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FACULTY OF MILITARY SCIENCE AND OFFICER TRAINING
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**The Hussite war wagons and their appliance
in the Carpathian Basin
(1428–1606)**

the author's description and official reviews of the doctoral dissertation

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Reasons for the thematic concept

The analyses of the Hussite war wagon and its application are inseparable. It was used on the battlefields for about 200 years, and only a few could defeat it in the first third of its career. The war wagon got effaced by the rapid spread of fire weapons and the appearance of effective field artillery (about 400 years ago). At the end of the process, this unic machine disappeared utterly.

As a war machine, the war wagon's examination belongs to the area of the history of military technology. Although the research of military equipment withered a long time ago and is also part of the Doctoral School of Military Engineering's profile, I am aware of very few dissertations with a similar object. For that reason, it would be necessary to do research that focuses on the structural characteristics of the aforementioned combat vehicle, like the types of raw materials required for its construction (types of wood and metalworking). I intend this dissertation to be the first step on this path.

The scientific problem

The fact that at the beginning of the 15th century, participants of the Hussite uprising broking out in the Kingdom of Bohemia used war wagons equipped with small barrel-sized cannons and other fire weapons is already known in the modern, relevant literature. The information that the insurgents' tactics were defensive, and was based on the wagon fortress (or with another expression: the *wagenburg*), is also not a piece of new information.

The invention and use of the Hussite-type war wagon and the wagon fortress are still considered revolutionary. The strength-based gap between heavy cavalry and infantry has been reduced thanks to the device. Otakar Frankenberger (1911–1998) wrote: „Standing on the chariot, the infantry member has the same height as the knight on his horse, but unlike him, both hands were free, and he could hide behind the wagonside if necessary. Like that, he could defeat the knight with his primitive weapon.”

In the first third of the 15th century, the army of the Hungarian state adapted the Hussite-type war wagons, the wagon fortresses combined with fire weapons and the method of use. In this dissertation, I proved through detailed examples that there are proofs of their application on the battlefields of the Carpathian Basin – one hundred and fifteen years after the decisive Battle of Mohács.

The relevant literature in Hungary has not paid enough attention to the phenomenon until now, even though there are many unanswered questions and unsolved problems connected to the weapon/war machine (war chariot) and the method (wagon fortress/*wagenburg*) itself. Is

it possible to make the description of the war chariot more precise? How the war wagon and wagenburg were used in the 15th century? Was it still in use in the 16th century? Those are only a few of the relevant questions. Science has not examined the possibility of manufacturing the war wagon yet, and the analysis of the expenses connected with the production and maintenance of the vehicle and the wagon fortress is still missing. The essence of the scientific problem is to explore a barely-researched topic. In this dissertation, I examined the construction and appliance of the war wagon and the use of wagon fortress in the Carpathian Basin.

The research itself needed to be limited. The previous application of the war wagon could not be ignored. For that reason, I examined how these vehicles were used in the Early Middle Ages, but not the chariots of ancient civilisations. The main reason is: that there may be common points in the method of use, but the role of the wagons was quite different.

Although I observed the appliance of the war wagon and wagon fortress in the Carpathian Basin between 1428 and 1606, the research limits needed to be violated. The reasons for geographic diversion:

1. The previous theoretics' use of the wagon fortresses was traced back to the (steppe) nomadic peoples. The elements of the steppe can be discovered.
2. In the way the battle of Muhi took place, the elements of the steppe style of the appliance can be discovered. Therefore, I considered it justified to involve it in the analysis.
3. The Hussite wagon fortress-tactics was developed in the Kingdom of Bohemia; therefore, in the research, I included the Bohemian application as well.
4. The Hussite way of the use of the war wagons and wagon fortresses has been tried to be copied several times in several places, but the only successful implementation was made by the medieval Polish state. Since the Polish adaptation is related to the application in the Carpathian basin (the wagon fortress was not, or not only, used for the protection of the infantry, but the cavalry also relied on it heavily), I used the relevant research as an analogy to conclude.

The reason for leaving the time frame was the geographical detour itself. The duration of applications outside the Carpathian Basin typically does not coincide with the one defined in the title of this work; nevertheless, due to the reasons listed in the numbered paragraphs above, I considered it necessary to include them in the analysis.

Objectives of the dissertation

The main goal of the research is to make a device-centred analysis of the development of the war wagon and wagon fortress, its use on the battlefield and the adaptation of the Hussite-type instrument and wagon fortress by the army of the Hungarian Kingdom from the first Hussite raid against the territory of the aforementioned state (1428) to the end of the Fifteen Years War (1606).

Partial objectives

- P1.)** To uncover the structure, characteristics and appliance of the Hussite war wagon.
- P2.)** To examine the economic background connected to the Hussite war wagon and wagon fortress. (Costs and its measures of manufacturing or buying of the devices.)
- P3.)** To uncover, organise and rate the use of the war wagon and wagon fortress in the Carpathian Basin between 1428 and 1606.
- P4.)** To compare the original usage (developed by the Hussite rebels) and the adaptation in the Carpathian Basin of the war wagon and wagon fortress.

Hypotheses of the dissertation

- H1.)** One of the agricultural/trade wagon types used in the Carpathian Basin in the researched period can be matched with the basic vehicle needed to build a war wagon.
- H2.)** Building a war wagon and setting up a wagon fortress in the examined period had significant expenses. I presume that the success of its application had to compensate for the costs.
- H3.)** Despite there are known some early examples of the adaptation of the vehicle and its tactics, [Ialomița-river (1442), Varna (1444)] the wagon fortress had a completely quite different role on the battlefield compared to the Hussite method.
- H4.)** The wagon fortress remained in use on the battlefields of the Carpathian Basin till the middle of the 17th century [pl. Mezőkeresztes (1596), Braşov (1603), Vezekény (1652)].

Research methods

Despite a large amount of monographies, articles and other works connected to the Hussite warfare, the examination of the structure of the war wagon is only partially possible, but beyond that, methodological obstacles are encountered. It is possible to answer such questions, and problems as the components of the wagon or the tools used to transfer the „horse-power” (or power of another draft animal); however, this required a synthesis of the results of several fields of science. The methods used were:

1. Thanks to my language knowledge, I have **also managed to examine** the *Slovak* and *Czech* researchers' articles. A large amount of the relevant literature is written in the aforementioned languages.
2. To identify the elements of the transport vehicles I have **collected** the relevant illustrations from contemporary sources. If possible, I have also **compared** the contemporary texts with the results of modern literature.
3. Using contemporary military regulations and other orders, I have **identified** the weapons and instruments connected to the war wagon's equipment.
4. I have **examined** and **made calculations** based on the measurements made on the 1:1 ratio *quintal cart* replica on the ground of Visegrad high castle.
5. I have made **calculations** related to the firepower of the fictional wagon row and costs of use based on the analysis of contemporary sources and modern literature.
6. Based on contemporary sources, I have analysed the diversity of each adaptation of the Hussite warfare.

Troubles during the research

As I underlined above, synthesis of the results of several fields of science was required. This presents challenges to the researchers, especially when, (as in the present dissertation), the subject of the research is distant in time from the present.

1. Regarding the interdisciplinarity of the topic, modern literature is highly far-reaching (from the fields like military technology and art, history, ethnography, and geography). Most of the articles are written in *Slovak*, *Czech* or *polish*.

2. There were no created technical instructions for the vehicles in the examined area. The notes written by the craftsmen who manufactured the civilian and military vehicles are also unavailable.
3. There is not possible to make a detailed and accurate measurement on a war wagon because any of those original (contemporary) vehicles were not preserved.
4. Many contemporary textual sources were written in Czech or German but in variants spoken in the 15th and 16th centuries. Those versions eventually contained different vocabulary and character-set. The last one caused another additional difficulty: many sources were written in Latin, German or Czech languages, so interpretation and the correct spelling required preliminary studies in history.

The structure of the dissertation is described in chapters

The thesis consists of five main chapters:

1. In the **first chapter**, which was the introduction at the same time, I phrased the main scientific problem that formed the basis of the dissertation. I laid out the research objectives, set up hypotheses and described the methods used during the examination. I briefly covered the procedures used (also by other authors) during interdisciplinary investigations.
2. The **second chapter** contains a device-oriented examination of the examined vehicle. I have given a detailed description of the structure of the „civilian” wagon, each element's role, and possible structural development time. In the rest of the chapter, I analysed the equipment, armament, capabilities and progress of the war wagon itself.
3. The **third chapter** I dedicated to the description of the wagon fortress or *wagenburg*. I analysed the aspects and criteria of the camp placement in the field and what factors were pivotal when placing the war wagon and supply carts. I described the weapons and equipment of the *wagenburg* and made a textual source-based firepower estimation regarding the wagon row (as part of the wagon fortress).
4. In the **fourth chapter**, I discussed and context the financial/economic aspects of the appliance of the war wagon and wagon fortress. (by comparison with treasury and estate income and monthly salaries).

5. In the **fifth** and last **chapter**, I collected and analysed the adaptations of the „wagon-and wagon fortress-warfare.” I researched the efficiency and weaknesses, examined the secret of success, and how the adaptation developed in the Carpathian Basin.

Summarised conclusions

The research interpreted in the dissertation focuses on the war wagons used by the Hussite rebels, the wagon fortress combined with fire weapons and how they were used. I searched for the answers to questions that science has not paid enough attention to, such as the possibility of making the description of the structural construction of the war wagon more precise, how the device and the wagon fortress were used in the 15th-, and their existence in the 16th century. I paid attention to the problem of the manufacturing of the device. In addition, I examined the amount of financial resources necessary to set up, maintenance and upkeep the war wagon and wagon fortress.

In the **first (introductory) chapter**, I explored the methodology used by another researcher in cases when contemporary sources relevant to the examined object or procedure were barely available. Furthermore, I phrased the scientific problem, the objectives and hypotheses, and last but not least, I described the relevant literature; using tools from several scientific fields and sub-fields was crucial.

In the **second chapter**, the subject of the study was the device-oriented analysis of the Hussite war wagon. I clarified which vehicles used in agriculture and trade can be named „wagon” and the difference between the mentioned vehicle and the „cart”. In the last parts of the chapter, I looked for the answer to which type of „civilian” vehicle the war wagon can be derived from. Based on the relevant literature and source material, I concluded that the so-called „quintal cart” was the primary vehicle. I examined the construction, equipment, armament and firepower, load capacity, and manufacturability of the transport vehicle and the war wagon.

Based on the reviewed literature and the analysed primary textual and pictorial source material, I concluded that the structural construction of a war wagon produced in the territory of the Kingdom of Hungary in the first half of the 15th century was as follows: The primary vehicle was a two-axle, four-wheeled iron-strengthened wagon, quite similar to the quintal cart. Approximately 3 m long (without the cart pole), 2 m wide and the same height, pulled by 2-4 workhorses harnessed in pairs behind each other. Including the pole, depending on the number of captured animals, the total length of the device could exceed 8 m. As was generally typical for the mentioned vehicles, the wagon consisted of two main parts, the wagon base and a detachable upper part, the so-called wagon bed. On both of the axles, the front- and rear bolsters

were fixed with iron braces. The upper bolster¹ was fitted onto the front bolster. This part allowed the axletree to move in two directions, thus, making it rotatable. The two parts mentioned above were attached with a bolt, and to be more specific, the „mobility” of the upper bolster was connected to this element. Stability was a significant aspect of the „primary vehicles” needed to build a war wagon. For that reason width of the two axles had to be almost the same; otherwise, during a curve, it could quickly turn over. As a part of the wagon wall, the stability also had a high level of importance since the overturning of the vehicle by the opponent had to be prevented in some way. The rear axle is fitted to the wagon bed directly. The wheels consisted of 6-8 curved fellies and the same number of spokes by each element. The individual fellies were fixed with iron belts and sometimes reinforced with metal plates. The difference between the width of the fellies on the front and rear wheels could not be significant in order to maintain stability. The wheel was mounted on the tapered end of the axle and reinforced with metal plates and rings. The spokes were held together by the hub. The end of the axle end was extended beyond the hub just so much, that it could be secured with nails. The front and rear axles were connected by the reach, the front of which was fixed between the front axle and bolster and the rear axle between the rear axle and the rear bolster. Since the rear axle was set higher than the front, the reach was slightly tilted forward. The coupling of the horses was possible by the cart pole and the hound, two separate elements. The two arms of the hound were attached between the front bolster and axle, while the cart pole was attached to the front part of the element for that it could be detached from the device in one move. The doubletree was fixed on the front part of the hound, parallelly with the front axle and bolster. On the doubletree were mounted two singletrees so the harness could be attached. On the upper beam and rear bolster was sitting the bottomboard. On the two opposite sides were fixed, the wagonsides strengthened with iron. Stakes, cart stakes or both fixed those elements.

What made the primary vehicle an actual war wagon was the following: a palisade with portholes to increase the crew’s protection, forks fixed up on the palisades to backup the fire weapons, and a plank attached to the bottom of the vehicle, which – due to the „slope” of the reach – possibly might have been fit upon the bottomboard. The equipment consisting of weapons and tools was also pivotal for the war wagon. These could be divided into five categories based on their use: long-range weapons, ammunition and tools for firing shots, melee weapons, tools for removing natural obstacles (or raising defences), and finally, horses and their equipment. It is essential to underline that in the period examined in the dissertation, there was

¹ The original name of the element – the *förgettyű* – is barely possible to translate into English.

no mass production based on standards, so there presumably were minor differences in size and construction between each vehicle, but these differences could not be considerable. At the same time, I have no reason to assume that the vehicle's structure would have changed significantly in the discussed era.

In the **third chapter**, I examined how the original Hussite wagon fortresses were set up, how much firepower the weapons represented, and finally, how much time the camp needed to decamp, transform into a wagon column, move to a new location and set up a closed formation – the wagenburg – there again. Based on the contemporary sources and relevant literature, the following summary can be given about the Hussites' wagon fortresses: they always tried to choose naturally well-defended areas with sufficient drinking water for people and horses. The war wagons that formed the main defence line of the camp were attached according to the “wheel to wheel” principle. The „wooden palisade” was strengthened with ramparts and trenches. The gates of the camp were always strongly guarded. The described method of setting up the camp was confirmed by the artefact found during archaeological excavations (see more: military camp near Klučov). For the Hussites, the wagenburg was also used as the framework for army organisation. The basic unit was the war wagon and its crew. The structure of the rebels' armies was provided by higher-level elements, organised with basic units. The leading was concentrated in the hands of a commander-in-chief.

I underlined that a hypothetical 180 m wide wagon row (literally one side of the wagon fortress) containing 45 wagons would have had 180 crossbows, 90 small firearms and nine guns. With such firepower, an enemy approaching 200 m could have been effectively targeted with crossbows and guns. If the distance is about 100 m, small firearms could also have joined the fusillade.

Due to the tempo of the charging cavalry, these devices could only be fired once, but the attackers faced 180 pieces of thick, fast arrows and 99 metal balls on a 180 m wide section. This effectively halted their charge. Also, that was the explanation that by the time they reached the line of chariots, the defenders could completely stop them with flails, lances and melee weapons.

In the third chapter, I also presented the daily performance of the Hussite wagon fort on the move. Regarding the comparison with the marching speed of armies made up of mounted units, or predominantly infantry, I showed that the speed of a column of wagons could be placed between the marching performance of the abovementioned army types: about 40 km per day.

In the **fourth chapter** of the dissertation, I scrutinised the financial aspects of the war wagon appliance and setting up the wagon fortress. After examining relevant literature, I briefly

presented the 15-17th century value of a payment, and then I outlined how the court incomes, estate revenues and contemporary (civilian and military) salaries were formed and how much they were worth. As far as the sources allowed in the discussed era, I reviewed the scale of costs connected with setting up a cart or wagon with entire equipage. Finally, with calculations based on data from contemporary sources, I tried to clarify how much of a burden it was (compared to the price conditions of the time) to buy (and maintain) a cart with horses and equipment, but a whole wagon fortress.

Calculations revealed that the expenses for setting up an average wagon fortress consisting of 300 wagons, including the vehicles, related blacksmith work, and a sufficient number of workhorses, only covered the starting costs. The amount could equal several years' income of an entire market town [*oppidum*] or large estate or three months' wages for a respectable group of mercenaries (hundreds or thousands of soldiers, depending on the type). In the same place, I pointed out that despite the very high budget of the appliance of war wagons and wagon fortresses, their use was quite common in the Carpathian Basin. The main reason is to be found in the advantages of the *wageburg*: it could be used as a mobile fortress, which the experienced crew was able to set up in a short time, and then, with the practical cooperation of the military branches of the time, they were able to confront an outnumbered enemy successfully. In short, its application paid off no matter how expensive it was.

The purpose of the **fifth chapter** was to examine, with the help of contemporary sources, its modern publications and modern literature, whether the army of the Hungarian Kingdom adapted the method of Hussite rebels along with the war wagons and wagon fortresses of the Hussites, and if so, for how long was it a part of it? For a broader context, I also examined Western European, Czech and Polish examples, including primary sources and the relevant literature. I enlightened that although Hussite war wagon and wagon fortress appeared in a short time in the army of the Hungarian Kingdom, they did not adopt the *wagenburg*-tactics. Várna and Rigómező are good examples of how the Hungarian leadership wanted to fight by relying on a traditional method based on (light and heavy) cavalry – leaving the advantages of the Hussites' combat equipment partially unexploited.

I proved that after the decisive defeat near Mohács in 1526, the use of war wagons and wagon fortresses – even if in a changed form – remained on the battlefields of the Carpathian Basin. For instance, the garrison members of Győr tried to use a „Hussite-like” war wagon, although the forming of the wagon fortress was an improvisation. Although wagons and wagon fortresses were used, the Hussite characteristics completely disappeared. The Battle of Vezekény is the last known engagement where the *wagenburg* was part of the war plan, and

thus – on a theoretical level – the idea shows similarities with the Polish adaptation of the Hussite tactics.

The new scientific results

1. Using the methodology of several scientific fields, I proved that the so-called quintal cart corresponded to the robust primary vehicle required by the military regulations, and the vehicle was good enough to construct Hussite war wagons. That seems to be confirmed by one of the relevant lines of the Hertnek account book (1621): „Under the horse stable’s arcade, there is a large copper howitzer, with all its tools. [Also a] Large long hooked gun mounted on a quintal cart.” [„Az lo istallo tornacha alatt vagon nogi (nagy) réz taraczk, minden szerszamaval. Nogi hoszu forgho szakalos *masas szekereken*”]
2. I researched and uncovered the language base, upon which it was possible to specify the names of each wagon element in the period under study. I confirmed the existence of the main structural elements of the aforementioned vehicle during the research period. I also proved that Hugo Toman’s statement about the unchangingness of wagons used in agriculture and trade between the 15th and 20th centuries concerning the Carpathian Basin is correct.
3. I clarified many parts of the war wagon’s and the wagon fortress’ already known structural description. On that basis, I managed to describe the components of the wagon fortress’ ability to stop the heavy cavalry attack. Relying on sources written in the researched historical period, the theoreticians have tried to conclude the abilities of the wagon fortress from the reasons for the collapse of the attack. In this work, the method of analysis was done oppositely. With that, I clarified the effectiveness of firearms mounted on or used by the personnel serving on each wagon of the defence line and the depth of the area that could be shot.
4. I first examined the economic casemaps connected to the Hussite war wagon and wagon fortress. The results of the calculations based on the literature and data from contemporary sources revealed that the initial costs of setting up a wagon fortress consisting of 300 wagons are two or three times more than the annual income of an entire market town [*oppidum*] or large estate, or several months' wages for a group of mercenaries.

5. I proved this with several examples [e. g. Győr (1577), Mezőkeresztes (1596), Brassó (1603)], János B. Szabó's idea regarded to the appliance of the war wagon and wagon fortress. Those were still in use in the Carpathian Basin until the beginning of the 17th century. I pointed out a hiatus in the region mentioned above of modern weapons in quantity and quality, which could have expelled the wagon fortresses entirely from the battlefields.
6. I revealed the specifics of the use of Hussite war wagons and wagon fortresses in the Carpathian Basin, and at the same time, I pointed out the differences between the original methods of the rebels and the adaptations. Despite the fact that Hussite war wagons and wagon fortresses were adapted by the army of the Kingdom of Hungary shortly after the decisive Battle of Lipany, the tactics „belonging” to the equipment were not adopted. In the example of battles at Varna and Kosovopolje, the Hungarian military leaders' tactics were built on the cavalry – the advantages of the Hussites' combat equipment were exploited only partially.

Recommendations

Due to the limitations of this dissertation, it was not possible to do research and elaborate on a few connected sub-topics. However, carrying out these analyses' would be necessary. Regarding the application of the Hussite war wagon and wagon fortress, I consider it very important to extend the research to the following ways:

- It would be pretty helpful to examine the processes of metalworking and the appearance of each part. This is especially true for the wheel rim – how and when can the metal bands holding the fellys be replaced with the aforementioned element?
- An important task is the further research of the infrastructural background of wagon manufacturing in the examined period. The initial goal is to localise and determine the raw material deposits (ores, types of wood). Clarification of wood types used to fabricate each part of the war wagon (especially the wheel elements) could provide data for calculating the vehicle's load capacity.
- By expanding the geographical framework, it is necessary to investigate further the application and adaptation of the war wagon and the wagon fortress in the examined period. I consider it very important (with the involvement of contemporary sources) to

analyse the wagon fortress variant developed by the ottoman army: the tabur çengi and the cossacks' wagon camps.

- In my view, it would be significant to present the wagon fortress tactic from the aspect of military art.

Practical application of research results

- The methodology used in this dissertation can help analyse objects and procedures that are difficult to examine due to limited resources. For this, using the methodology of several scientific fields during the research is essential.
- The new scientific results of the thesis can be helpful for further examinations regarding Hungarian military history and the history of technology, as well as for the more powerful utilisation of military regulations and inventories. The information extracted for the military equipment from the aforementioned contemporary sources justifies their deeper analysis during future investigations.
- Further use of the dissertation is also possible during future research when applying the economic-scientific approach. It also can provide a basis for mapping the economic framework of the military equipment used in the past.

Publications related to the research

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Professional–scientific curriculum vitae

Name: Dominik Tóth

Location and time of birth: Losonc/Lučenec (volt: CSSZK), 1991.10.02.

In 2011: Graduated in High School in Fil'akovo (Gymnázium Fil'akovo). He was admitted the same year to the Bachelor's Degree Program in History at the Károli Gáspár University of the Reformed Church in Hungary, which he completed in **2014** with a specialisation in *Military History, Weaponry and Military Strategy*.

In 2014: He continued his gradual studies in the Master's Degree Program in History at the same university. Graduated in 2016.

In 2016: He started his studies in the Doctoral School of Military Engineering, in the Faculty of Military Sciences and Officer Training, at the National University of Public Service.

Between 2015 and 2018: employer of House of Terror Museum (guide)

From 2018: a co-worker of Military History Institute and Museum and member of the Society of Hungarian Military Science

Language skills: Slovakian advanced (C1), English vantage (B2)