

ALEKSANDER BOLDYREW

HAND FIRE-ARMS OF THE POLISH MERCENARY INFANTRY DURING THE MOLDAVIAN CAMPAIGN OF 1538

The history of military science is usually associated with its most significant events. The most popular events are obviously the famous battles. The battle din, weapon clash, shouting soldiers and the injured fill the pages of many dissertations. Less popular seem to be the issues connected with marching as they are usually monotonous not to say boring. Not many people are interested in the organization of the armed forces or their financing. Mostly researched – except for history of military operations – seem to be the problems of armament of a unit or equipment of the soldiers. It is, however, only an apparent image. It turns out that the key to more profound studies is frequently, quoted at the beginning, a huge and spectacular event. It is often spectacular not only because of its important character but also for its particular reception in historiography.

According to the reverse rule, the lack of a significant moment diminishes the meaning of the event in the eyes of the researchers. A perfect example is the Moldavian campaign conducted by Polish units in summer 1538. It was almost unnoticed and it disappeared when compared to the Moscow campaign of 1514 which ended with the battle of Orsza. Probably an important influence had the painting which was probably painted a few years after the event and probably by a person who participated in the battle of himself. Relying on the latest settlements concerning the matter (which of course do not change the symbolic meaningfulness of the battle and its place in military historiography) one must assume that the painting was created in 1530s.¹

The last war with the Teutonic Knights was conducted between 1519-1521 and it was remembered as the end of Polish – Teutonic conflict. The so called Prussian Homage, immortalized by Jan Matejko in his painting, is treated

as the end of the struggle. Dionizy Runau wrote, however, that it was “kleiner, zweyjeriger krieg in Preussen”². The researchers paid much attention to the Moldavian campaign of 1531 and the battles of Gwoździec and Obertyn³. The latter battle, as the result of disproportion of the forces and tactics of fighting in the camp used by hetman Jan Tarnowski, is perceived today as the success of Polish army (in literal and metaphorical sense). For the time being the following Moldavian campaign – which was only seven years later – was not described in such details as the mentioned conflicts until today (except for short notes in history books for students)⁴. Interestingly, in the collection of the Central Archives of Historical Records in Warsaw there is preserved almost complete documentary of recruitment conducted before the Chocim campaign⁵. Some part of the documentary was researched in a different place⁶, therefore, I would like here to discuss only the problem of hand

² M. Biskup, „Wojna pruska” czyli wojna Polski z zakonem krzyżackim z lat 1519-1521. (U źródeł sekularyzacji Prus Krzyżackich, część II), Olsztyn 1991, p. 6. See also L. Kolankowski, *Polska Jagiellonów. Dzieje polityczne*, Lwów 1936; Z. Spieralski, *Jan Tarnowski 1488-1561*, Warszawa 1977; J. Szymczak, *Początki broni palnej w Polsce (1383-1533)*, Łódź 2004, J. Tyszkiewicz, *Ostatnia wojna z Zakonem Krzyżackim 1519-1521*, Warszawa 1991.

³ A. Czołowski, *Bitwa pod Obertynem r. 1531*, Lwów 1890; A. Czołowski, *Bitwa pod Obertynem 22 VIII 1531*, Lwów 1931; Z. Spieralski, *Kampania obertyńska 1531 roku*, Warszawa 1962; T. M. Nowak, *Polska sztuka wojenna w czasach Odrodzenia*, Warszawa 1955, pp. 250-253; Z. Spieralski, *Polska sztuka wojenna w latach 1454-1562*, Warszawa 1958, pp. 144-153; T. M. Nowak, J. Wimmer, *Historia oręża polskiego 963-1795*, Warszawa 1981, pp. 286-289; Z. Spieralski, *Wojskowość polska w okresie odrodzenia 1454-1576*, [w:] *Zarys dziejów wojskowości polskiej do roku 1864*, Vol. 1: do roku 1648, Warszawa 1965, pp. 337-340; J. Wimmer, *Historia piechoty polskiej do roku 1864*, Warszawa 1978, pp. 105-107; M. Plewczyński, *Obertyn 1531*, Warszawa 1994.

⁴ By the one positive except: M. Plewczyński, *Wojny i wojskowość polska XVI wieku*, Vol. I: Lata 1500-1548, Zabrze 2011, pp. 394-400.

⁵ Archiwum Główne Akt Dawnych w Warszawie, Archiwum Skarbu Koronnego, Oddział 85 (further quoted O85), sygn. 32, k. 3-59v, 60-83v, 166-171v.

⁶ A. Boldyrew, *Piechota zaciężna w Polsce w pierwszej połowie XVI wieku*, Warszawa 2011.

¹ J. Białostocki, *Zagadka „Bitwy pod Orszą”*, „Biuletyn Historii Sztuki”, Vol. XVII, 1955, pp. 80-98; Z. Żygulski jun., *Obraz „Bitwa pod Orszą” – pogranicze fikcji i prawdy*. (Streszczenie), „Kwartalnik Historii Kultury Materialnej”, Vol. 21, 1973, nr 2; S. Herbst, *Obraz bitwy pod Orszą*, [w:] idem, *Potrzeba historii czyli o polskim stylu życia*. Wybór pism, V. 2, ed. W. Majewski, Warszawa 1978, pp. 273-295; Z. Żygulski jun., „*Bitwa pod Orszą*” – struktura obrazu, „Rocznik Historii Sztuki”, Vol. 12, 1981, Where the further literature; idem, *Bitwa pod Orszą – struktura obrazu*, [in:] idem, *Światła Stambułu*, Warszawa 1999, pp. 253-289, as for the age of the work see p. 290; P. Drózd, *Orsza 1514*, Warszawa 2000.

Permanent number of a formation	Number of formations	Together
30	1	30
50	10	500
100	12	1200
150	5	750
200	9	1800
250	2	500
300	4	1200
Together	43	5980

Tab. 1. The number and size of infantry formations in the Chocim campaign of 1538 according to the preserved registers. (Based on: private calculations.)

fire-arms used by Polish mercenary infantry during this campaign.

Hand fire-arms of Polish mercenary infantry is a wide area of interest, especially taking into consideration the number of infantry which marched to Chocim during the summer campaign of 1538 (the historians say about 7000 people). Some issues concerning this topic have already been described by me earlier but so far there has been no overall elaboration of the problem⁷. The Moldavian campaign did not have a culminating moment and general solution. The Moldavian siege of Chocim was not finished by spectacular conquer of the castle. Although the Polish army gained the strategic point, they gave up military actions. It happened in spite of the fact that the army, which was conducted by hetman Tarnowski, was one of the biggest armies gathered at the time of the Jagiellonian family reign in Poland. According to numerous sources, there were about 19 000 soldiers⁸ and the maintenance of the army for three quarters of the year cost 200 thousand florins⁹.

After the spring recruitment, inspections and preparation of complicated diplomatic action, the leader moved with the army from Gliniany, marched through Trembowla

(or in its surroundings) and headed for Chocim. Just before August 17 he crossed the southern bank of the Dniester and on August 17 started the siege of the castle. This strong fortification was defended by self-confident Moldavian dignitary, castellan Toader. As Chocim was well fortified his faith in victory was justified. Besides, keeping that point would give the control of the armies crossing the Dniester which opened the way to Podolia and Red Ruthenia. Tarnowski did not intend to storm the castle and using the experience gathered during the previous sieges (for instance the siege of Starodub in 1535 which lasted four weeks) he ordered to begin sappers' works. In July 1535 due to army engineers' work a part of the curtain was destroyed which allowed to siege successfully. As the author of the anonymous chronicle written not long after 1538 noticed: "Sir Tarnowski invaded the Chocim castle with a huge army but he had to stop because the Turkish emperor entered Wallachia – next year the Vlachs made an alliance with the Poles and promised to fight together against the Pagans"¹⁰. Ten days after the arrival to the castle walls (August 28) when the work on the mines was almost finished ("[...] he would get them by mining the baileys [...]")¹¹ the Moldavian hospodar, Piotr Raresz arrived to the walls with forty thousand of soldiers. After two days of negotiating Raresz resigned of all his rights to Pokuttya which was confirmed by a prepared document (written in Polish and Moldavian).

Raresz's attempts turned out to be futile as on September 15 the sultan Suleiman took over Suceava (he was standing with his army since July 18) and he made a hospodar Stefan Lacusta (Szarańcza). John Zapolya imprisoned Raresz and the Turkish sovereign joined to his country the southern part of the Moldavian territory between the Dniester and the Prut. This area was strengthened at that time by Tehinia (Budjak) transformed into fortress¹².

As it has already been mentioned, mercenary infantry participating in the campaign was well represented. Until today there survived registers of 43 infantry formations recruited in 1538. According to the notes, the king's regimental headquarters issued 5980 payments. The formations varied as far as their size was concerned. There were from 30 to 300 payments (tab. 1).

The most popular were the small formations consisting of 50-100 people. There were 10 and 12 of them altogether. There were also the formations consisting of 200

⁷ Idem, *Arkebuzy w wojsku polskim w pierwszej połowie XVI w. (w świetle rejestrów popisowych piechoty zaciężnej)*, [in:] *In tempore belli et pacis. Ludzie – miejsca – przedmioty. Księga pamiątkowa dedykowana prof. dr. hab. Janowi Szymczakowi w 65-lecie urodzin i 40-lecie pracy naukowo-dydaktycznej*, eds. T. Grabarczyk, A. Kowalska-Pietrzak, T. Nowak, Warszawa 2011, pp. 539-550.

⁸ L. Kolankowski, *Roty koronne na Rusi i Podolu 1492-1572 r.*, „Ziemia Czerwieńska”, Vol. I, 1935, f. 2, pp. 157- 158 (18024 soldiers); M. Plewczyński, *Liczebność wojska polskiego za ostatnich Jagiellonów (1506-1572)*, „Studia i Materiały do Historii Wojskowości”, Vol. 31, 1988, pp. 42, 43 (19 400 soldiers).

⁹ L. Kolankowski, *Roty koronne...*, p. 159; A. Boldyrew, *Produkcja i koszty uzbrojenia w Polsce XVI wieku*, Warszawa 2005, p. 254; idem, *Piechota zaciężna...*, pp. 109-111, 328-331; M. Plewczyński, *Wojny i wojskowość polska...*, p. 398.

¹⁰ *Kronika od r. 1507 do 1541 spisana [z rękopisu 1549 r.]*, [in:] *Biblioteka starożytna pisarzy polskich*, Vol. 6, second edition, ed. K. W. Wojcicki, Warszawa 1854, p. 34.

¹¹ M. Strykowski, *Kronika polska, litewska, żmudzka i wszystkiej Rusi [...]*, ed. M. Malinowski, Vol. 2, Warszawa 1980 (fotooffset of issue Warszawa 1846), p. 399.

¹² Z. Spieralski, *Jan Tarnowski...*, pp. 291-295; W. Dworzaczek, *Hetman Jan Tarnowski. Z dziejów możnowładztwa małopolskiego*, Warszawa 1985, pp. 88-89; M. Plewczyński, *Wojny i wojskowość polska...*, pp. 399-400.

Decline	Number of formations
11-20 %	5
21-30%	34
>30%	3
Together	42

Tab. 2. The decline of actual state compared to permanent employment. (Based on: private calculations.)

Type of h f a*		Number	Percent
Matchlock guns	Matchlock guns	2421	76,6
	Small matchlock guns	238	7,5
Arquebuses	Arquebuses	485	15,3
Hook guns	Hook guns	7	0,2
	Semi hook guns	2	0,1
Krzoski	Krzoski	9	0,3
Together		3162	100

Tab. 3. Hand fire-arms of mercenary infantry in summer campaign of 1538, * – hand fire-arms. (Based on: private calculations.)

people and there were 9 of them. In fact, for the described above 5980 payments there were employed 4665 soldiers. Therefore, in 42 out of 43 formations the decline of soldiers in comparison with permanent employment was from 47% (in Lampert Gnoyeński's formation) to 18% in three other formations (J.T. Dziadulski's, Mateusz Kaszowski's and Wojciech Polak's from Leśnica).

Only in Mikołaj Lasiński's formation there were more soldiers recruited than the payments as the formation was to consist of 30 people and there were 31 people recruited. Summing up, the decline in actual number compared to permanent employment was usually about several dozen percent (about 21-30%, tab. 2).

Among the soldiers described during inspection 67,8% owned hand firearm (tab. 3)

Mostly represented were the matchlock guns of two types described in the sources, that is the matchlock guns and small matchlock guns; together 2659 copies. It is difficult to say what was the difference between them. They could have had different calibers, and therefore there were bigger and smaller matchlock guns, or it could have been the length of barrel and additionally a caliber. Then we would have to agree that there were short matchlock guns, in fact small matchlock guns which might be taken for an ancestor of much later popular handguns. There were as many arquebuses, meaning there were 485 of them. There were only 18 copies of hook guns, semi hook guns and flintlocks.

So popular at that time long fire-arms (according to rittmeister Tarnowski's instruction *pixidem manualem*

*longam*¹³) was straight and was not exceptional as far as its exploitation was concerned, but it was cheap and easy to operate. Matchlock guns in 1538 must have been popular since they were described as early as by the end of the 15th century¹⁴. It is difficult to assume that matchlock guns were made according to some standard pattern so their technical parameters, especially caliber, fulfilled some norms. In professional literature they were usually described according to the following parameters: length about 1-1,2 m, weigh about 10-15 kilos, caliber even 15 mm (such a group, meaning the bullets of 15 mm caliber were most frequently represented in medieval archaeological material)¹⁵. The muzzle was strengthened by additional ring. They were fired with a matchlock and it seems reasonable as the matchlock did not have a complicated structure and was unailing and matched the cheap matchlock gun¹⁶. Just like matchlock guns, the matchlocks varied¹⁷. One of the forms of the matchlock was the lock with a smouldering fuse was replaced by a glowing tinder placed in a special tube handle with which the cock of the lock was ended.

The matchlock guns were used to fire a tiny bullets which weighed up to 20 g. They were probably made of different materials but most popular seemed to be lead. Unfortunately, we can only assume that because the issue of the bullets for fire-arms used in the 16th century has not been researched so far. One can only base his views on the information from the previous and following epochs¹⁸. The price of ammunition and gunpowder raised the cost of using the matchlock guns but the value of the gun was about 19-36 groschen and it was acceptable for an average infantryman

¹³ S. Kutrzeba, *Polskie ustawy i artykuły wojskowe od XV do XVIII wieku*, Kraków 1937, No. 10, art. 9; Z. Spieralski, *Instrukcje i artykuły hetmańskie Jana Tarnowskiego*, „Studia i Materiały do Historii Wojskowości”, Vol. 36, 1994, p. 276; J. Szymczak, *op. cit.*, p. 45.

¹⁴ T. Grabarczyk, *Piechota zaciężna Królestwa Polskiego w XV wieku*, Łódź 2000, pp. 142-156; Z. Spieralski, *Polska sztuka wojenna...*, p. 6; T. Nowak, *Problem stosowania broni palnej przy obronie i zdobywaniu umocnień przez wojska polskie w XVI-XVII w.*, „Studia i Materiały do Historii Wojskowości”, Vol. 12, 1966, part 1, p. 55.

¹⁵ Z. Żygulski jun., „Bitwa pod Orszą” – struktura obrazu, „Rocznik Historii Sztuki”..., p. 92; K. Konieczny, *Ręczna broń palna w Polsce w XV i XVI w.*, „Muzealnictwo Wojskowe”, Vol. 2, 1964, pp. 202, 206-207, 221-223; S. Kobielski, *Polska broń. Broń palna*, Wrocław 1975, pp. 39-40; J. Szymczak, *op. cit.*, p. 45; P. Strzyż, *Średniowieczna broń palna w Polsce. Studium archeologiczne*, Łódź 2011, p. 57, graph 1.

¹⁶ L. Křížek, Z. J. K. Čech, *Encyklopedie zbrani a zbroje*, Praha 1999, pp. 285-286; Z. Żygulski jun., *Broń w dawnej Polsce na tle uzbrojenia Europy i Bliskiego Wschodu*, Warszawa 1982, p. 160; M. Gradowski, Z. Żygulski jun., *Słownik uzbrojenia historycznego*, second edition, Warszawa 2000, pp. 87-88, 91, 97.

¹⁷ J. Szymczak, *op. cit.*, pp. 49-50.

¹⁸ Ibidem, pp. 144-159; P. Strzyż, *op. cit.*, p. 49-58; I. Sviesznikov, *Bitwa pod Berestechkom*, Lviv 1993, pp. 238-257; idem, *Broń z pola bitwy pod Beresteczkiem 1651 r.*, „Muzealnictwo Wojskowe”, Vol. 7, 1995, pp. 244-292, especially pp. 267-292.

who was a rifleman¹⁹. Interestingly, the matchlock guns started to make room for other guns in the half of the 16th century. They dominated until 1536 (about 70%) but during the campaign of 1538 their number decreased to hardly 59% and the same situation happened the following year²⁰. It is possible that the matchlock guns became old fashioned weapon and started to be replaced with other types of weapon. Registers from 1538 give the information concerning a big group of soldiers so it is easy to find the combatants who were recruited with the weapon not fulfilling the technical requirements. The inspector noticed the necessity to show another copy of weapon. It happened in 13 cases and the soldiers “distinguished” in this way served in 8 different army units²¹. Two other cases are worth describing. Wojciech from Rudniki (in Stanisław Jarocki’s army unit) had *rucz vijstrzelijuna*²², and Stanisław from Drohiczyn had a gun but it had *loze zle*²³. Those descriptions (*vijstrzelijuna* is the synonym of used, damaged) suggest that the two copies were old fashioned and out of order. Tarnowski’s soldiers tried several times to replace arquebuses with matchlock guns²⁴.

More than 15% of all guns belonging to infantrymen were arquebuses in the number of 485. In 1538 they were used for the first time for such a large scale. The level achieved at that time stayed for quite a long time. The riflemen with arquebuses were usually placed in the third place in tens (beginning with the front of the formation). They stood just behind infantry spearmen and shielded warriors. Among 43 army units mentioned above this model of arrangement was used in 40. By recruiting the arquebuses to the army the volley was strengthened to some extent. It is known that the described model of an army unit was changed with time and the soldiers with arquebuses were placed as the last in tens. They created in this way the last row (one rifleman from a ten)²⁵.

The arquebuses had thicker walls of the barrel so they could have been loaded with double dose of gunpowder and the smaller calibre (about 10 mm) allowed to shoot with a small bullet but to a longer distance, more accurately and

with faster initial speed²⁶. Introductory research of manuscripts and partially iconographic sources raised a number of controversies. It is not only the question about what *de facto* arquebuses were (a new gun type or modern hook guns) but also about the system of shooting with them was. The issue needs further research²⁷. The lack of direct information does not allow to discuss wider the usage of arquebuses during Chocim campaign. One can only assume that fire-arms with further reach and better accuracy could have been used for firing the walls of the fortress.

There were only 7 hook guns and 2 semi hook guns taken by mercenary infantrymen to Chocim campaign of 1538 which suggests that, in my view, this kind of long hand fire-arms lost quickly its importance. It could have been possibly used to a bigger extent in supply columns, or on the walls when it was easier to lean the gun which facilitated shooting. For an infantryman fighting in the field probably easier and more comfortable were the guns which could have been operated only with hands. Their smaller weigh facilitated coordination while loading the gun, taking one’s aim and firing.

Nevertheless, it is worth noticing that the first part of the 16th century brought some modifications concerning the construction of hook guns. The barrels with a hook were placed not on logs gun mount but on gun mounts with an isolated gib. The system of firing was placed on a matchlock with an appendix, or rather a trigger lever of a cross-bow type²⁸. We know about hook guns which were stored in castles or bought in a bigger number at various merchants²⁹.

There were also 9 guns described as *krzoski* in the hands of the mercenary. The issues connected with nomenclature and interpretative possibilities have already been discussed by me³⁰. It is, however, worth reminding that they were found only in one army unit. (Mikołaj Iskrzycki’s army unit). All the riflemen holding them were also equipped with swords and wooden weapon³¹. It is difficult to associate the place of the riflemen in the

¹⁹ J. Szymczak, *op. cit.*, pp. 45, 99-100, 168. See also *Cracovia artificum 1501-1550*, ed. J. Ptaśnik, M. Friedberg, [in:] *Źródła do historii sztuki i cywilizacji w Polsce*, Vol. V, Kraków 1936-1948, nr 1335; K. Górski, *Historia piechoty polskiej*, Kraków 1893, p. 22; B. Gembarzewski, *Uzbrojenie i rodzaje broni*, [in:] T. Korzon, *Dzieje wojen i wojskowości*, Vol. 3: *Dokończenie epoki przedrozbiorowej*, Kraków 1912, p. 285; K. Badecki, *Ludwisarstwo lwowskie za Zygmunta I*, Lwów 1921, p. 83. S. Kobielski, *op. cit.*, pp. 39-40; Z. Konieczny, *op. cit.*, pp. 200-202, 206-207.

²⁰ A. Bołdyrew, *Piechota zaciężna...*, p. 231.

²¹ O85, sygn. 32, k. 21v, 26v, 37-38, 44v-45, 49, 53, 57.

²² O85, sygn. 32, k. 52v.

²³ O85, sygn. 32, k. 59.

²⁴ A. Bołdyrew, *Piechota zaciężna...*, pp. 232-233; see also O85, sygn. 32, k. 18, 18v, 49v, 79v.

²⁵ A. Bołdyrew, *Arkebuzy...*, pp. 547-548.

²⁶ M. Gradowski, Z. Żygulski jun., *op. cit.*, p. 94; see also B. Gembarzewski, *op. cit.*, p. 284; Z. Stefańska, *Arkebuz, hakownica, muszkiet. (Artykuł dyskusyjny)*, „Muzealnictwo Wojskowe”, Vol. 4, 1989, pp. 215-237; W. Kwaśniewicz, *1000 słów o dawnej broni palnej*, Warszawa 1987, p. 7; L. Křížek, Z. J. Čech, *Encyklopedie zbrani a zbroje*, Praha 1999, p. 15; A. Bołdyrew, *Piechota zaciężna...*, pp. 233-241.

²⁷ A. Bołdyrew, *Piechota zaciężna...*, pp. 223-225 where the issue was discussed in detail.

²⁸ J. Szymczak, *op. cit.*, pp. 43-45; S. Kobielski, *op. cit.*, pp. 39; K. Kozak, *Hakownice węgierskie XV-XVII w. w kolekcjach muzealnych*, „Kwartalnik Historii Kultury Materialnej”, Vol. 21, 1973, No. 2, p. 315; M. Gradowski, Z. Żygulski jun., *op. cit.*, p. 95.

²⁹ *Rachunki Podskarbiego Andrzeja Kościeleckiego z lata 1510-1511*, eds. A. Wąjs, H. Wąjs, Kraków 1997, p. 24: [...] *emi hakownicze 46* [...] and [...] *emi apud Casper mercatorem 9 hakownicze* [...]. See also A. Czołowski, *Inwentarz zamku trembowelskiego z r. 1551*, „Ziemia Czerwieńska”, Vol. 1, 1935, f. 1, p. 100.

³⁰ A. Bołdyrew, *Piechota zaciężna...*, pp. 226-227, 243.

³¹ O85, sygn. 35, k. 167v, 168, 169-170v.

unit arrangement with particular function of *krzoski* as the armed soldiers stood in tens accidentally and at random order. They took the third position, just behind shielded warriors but they also happened to take the last position. Looking at the place of origin of the combatants it is difficult to say whether one type of weapon was used by the combatants from the same region or province. Riflemen equipped with *krzoski* originated from the Greater Poland but also from the southern and eastern area. At the same time these were not people who served under the leadership of this rittmeister for a long time. Except for the inspection of Mikołaj Iskrzycki's detachment in 1538, we know the registers from 1535³², 1534³³, 1533³⁴, 1532 (double)³⁵ and 1531³⁶. Only the rifleman Jacob from Lublin appeared in the detachment in 1534³⁷ and Jacob from Kalisz appeared with a matchlock gun in the first register from 1532³⁸. I assume that the person appearing under the same name and identical place of origin within short period of time is the same person. I suspect, therefore, that *krzoski* were not introduced to the armament of the army unit by order of the leader and for some particular purpose but they appeared in the unit accidentally. They were a novelty but treated with reasonable interest of the soldiers.

The efficiency of the hand fire-arms depended on possibility of shooting to long distances, accurately and "strongly" enough. That is why a number of various mixes of black gun powder were created, and proportions and technology of producing them was the core of interest not only for craftsmen or soldiers but also for great scientific authorities. The following examples are worth mentioning: Marek Grek (in the work *Liber ignium ad comburendos hostes*), Roger Bacon (*Epistola de secretis operibus artis et naturae et de nullitate magiae*) or Albert the Great (*De Mirabilibus Mundi*)³⁹. Well chosen proportions of the gunpowder, its creation or its granulating were not the only prerequisites for a perfect shot. It was discovered that lengthened barrel maximised effective usage of compressed powder gases. The value, today called spout speed of a barrel, was enlarged also by diminishing the size of calibre. One can

say that the required effectiveness of a shot was achieved by joint features of the right calibre, length of the barrel, size of the bullet and the unfailing firing system⁴⁰.

The features mentioned above became more important during an open fire battle. At that time the battle itself was obviously important but also a distance to which the soldiers fired the guns. It is obvious that the unit shooting to the enemy tried to settle the most convenient (even from the point of view of seeing or perceiving the distance) shooting positions. While choosing them, the distance to which matchlock guns shot was taken into consideration as, which was already stated, they were the basic type of long fire-arms during the campaign of 1538. It is widely known that the calibre of a matchlock gun used at that time was mostly about 15 mm (up to 15 mm and rather not over). The whole length was about 1-1,2 m and they shot for a distance of about 100 m⁴¹. Nevertheless, it is not only the length of the weapon that influences directly shooting abilities but it is rather the length of the barrel. We can assume its length on the basis of iconographic information. I mean two basic sources, that is the painting "The Battle of " which, according to the latest research, was not painted before 1524-1530. Another source is the Wawel frieze made by Hans Durer and Antoni from Wrocław dated back to the second part of the 30s.

The images of hand rifle-arms are visible on the Wawel frieze at least a dozen or so times. They are mostly visible in three scenes. These are the infantrymen equipped with, among others, matchlock guns, marching in the first scene and following the standard bearer (or rather standard-keeper), in the second scene following the drummer, and in the third scene following infantry spearmen. In case of the painting "The Battle of " several cases, the most visible ones, were chosen for comparison. The central group of the infantrymen carry the biggest number of long fire-arms. The second most interesting group are the 5 riflemen standing above the pontoon bridge. The third group, hardly visible, are the infantrymen defending their camp in the upper right corner of the painting. We can assume what the length of the barrels was comparing them to the proportions of human body and the size of the barrel and the size of an adult man (I assume here 1670 and 1750 mm). To enlarge the basis of the "measurement" two woodcuts from the first part of the 16th century were taken into consideration. They both come from Germany and depict a rifleman with a matchlock gun (made by Sebald Behem living between 1500-1550)⁴² and the march of the riflemen with matchlock guns as well (by Erhard Schoen who was active between 1514-1550 in Nuremberg)⁴³.

³² O85, sygn. 26, k. 108-166v.

³³ O85, sygn. 25, k. 77v-81v.

³⁴ O85, sygn. 25, k. 77v-81v.

³⁵ O85, sygn. 20, cz. I, k. 12-15v; sygn. 22, k. 142v-148v.

³⁶ O85, sygn. 19, k. 219-221v; Z. Spieralski, *Kampania...*, pp. 251-257.

³⁷ O85, sygn. 25, k. 78v.

³⁸ O85, sygn. 20, cz. I, k. 14v.

³⁹ J. Szymczak, *op. cit.*, pp. 122-133; J. R. Partington, *Greek Fire and Gunpowder*, Baltimore 1999, pp. 74-76, 81 and next pages; T. M. Nowak, *Polska technika wojenna XVI-XVIII w.*, Warszawa 1970, p. 105; W. B. Wilinbachow, *Wynalezienie prochu i początki jego zastosowania do celów wojennych*, „Studia i Materiały do Historii Wojskowości”, Vol. 6, 1960, part 1, pp. 293-295; W. Świątosławski, *Artyleria przedogniowa, broń prochowa i gazy bojowe u późnośredniowiecznych Mongołów*, „Rocznik Łódzki”, Vol. 43, 1996, p. 229.

⁴⁰ S. McLachlan, *Medieval Handgonnes. The First Black Powder Infantry Weapons*, Oxford 2010, pp. 27, 37.

⁴¹ J. Szymczak, *op. cit.*, p. 45; K. Konieczny, *op. cit.*, p. 199.

⁴² K. Konieczny, *op. cit.*, pp. 204-205, table XVIII; H. L. Peterson, *The Treasury of the Gun*, New York 1962, p. 48.

⁴³ K. Konieczny, *op. cit.*, pp. 207, 211, table XXI.

The results of the measurement were counted into percentage, where the typical size of an adult man was accepted as 100%. As a result of these measurements we got the size in percentage (compared to the size of a soldier) of the whole matchlock gun and the length of the barrel. Then an average size of a man (in the first case 1670 mm and in the second 1750 mm) was taken as 100% and it resulted in the length of the barrels and the whole guns. We cannot forget that these are very general sizes and the results are not treated by me as the final outcome of the research⁴⁴. Summing up, it can be said that the length of a matchlock gun was (with the size of a man 1670 mm) between 820 and 1230 mm. When the size of a man was 1750 mm it was from 860 to 1290 mm. The last high scores were described for one of the German woodcuts. The length of the barrel was between 586 and 898 mm (614-941 mm with a taller man). Such differentiated values result from imperfect measurements and the form of iconographic imagination which was not the specification of inventory list or stock books of antique items of long hand fire-arms. Even those imperfections did not influence the differentiation of a hook gun loaded by one of the riflemen standing close to the pontoon bridge. In the painting "The Battle of". The length of his gun was described after the measurements as 1349 to 1414 mm and the barrel itself as 977-1023 mm. The three hook guns in the collection of the Polish Army Museum dating back to the turn of the XVth century have very similar sizes of the barrels⁴⁵. It was earlier known that a rifleman was using a hook gun but, in my opinion, confirms the rightness of the methods of measurement on the basis of iconographic images.

The long barrels of the matchlock guns of the Polish infantry influenced accuracy of shooting, especially that it compensated bad quality of the gun powder as it had bad moisture, bad burning time, and finally leaky barrel (even when the soldiers used self-deforming lead bullets) and most of all lack of rifle-bore in the barrel. The last issue is the trial to estimate the distance to which the matchlock guns from the first part of the 16th century were shooting.

Contemporary experiments with antique armament and measurements conducted on the replicas of the fire-arms seem to very useful to estimate the distance of the shot, penetrating force of the bullet and its speed. The first important (because close to the discussed problem) experience were the experiments conducted by Alan R. Williams at the beginning of 1970s. in the Institute of Science and Technology, University of Manchester. Williams shot from 3 replicas with the same calibre (3/4 in.=19,05 mm) but with different length of the barrels. Beginning with

the shortest and finishing with the longest they were supposed to be equivalents of the hand fire-arms from the 14th, the beginning of the 15th and the end of the 16th century. The gun powder was prepared out of 6 parts of saltpetre, 2 parts of charcoal and 1 part of sulphur on the basis of the recipe from the 13th century (after *De Mirabilibus Mundi*). There were two kinds of the gun powder used: dry-mixed and wet-mixed. The bullets were made of lead and metal and the soldiers shot with them for a distance of 9,1 m. This kind of steel concerning not less than 0,25% of coal makes it more plastic and allows to show all mechanical proprieties of the kinds used on the turn of the 15th century.

The effects of shooting with dry-mixed powder were unsatisfactory. One shot in 4 was a misfire, the powder burnt too slowly, a big part of powder gases escaped through a touch-hole. The bullets were, therefore, too slow to achieve longer distances. When the producers used wet mixed black powder only 10% of the shots were the misfires. The powder was burnt much faster and the bullet was faster. It must be emphasised that the replicas used for shooting had the following lengths of the barrels: 5, 10 and 15 in (accordingly 127, 254 and 381 mm). In spite of poor results the best seemed to be the lead bullets in the longest barrels as the bullets were moving with the speed of 460-560 m/s. The bullet from the gun with a 5 inch length barrel was not able to penetrate the aim which was steel plate. The bullet from the gun with a 10 inch barrel penetrated it 6 times for 14 shots and fired from the longest barrel it penetrated the plate five times (for 8 shots)⁴⁶. Although this almost 400 mm long gun had such an advantage, there were also some disadvantages like short distance of shooting. When there appeared some problems with loading the gun, taking the aim and firing, the distance of shooting of about 10 m did not give the rifleman the chance to do anything else. In other words, if the rifleman did not hurt attacking him enemy from such a distance, his life depended on mercy of the enemy.

Between 1988-1989 in *Landeszeughaus* in Graz another experiment was conducted. The soldiers were firing from 14 guns dated back to 1571-1700. The number of guns representing various centuries was comparable. Three guns were rifles, the rest were smoothbore weapons. All together there were 325 shots fired. Some shots were fired to the paper target of 1670x300 mm size which was to simulate the shape of an enemy facing the rifleman. The guns were loaded with contemporary black gun powder of 0.3-0.6 mm grain. The powder weighed about 1/3 of the bullet weigh. Since there were used hook guns and muskets from the end of the 16th century the results of the experiment are more

⁴⁴ According to the conclusion in study by W. Świątosławski, *Wizerunek zbrojnego króla z halabardą z 1509 r.*, [in:] *Cum arma per aeva. Uzbrojenie indywidualne na przestrzeni dziejów*, eds. P. Kucypera, P. Pudło, Toruń 2011, p. 281.

⁴⁵ K. Konieczny, *op. cit.*, pp. 189-190.

⁴⁶ S. McLachlan, *op. cit.*, pp. 69-70. See also A. R. Williams, *Some Firing Tests with Simulated Fifteenth-Century Handguns*, „Journal of the Arms and Armour Society”, Vol. 8, 1974-1976, pp. 114-120.

Specification	Calibre (in mm)	Muzzle velocity (in m/s)	Velocity after the distance of 100 m (in m/s)	Penetration on a dis- tance of 100 m (in mm)
Hook gun from 1571	19,8	482	305	2
Hook gun from 1580	20,6	533	349	4
Musket from ab. 1595	17,2	456	287	2
Musket from 1593	12,3	427	238	1

Tab. 4. Shooting parameters of long hand fire-arms replicas. (Based on: S. McLachlan, *Medieval Handgonnes...*, p. 70-71.)

important to assume the distance of shooting of matchlock guns. Although the time distance is comparable to replicas of the medieval fire-arms described above, from the point of view of construction the matchlock guns are closer to the guns used in Austria. The calibre of hook guns was 19,8 and 20,6 mm and of the muskets 17,2 and 12,3 mm which makes them similar to the assumed calibre of matchlock guns. Lead bullets used for the experiment moved quite fast (see tab. 4).

It is not difficult to observe that together with the observed muzzle velocity of a bullet (533 m/s while shooting from a hook gun from 1580 of 20,6 mm caliber) went the strongest penetration on a distance of 100 m (4mm). The most interesting, however, are the results of musket shots (because their caliber is similar to that of a matchlock gun). The observed muzzle velocity of lead bullets was more than four hundred m/s which allowed to go through 1-2 mm steel plate distant from a rifleman for 100 m. On the basis of the presented data it is not difficult to count that bullet speed after 100 m lowered to about 55-64% of muzzle velocity of the same bullet. So the speed decreased for about 40% (from 34,52 to 44,26%). In spite of this the fired bullet was surprisingly effective⁴⁷.

The last meaningful experiment was conducted in the Royal Armouries by Thomas Richardson in 1998. Contemporary gun powder was used at that time to load the guns. Probably because of that the effects of shooting were surprisingly positive. Taking into consideration this element one must acknowledge that the possibilities of the long hand fire-arms used during the experiment were pretty good. They are interesting because, for example, a hook gun with a caliber of 15,75 mm from the 15th century was used (the caliber is important here) or arquebus with a caliber of 12,7 mm (replica of the arquebus from the beginning of the 16th century was used). In case of the latter, the muzzle velocity was 521 m/s which is comparable with the results achieved during the experiment in Grazu⁴⁸. The summing up of the

English shooting experiments was the statement that hand fire-arms, although shooting slower than long bows or cross-bow had bigger blowing power. Neuroballistic weapon shot to a longer distance. Therefore, in the experimenters' opinion, there were in the field sometimes one kinds of weapon, another time the second types of weapon which gave them the possibility of supplementing each other. According to the book *Captain's Handbook* (1562) by Henry Berrett the leader should mix the riflemen of the first and second categories in order to maintain the continuity of shooting⁴⁹.

Matchlock guns of the Polish mercenary infantrymen with barrels of about 600-900 mm (closer to the first length) can be accepted as guns which were able to shoot with lead bullets to 100 m or further with the initial speed of 500 m/s. After the distance the speed decreased to 300 m/s but the bullets were still dangerous. During a battle a salve fired by tens of hundreds of soldiers from a distance of 100-150 m must have been very effective. The closer to the enemy, the bigger the shooting power. This could have been done, however, only with disciplined and brave soldiers. The suggested mixing of the soldiers with fire-arms and neuroballistic arms was not noticed or described in Polish realities of the first part of the 16th century. Maybe the continuity of shooting was guaranteed by the way of firing a salve by the infantrymen which has been described by me in another place⁵⁰. Using the matchlock guns in a siege meant for combatants approaching the walls to about 100-150 m or closer if the soldiers tried to shoot the enemy standing on the battlement (necessity to shoot on steep or raising trajectory). The lack of success in achieving the aim might have been compensated by a bigger number of arquebuses. They could have sent the bullets further than to 100 m as they had a bigger loading.

Polish mercenary infantry was the shooting formation. Their shooting power was predominantly based on a long

⁴⁷ P. Krenn, P. Kalas, B. Hall, *Material Culture and Military History: Test-Firing Early Modern Small Arms*, „Material History Review”, Vol. 42, 1995, pp. 101-109; S. McLachlan, *op. cit.*, pp. 70-71.

⁴⁸ S. McLachlan, *op. cit.*, p. 75; see also T. Richardson, *Ballistic Testing of Historical Weapons*, „Royal Armouries Yearbook”,

Vol. 3, 1998, pp. 50-52.

⁴⁹ J. R. Hale, *On a Tudor Parade Ground: The Captain's Handbook of Henry Barrett, 1562*, [in:] *idem, Renaissance War Studies*, London 1983, p. 247-284; J. Black, *Rethinking Military History*, Abingdon 2004, pp. 109-110; D. R. Lawrence, *The Complete Soldier. Military Books and Military Culture in Early Stuart England, 1603-1645*, Leiden 2009, p. 6.

⁵⁰ A. Bołdyrew, *Piechota zaciężna...*, pp. 341-343.

hand fire-arms. It means that the basic type of fighting was distance fighting. If the army units of spearmen or shielded warriors were included in the battle it was only a result of the leaders' providence. In this way, they tried to prepare infantry army units to hand-to-hand fighting. Although they did not search for such a way of fighting they also did not avoid it which was confirmed by the example of the attack on the Moldavian artillery close to Obertyn in 1531.

The character of the salvo of the infantry unit depended on the weapon used. The basic type of long hand fire-arms

used in the first part of the 16th century was a matchlock gun. It has been proved above on the basis of the documents connected with the Moldavian campaign of 1538 in which the infantry was large in number. The similar situation continued for half of the century. Matchlock guns started to be accompanied, beginning with this campaign, by another kind of guns – arquebuses. The rest of the guns appeared so rarely that it is impossible to confirm their influence on the creation of the salvo of the infantry army unit.

Streszczenie

Ręczna broń palna polskiej piechoty zaciężnej w kampanii mołdawskiej 1538 r.

Historię wojskowości na ogół kojarzy się z jej wielkimi wydarzeniami. Najbardziej znane momenty, to te, w których toczona jest bitwa. Na zasadzie odwrotności, brak ważkiego momentu zdaje się pomniejszać znaczenie wydarzenia w oczach badaczy. Doskonałym przykładem jest kampania mołdawska przeprowadzona przez siły polskie latem 1538 r., która (poza krótkimi notatkami podręcznikowymi) nie została opracowana szczegółowo. Jest to o tyle ciekawe, że w zbiorach Archiwum Głównego Akt Dawnych w Warszawie zachowała się bez mała kompletna dokumentacja zaciągów czynionych przed wyprawą na Chocim. Dotyczy ona również rodzajów używanego przez piechotę uzbrojenia, w tym ręcznej broni palnej. Wśród piechurów opisanych w trakcie lustracji, 67,8% posiadało ręczną broń palną. Najliczniej reprezentowane były rusznice w dwóch typach odnotowanych w źródłach, to jest rusznice i ruszniczki; łącznie 2659 egzemplarzy. Ponad 15-procentową grupę strzelb w rękach piechurów stanowiły arkebuzy w liczbie 485. W 1538 r. po raz pierwszy użyto ich na tak dużą skalę. Do tego należy dodać 7 hakownic i 2 półhakownice zabrane przez zaciężnych piechurów

na wyprawę chocimską 1538 r. sugerują, w moim odczuciu, że ten rodzaj długiej ręcznej broni palnej szybko tracił swe znaczenie. W rękach zaciężnych znalazło się również 9 strzelb określonych jako krzoski. Kwestie związane z nomenklaturą i możliwościami interpretacyjnymi tego typu broni omówiono już w innym miejscu.

Rusznice polskiej piechoty zaciężnej (stanowiące zdecydowaną większość) o lufach długich na około 600-900 mm (raczej bliżej pierwszej wartości) i kalibrze kilkunastu mm można uznać za strzelby, które były zdolne wyrzucać pociski ołowiane na skuteczną odległość około 100 m, lub nawet dalej, z prędkością początkową ponad 500 m/s. Wprawdzie po przebyciu tego dystansu prędkość pocisku spadała do niecałych 300 m/s, lecz jak wykazały doświadczenia przeprowadzone w różnych zbrojowniach europejskich pocisk taki nadal był groźny. W trakcie walki w otwartym polu salwa oddana jednocześnie przez kilkudziesięciu, czy nawet kilkuset strzelców na dystansie do 100-150 m musiała odznaczać się dość dużą skutecznością. Dla jej wzmocnienia zaczęto na szerszą skalę stosować arkebuzy.