AUTHOR'S REVIEW OF PHD THESIS

NATIONAL UNIVERSITY OF PUBLIC SERVICE
Doctoral Council

Lieutenant Colonel ATTILA BÁN

The Impact of Technical and Technological Development on the Development of the Equipment Used by Hungarian Artillery

Author's review of PhD thesis

Budapest
2018

NATIONAL UNIVERSITY OF PUBLIC SERVICE

Lieutenant Colonel ATTILA BÁN

The Impact of Technical and Technological Development on the Development of the Equipment Used by Hungarian Artillery

Author's review of PhD thesis

Supervisor:

Prof. Dr. Károly Turcsányi DSc

Budapest
2018

CONTENTS

1. DEFINING THE SCIENTIFIC PROBLEM

Throughout history, the characteristics of artillery pieces primarily determined the possibilities of artillery development. The development of artillery pieces was not a process in itself but a part of general scientific, technical and technological development. It is evident that artillery weapons and their state of technical development reflected the state of technical and technological development of the society that created them. However, there are historical examples that do not prove this seeming evidence.

Technical and technological development always contributed to the modernisation of artillery weapons. In the early days, modernisation simply meant the development of barrels. Later, the possibilities provided by barrel improvement were utilised in the field of developing carriages, as well as the instruments and methods of cannon operation, then projectiles and gunpowder, and finally (to date) the instruments and methods of cannon operation again.

It needs to be added, however, that traditional artillery tasks have partially been taken over by units equipped with mortars and rocket artillery. Weapons had been specialised and categories transformed: until the First World War, (land) artillery pieces were classified as field, fortress and siege weapons, while afterwards the categories were field, anti-tank and anti-aircraft guns.

It is impossible to examine the whole armament park of the artillery through the course of its full history within the framework of a PhD Thesis. So I had to find an element that exists through the entire period and its features well reflect on the advancement of artillery pieces and the potential behind.

Conventional guns have traditionally been the most traditional, most common and most characteristic artillery weapons from their early introduction to date. Although there was a period when the Hungarian armed forces had significant rocket artillery, it may be stated that conventional artillery pieces have predominantly and traditionally comprised Hungarian artillery throughout its history. Conventional guns are categorised based on the barrel's specifications (measurements and other characteristics). Gun barrels are central parts that can be specified in the case of early artillery pieces, too, and therefore can be examined throughout the entire history of artillery.

It is obvious that all developments apart from those aiming at the improvement of the specifications of the barrel targeted the most complete utilisation of the characteristics of this most crucial cannon part. In the case of traditional artillery, the barrel has remained a decisive element, and all the above listed components were and are to make the operation of this crucial gun part as effective as possible. This means that developments may be divided into those of the barrel and those others targeting the improvement of barrel operation. The first type of innovation should be examined first, as these developments also define the frames of the second type of improvement.

Based on the above my research's primary subject is the barrel, because this gun part can be studied from the first cannon up to date; for its production advanced industry is needed; and its properties mark the boundary how far a weapon system can be developed.

When analysing the influence of general technical and technological development the examination of production methods proves to be most important, as these define the specifications of gun barrels. Not only were each period's top technologies utilised when manufacturing barrels, but historical examples also prove that those technologies sometimes were even surpassed, making important and sudden technological headway possible for the civilian industry. At other times, when barrels were not manufactured in compliance with the industrial standard of the period, outdated artillery pieces were produced. Studying such cases, however, is made difficult by the lack of a comprehensive volume discussing the manufacturing of artillery weapons from the beginnings to date.

Because of these reasons I do not study missile artillery, recoilless guns and – since their history is rather short and their technology of manufacture does not differ from that of field guns – I do not analyse anti-aircraft and anti-tank artillery and most aircraft guns. I make an exception considering naval guns, but only in the case when an innovation was introduced in the field of barrel production which is essential to the subject under survey.

2. AIMS OF RESEARCH

1. I wish to prepare and introduce an objective, comparative method which contributes to the study on the impact of the technical and technological development and the requirements towards the weaponry, on the development of artillery pieces.

2. My purpose is to show the technical and technological development of barrel production from the beginning to date, to fill a gap in scientific literature. I wish to find the technological step not discussed in period sources which made the casting of long muzzle-loading barrels with cannon-like measures and proportions possible.

3. I wish to analyse a weapon system and a barrel producing method that was behind the period's general technical and technological development, and also to find the reason of the lag.

4. I research and evaluate arms industrial technologies that outpaced the period's general industrial advancement, as a result of the requirements set for the artillery. I intend to find the technical solutions which first appeared in the arms industrial production and had a great impact on civilian industry.

5. I wish to analyse how modern the weapons used by the artillery in Hungary were. In other words, how can the connection between the general technical and technological advancement of the most industrialised states and the technical level of their gun production (barrel manufacturing) be related to these weapons.

6. I wish to analyse the artillery weapons in the collections of the Hungarian Military History Museum to make a recommendation backed up both technically and economically for the collections to organize and show the equipment used by the Hungarian artillery more completely than before.

3. RESEARCH HYPOTHESES

1. A scientific method may be modelled that can be used to simply demonstrate a weapon's advancement stage compared to the given period's technical and technological level in an exact way.
2. The casting of muzzle-loading bronze cannon is only possible by pre-heating the muzzle of the casting mould, which is not mentioned in the scientific literature.
3. At the outbreak of the First World War, the Austro–Hungarian cannon and especially their barrels were outdated taking into account the arms industry's world standard and the state's industrial capacity.
4. Some procedures developed to produce barrel exceeded the given period's technical and technological standard and helped the development of civilian industry.
5. The Austro–Hungarian Monarchy's artillery weapons went through a significant and well demonstrable development.
6. It can be clearly determined which weapon or weapons need to be acquired to make the Hungarian Military History Museum's two collections containing artillery pieces more complete.

4. RESEARCH METHODS

The primary basis for my research was provided by the specialised literature. In order to gather the necessary material I carried out classical research in libraries and archives, but I also significantly relied on books and publications made available electronically. To evaluate and complement written sources I requested help from experts of the various scientific fields in the form of consulting and interviewing them in person. I also studied modern technologies similar to those in the past that I examined. I largely relied on my observations of available artillery pieces. When necessary, I had tests and experiments made to justify or complement sources.

Due to the diversity of the topic I grouped the consulted sources. I set up four different categories: period sources, works on the history of technology, works on military history and works on technology. For the sake of simplicity, I first compared and analysed works within each category. I made an effort to consult works with reference to most primary sources. Therefore, I preferred period works that gave account of their authors' direct experiences. Concerning works on the subjects of the history of technology and military history, I was looking for ones that cited most primary sources and made reference to archival and museum research and experiments. Regarding literature on technology, I aimed for works that described both theoretical basics and modern equivalents of old processes, technologies and material qualities.

From the aspect of cannon barrel manufacturing the period sources describing the technologies of gun barrel production proved to be most valuable. I consider it a significant result to have been able to consult period sources describing all the essential gun barrel manufacturing technologies. I verified, evaluated and complemented all the information gained from the above sources through consulting works on the history of technology, military history and technology; the experiences of theoretical and practical experts of metallurgy; the observation of present-day production methods; the analysis of period guns; as well as my previous test results and conclusions therefrom.

When specifying each period's technical and technological achievements I mostly relied on works on the history of technology. To complete the picture I also included data from period works and works on military history and technology. In order to provide a comprehensive analysis I also consulted works on economic history, economic geography and general history. Comparing each period's gun barrel manufacturing technologies with the period's general technological standards led to "instant" research results such as realising and validating certain cases of outflow of technology from the arms industry (like in the case of the Bessemer process or Wilkinson's boring machine).

For my research, I examined the historic guns preserved at the Hungarian Military History Museum. Inspecting the guns often made it much easier to interpret information found in printed sources. I also had the opportunity to make use of results of a previous research project of mine, namely tests performed on muzzle-loading bronze guns and an experiment on casting technology. Relying on those, I managed to specify which of several alloy combinations described was the most accurate, and I also managed to clarify an issue regarding solidification at the casting of muzzle-loading cannon barrels, which had previously not been discussed either in period or later works, although the matter logically followed from metallurgical descriptions. The previously achieved results successfully were incorporated in the present work.

In order to locate, evaluate and elaborate the diverse sources, I asked for and received help from experienced experts of various fields. Hereby I wish to thank retired Director of the Foundry Museum Dr Katalin Lengyel Kiss, bell founder Miklós Gombos, iron founder Dezső Géczy, military historian Dr György Domonkos, military historian Lieutenant Colonel Dr István Ravasz and Lieutenant Colonel Dr Géza Gulyás for the help they provided. I also wish to thank my supervisor, Professor Károly Turcsányi for his constant teaching, help and inspiration, and for canalising my work. I wish to give special thanks to my commander, Colonel Dr Vilmos Kovács for his support.

5. A SHORT SUMMARY OF THE PERFORMED RESEARCH BY CHAPTERS

In the first chapter, I defined the factors that determined the development of artillery pieces, the development of technology, the requirements the artillery as an arm of service had to meet, and I discussed the impacts of the above. Here I differentiated technological innovations that resulted in quality development from those bringing quantitative improvement. I also distinguished adaptations, i.e. the employment of already existing technologies for military purposes, from entirely new developments.

With the help of the above categories I managed to specify the level of modernity of certain technological solutions and products. In order to be able to correlate the degree of modernity of an innovation with the general technological level of the period, I generated a comparison matrix where the elements of any case in discussion could necessarily be entered.

The matrix shows whether the subject of examination was a result of innovation or adaptation, and whether it represented quality development or quantitative improvement. The analysis carried out with this method does not only result in evaluation on the given subject, but comparing various matrices may also help the researcher correlate various technologies and products. It serves as a proof of the above that with the help of a comparison matrix I examined four constructional characteristics of field guns considered to be modern in their time and I managed to justify the professional opinion that the construction of guns used by the field and mountain artillery of the Austro-Hungarian Monarchy were obsolete by the time the First World War broke out.

In order to determine how modern a product was considered in its own time, I examined the changes to the production technology of gun barrels and discussed the topic in the second and third chapters. I managed to find period sources regarding all the gun barrel production technologies, and I complemented those with works on history and the history of technology, as well as present-day literature on engineering. I broadly relied on experiments carried out on gun barrels and on discussions with experts in various fields. I made a casting experiment and completed the available information through modern calculations. I introduced the metallurgy and the relevant moulding processes of the discussed periods. I compared those with the applied gun barrel manufacturing methods, thus relating the general technological development of each period to the technical level of the examined vehicles. As a result, the two chapters provide a summary on the history of gun and gun barrel manufacturing that fills several gaps, may prove to be useful in education, and may serve as a basis for further research.

I have determined that developed states always utilised the latest industrial achievements for the purposes of gun and gun barrel production, and in certain cases, by recognising the needs, they even realised technological leaps and surpassed the general technical and technological standards of each period. Examples include the inventing of casting muzzle-loading iron cannon (Hogge), high-precision gun drilling (Wilkinson), mass production of steel with air processes (Bessemer) or the technique of autofrettage using enormous pressure. Wilkinson's invention solved the accurate fitting of steam engines' cylinders and pistons, thus making the spread of modern Watt steam engines possible. Henry Bessemer's creation facilitated the production of cast steel, in great quantities. The method reduced the price of steel significantly and increased production quantities considerably. It contributed to the expansion of railways, the building of skyscrapers and the extension or establishment of new industries such as steel casting or sheet metal manufacturing. Only one example has been found where a gun or a gun barrel was manufactured at a level significantly lower than the general industrial development of the state, and that illustrated the industry of the Austro-Hungarian Monarchy prior to the First World War. In the third chapter, I analysed the current technologies of the era and pointed out that bronze barrels were outdated by the beginning of the war.

In the 1870s, Austro-Hungarian industry was not yet capable of manufacturing artillery pieces similar to Krupp-type steel cannon. Regulation "steel bronze" guns introduced in 1875 were up to their rivals made of steel, and could be produced by domestic industry. The essence of Major General Franz Ritter von Uchatius' invention was strengthening the material by deformation after casting his guns. "Cannon bronze" (tin bronze containing 8% of tin) would otherwise have proved to be a poor material for manufacturing rifled, breech-loading gun barrels. This smart and progressive method, which is called autofrettage today, has been employed to date. The hydraulic version of the technique became widespread during the Second World War.

It was not only the Austro–Hungarian Monarchy's weapon constructors who were stimulated by the exceptional German guns to experiment. Based on period sources I introduced, for the first time in Hungarian, the improvements making cast-iron barrels' attributes better, as well as the manufacturing technology of barrels strengthened with hoops and later with wires and also of built-up barrels.

In the 1880s, modern steel production methods spread in the Austro-Hungarian Monarchy, as well. The Siemens-Martin furnaces made the accurate setting of carbon content possible, as well as the alloying of the raw material to some extent. However, while other great powers took advantage of the capabilities of steel industry and introduced steel gun barrels as well as barrels of steel alloyed with nickel, Austria-Hungary stuck with Uchatius' "steel bronze."

Furthermore, I introduced modern barrel manufacturing technologies spreading after the First World War, especially autofrettage as a technology of crucial importance. Autofrettage barrels are capable of bearing 50–150% more pressure than common monoblock barrels and have 200% longer exhaustion period. I introduced this method's history and its several types and I gave the basic calculations for its application.

In the fourth chapter, I compared the advancement of artillery pieces in Hungary and in industrially more advanced states. I relied on data accessible from the special literature and from period sources.

From the appearance of the first cannon to the Ottoman occupation, Royal Hungary had a great quantity of modern guns. . The inflow of technology was very strong in the period, owing to Western European craftsmen whose settling in Hungary was consciously organised.

During the skirmishes along the Habsburg–Ottoman border, founders always were Germans, although customers mostly were Hungarians. Thus, border castles generally were well equipped, even if older guns too remained in service and, more extensively than in Western Europe, they relied on field cannon rather than fortress guns in fortress defence, obviously due to transportation and financial issues.

The artillery of the Habsburg Empire was considered to be modern. The system of light 3, 6 and 12 pounder field guns used during the Seven-Year War proved to be so successful that other European great powers practically copied it. From the middle of the 18th century to the middle of the 19th century, the Imperial Artillery had enough good-quality cannon, surmounting its Prussian rival in the quantity of guns and its Russian opponent in the greater proportion of mobile (mounted) units. During the Napoleonic Wars "Austria had the best artillery of the continental allies, but it could not compare to that of the French."

In 1848, the troops of the Hungarian revolution had to confront the effective and well-equipped Austrian artillery. In November, the besieged region of Háromszék in Transylvania faced a seemingly hopeless situation, due to the lack of artillery. Founder Áron Gábor then reached back to an ancient and simple barrel casting method, fitted to local circumstances. The number of guns produced with his method matched the strength of opposing forces in the region, making resistance possible.

The need for breech-loading rifled guns set new requirements concerning raw materials. In the transitional period leading up to the widespread use of cast steel, various barrel-producing methods and various raw materials were in use in many states. The choice of the Austro-Hungarian Monarchy was bronze, the specifications of which were improved by the Uchatius method: work-hardening the gun after casting it. However, while other great powers immediately changed to the use of cast steel barrels as soon as steel industry met the needed requirements, Austria-Hungary stuck with bronze barrels and did not employ modern construction methods when manufacturing guns either.

When entering the First World War, the Austro-Hungarian artillery, equipped with outdated artillery pieces, hardly met the requirements of its age. This outdatedness was obvious already in 1914. In comparison with Russian artillery weapons, Austro-Hungarian guns were inferior concerning both technical specifications and performance. New, modern guns equipped with steel barrels were introduced to the Austro-Hungarian arsenal during the First World War. Constructional improvement clearly showed in the performance of artillery pieces: the new guns were equal to their Russian counterparts.

With the Trianon Peace Treaty the country lost its artillery arsenal and its armament producing capacities. Starting gun manufacturing at Diósgyőr was crucial and successful already by 1924. Any yet, by the time of the Second World War, an awkward situation had arisen: although modern Hungarian, Italian and Swedish armour was manufactured, production capacity proved to be insufficient to supply enough guns and to replace losses. The Diósgyőr Gun Factory (MÁVAG-D) reached its production peak by 1943, with 1,260 artillery pieces a year. At the same time, there was a pending order for 2,160 guns from the Ministry of Defence that the factory was unable to execute despite the well-organised and extensive cooperation with other companies.

After the Second World War, the Hungarian Defence Forces, and then the Hungarian People's Army were well equipped with artillery weapons regarding both quantity and quality. Borrowing modern Soviet technologies secured top-level weapons. Hungarian gun production reached its peak by 1953, which was followed by a drawback and almost complete termination, due to the reduction of the strength of the armed forces. Gradual modernisation from the 1960s meant the extensive involvement of foreign sources, providing the Hungarian People's Army with sufficient modern artillery weapons.

In the fifth chapter, I studied how the previously written development line is represented in the Hungarian Military History Museum's collections, and how suitable those are to present the equipment used by Hungarian artillery. Considering this I divided the collection items into the basic classes introduced in the second and third chapters and analysed this classification based on what was stated in the fourth chapter, comparing the available collection items with the cannon types used by the Hungarian artillery. I argued that a representative of the heavy mortars of the First World War would make the collection complete to present the full development history of artillery pieces used in Hungary.

6. SUMMARIZED CONCLUSIONS

The manufacturing of guns and barrels had gone through huge technological development since their appearance. The influence of general technological development can be well demonstrated throughout the entire history of weapons. With outstanding cases the development line diverges, and therefore those cases are worthy of studying.

The casting of the first mortar-like guns reflected the scientific experience of the casting of bells, which had the same proportions. The need for cheaper manufacturing brought the profession of blacksmiths (and coopers) to the field of gun manufacture, but they needed the hammer mills' wrought iron as well. This way, "wrought iron cannon" of hoops and staves were born, which could be used similarly to previous guns, but their production required less advanced technology and cheaper raw materials

The need for cheaper manufacturing brought the profession of smiths (and coopers) to the field of gun manufacture, but they needed the forge's wrought-iron as well. This way needing less advanced technology and cheaper materials the iron cannon was born.

To produce longer bronze cannon new improvements were needed such as casting the barrel with the muzzle facing upwards, using a large feeder to recover the shrinking metal and the partial pre-heating of the mould. In the new technology's development, sometime in the middle of the 15th century, several unknown "polyhistors" had a prominent part, such as Vanoccio Biringuccio who studied the creation of bells, statues, water conduits and several other products and wrote a book in the early 16th century. They were not afraid to use experiments and use the gathered experience to produce cannon. Certainly, it was essential to have access to the raw materials of bronze, i.e. copper and tin, the worldwide trade of which unquestionably existed by then.

To decrease costs, i.e. to replace the expensive bronze in the process of manufacturing modern muzzle-loading weapons brought about the development of cast iron cannon. This was to satisfy the expanding fleets' artillery needs. Its fundamental condition was the spread of more efficient blast furnaces from the 14th century. The topic needs further research, but it is most possible that a key to the new development was the widening use of reverberatories (basin furnaces where the metal does not touch the combustible), which had been widely used to melt non-ferrous metal by the 16th century, when the first guns of this type appeared.

The invention of rifled, and then rifled and breech-loading guns in the 19th century motivated experimenting to find more durable materials for barrels. Wrought iron refined through Cort's puddling procedure, which aimed at reducing the carbon content of iron and producing solid steel, was used. It became clear that cannon manufacturing needed cheap cast steel. Henry Bessemer solved this problem with such a success that the entire steel industry was revolutionised, and the cost of steel radically decreased. The Siemens-Martin method, which appeared not much later and made more sophisticated and precise alloying possible, however, was “taken back” by the arms industry, suddenly making cast iron and bronze cannon permanently outdated.

Annealed steel barrels with a nickel compound also paid off. To decrease weight, built-up barrels were started to be used where the undersized outer barrel compressed the inner barrel. This facilitated that the pressure pliantly expanding the barrel when firing first dissolved this pressure so the peak of the pressure would be less in the most stressed layers near the bore. Later the same effect was achieved by directionally deforming the barrel made from one piece, the name of this process employed to date being autofrettage.

The development of Hungarian artillery equipment immediately followed the most advanced states’. In the middle and early modern ages with the German (Austrian) masters’ immigration and later with the adoption of advanced Austrian, German then Swedish technologies and finally – after the Second World War – the modern Soviet weaponry. The only exception was the artillery’s outdated weaponry of the Austro-Hungarian Monarchy in preparation for the First World War.

The Austro-Hungarian Monarchy’s metallurgy routinely used the Bessemer converters and the Siemens-Martin furnaces by the turn of the 19th and 20th centuries. The Skoda Factory delivered modern cast steel barrelled, so-called “rapid-fire” naval guns to its customers. Despite this the Monarchy’s artillery entered the First World War mostly with the “steel bronze” barrelled Uchatius-type cannon which, being mechanically hardened, may have been outstanding when they were introduced, but had become outdated by 1914.

Nevertheless, as the industrial capacity and the scientific background were available, the Monarchy was still able to introduce modern guns during the First World War and produce them in large quantities.

It can be stated that except the period before the First World War the technical and technological development and the artillery pieces’ development progressed in Hungary parallel with the most advanced states. The technical and technological development resulted in the adoption of existing weapon manufacturing technologies and artillery armament bearing such influence. There are no sources indicating that any kind of progressive, new gun manufacturing method or artillery equipment inspired by the technical and technological development was first applied in Hungary.

7. NEW SCIENTIFIC RESULTS

1. I introduced a new comparison matrix based method to prove that the cannon of Austro–Hungarian artillery were outdated considering the general technical and technological advancement of the state at the beginning of the First World War.

2. I proved with measuring calculations that the casting of muzzle-loading bronze cannon is only possible by pre-heating the muzzle of the casting mould, which is not mentioned in the scientific literature.

3. I proved that the Austro–Hungarian industry could have been able to provide modern cannon to the Monarchy preparing for war. With this I verified that the use of cannon with bronze barrels of outdated construction up to the First World War was not due to the state's industrial under-development.

4. I was the first academic to recognize and verify that the Bessemer process and Wilkinson's high-precision gun drilling, both considered revolutionary in the civilian industry, were originally developed for gun barrel production.

5. I proved with comparative analysis that the artillery park of the Austro–Hungarian Monarchy stepped into the world's forefront due to the impact of the First World War.

6. I was first to analyse the structure of the Military History Museum's collections in the light of the technical and technological advancement. As a result I pointed out that adding a representative of the heavy mortars of the First World War would make the collection complete to present the full development history of artillery pieces used in Hungary.

8. THE PRACTICAL APPLICABILITY OF THE SCIENTIFIC RESULTS

- The tabular system of criteria set up in the first chapter of my thesis gives a quickly applicable handy guideline at the start of a weapon's or weapon system's evaluation process correlating to the general technical and technological development and the requirements set for the artillery.

- The comparison matrix set up in the first chapter is appropriate to specify the advancement of historical weapons and weapon systems compared to the given technical environment. The matrices put into a system are suitable to support and confirm the results of comparative examinations. This method can be used with other researches of technical history.

- The history of the development of production technology discussed in the second and third chapters could be a useful addition to the learning materials of the following fields of study at the Faculty of Military Sciences and Officer Training of the National University of Public Service: Institute of Military Leadership Training engineer and artillery specialization; Institute of Military Logistics military technology specialization; Logistics of Military Operations Master course. Also it can be a useful supplement to the programmes of the Doctoral Schools of Military Sciences and Military Engineering.

- Statements provided in the fifth chapter can serve as a basis for the establishment of an Armament Park introducing artillery, organised from the collections of the Military History Museum.

9. RECOMMENDATIONS

- I plan to widen the research on the casting technology of muzzle-loading bronze cannon to include muzzle-loading cast-iron cannon. A widespread scientific cooperation is forming, the conclusions of which can solve problems of military history such as the disproportionately rare usage of muzzle-loading iron cannon in the territory of the Hungarian Kingdom.

- I wish to draw the attention of researchers of military history to the extraordinary period characterised by the preparations for the First World War and the years of the war itself. It seems necessary to reflect further on what kind of mistaken decisions led the Monarchy to not exploiting the existing industrial capacity to improve its artillery with modern guns.

- A possibly field of further research may be the investigation of what kind of steps were needed during the First World War to evolve cannon and barrel production to the general technical and technological standard of the period.

- The fourth chapter dealing with the development of Hungarian artillery pieces is recommended as military history educational material.

10. LIST OF PUBLICATIONS ON THE TOPIC BY THE PHD CANDIDATE

PEER REVIEWED BOOK CHAPTERS

Bán, Attila: Fegyvergyártás és fegyverzet.
In: Turcsányi, Károly (Ed.): *Haderők és hadviselés az elöltöltő fegyverek korában*.
MoD Military History Institute and Museum, Budapest, 2015. pp. 47–124.
(ISBN: 978-963-7097-73-7)

Turcsányi, Károly, Bán, Attila, Hegedűs, Ernő, Molnár, Gábor: A fegyvernemek és alkalmazásuk fejlődése.
In: Turcsányi, Károly (Ed.): *Haderők és hadviselés az elöltöltő fegyverek korában*.
MoD Military History Institute and Museum, Budapest, 2015. pp. 157–275.
(ISBN: 978-963-7097-73-7)

Bán, Attila: Az ágyúöntés technikája a Székelyföldön 1848–1849-ben.
In: Hermann, Róbert, Benkő, Levente (Eds.): *Ágyúba öntött harangok: Tanulmányok Gábor Áron születésének 200. évfordulójára*.
Háromszék Vármegye Kiadó, Sepsiszentgyörgy, 2014. pp. 100–120.
(ISBN: 978-973-8995-13-0)

Bán, Attila: Egy kiemelkedő magyar optikai-hadiipari termék.
In: Ravasz, István (Ed.) *Hadi Múltunk kincsesháza*.
MoD Military History Institute and Museum, Budapest, 2009. pp. 32–33.
(ISBN: 978-963-7097-39-3)

PEER REVIEWED ARTICLES IN JOURNALS

Bán, Attila: The influence of technical and technological development on cannon manufacturing in Hungary. *Műszaki Katonai Közlöny* Vol. 28. Issue 1. Budapest, 2018. pp. 277-286. (ISSN: 2063-4986

Turcsányi, Károly, Hegedűs, Ernő, Bán, Attila:
A nagyhatalmak tengeri hadviselése az elöltöltő fegyverek korában (1648–1866) Part IV.
Hadtudományi Szemle Vol. 9. Issue 4. Budapest, 2017. pp. 126–146. (ISSN 2060-0437)

Turcsányi, Károly, Hegedűs, Ernő, Bán, Attila:
A nagyhatalmak tengeri hadviselése az elöltöltő fegyverek korában (1648–1866) Part III.
Hadtudományi Szemle Vol. 9. Issue 3. Budapest, 2016. pp. 78–95. (ISSN: 2060-0437)

Turcsányi, Károly, Hegedűs, Ernő, Bán, Attila:
A nagyhatalmak tengeri hadviselése az elöltöltő fegyverek korában (1648–1866) Part II.
Hadtudományi Szemle Vol. 9. Issue 3. Budapest, 2016. pp. 57–78. (ISSN: 2060-0437)

Turcsányi, Károly, Hegedűs, Ernő, Bán, Attila:
A nagyhatalmak tengeri hadviselése az elöltöltő fegyverek korában (1648–1866) Part I.
Hadtudományi Szemle Vol. 9. Issue 1. Budapest, 2016 pp. 111–158. (ISSN: 2060-0437)

Bán, Attila: Változások a hadiellátásban a 14.-től a 19. századig. *Katonai Logisztika* Vol. 23. Issue 2. Budapest, 2015. pp. 240–249. (ISSN: 1789-6398)

Bán, Attila: A Monarchia utolsó bronzágyúja és első autofrettált lövegcsöve. Part I. *Haditechnika* Vol. 48. Issue 2. Budapest, 2014. pp. 2–4. (ISSN: 0230-6891)

Bán, Attila: A Monarchia utolsó bronzágyúja és első autofrettált lövegcsöve. Part II. *Haditechnika* Vol. 48. Issue 3. Budapest, 2014. pp. 2–4. (ISSN: 0230-6891)

Bán, Attila: Ágyúk a XIV. században. *Hadtörténelmi Közlemények* Peremirat. Budapest, 2013. pp. 24–34. (ISSN: 0017-6540)

Bán, Attila: A magyar királyi Honvédség ellátása optikai eszközökkel az első világháború előtt és alatt. *A Hadtörténeti Múzeum Értesítője* 12. Budapest, 2011. pp. 207-213. (ISSN: 0238–4442)

Bán, Attila: Az ágyúgyártás különös nehézségei Háromszéken 1848–1849-ben. *Acta Siculica* 2009. Sepsiszentgyörgy, 2010. pp. 323–338. (ISSN: 1843-8385)

Bán, Attila: Középkori és újkori bronzágyúk öntéstechnológiájának vizsgálata. *Bányászati és Kohászati Lapok. Kohászat* Vol. 142. Issue 1. Budapest, 2009. pp. 6–12 (ISSN: 0005-5670)

ARTICLES IN FOREIGN LANGUAGE PUBLICATIONS

Bán, Attila: The M1941 Field Telephone. In: Sallay Gergely Pál, Závodi Szilvia (Eds.) *100 Years – 100 Artefacts*. MoD Military History Institute and Museum, Budapest, 2012. pp. 102-103. (ISBN: 978-963-7097-54-6)

Bán, Attila: The M1934/38 Gamma-Juhász Director or Auxiliary Predictor. In: Sallay, Gergely Pál, Závodi, Szilvia (Eds.): *100 Years – 100 Artefacts*. MoD Military History Institute and Museum, Budapest, 2012. pp. 86–87. (ISBN: 978-963-7097-54-6)

Bán, Attila: The M1930 Compass. In: Sallay, Gergely Pál, Závodi, Szilvia (Eds.): *100 Years – 100 Artefacts*. MoD Military History Institute and Museum, Budapest, 2012. pp. 78–79. (ISBN: 978-963-7097-54-6)

PRESENTATIONS PUBLISHED IN CONFERENCE PROCEEDINGS

Bán, Attila: A bronzágyúk öntéstechnikája a középkor és az újkor fordulóján. In: Szabó Sarolta (Ed.): *Örökös háború két világ határán: Katonák, fegyverek és hadviselés a törökök elleni küzdelemben: hadtörténeti konferencia a kenyérmezei csata 510. évfordulóján.* (Place and date of conference: Nyírbátor, Hungary, 13. 10. 2009) Nyírbátor, 2011. pp. 77–91. (ISBN 978-963-7220-74-6)

11. PROFESSIONAL CURRICULUM VITAE OF THE PHD CANDIDATE

PERSONAL DATA

Name: Attila BÁN
Rank: lieutenant colonel
Date of birth: 04 09 1972
Place of birth: Cegléd
Present workplace: MoD Military History Institute and Museum
Position: deputy director

CAREER

1 May 2011	deputy director, MoD MHIM Military History Museum
1 May 2010	deputy head of department, Motorised Vehicles Collections
1 November 2000	curator, head of collection, Collection of Instruments
1 November 1998	head of subdepartment, Conservation Subdepartment
1 January 1993	collection companion, Arms Collection
1 October 1991	collection assistant, Arms Collection

Decorations and Medals

2017 Migration Crisis Medal
2012 Officer's Long Service Cross, 2nd Class
2010 Meritorious Service Medal in Gold
2005 Meritorious Service Medal in Silver
2002 Officer's Long Service Cross, 3rd Class
1999 Meritorious Service Medal, 3rd Class
1998 Home Defence Medal (Civilian), 3rd Class

STUDIES

Miskolc University
    12 06 2008 University Degree: Metallurgical Engineer
HDF Budapest Military Professional Training School and Boarding School
    14 05 1999 Military Special Examination in Logistics
Technology College of Engineering Industry and Automation
    29 06 1998 College Degree: Mechanical Engineer
Hungarian National Museum (Central Museology Institute)
    31 01 1994 Skilled Museum Collection Assistant Certificate
Gábor Egressy Technical School
    18 06 1993 Technician Certificate: Precision Mechanics and Automation Technician

Command of Language: English intermediate exam (oral and written) specialised in military terminology
Russian elementary exam (oral and written)

PROFESSIONAL EXPERIENCE:

I have worked at the Hungarian Military History Museum since October 1991. I worked as collection assistant from 1 January 1993. I had the chance to get acquainted with the basics of museum administration, conservation and exhibition making. I participated at the Scientific Students' Competition launched by Miklós Zrínyi National Defence College in 1996, winning first prize in the military history category with my paper titled “Hungarian-Made Handguns of the Royal Hungarian Defence Forces with Special Regard to the Arms Industry Background, 1886–1945.” I was awarded the Home Defence Medal (Civilian), 3rd Class for my work as collection assistant.

In June 1998, I got my degree in mechanical engineering. My thesis discussed the partial automation of the dismantling of artillery pieces. In November, I was commissioned as military officer and was appointed head of a subdepartment. I completed a special military course in logistics at the HDF Budapest Military Professional Training School and Boarding School. The Conservation Subdepartment that I was head of comprised colleagues who directly handled artefacts: collection companions and restorers. I introduced new types of register books for the relocation and restoration of artefacts; I managed to organise the partial dehumidifying of the storages below ground level and the sterilisation of mouldy collection items; and took part in the supervision and rationalisation of loan contracts. For my activity, I was awarded the 3rd Class of the Meritorious Service Medal by the Minister of Defence.

In November 2000, after my subdepartment ceased to exist, I was appointed curator and head of collection of the Collection of Instruments. The collection primarily consists of instruments of military communication, as well as optical tools. The great variety of items in the collection requires diversified technical knowledge and constantly offers opportunities for self-education. Owing to the continuous acquisition of instruments presently or formerly introduced to the Hungarian Defence Forces, the number of collection artefacts rapidly increases, on a scale unparalleled by several other museum collections.

In 2008, I obtained a metallurgical engineer’s university degree, specialised in metal casting and material testing. The knowledge that I had acquired during my studies enhanced my opportunities to research the technologies of manufacturing historic weapons. When writing my dissertation on technologies of bronze cannon casting I had the chance to test historic gun barrels, which, to my knowledge, had been unprecedented in Hungary.

In 2008, I was admitted to the Hungarian National Mining and Metallurgical Society. From March 2009 to the end of 2012, I acted as secretary of the Casting History and Museums Specialist Group within the Casting Section.

In May 2010, my collection was integrated into the newly established Motorised Vehicles Collections, appointed as deputy head of department.

For my museum activity, I was awarded the Meritorious Service Medal in Silver in 2005, then the same in Gold in 2010.

From July 2011, I have been deputy director of the MoD MHIM Military History Museum. At present, I am a PhD student at the Doctoral School of Military Engineering of the National University of Public Service. To date, I have published 26 articles on the Collection of Instruments that I am head of; the guns of mediaeval and modern artillery; and other topics related to the history of military technology.

Budapest, 25 April 2018