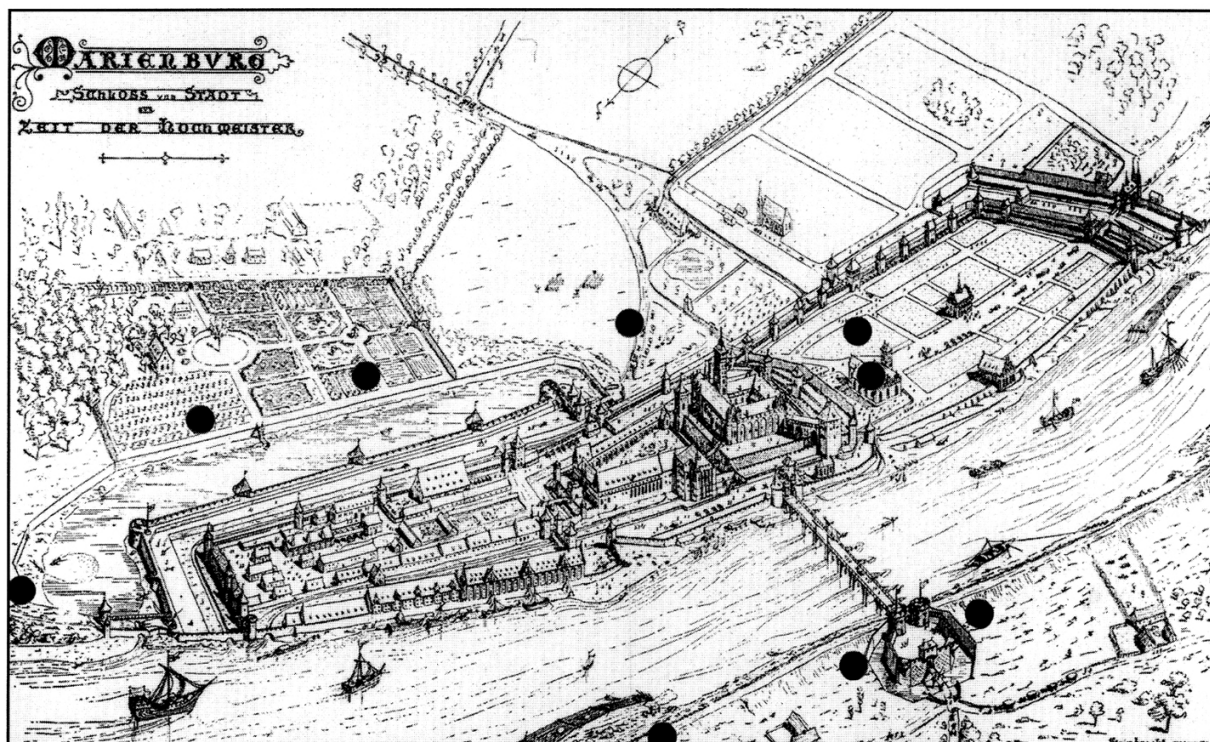


Fig. 4. Hot spots of Polish and Lithuanian siege of Malbork in 1410 (after Haftka 2000, p. 3).

in December 1410 by the then Grand Master Heinrich von Plauen to dukes of the Empire. The Grand Master stated that the castle was attacked “days and nights, with cannons, throwing engines, saps and devices of all kinds. And for ten weeks [the King of Poland] horrifically attacked, bombarded and assaulted [the castle]”²⁰.

In the 15th c. artillery was first of all used in sieges but the battle of Grunwald on 15 July 1410 marks the beginning of its use in open field battles. It was the Teutonic party that decided to first use the new weapon in this manner, in spite of the fact that the Polish-Lithuanian army also possessed powerful artillery. Sources inform us that the artillery of the Order’s troops launched two volleys only, and then it was taken by the Polish-Lithuanian troops. The author of “The Chronicle of the Conflict” recorded scrupulously:

“And at the very beginning of that rain, the enemy’s cannons – for the enemy had numerous cannons – launched two volleys with stone cannonballs, but were unable to do any damage to our men with this fire. And soon in the first encounter with the King’s men [the enemy] was pushed back from these cannons for the distance of almost a stadium”²¹. This records confirms low effectiveness of artillery of that time, but at the same time it informs us about the material used for the manufacture of ammunition.

Better effectiveness in the fight against moving adversaries was achieved by Czech master gunners. Contemporary chroniclers inform us about devastating effects of use of cannons against the manpower of crusading armies. For instance, on the occasion of the encounter at Ústí in 1426 the chronicler recorded: “But then the Czechs gave a shout and fired at them from the wagons with field cannons and

a vestige of these events, which has survived until present. The diameter of the cannonball is c. 37 cm and the cannon which fired it was located slightly to the west of the abutment of the bridge. This means that the cannonball was launched from the distance of c. 250 m, cf. M. Haftka, *Wielka wojna...*, pp. 11-12; id., *Pod murami...*, pp. 109-112; S. Józwiak, K. Kwiatkowski, A. Szweđa, S. Szybkowski, *Wojna Polski i Litwy...*, p. 500, footnote 1356.

²⁰ Quoted after S. Józwiak, K. Kwiatkowski, A. Szweđa, S. Szybkowski, *Wojna Polski i Litwy...*, p. 505: “(...) tagund nacht mit buhsen, bleiden, undigraben und allirley stormesgezuges bis in dy czende woche jemmerlich czuwarf czu schok und czustormethe”.

²¹ Quoted after *Kronika konfliktu Władysława Króla polskiego z krzyżakami w roku pańskim 1410*, transl. by J. Danka, A. Nadolski, Olsztyn 1983, pp. 11-12; *Cronica conflictus Wladislawi regis Poloniae cum Cruciferis anno Christi 1410*, ed. Z. Celi-chowski, Poznań 1911, p. 24: “Cumque in ipsius pluviae initio duo ictus in emmissione lapidum de pixidibus hostium facti erant, quia hostes multos pixides haberunt, nullum tamen nocumentum per hujusmodi emissiones nostri facere potuerunt; et statim primo congressu cum gente regis facto ab eisdem pixidibus fere per stadium sunt repulse”. Cf. also Jan Długosz, *Roczniki...*, Books 10 and 11, p. 123; J. Szymczak, *Początki...*, p. 236.

terrace guns and they made broad paths and passages in the enemy's lines"²². Similarly murderous effect was recorded in the case of hostilities near Most. Attacking troops of Meissen met an unpleasant surprise: "But master gunners killed many from the Meissen troops, who wanted to climb on the mountain. And, as it is maintained, about thousand men fell on both sides"²³. Furthermore, during the battle near Kutna Hora in 1420 the Hussites prepared a blood-bath for the attacking troops of Sigismund of Luxembourg. At first, before the battle commenced, the Hussites: "had prepared themselves between the wagons with their flails and weapons, having made numerous cannons on the wagons ready to fire". Then, when the battle started, "When some royal detachments wanted to attack the wagons with a charge, they were thrown back with cannon fire to a great detriment to themselves. And such enemy charges and battle actions lasted until the night"²⁴. Similarly, during the encounter of the Hussites with Silesian troops at Sary Welisław near Kłodzko, the attack of Silesian cavalry broke down in the fire of wagon fort cannons: "Wenne sie gar vil boechsen yn irer waynfart hattten"²⁵.

An enormous scale of destruction which could be made by some dozen kilograms heavy stone cannonballs fired from cannons is very clearly depicted in a record concerning the siege of Poděbrady in 1426: "On one day, when a priest was preaching and brethren were sitting around him and listening, eleven of them were killed by a single cannon shot"²⁶. It is therefore clear that the aforementioned "bloody paths" are not merely a *licentia poetica* used by chroniclers. It is beyond doubt that in its initial period artillery was unable to fight independently and required a steady protection by infantry. This is perfectly evident in Czech realities, where cannons were deployed in the wagon fort, which offered protection provided by shooters with crossbows and hand-held firearms.

Maximum range and accuracy

We do not have unambiguous data, either, with regard to the range and accuracy of medieval cannons. It is usually assumed that the effective range of fire was between

200 m in the case of small cannons, such as field cannons or terrace guns, and about 500 m in the case of larger bombardments²⁷. It seems therefore that we have to do with two terms here: the effective range and the maximum range. In the latter case it would be difficult to speak about aiming. The cannon barrel was simply placed at the angle of 30-45 degrees and the projectile which was fired that way could in fact have an actually long range. There are many examples for this. The chronicler Vavřinec of Březová who was already quoted above informs us that in 1420 during the siege of Vyšehrad: "on Friday before St Wenceslas' day they killed one man and five women in the Old Town Market Square with one shot of a large cannon from the Prague castle". According to Czech scholars, a large bombard posted at the Prague castle was fired, which means that the distance was about 1600 m²⁸.

An analogous event is described by an unknown burgher in records concerning the years 1492-1515. Under the year 1515 he recorded: "In this year XV [1515] (...) a cannonball was fired at the Old Town, so that a finial on the house of the lord of Rožmberk was pulled down"²⁹. Also in this case the range of the shot was slightly more than 1 km; on the other hand, it is possible that in this case we have to do with a newer type of cannon.

While shooting at selected targets, the accuracy depended to a great degree not only on the skills of the master gunner, but also on the stroke of luck. It was merely enough to slightly displace the wedges under the cannon barrel and the cannonball missed its target. We can therefore assume that the master gunner who participated in hostilities between the Old and the New Town in Prague in 1434 was both lucky and hawk-eyed. "Furthermore, from there they took a beautiful bell from the other party, as they shot off its crown and it fell to the ground and broke into pieces"³⁰.

Three interesting records concern the early 16th c. They were written by a chronicler who was no doubt perfectly competent in the matters of artillery. In the first one we read: "In this year on Monday after the Laetare Sunday [19 March 1515] two large cannons were transported to the

²² *Ze starých...*, p. 102; *Duchem i mečem*, ed. F. Heřmanský, Praha 2008, p. 387; J. Dolejší, L. Křížek, *Husité...*, p. 272.

²³ Vavřinec of Březová, *Husitská...*, p. 252.

²⁴ Vavřinec of Březová, *Husitská...*, p. 275; *Duchem i mečem...*, p. 364. These events are also mentioned in Old Czech Letopises, where it was recorded that "...there was a heavy cannon fire from both sides", cf. *Ze starých...*, p. 81.

²⁵ *Kronika Marcina z Bolkowa*, Scriptorum Rerum Silesiarum, ed. F. Wachter, Breslau 1883, pp. 6-7.

²⁶ *Ze starých...*, p. 103, cf. also *Staré latopisy české z rukopisu Křižovnického...*, p. 88: "In this year the Taborites and the Orphans besieged lord Hynek Boček in Poděbrady and attacked the castle with throwing engines and cannons. The said lord Boček defended himself bravely and successfully, did great harm to them and killed many of them with throwing down. On one day during a preaching he killed eleven of them with a cannon".

²⁷ Cf., e.g., J. Durdík, *Sztuka wojenna...*, pp. 94-95; id., *Husitské vojenství*, Praha 1954, pp. 78, 86; Jan Szymczak, *Początki...*, p. 64.

²⁸ Vavřinec of Březová, *Husitská...*, p. 151; J. Dolejší, L. Křížek, *Husité. Vrchol válečného umění v Čechách 1419-1434*, Praha 2009, p. 273. The same events were also described in Old Czech Letopises: "On Friday before St Wenceslas' day [27 September] four women, one woman with a child and one man were killed in the Fish Market of the Old Town with a cannon shot from the Prague castle", *Ze starých...*, p. 67.

²⁹ B. Zilynskyj, *Latopis měšťana Nového Města Pražského z let 1492 až 1539*, "Pražský Sborník Historický", Vol. XVII, p. 58. It is possible that the event in fact took place a year before, in 1514, cf. B. Zilynskyj, *Latopis...*, p. 58, footnote 6, with previous scholarship.

³⁰ *Ze starých...*, p. 116.

Spital Field; however, these cannons were not fired on that day due to a day-long dense snowfall. On the other day, one fired the Pražka cannon and the cannonball went over the entire bend of the River Vltava and fell at one hon³¹ beyond the river; the cannonball which was fired from the Hovorka cannon fell at one and a half hon. Then, they charged the cannons again and loaded more gunpowder than before. After the shot, both cannonballs broke into pieces, and the Pražka broke a very strong log, with which it was wedged on the back. If the cannon had not broken the log, one would have fired it for the third time. As regards the distance at which the cannonball from the Pražka went, some people said that if the cannon had been posted on the bank behind the Jewish Town, the cannonball would have gone beyond the Prague castle and the vineyards. And concerning the Hovorka, the majority of people did not experience that cannon being fired. Only some people did, but they were few, and they remembered as the cannon was fired 48 years earlier, during the siege of Roudnice³².

This record is of enormous interest for us, as it testifies to systematic exercises in shooting. At the same time, it evidently proves a well-known fact that due to enormous costs of manufacture of large cannons, cannon barrels were used yet in the 16th and the 17th c., in spite of the fact that they were not a very modern equipment at that time³³.

Another mention from the next year, i.e., 1516, informs us about exercises in shooting at a specific target: "On Tuesday after the Epiphany [8 February 1516] a long cannon was transported to the Spital Field and it was fired three times. First, with an iron cannonball and then with a stone one. – In the New Town a master gunner, a German from Nürnberg also fired a large cannon; he aimed at destroying the citadel in Strašnice. He fired twice before it and he hit the walls with the third shot. He was shooting with iron cannonballs from the lower fishpond³⁴. A considerable professionalism of the German master gunner is worth stressing here, as he already hit the defined target with the third shot.

The third record concerns shooting exercises which were carried out several months thereafter in the same place: "On St Kilian's day [8 July 1516] a German master gunner fired a long cannon in the Spital Field; he charged it

with thirty pounds of gunpowder and the cannonball went as far as the riverbank behind the bend. Then, he charged the cannon with thirty-five pounds, but the cannonball did not reach the river. One thought that the cannon was faulty and one wanted to have the cannon melted down. In the following day, however, a master gunner Petr, a miller from the bridge and a burgomaster's son Vaclav and some other men charged the cannon with seventeen pounds of gunpowder. And with the first shot the cannonball went beyond the village of Kobylisy. When the cannon was fired twice, the cannonball went up to the forest of Ládvi, and with the third shot it went above Skalka. Thereafter, only fifteen pounds of gunpowder remained and with the fourth shot the cannonball fell beyond the riverbank at the rock³⁵.

In this case, a very important piece of information is that the range of the cannon was not always influenced by increasing the gunpowder charge. Sometimes it was necessary to do the opposite and reduce the charge, so that it could completely burn in the gunpowder chamber, thus securing a proper pressure for launching the projectile.

Examples of firing at considerable distances can be found in the chronicle of Jan Długosz. Under 1433 he recorded: "When [the troops] reached the castle and the town of Tuchola, they devastated neighbouring villages and all the outskirts with fire and plundering; due to heavy fire from a large cannon from the castle of Tuchola the troops could not come close to the town and put up the camp there. It was therefore necessary for the troops to withdraw from the mentioned castle of Tuchola and they put up the camp near a lake, in a forest one mile from Tuchola. But also there stone cannonballs fired from the cannons in Tuchola reached the king's camp, which was admired by many³⁶. Polish troops reached Tuchola from the direction of Koło, having crossed the River Brda near Bydgoszcz. There were two lakes in the neighbourhood of the castle of Tuchola: on the north and the west there was a rivulet called Kicz with an artificial lake called Zamkowe (Castle Lake). On the north-east there was Lake Głębocek, which extended to the town walls in the Middle Ages³⁷. It is certain that the distance stated by the Polish chronicler is much exaggerated as 1 mile was between 6 and 8 kilometres in the Middle Ages, which was beyond the reach of any

³¹ Hon – an early unit of length being between 124 and 187 m, see *Ze starych...*, p. 496.

³² *Ze starych...*, s. 389.

³³ An example of the long period of use of the heaviest cannons is also the "Swine" (*Sau*) of Świdnica. This was the earliest Silesian cannon, which was manufactured perhaps before 1431 in Nürnberg. It was probably used for the first time at Bolków in 1468. The last mention of its use comes from 1635 when it fired a stone cannonball weighing 3 Zentener and 20 lbs, which reached the distance of 2667 steps (c. 2 km), cf. M. Goliński, *Broń palna na Śląsku do lat 30-tych XV w. oraz jej zastosowanie przy obrońie i zdobywaniu twierdz*, "Studia i Materiały do Historii Sztuki Wojennej", Vol. 31, 1989, pp. 14-15.

³⁴ *Ze starych...*, p. 400.

³⁵ *Ze starych...*, p. 403.

³⁶ Jan Długosz, *Roczniki...*, Books 11 and 12, p. 102; Joannis Długossii, *Annales...*, liber XII, p. 87, "Et dum ad castrum et opidum Tucholya pervenisset et villas propinquas atque queque suburbana incendiis et spoliis vastaret, bombarde magne ex castro Tucholya crebra percussione consistere de prope opidum et stativa illic ponere prohibitus est. Necessitate itaque compulsus, a prefato opido Tucholya discedens, castra circa lacum in borra a Tucholya uno milliari distante point. Sed et ibi quoque lapides, bombarde ex Tucholya proiecte castra regis non sine admiratione multorum attingebant". Cf. also a slightly altered translation by M. Haftka, *Zamki krzyżackie w Polsce. Szkice z dziejów*, Malbork-Płock 1999, p. 336.

³⁷ M. Haftka, *Zamki krzyżackie...*, p. 332.

cannon of that time, even the largest one. In order to calculate an approximate range of fire of the Tuchola cannon we would need to know an approximate location of the camp of the troops of Jagiełło. It is a difficult task, as we do not know near which lake the Polish troops put up their camp. Lake Zamkowe does not exist now and Lake Głę boczek is at the distance of 1-1.5 km from the medieval town centre.

The situation repeated slightly more than a month thereafter, when the Polish troops had withdrawn from besieged Gdańsk and intended to put up the camp near Tuchola again. Then, "...having reached the town of Tuchola after six stops, when the troops intended to put up the camp near the town, it was rendered impossible by heavy fire of cannons, repeated over and over again from the castle. For this reason the troops withdrew to a place situated almost half mile from the town and put up their camp there"³⁸.

Susceptibility to damage

A serious problem of both early artillery and hand-held firearms was their low durability, which caused their barrels to burst. This fault resulted from two factors. Manufacturing flaws, such as air bubbles in cast bronze barrels or low quality of forged iron barrels were common. Another issue was unskilled operation, and first of all using too powerful gunpowder charges. Already one of the first mentions of the use of firearms in the Kingdom of Bohemia, recorded in the chronicle of Bishop Jan of Jenštejn under 1383, informs us that a shooter was lethally injured while attempting at firing "a so-called gun"³⁹.

In the course of the siege of Chojnice by troops of Poland and the Prussian Union, a large cannon was used to bombard the town walls during an assault on 6 May. The cannon was transported from Tuchola and it got destroyed. A master gunner Jan was blamed for it, as he was said to add sand to gunpowder, for which he was imprisoned at the castle of Człuchów⁴⁰.

³⁸ Jan Długosz, *Roczniki...*, Books 11 and 12, p. 111; Joannis Dlugossi, *Annales...*, Liber XII, p. 96, "et at opidum Tucholya sextis stavis perveniens, dum stativa prope opidum ponere voluisset, bombardam magna crebro ex castro missa, venitus est, propter quod in locum fere medii milliarii ab opido secessit et illic castra locavit".

³⁹ *Život Jana z Jenšteina, arcybiskupa Pražského*, Fontes Rerum Bohemicarum, Vol. I, Praha 1873, pp. 467-468: "As one of them attempted at firing a so-called gun, it burst and tore his one ear off, so that he died on the following day; cf. also L. Kocourek, *Vojenská technika*, [in:] *Dějiny techniky v Československu [do konce 18. století]*, ed. L. Nový, Praha 1974, p. 314.

⁴⁰ M. Biskup, *Trzynastoletnia wojna z Zakonem Krzyżackim 1454-1466*, Warszawa 1968, p. 180; J. Szymczak, *Początki...*, pp. 252-253. Several months after that event, the accused Hans Czinkefütze sent a letter from the prison at Człuchów to the Town Council of Gdańsk. He excused himself, stating that the cannon burst was not his fault. Furthermore, he obliged to manufacture a new cannon using his own raw materials if he regained freedom, cf. B. Mozejko, *Ikonograficzne źródło do historii artylerii*

About 1431 Waclaw, Duke of Krosno, Bytnica and Świebodzin lost his life in result of a cannon explosion. According to a 16th c. record, "Wenceslao assignata fuerat Crosna et illa vicinia, sed cum in ea urbe incaute tractaret machinam bellicam, ab ea discerptus est." A doubt concerning the term "machina bellica" is clarified in the Annals of Głogów: "Dux Wentzeslaus qui fuit in Crossen et stetit juxta pixidem et fracto pixide eum interfecit et sic mortus est"⁴¹.

In one case the records inform us about the cause of the cannon burst. In 1440 a large cannon was being cast in Bratislava. The work, however, proceeded very slowly, as local founders were from the very beginning plagued with misfortune. During the first attempt on 11 May 1440, the cannon mould broke as melted metal was being poured into it and the entire procedure had to be started anew. It was begun again in mid-May, and on 7 June the cannon was ready. Mandatory shooting tests which were carried out a month thereafter resulted in the barrel burst. As it was recorded in the report on incurred expenses, the burst was caused by too thin walls of the barrel⁴².

The most detailed description of destructive power of gunpowder is provided again by a chronicler of the Old Czech Letopises when mentioning shooting exercises at the Prague greens. Under 1517 the chronicler recorded the following event: "In this year the burghers of Prague were shooting with a larger carthaun and with nine smaller field cannons from the Zlichovská Meadow to the Kavčí Mountains. When they fired the larger carthaun for the first time, the iron cannonball broke into three pieces; and when they fired the smaller cannons, one field cannon burst and a splinter hit a tailor Jiřík of Fronta behind Klíč at his neck and tore a piece of skin with flesh. And he barely survived it"⁴³.

Operation of artillery park was therefore related to real dangers⁴⁴; however, not everything depended on the master gunner who operated the cannons. Honesty and trade skills of founders or blacksmiths who manufactured the cannons were of equal significance.

w drugiej połowie XV wieku, "Kwartalnik Historii Kultury Materialnej", Vol. 48, 2000, fasc. 3-4, p. 175, footnote 18.

⁴¹ *Rocznik Głogowski*, *Scriptores Rerum Silesiacarum*, Vol. 10, ed. H. Markgraf, Breslau 1877, p. 10; M. Goliński, *Broń palna...*, p. 25.

⁴² J. Durdík, *Pracovní postupy v bratislavské puskarske huti v 1. polovinie 15. století*, "Historie a Vojenství", 1957, fasc. 3, pp. 305, 319: "Item und als man dy puxen beschoss pey dem Judenfreithoff, dy zeproch, wen sy was zu donn gossen".

⁴³ *Ze starých...*, p. 406.

⁴⁴ No doubt such incidents were not infrequent. We may add there that during the tests of a new cannon at the castle of Roxburgh in 1460 splinters of the burst barrel killed James II King of Scotland. In 1478 in Tours the explosion killed both the master gunner and the founder who cast the cannon, see A. Kiersnowski, *Historia rozwoju artylerii*, Toruń 1926, pp. 33, 34; J. Szymczak, *Początki...*, p. 91.

These records of use of gunpowder artillery in its earliest stage of development, completed with archaeological data, enable us to conclude that the use of artillery was related to numerous difficulties, which were often difficult to solve. As both the effective range and the rate of fire were low, it was difficult to achieve results which would be adequate to financial means invested in the new weapon. It was therefore quite frequent that besieged fortresses were

able to resist the siege, as it was the case of, e.g., Karlštejn in 1422-1423 or Plzeň between 1433 and 1434. It was easier to achieve success in the case of sieges of smaller premises, manned by smaller garrisons (such as Bechyně in 1428). The effectiveness depended first of all on skills and experience of employed specialists, who were able to destroy selected targets, such as posts of cannons or throwing engines, even with the use of such primitive cannons.

Streszczenie

Charakterystyka średniowiecznej artylerii w świetle przekazów pisanych z Czech i Polski.

Od samego początku istnienia broni palnej, stosowano ją na dwóch płaszczyznach – w oblężeniach oraz w bitwach w polu. Efektywności wczesnej artylerii w ostrzale obiektów umocnionych – zamków czy miast, nie można ocenić jednoznacznie. Wiele jest przykładów, informujących nas, że podczas ostrzału poczyniono duże szkody zarówno w zabudowie i mieniu mieszkańców jak i ludziach (Hradczany 1420 r., Karlštejn 1422/1423 r.). Niemniej jednak źródła zawierają informacje o bombardowaniach całkowicie nieskutecznych, pomimo zaangażowania znacznych środków (Malbork 1410 r., Pilzno 1432-1433 r.). W początkach XV stulecia w Europie środkowej podjęto też pierwsze próby zastosowania artylerii w działaniach polowych. Miało to miejsce w bitwie pod Grunwaldem, 15 lipca 1410 r., a na pierwsze takie zastosowanie nowego środka rażenia zdecydowała się strona krzyżacka. Zapiski kronikarskie dotyczące tej bitwy dowodzą słabej jeszcze skuteczności ówczesnej artylerii w nowej roli. Lepsze efekty w walce z ruchomym przeciwnikiem osiągnęli puszkarze czescy. Ówcześni kroniki dają nam świadectwo straszliwych skutków zastosowania dział przeciwko sile żywej wojsk krucjatowych, jak np. pod Ústí w 1426 r. czy koło Kutnej Hory w 1420 r.

W odniesieniu do zasięgu i celności średniowiecznych dział nie posiadamy jednoznacznych danych. Powszechnie sądzi się, że skuteczna odległość strzału wynosiła od 200 m w przypadku lżejszej artylerii jak hufnice czy targańnice, do około 500 m w przypadku większych bombard. Wydaje się że, mamy tu do czynienia z dwoma pojęciami: zasięgiem skutecznym i maksymalnym. W przypadku strzału na odległość maksymalną, trudno mówić o celowaniu. Lufę działa ustawiono pod kątem 30-45 stopni, i tak wystrzelony

pocisk mógł dolecieć naprawdę daleko, wiele jest przykładów strzelania na odległość do około 2 km.

Poważną bolączką najstarszej artylerii jak i ręcznej broni palnej była jej mała trwałość, skutkująca rozrywaniem luf. Mankament ten wynikał z dwóch czynników. Powszechnie były niedoróbki produkcyjne w postaci pęcherzy powietrza w odlewanych lufach brązowych lub słaba jakość kutych luf żelaznych. Drugim była nieumiejętna obsługa, a przede wszystkim aplikowanie do komory zbyt silnych ładunków prochowych. Już jedna z pierwszych wzmianek o użytkowaniu broni ogniowej w Królestwie Czeskim, zawarta w kronice biskupa Jana z Jenšteina, pod rokiem 1383 informuje nas, że strzelec chcąc wystrzelić z puszkki odniósł śmiertelne obrażenia w wyniku rozerwania lufy. Ofiarami nieumiejętnego obchodzenia się z bronią Roxburgh w 1460 r. odłamki z rozerwanej lufy zabiły króla Szkocji Jakuba II byli nie tylko puszkarze, ale i często głowy koronowane przyglądające się odpalaniu dział. Tak zginęli m. in. Waclaw, książę na Krośnie, Bytnicy i Świebodzinie oraz król Szkocji Jakub II.

Opisy zastosowania artylerii ogniowej w jej najstarszym stadium rozwoju, uzupełnione o dane archeologiczne, pozwalają stwierdzić, że jej użycie nastroczało jeszcze wielu, często trudnych do rozwiązania problemów. Przy skromnym zasięgu skutecznego strzału i równie małej szybkostrzelności, trudno było uzyskać efekty adekwatne do zainwestowanych w nową broń środków finansowych. Skuteczność zależała przede wszystkim od umiejętności i doświadczenia zatrudnionych specjalistów, którzy nawet przy tak prymitywnych działach potrafili niszczyć wybrane cele jak stanowiska dział czy machin miotających.