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GRZEGORZ ŻABIŃSKI

THE *GROSE BOCHSE* – A TEUTONIC SUPERGUN FROM 1408

Introduction

Von eynir grosin bochsin. Ouch wart czu Marienburg gegoszin eyne grosze buchsze in desim zomir [1408] *von czwen stuckin, der gliche nicht was von grose yn allin Dutschin landing, noch czu Polan, noch czu Ungern*[1] – "On a large cannon. Moreover, a large cannon of two parts was cast at Malbork/Marienburg in this Summer (1408). There was no cannon of equal size in all the German lands, or in Poland, or in Hungary." In this way the continuator of the chronicle of Johann von Posilge reported on the casting of an enormously large cannon at the capital castle of the Teutonic Order at the eve of the war with Poland and Lithuania (1409-1411). This impressive example of late medieval heavy artillery has already been paid a lot of attention in previous scholarship[2]. Based on the account book of the Teutonic treasurer (*Tresslerbuch)* from the early 15th c., it is possible to say more about the manufacture process of the cannon itself, as well as necessary utensils[3]. Furthermore, entries from 1409 shed light on the field use of the cannon at the early stage of hostilities against Poland.

Manufacture process

The very first record (May 1408) concerns a payment of 2 Marks to brethren-knight Johann of Dzierzgoń/Christburg, who was supposed to supervise the casting process.[4] On 14 May he was given 5 Vierd for 1 stone (13.77 kg, according to Gdańsk/Danzig measures) of wax with regard to the casting[5]. Johann was mentioned for the next time on 4 November 1408, when he was travelling for the first time for the cannon (*der zum irsten vor dy grose bochse ryt*). He was paid 10 Marks on this occasion[6]. This record also implies that the very process of casting was completed. In 1408, one more entry concerning payment of raw materials for the barrel was recorded (between 1 and 20 November)[7], but it may have related to a later payment for a earlier supply[8]. Therefore, Johann was in all probability supposed to carry out an examination of the newly cast barrel and possibly supervise further works.

It is difficult to say who exactly Johann was – V. Schmidtchen assumed that he was identical with Johann von Rumpenheym, Commander of Elbląg/Elbing in 1339-1404[9]. Unsurprisingly for a late medieval artillery specialist, he also operated cannons in the field (in 1409, possibly in September, he was paid 2 Marks with regard to that)[10].

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[1] J. Posilge, *Johanns von Posilge, Officials von Pomesanien, Chronik des Landes Preussen (von 1360 an, fortgesetzt bis 1419) zugleich mit des auf Preussen bezuglichen Abschnitten aus der Chronik Detmar's von Beck*, [in:] *Scriptores rerum Prussicarum* 3, ed. E. Strehlke, Leipzig 1866, p. 292.

[2] B. Rathgen, *Die Pulverwaffe im Deutschordensstaate von 1362 bis 1450*, Elbinger Jahrbuch, Vol. 2, 1922, pp. 37-38, 43-48; V. Schmidtchen, *Die Feuerwaffen des Deutschen Ritterordens bis zur Schlacht bei Tannenberg 1410: Bestände, Funktion und Kosten, dargestellt anhand der Wirtschaftsbücher des Ordens von 1374 bis 1410*, Lüneburg 1977, pp. 46, 56-59, 64; W. Świętosławski, *Koszty broni palnej i jej użycia w państwie krzyżackim w Prusach na początku XV wieku*., „Studia i Materiały do Historii Wojskowości", Vol. 35, 1993, p. 28; A. Nowakowski, *Źródła zaopatrzenia w uzbrojenie wojsk krzyżackich w Prusach w XIV-XV w.*", [in:] *Pamiętnik XIV Powszechnego Zjazdu Historyków Polskich*, Vol. 2, Toruń 1994, p. 334; J. Szymczak, *Początki broni palnej w Polsce 1383-1533*, Łódź 2004, p. 108, 185; A. R. Chodyński, *Bombarda krzyżacka z Kurzętnika*, [in:] *Imagines potestatis. Insygnia i znaki władzy w Królestwie Polskim i Zakonie Niemieckim. Katalog wystawy w Muzeum Zamkowym w Malborku 8 czerwca – 30 września 2007 roku*, ed. J. Trupinda, Malbork 2007, p. 389; S. Jóźwiak, K. Kwiatkowski, A. Szweda, S. Szybkowski, *Wojna Polski i Litwy z Zakonem Krzyżackim w latach 1409-1411*, Malbork 2010, p. 101; P. Strzyż, *Średniowieczna broń palna w Polsce. Studium archeologiczne*, Łódź 2011, p. 38.

[3] For the purpose of price calculation, the following system was used: currency: 1 *Mark* = 4 *Vierdung* (*Vierd*) = 24 *Scot* = 720 *Denars* (*Den*) With regard to measures of weight, the system is based on Schmidtchen, *op. cit*., passsim, and the author's own examinations of source data. Its accuracy must be treated with care, which obviously refers to figures calculated in this paper. Weight: 1 *Last* = 12 *Schiffspfund* = 3 *Zentener* = 20 *Lispfund* = 360 *Pfund* (*Markpfund*) = 400 *Krompfund;* 1 *Stein* (in Gdańsk/Danzig) = 34 *Pfund* = 13.77 kg; 1 *Pfund* = 0.405 kg

[4] *Das Marienburger Tresslerbuch der Jahre 1399-1409* [henceforth as: MTB], ed. E. Joachim, Königsberg 1896, p. 479.

[5] *Ibidem*, p. 483.

[6] *Ibidem*, p. 510.

[7] *Ibidem*, p. 511.

[8] Cf. *ibidem*, p. 507.

[9] V. Schmidtchen, *op. cit*., p. 46, cf. A. Nowakowski, *Źródła…*, p. 334.

[10] MTB, p. 587, cf. *ibidem*, p. 574; for other master gunners employed by the Order see *ibidem*, pp. 245, 248, 250, 259, 311, 384, 511, 553-554, 558, 572-574, 576, 578, 583, 588, 587-589, 591,

Table 1. Raw materials used for casting of the large cannon in 1408								
Raw material	*Schiffspfund*	*Zentener*	*Stein*	*Lispfund*	*(Mark) Pfund*	*Krompfund*	Total Kg	Source (MTB)
Copper		243			119		11857.995	480, 501, 506
Tin	9	2		18	3	2	1542.565	480, 501, 507, 511
Lead		2			48		116.64	506
Wax			2				27.54	483, 496, 502
Total weight (excluding wax) **13517.2 kg**								

The first issue is the amount and kind of raw material used for the casting process. Based on preserved entries, it may be reconstructed in the following manner: tab. 1.

This figure needs not be an exact one, as some raw material may have been lost in the casting process. Furthermore, a repeated casting of the cannon chase (*vorder ende*) was recorded in September 1409 and 38 *Zentener* and 22 *Pfund* of copper (1855.71 kg) was bought for this purpose[11]. There is also another mention of a repeated casting of the gunpowder chamber (*hinderteil*) which is perhaps also related to the large cannon. For this purpose, 0.5 *Stein* of wax was bought (July 1408)[12]. Interestingly, no purchase of metal was mentioned on the other occasion, which strongly suggests that the material was reused. V. Schmidtchen rightfully stresses the fact that the repeated casting speaks of the complicatedness of the process. Furthermore, these mentions confirm the chronicle's information that the cannon had a detachable gunpowder chamber[13].

Therefore, it seems that the most convenient analogy is offered by a Turkish bronze cast cannon, dated to 1464 and known as the "Bombard of Muhammad." In this case, the gunpowder chamber and the chase were screwed together. The length of the cannon is is 5.2 m and its bore diameter is 63 cm, with an approximate weight of a stone projectile being c. 300 kg. The total weight of the cannon is 17.070 t (now in the collection of the Tower of London)[14] (Fig. 1).

Concerning other examples of contemporary superguns, one could mention such examples as the "Dulle Griet" of Ghent (wrought iron; calibre 640 mm; length over

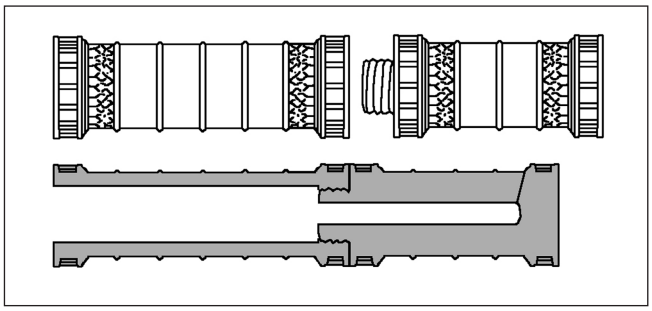

Fig. 1. Bombard from the Tower of London, the so-called "Bombard of Muhammad," 1464. Drawing G. Żabiński, after Żygulski jr, *Broń…*, p. 123, Fig. 65e-f.

5 m; weight 16.4 t; cannonball weight 340 kg), the "Swine" of Świdnica/Schweidnitz from c. 1467 (calibre c. 500 mm; weight c. 8.5 t); the "Mons Meg" of Edinburgh from 1449 (wrought iron; weight c. 6 t)[15]; the early 15th c. Austrian "Großer Pumhart von Steyr" (wrought iron; weight c. 8 t)[16]; or the "Feule Mette zu Braunschweig" from 1411 (cast-bronze; weight c. 8.75 t)[17]. It seems therefore that there is no exaggeration in the words of the chronicler that no cannon of equal size could be found in the neighbouring lands.

The *Grose Bochse* was not the only large cannon cast at Malbork/Marienburg. In the following year, a cannon referred to as *bochse nest der grosten* or the second largest cannon was cast[18]. Its weight can roughly be estimated at c. 4.6 t and the cost of casting was around 290 Marks[19]. It is assumed that it was that cannon that was lent in 1413 by Grand Master Heinrich von Plauen to Friedrich Burggrave of Nürnberg, the administrator of the Mark of Brandenburg since 1412. The cannon, used by Friedrich to suppress the local opposition, was much later known as the "Faule Grete"[20].

as well as Schmidtchen, *op. cit.*, pp. 47, 58, 60-61; A. Nowakowski, *O wojskach Zakonu Szpitala Najświętszej Marii Panny Domu Niemieckiego w Jerozolimie zwanego krzyżackim*, Olsztyn 1988, p. 91; idem, *Źródła…*, p. 335; J. Szymczak, *op. cit.*, p. 140; in 1409, a brethren-knight Kulman was mentioned with regard to gunpowder manufacture, MTB, p. 587.

[11] MTB, p. 506.

[12] *Ibidem*, p. 496.

[13] On the casting process see B. Rathgen, *Die Pulverwaffe…*, pp. 37-38, 43-48; V. Schmidtchen, *op. cit.*, pp. 56-59; J. Szymczak, *op. cit.*, p. 180.

[14] A. R. Williams, A. J. R. Paterson, *A Turkish bronze cannon in the Tower of London*, „Gladius", Vol. 17, 1986, pp. 185-205; Z. Żygulski jun., *Broń w dawnej Polsce na tle uzbrojenia Europy i Bliskiego Wschodu*, Warszawa 1975, p. 123, Fig. 65e-f.

[15] H. Müller, *Deutsche Bronzegeschützrohre 1400-1750*, Berlin 1968, p. 28; D. Goetz, *Die Anfänge der Artillerie*, Berlin 1985, pp. 26, 48; J. Szymczak, *op. cit.*, pp. 63, 81, 108.

[16] V. Schmidtchen, *op. cit.*, p. 10, Fig. 1.

[17] H. Müller, *op. cit.*, p. 28; V. Schmidtchen, *op. cit.*, p. 13, Fig. 3.

[18] MTB, pp. 557-558, 574, 577, 597.

[19] V. Schmidtchen, *op. cit.*, p. 59-60, 77.

[20] B. Rathgen, *Die Faule Grete*, „Elbinger Jahrbuch", Vol. 4, pp. 45-76.

Concerning the raw material, some words should also be said about the sources of supply. On 4 May 1408, a purchase of 64 *Zentener* and 40 *Pfund* (3126.6 kg in total) of copper was recorded, with a mention that it came from Banská Bystrica/Neusohl in Upper Hungary (today: Slovakia). Furthermore, 2 *Schiffspfund*, 7 *Lispfund* and 2 *Krompfund* (343.36 kg) of tin was mentioned. All this was brought from Gdańsk/Danzig to Malbork/Marienburg[21]. On 29 June, a purchase of 34.5 *Zentener* and 24 *Pfund* (1686.42 kg in total) of copper and 1.5 *Schiffspfund*, 4 *Lispfund* and 4 *Markpfund* (249.48 kg in total) of tin was mentioned. The place of purchase was not named, although it was said that the material had been transported by ship[22]. The reference to the transport from Gdańsk/Danzig is also given for the next purchase of 44.5 *Zentener* and 12 *Pfund* (2167.56 kg in total) of copper and 1.5 *Schiffspfund*, 5 *Lispfund* and 4 *Markpfund* (256.77 kg in total) of tin, which was paid for on 23 June[23]. The same concerned another purchase of 61.5 *Zentener*, 4 *Lispfund* and 9 *Markpfund* (3021.705 kg) of copper and 4 *Schiffspfund*, 1.5 *Lispfund* and 4 *Markpfund* (595.755 kg) of tin (20 August)[24]. Gdańsk/Danzig was also the place of purchase of 38 *Zentener* and 22 *Pfund* (1855.71 kg) of copper for the repeated casting of the chase, as well as of 2 *Zentener* and 48 *Pfund* (116.64 kg) of lead (29 September)[25]. On the other hand, 2 *Zentener* (97.2 kg) of tin were bought locally in Malbork/Marienburg (31 October)[26].

Data on the quantities of raw material also allow for an approximate estimation of the chemical composition of the cannon. The total weight of 13517.2 kg with 11857.995 kg of copper, 1542.565 kg of tin and 116.46 kg of lead gives 87.7% Cu, 11.4% Sn and 0.9% Pb. With regard to lead, however, it must be borne in mind that it was mentioned only once, together with the repeated casting of the chase. It seems rather obvious that the amount of copper that was bought for that purpose (1855.71 kg) is not representative for the weight of the chase as a whole, which must have been much greater. On the other hand, lead may have been used as an additive for this part of the cannon only, perhaps in order to provide it with more elasticity. V. Schmidtchen, however, says with right that this would have a rather adverse effect[27]. If one assumes that the weight of the chase was more or less equal to the weight of the gunpowder chamber (as in the case of the "Bombard of Muhammad" – breech weight 8492 kg, barrel weight 8128 kg[28]), one receives c. 6750 kg for the chase. This would mean a rather high proportion of lead, being more than 1.7 % Pb.

A. R. Williams and A. J. R. Paterson provided insightful data on the chemical composition of the Turkish supergun. They mention later evidence from 1522-1526, concerning the casting of guns at the Tōpḫāne (gun-foundry) in Galata, the suburb of Constantinople. Based on the proportion of copper and tin in the supplies to the foundry, it can be said that the metal used for gun casting was supposed to contain about 11% tin[29]. This is to a great degree similar to the proportions in the case of the Teutonic large cannon.

Furthermore, the 19th c. analysis of the Tower cannon (based on surface samples from each end) demonstrated varying proportions of tin (from 4.8% to 10.1%). Roughly similar results were received for 18 Austrian 16th bronze guns (between 3.4% and 10.5%, with an average of 7.3% tin)[30]. A. R. Williams and A. J. R. Paterson state with right that it is impossible to assess the overall composition of a cast heterogeneous object, as various chemical elements will melt and solidify at different temperatures, thus becoming segregated. Anyway, they proposed that as the α phase of metal in most samples contains c. 8% Sn, the average composition may be close to the afore-mentioned 11% ratio[31]. A similar ratio of c. 90% Cu and c. 10% Sn for medieval cannons was also given by M. Dąbrowska[32] and V. Schmidtchen[33].

Hardly anything can be said about the way of casting of the Teutonic large cannon. The account of Kritoboulos from 1467, concerning the casting of huge cannons by the Turks on the spot of the siege of Constantinople in 1453, states that a cylindrical core was made of clay and linen. Then, a mould or an "exterior shape" was made of the same components. It was large enough to accommodate the core and leave some empty space between the two. The empty space, corresponding to the shape of the cannon, was supposed to receive the cast metal. For the sake of strengthening, the "exterior shape" was "surrounded with iron, timber, earth and stones." Then, two furnaces were erected at each end (of the "exterior shape"), from which the bronze was to be poured into the mould[34].

Another method, also known as "slow forming," was discussed by J. Szymczak and M. Dąbrowska, based on 18th-19th c. military manuals. When the core (also called false or counterfeit model of the barrel) was prepared, one made models of holders, ornaments and inscriptions, using wax, fat and charcoal and placing them in proper places of the core (the false model). Then, a mould was formed around the core. The mould consisted of layers of clay mixed with horse dung and cow fur. Eventually, the mould was fitted with rims and metal sheets in order to reinforce it. The mould

[21] MTB, p. 480.
[22] *Ibidem*, p. 480.
[23] *Ibidem*, p. 480.
[24] *Ibidem*, p. 501.
[25] *Ibidem*, p. 506.
[26] *Ibidem*, pp. 507, 511; on purchases of raw materials see also V. Schmidtchen, *op. cit.*, pp. 56-59.
[27] *Ibidem*, p. 59.
[28] A.R. Williams, A.J.R. Paterson, *op. cit.*, p. 185.
[29] *Ibidem*, p. 187.
[30] *Ibidem*, p. 190.
[31] *Ibidem*, pp. 190-194.
[32] M. Dąbrowska, *Proces odlewania dział w lejni malborskiej w XV wieku*, „Archaeologia Historica Polona", Vol. 18, p. 36
[33] V. Schmidtchen, *op. cit.*, pp. 52-53.
[34] A.R.Williams, A.J.R. Paterson, *op. cit.*, pp. 186-187.

Table 2. Costs of casting of the large cannon in 1408					
Raw material	*Mark*	*Vierd*	*Scot*	*Den*	Source (MTB)
Copper	629.5		1		480, 501, 506
Tin	121		4	2	480, 501, 507, 511
Lead	1.5		2		506
Wax	2.5				483, 496, 502
Weighing and transport	10.5		5	20	480, 501, 506, 511
Supervision	12				479, 510
Total cost **779.5 Marks 1 Scot**					

was then fired. What was different from the previously depicted process was the fact that the clay of the core (the false model) was removed from inside. In place of it, an iron rod was then placed and fixed inside of the mould for the sake of securing a precisely vertical direction of casting. It was wrapped with a rope, so that it did not melt together with the barrel. Hot bronze was then poured into the mould. After the cast had cooled down, the mould was broken into pieces and the iron rod was removed. The barrel was then drilled to receive a bore of desired diameter. Eventually, it was cleaned and polished, and the touch hole was drilled[35].

As no mentions of drilling can be found in the account books with regard to the casting of the large cannon, it may be assumed that it was rather the first method that was used. Furthermore, a rather small amount of used wax is significant (merely 2 *Stein* or 27.54 kg). It strongly suggests that wax was only used to make models of holders, ornaments etc., and not the entire shape of the cannon, unlike in the lost-wax (*cire-perdue*) process. On the other hand, as considerable amounts of wax were purchased by the Order for gun casting at that time, the lost-wax process may have been used for that purpose in the early 15th c., perhaps with regard to smaller guns[36].

Concerning the casting itself, a question concerning its costs naturally emerges. These can be summarised in the following manner: tab. 2.

This sum may be compared with the total expenses of the Order's treasurer in 1408, which were 25800 Marks[37], including roughly 1791 Marks for firearms[38]. It is therefore evident that the casting cost of the large cannon amounted to nearly half of the expenses for that purpose. Based on data on prices provided by V. Schmidtchen[39], it can be said that the cost of casting rougly equalled the price of 25.5 *Faß* (large barrels) of wine, 52 good geldrings, or 223 pairs of oxen. Furthermore, for that sum of money one could purchase 390 medium calibre iron guns[40].

The casting did not end the manufacture process. Further entries concern the making of a wooden stand or trestle, wagon wheels and the wagon itself, shutters, ropes, stoppers used to secure the charge, utensils, etc. As some of these were recorded already in 1409, where the large cannon was in operation during the hostilities, it cannot be certainly said which entries concern first-time manufacture of necessary hardware, and which ones refer to repairs and maintenance. Furthermore, it cannot be always said with certainty whether a given entry refers to the cannon in question or to another large gun possessed by the Order at that time. Finally, some expenses were calculated jointly with expenses for other purposes. For the sake of brevity, these expenses are summarised in a table (tab. 3).

Some important details may be inferred from these data. It is obvious that a significant amount of ropes and straps was necessary to properly secure and operate the cannon. The mention of the stand or trestle may imply that the cannon was supposed to be operated on an immobile wooden bed. As the stand was to be provided with pulleys or drums, one could suppose the existence of some system of moving the gunpowder chamber forwards and backwards for the purpose of charging it with gunpowder and then securing to the chase. Naturally, a wagon was needed to transport the cannon. One could naturally assume that due to the weight of the cannon its both parts were transported separately and the same was perhaps true for the stand[41]. Interestingly, the wagon was provided with shutters (Fig. 2.).

Projectiles and propellant charge

The account books also contain data on manufacture of projectiles for the large cannon and their costs. Again, it cannot be said with absolute certainty whether all these

[35] Szymczak, *op. cit.*, pp. 89-91; see also Müller, *op. cit.*, pp. 21-32; M. Dąbrowska, *op. cit.*, pp. 28-32, based on a late 18th c. *Nauka Artyleryi*, Warszawa 1781 manual by J. Jakubowski).

[36] V. Schmidtchen, *op. cit.*, pp. 52-53; M. Dąbrowska, *op. cit.*, p. 33; for wax purchases see MTB, pp. 483, 496, 502, 545, 547, 558.

[37] *Ibidem*, p. 515.

[38] *Ibidem*, pp. 464, 470, 474, 478-479, 480, 482-483, 487-488, 493, 495-497, 500-502, 506-507, 510-511, 514-515.

[39] V. Schmidtchen, *op. cit.*, pp. 76-77.

[40] MTB, p. 119; Schmidtchen, *op. cit.*, p. 62; W. Świętosławski, *op. cit.*, p. 22.

[41] On the issues of transport of artillery see J. Szymczak, *op. cit.*, pp. 213-230.

Table 3. Other manufacturing costs of the large cannon in 1408 and 1409					
Date and purpose	*Mark*	*Vierd*	*Scot*	*Den*	Source (MTB)
1 – 20 November 1408 For harness (*gezoume*) for the large cannon, paid to a rope-maker (*seyler*)		3			511
17 December 1408 For 12 large rivets (*clinkennagel*) and 24 small nails (*cleyne nagel*) for a stand or trestle (*bock*) for the large cannon, paid to the smith Swenkenfeld		1			515
August 1409, at the eve of the expedition to the land of Dobrzyń For 4 wheels (*rade*) for the large cannon wagon (*groser bochsenwayn*)			16		555
August 1409 For casting of 12 red brass pulleys or drums (*erynne schywen*) for the stand or trestle (*bock*) for the large cannon	7.5		7		558
4 August 1409 For large wheels (*grose rade*) for the cannon wagon	1				559
September 1409 For 4 large cannon wheels (*grose bochsenrade*) and 1 wheel for a cannon wheelbarrow (*bochsenkarre*), paid to the wheelwright Hannos Hoffeman		3			562
August-September 1409 For 5 ladles (*ladeleffel*) for the large cannon, 4 hammers (*hamer*) 1 carpenter's knife (*snetemesser*), 1 pair of farrier's pincers (*hufzange*), and 1 file (*fyle*), paid to the smith Jauwernig, all this taken by Dumechen [Heinrich, a renowned Prussian bell-founder and master gunner]	1				573
August-September 1409 For fitting 23 gun stoppers (*proppe*) for the large cannon with rings (*rinken*) on both ends	1		3	18	573
August-September 1409 For 21 gun stoppers (*proppe*) for the large cannon			8		573
August-September 1409 For 4 ropes (*lynen*) made of 12 *Stein* of hemp (*hanf*) for the large cannon, paid to a rope-maker (*seyler*)	3	1			574
August-September 1409 For 4 short straps (*korze stroppen*) to secure the large cannon (*do mete man dy grose bochse zu samne spennet*), paid to a rope-maker (*seyler*)	1				574
August-September 1409 For 4 straps (*stroppen*) for the large cannon, paid to a rope-maker (*seyler*)	1				574
September 1409 For making 1 wagon (*wayn*) for the large cannon	2				577
7 September 1409 For fitting a gun on the wheelbarrow and for movable shutters for the large cannon cart (*luse lonen zum grosen bochsenwayne*), paid to the smith Swenkenfeld	1		1	6	579
3 November 1409 For 5 gun stoppers (*proppe*) for the large gun			1	10	589
3 November 1409 For fitting 5 large gun stoppers (*grose proppe*) with rings (*rinken*) on both ends		1			589
December 1409 For fitting the large cannon with iron (*dy groste bochse zu beslon*)	1.5				597
December 1409 For a metal sheet (*blech*) for the ladle (*ladeleffel*) for the large cannon			2		597
Total cost **23 Marks 3 Scot 4 Den**					

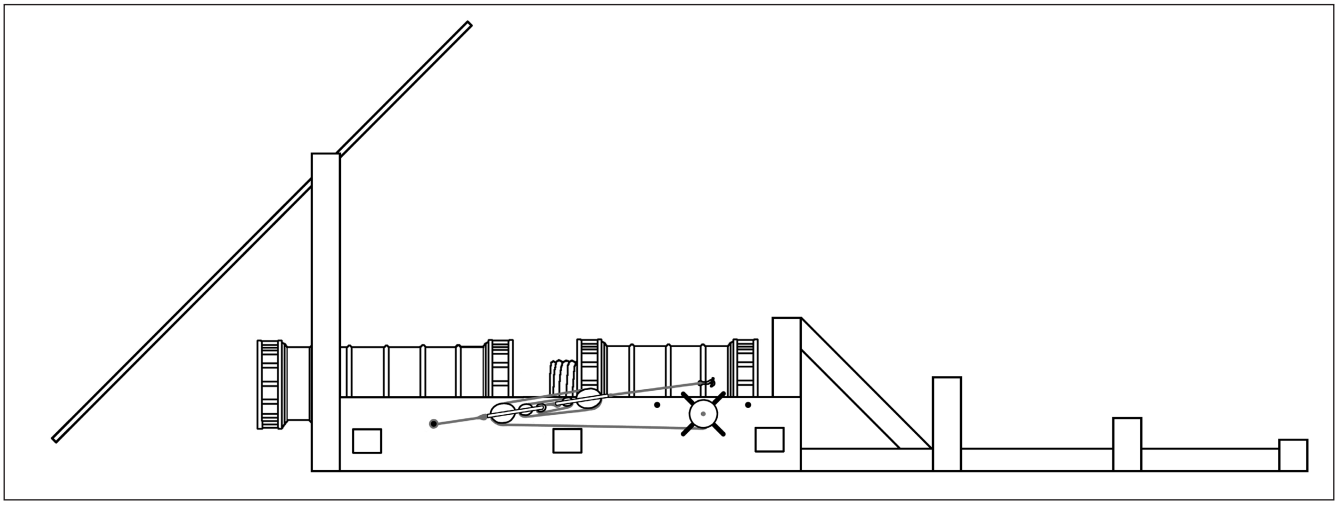

Fig. 2. Tentative reconstruction of the Teutonic Grose Bochse. Drawing G. Żabiński.

records refer to the cannon in question. The total price calculation must be therefore treated as maximum (tab. 4).

What is conspicuous is a considerable price difference between the stone cannonball made in July 1408 (2 Marks 8 Scot) and the projectiles made in November 1408 and March-April 1409 (1 Mark 3 Scot). In the last case, their relation to the large cannon is additionally implied by an entry from December 1409, stating that 14 stone cannonballs for the largest cannon (*steyne zur grosten bochsen*) were transported from Elbląg/Elbing to Brodnica/Strassburg[42].This may imply a sea transport from Polessk/Labiau to Elbląg/Elbing and then to the border region. Perhaps the first item was an "experimental one", demanding new tools and measuring equipment. This would not be suprising, bearing in mind that a cannon of than calibre was no question an unusual weapon.

It is considerably difficult to estimate an approximate weight of projectiles for the Teutonic supergun. As mentioned, the bore diameter of the "Bombard of Muhammad" is 63 cm and the weight of its projectiles was around 300 kg[43]. As the Teutonic large cannon was somehow smaller, one could assume a putative calibre of c. 50 cm and thus propose the weight of a granite projectile being c. 180 kg. The Castle Museum of Malbork holds a collection of stone cannonballs, with the diameters of some of them being between 47 and 56 cm and the weight oscillating between 146.8 and over 155 kg. It could therefore be assumed that these projectiles were supposed to be used for the cannon in question[44]. Furthermore, in 1403 1 Scot was paid for a stone cannonball which was as large as a head (*also gros als eyn houpt*)[45]. Assuming a diameter of

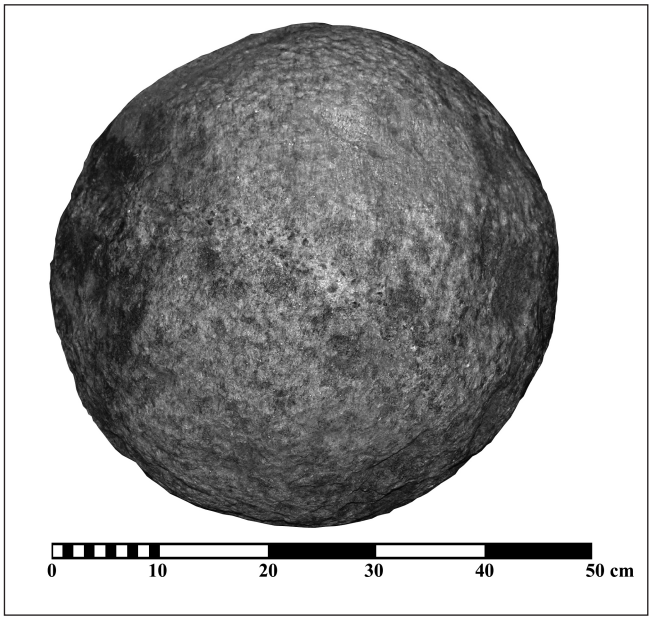

Fig. 3. Stone cannonball from the collection of the Castle Museum in Malbork, MZM/KA/149. Diameter 47 cm, weight 156.4 kg. Photo G. Żabiński.

c. 16-17 cm, one receives an approximate weight of about 6-7 kg. The stone cannonballs for the large cannon were 27 times more expensive (1 Mark 3 Scot = 27 Scot); therefore, if one assumes a simple relation between the weight and the price, one receives a putative weight between about 160 and 190 kg. This roughly corresponds to the afore-mentioned data (Fig. 3).

The weight of the projectile naturally determines the weight of the propellant charge. A proportion of 1 : 19 is sometimes stated[46]. The charge for the "Mons Meg", which launched 340 kg balls, was estimated at 38 kg, i.e., the proportion was c. 1 : 10[47]. J. Szymczak rightfully states that

[42] MTB, p. 591.

[43] A.R. Williams, A.J.R.Paterson, *op. cit.*, pp. 185-196.

[44] P. Strzyż, *op. cit.*, pp. 38, 160, 165, catalogue, Table 3, Nos. 440, 441, 451, 584-588

[45] MTB, p. 212; see also B. Rathgen, *Die Pulverwaffe...*, p. 41; V. Schmidtchen, *op. cit.*, p. 75.

[46] *Ibidem*, p. 14; J. Szymczak, *op. cit.*, p. 163.

[47] B. Rathgen, *Die Faule Grete...*, p. 52.

Table 4. Projectiles for the large cannon in 1408 and 1409					
Date and purpose	*Mark*	*Vierd*	*Scot*	*Den*	Source (MTB)
July 1408 For 12 picks (*bicken*) for cutting large stone cannonballs (*grosse bochsensteyne*)	3				497
July 1408 For making a measure (*kromme holze zu machen noch zirkelmose*) for cutting large stone cannonballs (*grose bochsensteyne*), paid to a carpenter			4		497
July 1408 For cutting 1 large stone cannonball (*grosser bochsensteyn*), paid to the stone-cutter (*steynhauwer*) Belgart and his apprentice (*geselle*)	2		8		496, 497
November 1408 For cutting 1 stone cannonball (*steyn*) for the large cannon (*zu grossen bochse*), paid to the stone-cutter Hannos	1		3		511
March-April 1409 For cutting 16 large stone cannonballs (*grose bochsensteyne*) in Labiau/Polessk, 1 Mark 3 Scot per item	18				532
Total cost **24.5 Marks 3 Scot**					

the propellant charge weight could also depent on the type of firearms and sort of gunpowder. For large cannons, which launched projectiles of 150-200 kg, the proportion could be even 1:3 or 1:1.5[48]. This would mean that the propellant charge may have been even 50-120 kg. As the prices of manufacture gunpowder at that time were roughly 4 Scot per *Stein* (13.77 kg)[49], the cost of manufacture of the propellant charge may have been between c. 0.5 Mark 2 Scot and c. 1.5 Mark 10 Scot, giving 1 Mark on average. If ready gunpowder was bought, its price was naturally much higher, being about 2.5 Marks 8 Scot per *Stein*[50].

The cost of use of the large cannon (assuming the use of purchased gunpowder) can therefore be assessed in the following way:

- stone cannonball – 1 Mark 3 Scot
- propellant charge – 17,5 Marks
- wooden stopper – 8 Den
- stopper's fittings – 36 Den

Altogether about 18,5 Marks 4 Scot 14 Den[51]

Field use and transport

As it is known, the war was declared on 6 August 1409 by Grand Master Ulrich von Jüngingen. The main Teutonic forces concentrated in Brodnica/Strassburg in mid-August and on 16 August the Teutonic troops invaded the land of Dobrzyń, proceeding through Rypin and Lipno. Two days later, on 18 August, the castle of Dobrzyń was captured. On 20 August, the castle of Bobrowniki was besieged and bombarded with heavy artillery, which made the garrison surrender after a couple of days (possibly on 28 August). On 29 August the Teutonic troops surrounded the castle of Złotoria, which was assaulted and captured on 2 September. The newly seized land of Dobrzyń was organised as a reveeship (*Voigtei*) with the administrative centre in Bobrowniki. At the same time (mid-August), another Teutonic attack was launched on Cuiavia, with the castle and town of Bygdoszcz having been captured on 28 August[52]. This fortress, however, was soon re-captured in result of the Polish counter-offensive at the turn of September and October. On 8 October 1409 a truce was made[53]. The land of Dobrzyń, however, remained in the hands of the Order until the second half of July 1410[54]. The Franciscan annals of Toruń/Thorn mentioned the participation of *magnae pixides*[55], which implies that the Teutonic supergun was not the only large cannon that was taken for the expedition. Significantly, the continuator of Posilge states that the castle of Bobrowniki was bombarded mit *der gar groszin buchszin und andern geczouyn und geschos*[56], which may imply that the large cannon in question was used there. Nothing, however, is said with regard to that in the case of Złotoria.

Based on the account book, some words may be said concerning the cost of transport of the Teutonic supergun

[48] J. Szymczak, *op. cit.*, pp. 134-135, 143, 163-164, Table 10.
[49] MTB, pp. 172, 287, 446.
[50] MTB, p. 525; B. Rathgen, *Die Pulverwaffe...*, pp. 83-86.
[51] J. Szymczak, *op. cit.,* p. 164, gives similar results.
[52] S. Jóźwiak, K. Kwiatkowski, A. Szweda, S. Szybkowski, *op. cit.*, pp. 92, 118-127.
[53] *Ibidem*, pp. 136-143.
[54] *Ibidem*, p. 159.
[55] *Franciscani Thorunensis Annales Prussici (941-1410)*, [in:] *Scriptores rerum Prussicarum* 3, ed. E. Strehlke, Leipzig 1866, p. 301.
[56] J. Posilge, *op. cit*., p. 301.

Table 5. Transport costs of the large cannon and its projectiles in 1409					
Date and purpose	*Mark*	*Vierd*	*Scot*	*Den*	Source (MTB)
August 1409, expenses for the expedition to the land of Dobrzyń Transport of 2 large stone cannonballs (*grose boch-sensteyne*) to Grudziądz/Graudenz	2		2		579
November 1409, expenses for the expedition to the land of Dobrzyń Transport of 8 large stone cannonballs (*grose bochsensteyne*) to Bobrowniki (Poland), paid to the Commander of Golub/Gollub	8				576
As above For transport servants (*karwansknechte*) who transported the large cannon	0.5				577
As above For 4 wagoners (*furluten*) with 8 horses, who transported the cannon from Brodnica/Strassburg for 15 days	7.5				577
As above For the transport of 14 large stone cannonballs (*grose bochsensteyne*) from Brodnica/Strassburg to Golub/Gollub, 4 horses for each cannonball	2.5				577
As above For unloading the large cannon (*grose bochse*) from the ship, paid to carpenters			8		577
As above For the Commander of Grudziądz/Graudenz for the trans-port of 2 large stone cannonballs (*grose bochsensteyne*)			10		578
December 1409 For the transport of 14 stone cannonballs (*steyne*) from Elbing/Elbląg to Brodnica/Strassburg, paid to brethren-knight Lewe, the garden master of Elbląg/Elbing	14				591
Total cost **35 Marks 8 Den**					

and its projectiles. Naturally, the afore-mentioned reservations are also valid here. Furthermore, payment dates need not exactly match event dates, as some payments were made with a considerable delay. Anyway, it seems possible to somehow relate the entries to what is known on the Teutonic campaign of August 1409 (tab. 5).

What is first of all striking is a relatively low number of horses (merely 8, which gives a load of nearly 1.7 t per horse) used to transport the cannon from Brodnica/Strassburg. This is especially astonishing as the account book states much different data concerning the transport of stone projectiles from Brodnica/Strassburg to Golub/Gollub, where 4 horses were used to transport 1 projectile (which might have weighed, as stated above, between 160 and 190 kg). Of course, it cannot be excluded that some locally paid means of transport were also used. J. Szymczak states that a team of 12 horses was necessary to transport a 2.5 t cannon, while each wagon with its projectiles was pulled by 4 horses. In 1467, a team of 20 horses was used to transport a c. 4 t. cannon, and the distance of 65 km was made in 3 days.[57] Based on mid-16th data, this author states that 33 horses were needed for a wagon with a 6.5 t cannon[58]. Such a huge load of 1.7 t per horse could be physically possible, but for an extremely short distance only. Therefore, it would be absolutely impractical. The transport took 15 days, which may be easily related to the period within which the Teutonic troops set off from Brodnica/Strassburg and captured Bobrowniki and Złotoria. If the large cannon was sent directly to Bobrowniki from Brodnica/Strassburg, the shortest possible distance by land is about 60 km, and it was to be made within 4 days, assuming that the large cannon was present at Bobrowniki from the beginning of the siege. Therefore, it can be supposed that the supergun must have been transported by water, and the horses were used to transport the cannon from the vessel to its position. The low number of horses could mean that the team of 8 horses transported each part of the cannon, its stand and other hardware separately. Water transport is anyway implied by the entry concerning unloading the supergun from the ship.

Based on these data is is also possible to tentatively re-construct the use of the large cannon in the campaign. The mention of the transport of large stone cannonballs to Grudziądz/Graudenz[59] may imply that the large cannon was also transported there by water from the Order's capital[60].

[57] J. Szymczak, *op. cit.*, pp. 215-217.
[58] *Ibidem*, p. 222, Table 12.
[59] MTB, p. 579.
[60] *Ibidem*, p. 577.

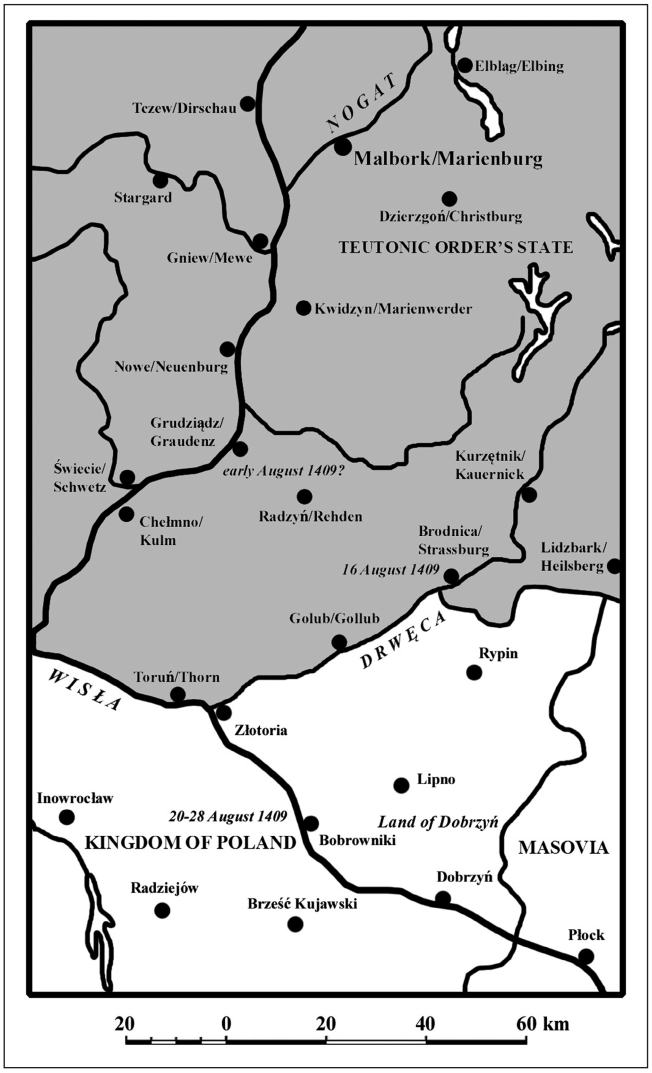

Fig. 4. Field use of the large cannon in 1409. Map G. Żabiński, adapted from M. Biskup, R. Czaja (eds), *Państwo Zakonu Krzyżackiego w Prusach. Władza i społeczeństwo*, Warszawa 2008, p. 239, Map 12.

In the first half of August 1409, the supergun was carried (from Grudziądz/Graudenz?) to Brodnica/Strassburg[61], which was the point of concentration of the Order's army. From there, the projectiles were transported to Golub/Gollub[62], and it can be supposed that the large cannon was also carried there. It was perhaps from Golub/Gollub that the supergun was carried to Bobrowniki to be used in the siege of that castle, as it may be inferred based on the mention of transport of large stone cannonballs to Bobrowniki[63]. Anyway, it was definitely a truly amazing logistic operation.

Regrettably, nothing certain can be said on the later fate of the cannon. As the Teutonic plans in the event of renewal of hostilities were rather defensive than offensive[64], it could tentatively be proposed that the supergun may have been sent back to Malbork/Marienburg. The afore-mentioned records concerning other costs of manufacture and repair make it hardly possible to identify its actual whereabouts in Autumn and Winter 1409. However, the mention of another Teutonic great cannon, called the Wall-Breaker (*Fellemuwer*), which also participated in the expedition and was then transported back to the capital castle by a wagoner Kobir[65], may imply that the Order's largest cannon was also sent there. There is also a mention of a payment of 3 Marks to a ship master (*schiffman*) for transporting a gun (*eyne buchse*) to Malbork/Marienburg. Interestingly, these expenses made in December 1409 (including those for the large cannon) were made by the House Commander of Toruń/Thorn[66]. This may suggest that the water route was used again (Fig. 4).

Conclusions

The Teutonic *Grose bochse*, having been made at a considerable expense of nearly 800 Marks and weighing over 13.5 t, was no question a masterpiece of medieval siege artillery. As it was cast in two pieces (with a detachable gunpowder chamber), it seems that it finds its best analogy in the "Bombard of Muhammad" from 1464. Based on preserved account data, it can be said that it may have contained a "standard" proportion of copper and tin, although the ratio of lead may have been higher in its chase, due to its repeated casting.

In spite of numerous data concerning the manufacture process, it is rather difficult to reconstruct the overall image of the supergun. There must have been some system used to move the gunpowder chamber. It is known that a four-wheeled wagon with shutters was made to transport the cannon. The weight of the projectile may have been about 160-190 kg and the largest stone cannonballs stored at present at the Castle Museum of Malbork may have been used for that cannon.

It is known that the cannon participated in the first phase of the Great War between the Polish-Lithuanian and the Teutonic Order in August 1409. Having been used in the siege of Bobrowniki, the cannon possibly returned to Malbork/Marienburg in Autumn/Winter 1409. Its further fate, however, is unknown.

[61] *Ibidem*, p. 577.
[62] *Ibidem*, p. 577.
[63] *Ibidem*, p. 576.
[64] S. Jóźwiak, K. Kwiatkowski, A. Szweda, S. Szybkowski, *op. cit.*, p. 212-230.
[65] MTB, pp. 589, 597.
[66] *Ibidem*, pp. 596-597.

Streszczenie

***Grose Bochse* – superdziało Zakonu Niemieckiego z 1408 r.**

Grose Bochse – ciężkie działo z odłączaną komorą prochową, zostało odlane w 1408 r. w zamkowej działołejni w Malborku. Na podstawie zachowanych ksiąg rachunkowych Zakonu masę działa szacować można na ok. 13,5 tony. Działo zostało odlane z brązu, a jego przybliżony skład chemiczny wynosił 87,7% Cu, 11,4% Sn i 0,9% Pb. Całkowity koszt produkcji działa wyniósł niemal 800 grzywien, co stanowiło prawie połowę wydatków Zakonu Niemieckiego na broń palną w 1408 roku. Kaliber działa wynosił zapewne ok. 50 cm, a masę granitowego pocisku szacować można na ok. 180 kg. Wydaje się, iż najbliższą analogią do zakonnego superdziała jest turecka "Bombarda Mahometa" z 1464 r.

Można także poczynić krótkie uwagi na temat wykorzystania działa w polu podczas początkowej fazy Wielkiej Wojny między Zakonem Niemieckim a Unią Polsko-Litewską (1409-1411). Działo uczestniczyło w zakonnej wyprawie do ziemi dobrzyńskiej w sierpniu 1409 r. Ciekawym jest, iż transportowane było głównie drogami wodnymi, co nie dziwi biorąc pod uwagę jego ogromną masę. *Grose Bochse* została zapewne użyta podczas oblężenia zamku w Bobrownikach w końcu sierpnia 1409 r. Przypuścić można, iż superdziało powróciło do Malborka jesienią lub zimą 1409 r. Dalsze losy działa pozostają nieznane.