Zrínyi-Újvár

A Seventeenth-Century Border Defence System on the Edge of the Ottoman Empire

Edited by:
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dialóg Campus

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Contents

Preface

Gábor Hausner – András Németh

The region where the modern frontiers of Croatia, Hungary and Austria meet was protected against the Ottoman occupation by chains of smaller and larger defences (fortresses, watch towers, outposts, fortified castles, engineer barricades, water barriers) established along the Rába, Mura and Drava Rivers in the seventeenth century. A part of this system was the defensive zone of Muraköz, including about a dozen outposts, managed by members of the Zrínyi family; hence its contemporary name, the *Zerinische Grenze* ("Zrínyi border area"). Beginning with 1649, Miklós Zrínyi (VII, 1620–1664), Ban of Croatia and Slavonia, directed its defence as the Captain General of Muraköz and Légrád.[1] This charismatic military leader of the border fights, one of the high dignitaries of the Kingdoms of Hungary and Croatia, a politician with European perspectives, added a new stronghold to this border defence system in the summer of 1661. It was meant to keep the Ottoman territories found beyond the Mura under closer control, and to hold Kanizsa (an important Ottoman *vilayet* centre) at bay. Zrínyi-Újvár was built from rammed earth and timber "in the Hungarian way", to the north of the confluence of the Mura and Drava Rivers, on the left bank of the Mura, making effective use of the favourable geomorphological and other natural features of the region. It played an important role in international anti-Ottoman schemes and served as a *casus belli* for the outbreak of the Ottoman–Habsburg War of 1663–1664.

It was during this war (in June 1664) that the Ottoman main army led by Grand Vizier Köprülü Ahmed took the fortress after more than three weeks of siege, and subsequently levelled it to the ground. The sixth article of the armistice agreement accepted by the envoys of Habsburg Leopold I, Holy Roman Emperor and King of Hungary, and Sultan Mehmed IV in Vasvár, on 10 August, stated that neither party would be allowed to rebuild the fortress and post guards in it. Zrínyi-Újvár existed for only three years, but it was the focus of Europe's attention from 1663 to 1664. Finally, it completely disappeared from the face of the earth and slowly faded from historical memory, as well. Compared to its strategic significance and the large number of pamphlets and pictorial representations that have survived about it, until the late twentieth century, we had little information about the location and character of the fortress, as well as the circumstances of its establishment and its end. The reason for this lies not only in the complete destruction of the stronghold, but also in the diverse perceptions of its role already among the contemporaries.

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[1] For the latest summary of Miklós Zrínyi's life's work, see the following volume published in Hungarian and English: *Sándor Bene – Nóra G. Etényi – Gábor Hausner – József Kelenik – Ágnes R. Várkonyi:* Zrínyi-album [Zrínyi Album]. HM Zrínyi Nonprofit Kft. 2016.

The history of the location, role, building and destruction of Zrínyi-Újvár came back to the forefront of international interest with the launch of cross-border, interdisciplinary research programs in the mid-1990s, which focused on the historical investigation of this special border region flanked by the Mura and Drava Rivers and the triple frontier stretching there.

In Hungary, the historical research and excavation of Zrínyi-Újvár was initiated by László Vándor, archaeologist, supported from the side of history by Ferenc Szakály, an internationally renowned researcher of the Ottoman period, and a member of the Hungarian Academy of Sciences. Finally, the on-site investigations were carried out with the collaboration of experts from the Institute and Museum of Military History of the Ministry of Defence, the Miklós Zrínyi University of National Defence (since 2011 National University of Public Service), the Directorates of Somogy and Zala County Museums – historians, military historians, military engineers, cartographers and archaeologists. Their work was supported by the municipalities and helpful residents of Belezna and Őrtilos (these settlements share the area and neighbourhood of the fortress today).

Our research group – comprising mainly former and current teachers of the Faculty of Military Science and Officer Training at the National University of Public Service, and its predecessor the Miklós Zrínyi University of National Defence – has been conducting systematic battlefield investigations in the immediate vicinity of the current Croatian–Hungarian border since 2005.

The first results of this research can be found in a volume entitled *Zrínyi-Újvár emlékezete* [The Memory of Zrínyi-Újvár] published at Argumentum in Budapest, in 2012. At that stage of the research, the emphasis was on new sources and their historical interpretation, whereas the study of on-site excavations and finds occupied a minor role due to the scarcity of financial and human resources. Since then, we have adopted a number of state-of-the-art technical solutions, instruments and methods in order to gain the most comprehensive and accurate picture possible of the fortress, its surroundings and the siege of 1664. In this book, after discussing the construction, role and siege of the fortress, we present the latest results of excavations beginning with 2012 (including the archaeological excavation of a section of the wooden post structure and the well of the fortress). Furthermore, we demonstrate non-destructive survey methods, which can be used to obtain information without disturbing the ground surface in order to detect, investigate, evaluate and interpret subsoil anomalies of archaeological interest.

The presentation of techniques and methods based on different principles of surveying and their potential areas of application have therefore received significantly greater attention in our volume than in the 2012 edition. We obtained new results in the metallographic (electron-microscopic and X-ray Fluorescence Spectroscopy) analyses of artillery and infantry projectiles and their shrapnel, which can be connected to the Ottoman siege of Zrínyi-Újvár in 1664, as well as in the archaeometric analysis of iron nails used for the construction of the well uncovered from the well in the spring of 2017. Additionally, we carried out a xylotomical analysis of timber materials used for the well. Last but not least, we dedicate a major case study in our volume to 3D imaging and modelling, in which we demonstrate through the examples of Zrínyi and Zrínyi-Újvár the possibilities of their application in archaeology and their use in education. Virtual/augmented reality-based solutions can become useful tools for interactive teaching of history. In a prototype version prepared while developing a virtual view of Zrínyi-Újvár, we can explore the contemporary landscape and the fortifications in the role of Miklós Zrínyi himself.

In the last chapter of our work, we include again the texts of the most significant Christian and Ottoman written sources on Zrínyi-Újvár.

We do hope that by applying the up-to-date methods and tools of history, archaeology and engineering side by side, we shall be able to unveil the past, and bring to light the historical heritage that has been destroyed but preserved deep in the ground, and thus bring out from the obscurity of oblivion an important piece of Miklós Zrínyi's life's work.

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The Research History of Zrínyi-Újvár

Géza Szem – Gábor Hausner

Historical research, both Hungarian and international, relating to the fortress of Zrínyi-Újvár has long been seeking answers to the following questions: 1. Where did the fortress stand and what was it like? 2. What role and significance did it have, if any, in the struggles of Miklós Zrínyi and his contemporaries against the Ottomans? The first question was raised due to the destruction of the fortress and the complete vanishing of its remains by the mid-eighteenth century. As a result of that, the fortress had ceased to be indicated on maps by then. It is not shown on the 1784 map sheets of the First Military Survey of the Habsburg Empire *(Josephinische Landesaufnahme)* conducted under the reign of Emperor Joseph II, and it was not included in the so-called Country Description, a written supplement to the maps, either.[1] At the end of the nineteenth century, Károly Eötvös, describing Zala County in his work written about the Austro–Hungarian Empire, could but sadly record the following: "The fortress, once a historic landmark, has now disappeared without a trace, and even the place where it stood, can hardly be determined."[2]

Zrínyi-Újvár in the seventeenth–twentieth-century historiography

The role and significance of Zrínyi-Újvár was already controversial during its existence. On 5 July 1661, Miklós Zrínyi, who had the fortress built, informed the members of the Imperial War Council *(Hofkriegsrat)* about the military reasons for the construction: "In military terms […] this place is the shield or bastion of the whole Muraköz, and even of the entire border region of Slavonia, from here to the south beyond the Drava. The one who holds this hill, has control over the Muraköz and the two rivers, the Mura and Drava, too […]. Once this fortress, as I hope, is successfully completed with a little help of His Imperial Majesty, I can promise Your Excellencies that Kanizsa will soon be in distress and thousands of Christians will be freed from the yoke of Turkish tyranny, and Styria will be able to enjoy peace and tranquillity without fear, even if Kanizsa remains on the hands of the Turks."[3] In his last will and testament written in April 1662, Zrínyi described the role of his fortress in a similar way: "We built Zrínyi-Újvár and our fortress from its foundations in an unoccupied place, with immense work, including our own sweat. The constructions demanded great effort and enormous costs. This place is so important that our Muraköz

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1 *Janko* 1995. 40.
2 *Eötvös* 1896.
3 Miklós Zrínyi to the Imperial War Council, Légrád 5 July 1661. See pages 271 and 272 of the present volume.

https://doi.org/10.36250/00757_01

Island cannot remain safe without it."[4] One year later, on 30 April 1663, Zrínyi mentioned Zrínyi-Újvár again in his letter addressed to Giovanni Sagredo, the Ambassador to Venice in Vienna: "My fortress, although it may be different from Breisach or Dunquerque, you need to know, Your Highness, is stronger in terms of its location and construction than Ivanics, Szentkereszt, Petrinja, or any other place along the border, with the sole exception of Kapronca. The claim that it is not meant to defend Styria but my island is ignorant and envious speech […] because retaining or losing Styria depends on retaining or losing the island, since Styria is immediately adjacent to it and has no other defence."[5]

Underlying the cited lines were the criticisms of Zrínyi-Újvár. In the spring of 1662, the Imperial War Council in Vienna, which was the central governing body responsible for defence operations against the Ottomans, instructed Colonel Jacob von Holst, a military engineer, to "find out whether it is a place as it is said to be, that is, whether it is capable of defending itself against an army, and whether it can be fortified any further in a clever way". The surveyor allegedly found the fortress indefensible and reported that "it cannot be restored because of its position".[6] Zrínyi denied this statement. In his letter to Sagredo, he rejected the unfair comparison with significant and well-built fortifications, such as Breisach or Dunquerque along the border of France. He compared Zrínyi-Újvár in the Hungarian (and Croatian–Slavonian) system of strongholds to Ivanics (today Ivanić, then a seat fortress in the Varaždin Generalate, reinforced with bastions along the small Lonja River), Petrinja in Zágráb County (which was a strong fortress as early as the sixteenth century due to financial support it received from the Styrian Estates), and Kapronca (today Koprivnica, one of the most important strongholds in the Slavonian defensive line of fortresses at that time).

This disagreement already contained the seeds of future opposing interpretations, which turned into a fierce debate following the fall of Zrínyi-Újvár on 30 June 1664. After the occupation of the fortress, Zrínyi rushed to Vienna, where he addressed a bitter memorandum to Emperor Leopold I on 17 July 1664. He blamed Montecuccoli for the unsuccessful siege of Kanizsa and the fall of Zrínyi-Újvár.[7] On the basis of at least nearly one hundred printed newspapers, reports, and historical works,[8] relating to the siege of Zrínyi-Újvár, he also informed the foreign public and diplomatic circles about his views. In 1664, the pro-Habsburg publicity temporarily lost battle against Zrínyi's large-scale propaganda.[9]

The counter-attack began with the active participation of the gravely offended Count Raimondo Montecuccoli in the second half of the 1660s. One of the most important contemporary works, which until today has greatly influenced international opinion of the events that took place in Hungary, is the *Historia di Leopoldo Cesare* by Gualdo

4 The last will and testament of Miklós Zrínyi, Csáktornya (today Čakovec, Croatia), 6 April 1662. ZMVL 1997. 188.

5 Miklós Zrínyi to Giovanni Sagredo, Csáktornya, 30 April 1663. ZMVL 1997. 135.

6 *Priorato* II. 1672. 106–107.

7 Miklós Zrínyi to Emperor Leopold I, 27 June 1664, military camp below Zrínyi-Újvár; Miklós Zrínyi to Leopold I, 17 July 1664, Vienna. ZMVL 1997. 159–162, 213–222.

8 The catalogue by Ilona Hubay comprises 68 leaflets that discuss the events of 1664. *Hubay* 1948. 135–148. Katalin S. Németh significantly expanded the number of these while preparing the Hungarica catalogue of the Herzog August Library in Wolfenbüttel. *Németh S.* 1993. The material was further expanded by *G. Etényi* in 2003. See also *R. Várkonyi* 1975 for an analysis, as well as for the levels and genres of the pro-Zrínyi propaganda literature of the 1663–1664 war. *R. Várkonyi* 1975. 65–67; *Bene* 1993b. 650–668.

9 *Bene* 1993b. 661.

Galeazzo Priorato, a court historian to Emperor Leopold I. The manuscript of this significant historical work recording the emperor's deeds was revised, on the author's request, by Montecuccoli.[10] The Count of Vicenza, who belonged to the leading intellectuals of contemporary Europe, enjoyed the support of the emperor. The text of the *Historia* was read out in the making to Leopold I, who recognised the enormous potentials for propaganda inherent in this imperial work, and fostered its preparation with financial support and the provision of subordinate officials, as well as by giving him access to the state and office archives. The emperor had Viennese engineers engrave copperplates with depictions of "all the battles and sieges, along with the maps of all the countries where the fights took place".[11]

Figure 1.
Copperplate engraved by Cornelis Meysens representing Zrínyi-Újvár and its surroundings in the Historia di Leopoldo Cesare by Gualdo Priorato
Source: Priorato II. 1672. 404–405.

10 Corrections and additions by Montecuccoli: ÖStA KA Nachlasse Mémoires B/492/167. *Annotazioni all'istoria di Transilvania e d'Ungheria del Conte Gualdo Priorato e riflesioni soprano alcuni passagi dell'istoria Transilvania di Betlino.* Published by Ausgewählte Schriften. III. 1900. 363–381. On the relationship between Priorato and Montecuccoli, and the role of the latter in finalising the text of the work, see *Luraghi* 1988. 257; *Martelli* 1990. 1055–1056; *Bene* 1993b. 661; *Bene* 1993c. 49–56.

11 *Bene* 1993c. 53.

Montecuccoli, as it is suggested both by his emendations of the published text and the concordances with his own works, took great care to rephrase the passages in the *Historia* about Zrínyi and his fortification according to his own taste.[12] The goal of his comments was twofold. Firstly, they were aimed at raising doubts about the significance of Zrínyi-Újvár. Secondly, they were meant to exaggerate the role of Count Zrínyi in the unfortunate course of events. Ultimately, these two threads converged in one point, which was the questioning of Zrínyi's military skills.[13] The second volume of the *Historia di Leopoldo Cesare,* published in 1672, reflects Montecuccoli's opinion at the very first mention of Zrínyi-Újvár relating to its 1661 construction: "This was a private man's work and was designed by an inexperienced military engineer, so it was not as strong and remarkable as the ignorant believed it to be. The experts were of the opinion that it was not even as good as a closed rampart [*ridotto di campagna* – a temporary fortification of a military camp]."[14] Montecuccoli wrote about the 1664 siege of Zrínyi-Újvár the following: "It was not easy to hold that small palisade for hours, not to say for days or weeks. However, it is widely known as one of the most important fortifications in Europe, and the reputation of the whole imperial army depends on this."[15]

Montecuccoli's negative evaluation found its way without any source criticism into French,[16] Austrian, and Italian historical and military works[17] of the eighteenth and nineteenth centuries through the propagandistic biography of Emperor Leopold I by Priorato and the popular editions of *Della Guerra col Turco in Ungheria* by Montecuccoli, a work of military science that was published several times in the eighteenth century. In this latter work, Montecuccoli repeated word for word his low opinion of Zrínyi's military deeds and Zrínyi-Újvár.[18] Franz Wagner, an Austrian Jesuit who translated the above-mentioned work by Montecuccoli into Latin, recalls the views of the imperial general and Priorato concerning Zrínyi-Újvár in his biography of Leopold I. His rejection of Zrínyi's qualities as a military strategist is based on similar arguments.[19] Cesare Campori, the Italian author of the first scholarly biography of Montecuccoli, also adopted this view in his work published in 1876.[20]

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12 *Bene* 1993b. 661. The narration of the siege of Zrínyi-Újvár is, for example, almost literally identical to the text of the summary report written to the Emperor by Montecuccoli: Relazione della campagna dell'Armata Cesarea nell'Anno MDCLXIV. ÖStA KA AFA 1664/13/29. (We are thankful to Mónika F. Molnár for the translation and interpretation of the report.) Cf. *Priorato* II. 1672. 410–416.

13 In various notes, General Raimondo Montecuccoli described Zrínyi as an inexperienced and unskilled soldier: Ausgewaehlte Schriften III. 343, 377. (The latter: *Testa* 2000. 198) and IV. 120.

14 *Priorato* II. 1672. 31–32. Cf. Raimondo Montecuccoli: Della guerra col Turco in Ungheria. In: *Luraghi* II. 428–431; *Rónai Horváth* 1891. 305–306. *Nagy–Hausner* 2011. 717–724.

15 "In somma si fece ogni cosa per mantenerlo, gia che s'era imbeuuto il Mondo, che quella bicocca, che non era buona per sostentarsi hore, non che giorni, e settimane fusse vna delle piu importanti Fortezze d'Europa, e che da essa dipendesse la reputatione dell'armi Imperiali…" *Priorato* II. 1672. 411.

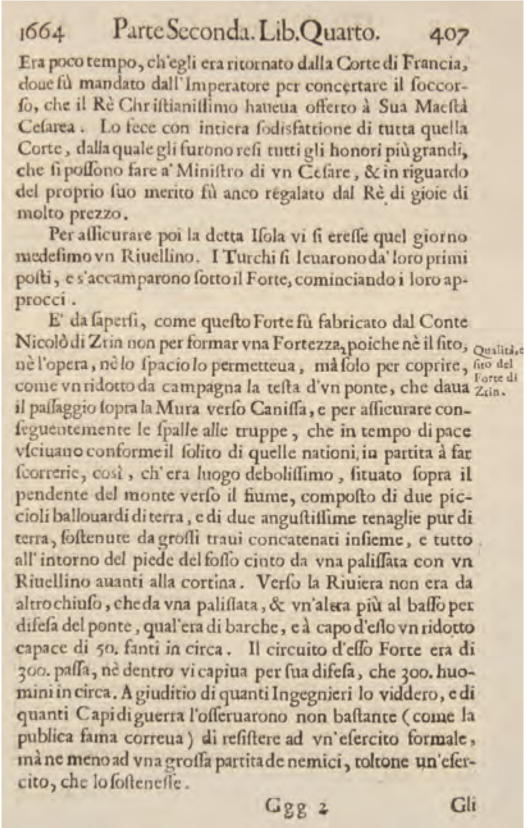
16 *Perjés* 1999. 309; *Montecuccoli* 2017; *Montecuccoli* 2019. 26–29.

17 *Perjés* 1999. 309.

18 Montecuccoli went even further in his *Della guerra* and described the fortress as follows: "When someone entered the fortress, he had to ask where the stronghold was, and the soldiers called it a sheepfold." See *Montecuccoli* 2019. 214.

19 *Wagner* I. 1719. 142–144. Montecuccoli: *Commentarii bellici iuncto Artis bellicae systemate*. Translated by Wagner. Viennae, 1718. *Borián* 2004. 158–162.

20 *Campori* 1876. 395.



1664 Parte Seconda. Lib. Quarto. 407

Era poco tempo, ch'egli era ritornato dalla Corte di Francia, doue fù mandato dall'Imperatore per concertare il ſoccorſo, che il Rè Chriſtianiſſimo haueua offerto à Sua Maeſtà Ceſarea. Lo fece con intiera ſodisfattione di tutta quella Corte, dalla quale gli furono reſi tutti gli honori più grandi, che ſi poſſono fare a' Miniſtro di vn Ceſare, & in riguardo del proprio ſuo merito fù anco regalato dal Rè di gioie di molto prezzo.

Per aſſicurare poi la detta Iſola vi ſi ereſſe quel giorno medeſimo vn Riuellino. I Turchi ſi leuarono da' loro primi poſti, e s'accamparono ſotto il Forte, cominciando i loro approcci.

E' da ſaperſi, come queſto Forte fù fabricato dal Conte Nicolò di Zrin non per formar vna Fortezza, poiche nè il ſito, nè l'opera, nè lo ſpacio lo permetteua, mà ſolo per coprire, come vn ridotto da campagna la teſta d'vn ponte, che daua il paſſaggio ſopra la Mura verſo Caniſſa, e per aſſicurare conſeguentemente le ſpalle alle truppe, che in tempo di pace vſciuano conforme il ſolito di quelle nationi, in partita à far ſcorrerie, così, ch'era luogo deboliſſimo, ſituato ſopra il pendente del monte verſo il fiume, compoſto di due piccioli ballouardi di terra, e di due anguſtiſſime tenaglie pur di terra, ſoſtenute da groſſi traui concatenati inſieme, e tutto all'intorno del piede del foſſo cinto da vna paliſſata con vn Riuellino auanti alla cortina. Verſo la Riuiera non era da altro chiuſo, che da vna paliſſata, & vn'altra più al baſſo per difeſa del ponte, qual'era di barche, e à capo d'eſſo vn ridotto capace di 50. fanti in circa. Il circuito d'eſſo Forte era di 300. paſſa, nè dentro vi capiua per ſua difeſa, che 300. huomini in circa. A giuditio di quanti Ingegnieri lo viddero, e di quanti Capi di guerra l'oſſeruarono non baſtante (come la publica fama correua) di reſiſtere ad vn'eſercito formale, mà ne meno ad vna groſſa partita de nemici, toltone un'eſercito, che lo ſoſteneſſe.

Qualità, e ſito del Forte di Zrin.

Ggg 2 Gli

Figure 2.
Gualdo Priorato on Zrínyi-Újvár

Source: Priorato II. 1672. 407.

The traditional evaluation of Zrínyi-Újvár offered by Montecuccoli, Priorato and Wagner was not questioned by late eighteenth- and early nineteenth-century Hungarian geographical and historical works. They only slightly modified this point of view, supporting it with further oral and written sources. The manuscript of the description of Zala County, a part of the *Notitia Hungariae* by Mátyás Bél, was written in the 1730s. It says about Zrínyi-Újvár, among other things, the following: "Wagner describes the location of the fortress and its armament in a competent way, but with criticism. »That fortress, so to speak, was built by Zrínyi, who erected it as a guardian of the bridge placed over the Mura River and as a refuge for the Croatians from the enemy threatening the region of Kanizsa with their constant raids. It was constructed in an unsuitable location. It is rather some kind of shelter, as they say, which is usually erected to defend the camps and to provide support during the siege of cities. It has several other deficiencies, because neither is it surrounded by a ditch, nor are the sides of the ditch designed for defence. The rampart is raised from the ground to such an extent that even its base can be fired by cannons, and the fortification itself is so cramped that if there are but a little more people in it, they bump into each other, hence its humorous military name, the ‘sheepfold’. Yet what makes it most unsuitable is that the guards can be spotted and counted from the top of the nearby hills, making them unable to leave the base and make sorties. As far as its river frontage is concerned, it is only blocked with stakes. Apart from that, the fortification allows unimpeded entry for horsemen.«”[21]

Thereafter, Zrínyi-Újvár is next mentioned in mid-eighteenth- and early nineteenth-century works by Ferenc Kazy, Miklós Schmitth, Ferenc Károly Palma, György Pray and István Katona, who were members of the Jesuit Historical School. They were the first to collect data about Zrínyi’s deeds, and reported about the fortress and the events of struggle against the Ottomans.[22] István Katona, for example, relates the story of the fortress in volume 33 of *Historia critica Regum Hungariae* published in Buda, in 1804. He draws on the *Commentarii Bellici* by Raimondo Montecuccoli, the *Historia Magni Leopoldi* by Georg Wagner, works by János Bethlen, and handwritten records, such as the letter written by Zrínyi to the War Council of Graz on 30 June 1664, as well as his memorandum addressed to the emperor. Katona published the texts of the latter two.[23]

This interpretative approach seeking to collate and balance the Italian, Austrian and Hungarian sources went through a dramatic change in Hungarian (military) historiography after the Hungarian Revolution and War of Independence in 1848–1849. The first document representing this shift was an essay entitled *Zrínyi Miklós a költő* [Miklós Zrínyi, the Poet], written by Pál Vasvári, one of the leading figures of the revolutionary Hungarian youth, in May 1848. This was the moment when the negative image of Montecuccoli, along with the conflict between Zrínyi and Montecuccoli first emerged in what was later called national romantic Hungarian historiography. Discussing the 1664 siege of Zrínyi-Újvár, Vasvári named Montecuccoli the “favourite” of the Viennese Court, and blamed him for losing the stronghold, “as if he was ready to surrender the fortress to the enemy” by commanding the Hungarian and Croatian guards out of the fort. “Is not what Montecuccoli is doing the execution of some secret order of the dark cabinet?” he asked.[24]

The affirmative answer to this question was formulated as a fact in scholarly literature about Zrínyi in the second half of the nineteenth century, its main elements being the “numbing malevolence” against Zrínyi in the court of Vienna, the cowardly “Italian tactics” of avoiding battles, and lastly, the assassination of Zrínyi himself. The greatest supporter of this interpretation focusing on the conflict between Zrínyi and Montecuccoli was Jenő Rónai Horváth, a captain (later a general) in the Hungarian army and a member of the Hungarian Academy of Sciences, whose inaugural speech was entitled *Zrínyi Miklós (a költő és hadvezér) hadtudományi elvei* [The Principles of Military Science of Miklós Zrínyi (Poet and Military Leader)].[25] Rónai Horváth dedicated several studies to the praise

21 *Zala megye a XVIII–XIX. században* [Zala County in the Eighteenth and Nineteenth Centuries]. 1999. 57. It is a translation by Béla Szőke of a manuscript preserved at the Batthyány Collection of the Cathedral Library of Esztergom, under record No. Hist. I. hhh.

22 For the Jesuit historians’ assessment of Zrínyi and their source interpretation, see *Borián* 2004. For early nineteenth-century Austrian historiography about the events of 1663–1664, including the deeds of Zrínyi and Montecuccoli, see also: Die Feldzüge 1828.

23 *Katona* XXXIII. 1804. 585–588. *Borián* 2004. 263–264.

24 *Vasvári* 1956. 78–79.

25 *Rónai Horváth* 1889.

of Zrínyi as a military commander. In his work concentrating on the events of 1664, he dealt with the environment, architecture, and general strategic significance of Zrínyi-Újvár at length. He also introduced Montecuccoli's low opinion and included a drawing of the fortress made by the count, adding that: "The explanation is to be found in the hatred between Montecuccoli and Zrínyi. The more inferior Zrínyivár ("Zrínyi's Fortress") was shown and the more discredited Zrínyi was in the eyes of the Viennese Court as someone who had exposed the country to the dangers of war, the greater Montecuccoli's glory was, as he was the one who managed to hold off the Ottoman army of superior strength for weeks, even from this sheepfold. The fortress may have had some deficiencies in terms of technical matters, and the environment was certainly also disadvantageous, which made defence difficult. Nevertheless, considering the firing range of the guns at that time, it can hardly be believed that the bridge could be shot at from the surrounding elevations. In spite of all these, it is certain that Zrínyivár provided excellent services in defending Muraköz for four years. Additionally, beginning with the time when the southern army had withdrawn beyond the Mura River, it formed an excellent stronghold for defending the front line along the Mura. It depended only on this 'sheepfold' that Montecuccoli still found an army beyond the Mura in mid-June, and thanks to its weak rampart, he had time to wait for the arrival of the imperial army. Consequently, Zrínyivár was undoubtedly of considerable military value, and it should be noted that he who had made the most of Zrínyivár, namely Montecuccoli, disparaged it the most."[26]

This was how the underlying ideas of the so-called Zrínyi–Montecuccoli conflict[27] developed in the nineteenth century. It was only in the early 1960s that Géza Perjés, an outstanding Hungarian military historian, convincingly demonstrated that this conflict had, in fact, nothing or little to do with military science.[28] It also turned out later that the two allegedly disputing parties were the least involved in the debate.[29] The "debate" which was initially about Zrínyi's practical role and later about his historical significance, eventually outlived not only Miklós Zrínyi, who died shortly afterwards, but also his opponent, shaping posterity's understanding of the events for centuries to come.[30]

During the debate, Zrínyi-Újvár and its judgement slowly receded into the background, and it was finally forgotten for a while. On the "imperial" side, this may as well be considered intended. Immediately after the events, it perhaps did not seem the best idea to mention this issue which was such a delicate topic concerning the balance of power, and a painful loss for the Hungarians. Later, it can be presumed, Montecuccoli's influence prevailed. He consciously tried to underrate both the stronghold and its significance.

It has been known since the monumental edition of Montecuccoli's works by Alois Veltzé in the late nineteenth century that Priorato had the sections of his work discussing Zrínyi revised by Montecuccoli, who carefully reviewed the text and reshaped it according to his own taste.[31] Twentieth-century historians specialising in this period are still

26 *Rónai Horváth* 1891. 307–308.
27 For the debate, see *Barker* 1972; *Perjés* 1982; *Perjés* 1999; *Hausner* 2010; *Nagy–Hausner* 2011. 693–708.
28 *Perjés* 1961–1962.
29 *Nagy–Hausner* 2011. 724–726.
30 *Hausner* 2013. 118–128.
31 Ausgewaehlte Schriften I. LXXIV–LXXVIII; Cf. *Luraghi* 1988. 257; *Bene* 1993b; *Bene* 1997; *Nagy–Hausner* 2011. 717–724.

likely to refer to the work by Priorato and Montecuccoli without any source criticism. For example, the monograph by Austrian historian Georg Wagner, which is to this day the most comprehensive study of the mid-1660s and the Battle of Szentgotthárd, justifies Montecuccoli on the basis of Priorato's work, ignoring the findings of the Hungarian historical scholarship. To cite but one example, he refers to Zrínyi as a "furious and hot-headed soldier".[32] Practically, Montecuccoli's opinion was adopted, supplemented with more recent scholarly arguments, by Italian scholars, in particular by Fabio Martelli, the author of a monograph on Montecuccoli, and by military historian Raimondo Luraghi, the editor of the works of Montecuccoli.[33] Having also consulted Hungarian works on Zrínyi, American historian Thomas Barker, who wrote the most thorough study about the relations of the Italian strategist with the Hungarians and the differing views about Zrínyi-Újvár among foreign scholars, expressed a more balanced view.[34]

Zrínyi-Újvár in geographic literature and country descriptions – attempts at localisation

In the 1720s and 1730s, János Matolai attempted to identify the location of Zrínyi-Újvár while collecting data for the country description published by Mátyás Bél. The sketches made by Matolai for the description of Somogy County in Mátyás Bél's manuscript of the *Notitia Hungariae* have been preserved to us. They depict the fortress of "Serény-Újvár", also known as "Új-Zerén", on the ultimate peak of the Légrád vineyard, called Új-hegy.[35]

In addition to the sketches by Matolai, contemporary maps (by M. Seuter, Josip Bedeković, C. Weigelius),[36] as well as an image of Zrínyi-Újvár in the book by Burckhard Puerkenstein on military and mathematical sciences, published in Augsburg, in 1731, suggest that the memory of Zrínyi-Újvár was still alive at the beginning of the eighteenth century.[37] Subsequently, the existence and the location of the fortress were forgotten, and the surviving ruins, which had already been "completely destroyed, formed only small mounds".[38]

The name of the one-time stronghold re-emerges only decades later, in a statistical work of Hungary by Elek Fényes. When describing rivers, lakes, and marshes in Somogy County, the author notes in connection with the Drava, that "it meets the Somogy Hills at Légrád, where the (Zerinvár) earth mound of the Zrínyis, the Lord Lieutenants of Somogy County, once stood."[39]

32 *Wagner* 1964. 114–120, 479, 526–527. Reviewed by Ágnes R. Várkonyi: *R. Várkonyi* 1975. 90. Cf. *Perjés* 1962. 28–41; *Bene* 1996. 406; *Perjés* 1982; *Perjés* 1997. 810–811.

33 *Martelli* 1990; *Luraghi* 1988. 24, 99, *passim*. Cf. *Bene* 1996. 394.

34 *Barker* 1972. Barker primarily draws on monographs by Tibor Klaniczay (1965) and Géza Perjés (1964). Cf. *Nagy–Hausner* 2011. 733.

35 Drawings by Matolai: The Manuscripts Archive of the OSZK KT Fol. Lat. 277 Minuta Clarissimi Mathiae Belii Comitatus Békés, Veszprim, Ugocsa, Simig, Sala Albensem ac Tolnensem concernentia. fol. 120v, 131r.

36 On the maps, see *Petrić–Feletar–Feletar* 2001. 25–29.

37 *Puerkenstein* 1731. Cf. *Széchy* IV. 1900. 177, 182.

38 Zala megye a XVIII–XIX. században [Zala County in the Eighteenth and Nineteenth Centuries]. 1999. 60.

39 *Fényes* 1841. 194.

Figures 3–4.
Sketches by János Matolai depicting the site of Zrínyi-Újvár in the 1720s and 1730s
Source: The Manuscripts Archive of the OSZK KT Fol. Lat. 277. fol. 120v., 131r.

For a long time afterwards, researchers relied solely on the surviving descriptions, drawings, and copperplates. However, the latter, in particular, caused considerable confusion in identifying the location of the fortress. Several authors writing about the subject "could not even determine which bank of the Mura River the fortress was situated on".[40] We will not discuss these here in detail, but focus on the localisation attempts in the past decades, which mostly involved field surveys and making site plans.

[40] *Vándor* 1992. 67.

Géza Perjés tried to resolve the uncertainties regarding the location of Zrínyi-Újvár in the chapter *Új-Zrínyivár építése* [The Construction of Új-Zrínyivár] of his book on Zrínyi, which was published in 1965.[41] He made a map with orientation and scale, which placed the fortress back to the left bank of the Mura River, where Kanizsa was also found, on the slope of the final ridge of the Légrád vineyard. Perjés, who did not go to the field himself, was doubtful about the appropriateness of this site plan, stressing that it was very difficult to express a definite opinion concerning the location of the fortress because "the surviving drawings are not indicative of the exact place of the fortress, or its layout. To complicate matters further, the course of the Mura River also changed over the past three hundred years."[42]

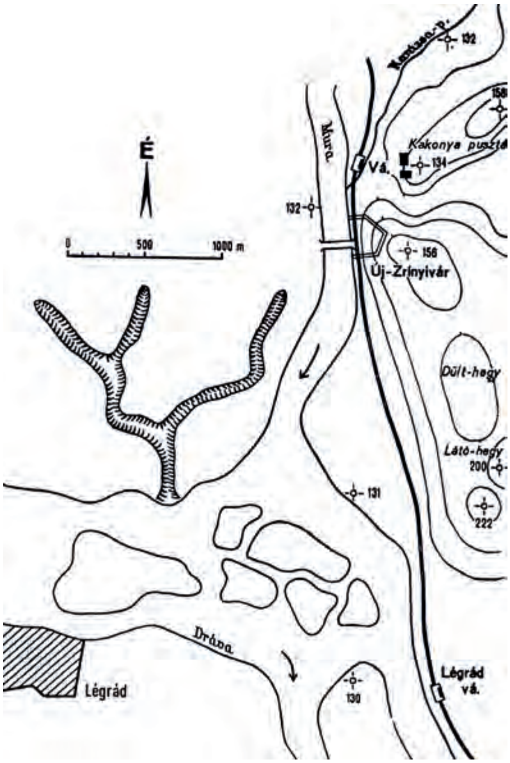


Figure 5.
Sketch map of Zrínyi-Újvár by Géza Perjés

Source: Perjés 1965.

This sketch map shows the original courses of the Mura River and the Kanizsa Stream in the 1660s. However, presumably to facilitate orientation, the railway tracks and stations built in the nineteenth century, as well as the names of the hills and elevation points of vineyards

[41] *Perjés* 1965. 309–314. (*Perjés* 2002. 334–339.)

[42] *Perjés* 1965. 313. (*Perjés* 2002. 338.)

are also indicated on it. He did not know about, or did not attribute much importance to the Visszafolyó [Backflow] Stream, which is known today to be the most important landmark, as its course has practically remained unchanged over the past centuries.

A desire for the "re-discovery" of the stronghold emerged at local and regional levels in the 1970s.[43] Investigations into local traditions, as well as the interpretation of the surviving depictions of the fortress by cartographer Pál Hrenkó[44] assisted the work of archaeologists from Somogy and Zala Counties. Based on Montecuccoli's sketch and a contemporary representation in the legacy of Pál Esterházy (1635–1713), who was an eyewitness, as well as field surveys, Hrenkó set the location of the fortress on the highest point of the ridge, which he marked as 156 metres high. The site plan by Hrenkó on a scale 1:11.000 shows only the most important hydrographic features existing today (Mura, Principális-csatorna [Main Canal], Visszafolyó-patak [Backflow Stream], the latter marked nameless), and the contour lines. The author did not try to indicate the place and shape of the fortress on the map.[45] In his 1972 university thesis, László Vándor accurately located the site of Zrínyi-Újvár on the plateau of the vineyard belonging to the village of Őrtilos, in Somogy County.[46] However, without an archaeological excavation, he did not attempt to identify the location of the fortress in the field today.

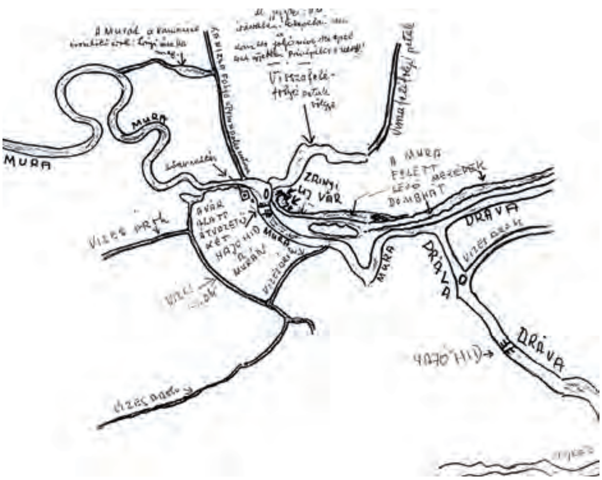


Figure 6.
Sketch drawing of Zrínyi-Újvár by László Vándor

Source: Vándor 1992. 67.

In the 1980s, László Horváth also identified the location of the fortress. Based on this, Péter Németh surveyed the area in 1988. The records of his field survey comprise the following rather surprising statement: "The north-western Italian bastion is still in relatively good

[43] *Vándor* 2012. 84–87.
[44] *Vándor* 2012. 85.
[45] *Hrenkó* 1979. 133.
[46] *Vándor* 1992. 67.

condition.'"[47] Péter Németh believed that he was the first to have seen the remains of Zrínyi-Újvár in the field. What makes, however, his finding less convincing is that the fortress is known today to have had no bastion(s) in the north-west, and the built bastions were not necessarily "Italian bastions", either.

In 2005, archaeologists Kálmán Magyar and Gyula Nováki carried out a field survey around Őrtilos with the aim of finding the remains of the fortress. However, they were unable to find any definite trace of the defensive lines near in the area that was cut through with trenches and showed considerable differences in height: "The sides of the former fortress could not be determined with certainty. At its highest part, there are many brick shards. The size and layout of the fortress could only be determined by excavation. In 2003, a monument was erected to the north-west, on a large plain, which can be accessed on a staircase.'"[48]

A new paradigm in the research of Zrínyi-Újvár

As can be seen from above, none of the two questions raised by earlier research in Zrínyi-Újvár could satisfactorily be answered in the past centuries. There are three main reasons for this. The first is the scarcity of written and pictorial sources. The second is the circumstances that had made exploration of the site impossible for a long time.[49] Finally, the third reason is to be sought in the dominance of narratives explaining everything in light of the controversy between Zrínyi and Montecuccoli. As no significant increase can be expected in the number of written (archival and narrative) and pictorial sources about Zrínyi-Újvár,[50] new paradigms and methods were needed to proceed. Rising above a biased national perspective was possible only due to cross-border and interdisciplinary research programs at the end of the twentieth century.

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[47] Rippl-Rónai Museum, Kaposvár, Archaeological Archives 107/1988. Cf. *Magyar–Nováki* 2005. 108, 182.

[48] *Magyar–Nováki* 2005. 108.

[49] Until the 1990s, the potential area of the fortress belonged to a heavily guarded border zone, which made field survey extremely difficult at the beginning. Finding the remains of the fortress was not an easy task, either. Its walls were raised from locally extracted soil and organic materials, and after the siege, it was levelled to the ground in the closest sense of the word.

[50] The collections of royal and imperial central administrative bodies and Hungarian family archives are not likely to yield a significant amount of new information about Zrínyi's activities and the construction of Zrínyi-Újvár. In this respect, the records of the Styrian Provincial Archives *(Steiermärkisches Landesarchiv)* in Graz, and in particular the fonds of the Inner Austrian Imperial War Council *(Innerösterreichische Hofkriegsrat),* founded in 1578, may offer novelties as it has a large number of little-researched documents that had been spared from major scrapping. Most recently, these were discussed by József László Kovács: *Kovács* 1998. In 2012, fifty-four copies of the fonds of the *Steiermärkische Landesarchiv Militaria* were obtained by the research group established for the exploration of the archaeological and historical resources of Zrínyi-Újvár. Most of the documents selected by Austrian archivists include correspondence of the Inner Austrian Privy and War Council *(Innenösterreichische Geheim und Kriegsrat),* which discuss Zrínyi-Újvár and the fortification of Muraköz. The German-language documents were translated by Ferenc Csóka. In addition to the Habsburg central and provincial offices, the Ottoman narrative sources and official documents also contain novelties. Research in these has already produced considerable results, influencing the assessment of the role of Zrínyi-Újvár. See *Sudár* 2012a; *Sudár* 2012b, and a paper by Balázs Sudár in the present volume. The most thorough study of the visual resources of the fortress to date: *Szalai–Szántai* II. 2006. 158–161.

In 1996, under the leadership of the Croatian Institute of History, an international project called *Triplex Confinium* was launched, which was supervised by Drago Roksandić. Within the framework of this project, Croatian territories were examined as the borders of large empires. One of the main research topics in this program was the history of the region along the Drava River, from the Late Middle Ages to the mid-twentieth century.[51] On the part of Croatia, this research project gave fresh impetus to processing the history of Novi Zrin [Zrínyi-Újvár].

In order to explore the site of the fortress, a group of Croatian experts led by Dragutin Feletar, a member of the Croatian Academy of Sciences, carried out a field survey of the site in 2001. Their findings were published in a monograph on the fortress. This was a pioneering volume, which synthetised historiographic and cartographic research, and demonstrated a thorough knowledge of Hungarian scholarship, as well. Drawing on László Vándor's topographic reconstruction, the fortress was placed in a vineyard belonging to Őrtilos, a village in Somogy County, and its precise geographical position was also given. According to this, the fortress lay at a latitude of 46 degrees 19 minutes 30 seconds north, and a longitude of 16 degrees 53 minutes 30 seconds east.[52] Croatian researchers accepted the results of the Hungarian scholarship and the conclusion that the one-time stronghold was situated across the border, on the other side of the Mura, in the territory of today's Hungary.

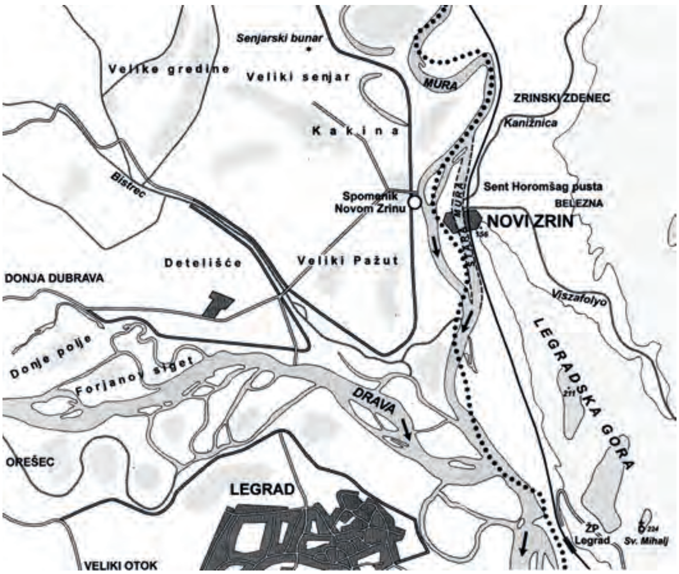

Figure 7.

Cartographic representation of the position of Zrínyi-Újvár in the Croatian monograph

Source: Petrić–Feletar–Feletar 2001. 37.

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51 See *Ekonomska i ekohistorija: časopis za gospodarsku povijest i povijest okoliša,* 7. (2011) 1, studies in a special issue of the Ekohistorija Drave (Environmental History of the Drava).

52 *Petrić–Feletar–Feletar* 2001. 15, 37.

After the real and virtual boundaries could be crossed, the actual field work could be started. The research initiated by archaeologists eventually produced results with the involvement of a wider community and the use of new methods. At the request of Ferenc Szakály, Miklós Zrínyi Military Academy (later University of National Defence, today the Faculty of Military Science and Officer Training at the National University of Public Service), the Institute and Museum of Military History, as well as several corps of the Hungarian Defence Forces joined the research and the related cultural initiatives.[53] Thereupon, a new element of research appeared as the military community approached this question from a new angle. As a result, Zrínyi-Újvár became the subject of military history and battlefield investigations. For the latter, the terrain proved to be advantageous, as the fortress existed for merely three years, and only one single major armed conflict, the 1664 siege, is related to it. Moreover, the traces of this can be found largely outside the fortress, and not on the territory of the stronghold which was subsequently destroyed.[54] Setting the exact location of the fortress meant significant help for the exploration of the battlefield, as well as for the (re)interpretation of the sources. This was reciprocated, as identifying and recording certain elements of the siege in the field also helped to clarify the uncertainties related to the location and layout of the fortress. The extensive, all-round research has "recruited" many new processes and technologies, producing more diverse results than ever before.

[53] *Papp* 2012. 123.
[54] *Négyesi–Padányi* 2012. 73.

THE CONSTRUCTION, SIEGE AND ROLE OF THE FORTRESS IN THE FIGHT AGAINST THE OTTOMANS

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The Anti-Ottoman Defence System in Muraköz and Zrínyi-Újvár

István Czigány

Muraköz (Croatian: Međimurje), the area between the Mura and Drava Rivers, was one of the most valuable estates of the Zrínyi family. It turned into a border fortress district after the 1566 capture of Szigetvár by the Ottomans. The defence system of the area was set up by György Zrínyi IV (1549–1603) with the support of the Hungarian king and the Styrian Estates. After the Ottomans seized Kanizsa (on 22 October 1600) in the Fifteen Years' War (1593–1606) the Christian defensive line facing Styria was breached and the strategic importance of Muraköz increased significantly. The Christian forces could not recapture Kanizsa, but the Ottomans did not manage to construct a defensive ring of fortifications around the castle, either. As a result of this, the former seat of the Generalate became practically wedged into the Christian border fortress district.

The Treaty of Zsitvatorok (today Zsitvatorok [today Žitava, Slovakia]), which ended the Fifteen Years' War between the Ottoman Empire and the Habsburg Monarchy on 11 November 1606, defined the borderline on the basis of properties owned or controlled by fortresses on both sides of the border before 1593. In practice, this meant a zone that could be interpreted very broadly. Consequently, its determination was the subject of much debate for decades, and caused multiple renewals of the peace treaty.[1] The peace treaty tried to regulate double taxation in the border zone of Ottoman Hungary. However, by allowing the collection of taxes on the counterparty's territory by military force as a 'last resort', it created a breeding ground for raids against each other.[2]

The ownership of fortresses around the Fortress of Kanizsa was so vague that it was already laid down at Zsitvatorok (today Žitava, Slovakia) that the boundaries would be defined there by Ferenc Batthyány II (1573–1625), Captain General of the border fortress district facing Kanizsa (1604–1609), and the Pasha of Kanizsa. Although the settlements were registered by both sides, no agreement was reached, so the committee operated intermittently until the late thirties.[3]

The reasons were connected to double taxation that affected the largest part of Royal Hungary. The Hungarian state and its landowners had reorganised more or less the institutions of the counties and a part of their estate administration network by the early seventeenth century. Afterwards, they collected taxes from the majority of the population of Ottoman Hungary with the help of soldiers serving the border fortresses and landowners. They regraded the whole of the country as their own, and looked on the Ottomans as incomers, at best.

1 Vienna, 1615; Komárom, 1618; Kőhídgyarmat, 1625; Szőny, 1627; Szécsény, 1628; Buda, 1629; Szőny, 1641.
2 *Czigány* 2018. 81–82.
3 *Szvitek* 2008. 134; *Szakály* 1992. 25; *Jászay* 1837. 71.

https://doi.org/10.36250/00757_02

The Ottomans, on the other hand, wanted to make use of the lands that remained on the hands of Christians as much as possible, even at times of peace. Their taxation system was meant to serve this purpose. They first tried to exploit the economic potential of the other party's territories. After defining the expected incomes, they drew up fictitious tax registers of settlements they wanted to levy taxes on. These, at the same time, determined the directions of their raids. This is how Muraköz, for example, was targeted in the 1570s. Settlements Perlak and Otok found in Muraköz were allocated as anticipated estates to soldiers serving in the Sanjak of Szigetvár.[4]

Miklós Zrínyi VII pointed out with great insight that the reason for the ongoing conflicts along the border lay in uneasy peace and the aggressive taxation practices of the Ottomans.[5] The Ottomans had been trying to subjugate his estates for decades, but he was able to prevent this by the continuous fortification of the defence system. According to our current knowledge, none of the settlements in Muraköz suffered a serious attack like, for example, the town of Egerszeg [Zalaegerszeg] in 1616, which was defended by royal guards.[6]

The military action taken against the town had a great resonance partly because the new border defence system set up against Kanizsa had already been consolidated by that time. Between 1610 and 1660, generally 2,300 to 2,400 royal guards were garrisoned in each of the eighteen fortresses belonging to the border defence system facing Kanizsa. They were supplemented by a considerable number of soldiers serving landowners, by temporary recruits, and also, from the 1640s onwards, by German troops.[7] The cornerstones of the defence system were Egerszeg, Kiskomárom, Lenti and Légrád, which were guarded by large garrisons each. The latter stronghold, located at the confluence of the Drava and Mura Rivers, was organisationally under the control of the captain general of the border fortress district facing Kanizsa, but the "perpetual" captain of the castle, like the Captain of Muraköz, came from the Zrínyi family.[8] The Zrínyis were so closely linked to the ownership and defence of the area that Muraköz was often referred to in official documents and by contemporaries as *Zerinische Grenze* ('Zrínyi borderland'), *Zerenische Insel* ('Zrínyi island'), or simply as *sziget* ('island').

The fortification of Muraköz and the establishment of the Zrínyi border defence district

After the fall of Kanizsa, Archduke Ferdinand, who ruled the provinces of Inner Austria,[9] invited György Zrínyi IV (1549–1603), among others, to make a proposal for organising the border defence district facing Kanizsa, which was regarded a temporary construction at that time. The magnate, who had been borderland and regional Captain General at Kanizsa twice (1574–1575, 1582–1598), based defence primarily on those fortifications that were still held by

4 *Sz. Simon* 2014. 185–189, 200–202, 254, 256; *Sz. Simon* 2018. 68–71.
5 ZMÖM 2003. 545–546.
6 The action caused such uproar that the Ottomans offered compensation for the losses in clause 8 of the Peace Treaty of Komárom in 1618. *Salamon* 1885. 277.
7 *Czigány* 2013. 76–77.
8 *Pálffy* 2007. 52.
9 County of Gorizia, Carinthia, Carniola and the Duchy of Styria.

the Christians. However, he shifted its centre of gravity to the southern part of the borderland by fortifying his estates in Muraköz that were on the frontline.[10] The other proposal was put forward by Count Ferenc Nádasdy II (1555–1604), the current Captain General at Kanizsa (1598–1604), who wanted to shift the centre of defence northwards by involving the strongholds along the Rába River (Körmend, Rábahidvég, Sárvár, Rum) in it. Since Kiskomárom was still on the hands of the Ottoman Turks, his proposal was motivated by blocking the roads leading to the Rába Valley, in addition to defending its own properties. He suggested the establishment of a separate fortress district (Csesztreg, Kányavár, Lövő [Zalalövő], and Szemenye [Muraszemenye]) with Lenti as its centre, in order to block roads along the Mura River.[11]

In the end, the high command considered the proposals of both magnates. From the proposition put forward by György Zrínyi IV, the plan made for the fortification of Muraköz was put into effect. Nine outposts were to be established along the right bank of the river to watch over crossing points. Additionally, the palisades at Domasinec (Damása, today Domašinec, Croatia), Goricsány (Muracsány, today Goričan, Croatia), and Perko (Perlak, today Prelog, Croatia), as well as the fortress of Csáktornya (today Čakovec, Croatia) were strengthened and manned with an adequate number of guards.[12] Zrínyi died in May 1603, but the new defence system devised by him had already been established. In the military report prepared about the Muraköz at the end of 1603, the dislocation of the guards was basically the same as shown in the sketch drawing made by György Zrínyi IV and attached to his proposal at the end of 1601.[13] One of the most important elements of the concept was the defence of the river crossings along the Mura. The outposts *(Castell)* erected at Kotor (today Kotoriba, Croatia) and Malikotec, as well as opposite Letenye, Ördöglika and Szemenye had 100 guards each, whereas the ferry port at Kakony was watched over by a 200-strong troop stationed at Légrád. Furthermore, Archduke Ferdinand contributed to the defence of Muraköz by the provision of 300 infantrymen and 200 horsemen, who were probably mainly stationed behind the palisades mentioned in Zrínyi's proposal.[14]

The organisation of the border fortress district facing Kanizsa was adapted to the changes of the military situation and then to the needs of the border defence and the current captain general. However, there was no fundamental change in the defence structure of Muraköz. The 200 royal guards stationed at Légrád remained under the command of the captain general of the border fortress district facing Kanizsa. The other part of the military force paid by the monarch (100 horsemen and 200 infantrymen) was garrisoned in the forts of Muraköz, at Kotori (today Kotoriba, Croatia), Goricsány (today Goričan, Croatia), Hodosány (today Hodošan, Croatia) and Damása (today Domašinec, Croatia). This armed force was complemented by the private army of the Zrínyi family, the soldiers of which served along the palisades, at dozens of outposts, as well as at the Csáktornya residence of the family.

The border fortress district administered by the Zrínyis was under the direct control of the monarch after György Zrínyi IV had been appointed the Captain of Muraköz, or,

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10 *Simon* 1997. 67; *Kelenik* 2005a. 328–332, 348–349.

11 *Simon* 1997. 68; *Kelenik* 2005a. 354–355.

12 *Kelenik* 2005a. 328–330, 344.

13 *Kelenik* 2005a. 329, 345–346.

14 ÖStA KA HKR Akt. 1604/February/51.

more precisely, the king himself entrusted the members of the Zrínyi family to watch over the area.[15] They were supported by the Styrian Estates, and received military assistance from the Slavonian borderland, mainly from the Generalates of Kapronca (today Koprovica, Croatia) and Körös (Kreuz, today Križevci, Croatia), which defended the interfluve area from the south.[16] Légrád, located in the southern tip of the Muraköz "island" but administratively belonging to the border fortress district facing Kanizsa, for example, received military aid from there most quickly. In view of this, the Inner Austrian Privy and War Council rejected the request submitted by the Zrínyi brothers to keep and pay 200 horsemen.[17]

After the death of his father, Miklós Zrínyi VI (158?–1625) took over the Muraköz captaincy, but there is no credible information about what rights he could exercise over the army stationed at Légrád. His younger brother, György Zrínyi V (1599–1626), was granted the rank of Governor ('Guberno') of Légrád in May 1620, when he also received the title of Captain General of the border fortress district facing Kanizsa.[18] He held the title for only a short period of time, until his appointment as the Ban of Croatia and Slavonia (in 1622).[19] It is a question why, being such a high-level national dignitary, he was elected Voivode of the Légrád infantry two years later. Finally, after the death of his elder brother, he also inherited the title of the Captain of Muraköz.

Miklós Zrínyi VII as the Captain of Légrád and Muraköz

In May 1640, Miklós Zrínyi VII, the oldest son of György Zrínyi V, was appointed Captain of Légrád by Ferdinand III (1637–1657).[20] (However, this did not mean unlimited jurisdiction even over his own soldiers, as he had to share the tasks of command with his brother Péter Zrínyi until 1649.[21]) Still in childhood, Miklós inherited his father's title as Master of the Royal Mews. In December 1637, the monarch appointed him Royal Chamberlain. This was not only meant to win the loyalty of the Croatian–Hungarian aristocrat, but also to reward his family for their efforts in defence against the Ottomans.

Similarly to his father, Miklós Zrínyi fought in the Thirty Years' War. In the summer of 1642, when the Swedish troops invaded Moravia and captured the Fortress of Olmütz (today Olomouc, Czech Republic), the young lord organised a 500-strong regiment in support of the ruler.[22] He himself fought in the battles, and at the head of his soldiers,

15 *Végh* 2017. 223.

16 The fortresses of the Generalates of Kapronca and Körös had over 1,100 royal guards in 1644. ÖStA KA AFA 1644/13/6.

17 ÖStA HKA HFU RN 157. Konv. March 1638. fol. 127–130.

18 ÖStA KA HKR Prot. Reg. Bd. 252. 25 June 1624. fol. 309.

19 The Voivode was also called the Captain General of the infantry. ÖStA KA HKR Prot. Reg. Bd. 244. 8 May 1620. Nr. 19. fol. 237v.

20 ZMVL 8; *Pálffy* 2014. 873; ÖStA KA Bestallung Prot. Reg. Bd. 2. 1630–1663. Nr. 1331. fol. 16.

21 There was a disagreement between the two brothers concerning command over Légrád, as Péter Zrínyi also claimed authority over the fortress, and they jointly administered Muraköz until 1649. *Végh* 2017. 223–225. Beginning with 1647, Péter Zrínyi was Captain General of the garrisons of Zsumberák (German: Sichelberg, today Sierpc, Poland), Szluin (today Slunj, Croatia) and Velemerich. In January 1658, he also became the Captain General of Zengg (today Senj, Croatia) and the fortresses along the coastal frontier belonging to it.

22 ÖStA KA HKR Prot. Reg. Bd. 287. July 1642. fol. 218.

he joined the imperial forces that maintained the blockade of Olmütz in early October.[23] At this time, the main army commanded by Archduke Leopold Wilhelm of Austria was already marching towards Saxony. They battled with the Swedish forces at Breitenfeld, near Leipzig, on 23 October 1642. Although approximately 1,400 Croatian and Hungarian light cavalrymen fought in the battle that ended with the defeat of the imperial army, there is no evidence to the participation of Miklós Zrínyi in it.

In the following year, the Swedish troops led by Field Marshal Lennar Torstenson returned to Bohemia and Moravia, invaded Lower Austria, and menaced the Hungarian border. The armed forces of the kingdom were mobilised. Under the leadership of Palatine Miklós Esterházy, a significant number of troops gathered in a camp by Szakolca (today Skalica, Slovakia), who were inspected by King Ferdinand III, as well. However, no major military operation took place there.

Miklós Zrínyi VII was much more active during the campaign of György Rákóczi I, Prince of Transylvania, fighting against the king in a Swedish and French alliance (1644–1645). He not only set up another regiment, but he also demonstrated his loyalty to the king with his personal participation in the campaign. Further research is needed in order to determine to what extent should we ascribe Zrínyi's engagement in the campaign to his religious affiliation, loyalty to the ruler, advancement in the political hierarchy, or perhaps to a "remedy" for sabotaging the nobility's uprising in the previous year. [24]

It is clear that Zrínyi's strategic and military activities on the Western and Hungarian frontlines of the Thirty Years' War, as well as his increasing engagement on the military frontier of the kingdom must have been decisive in his gaining the title of Lord Lieutenant of the Zala and Somogy Counties in April 1646, and his appointment as the Ban of Croatia and Slavonia two years later.[25]

On 26 January 1646, Zrínyi was appointed Imperial General *(Generalfeldwachtmeister).* Based on this, some scholars considered him to have been the first Hungarian Imperial General of the imperial army.[26] However, the registry entry shows that the document was not signed, which means that the appointment did not take effect.[27] The reason for this is unknown, but by that time the magnate had already had the title of General. At the beginning of 1643, he was appointed General Commander of Croatia, and in the summer of 1644, he was granted the title of Cavalry General, too. Field Marshal Johann Götz, the Commander-in-Chief of the imperial army in Hungary, was then instructed by the monarch to provide Zrínyi with a carabineer regiment in the event of vacancy. In 1644, the young aristocrat therefore had every right to use the title of the General of Light Field Troops in Croatia.[28] The written appointment of the Ban also comprised the title *supremus campi vigiliarium praefectus,* the Latin equivalent of *Generalfeldwachtmeister.* Considering that it was the appointment document of a national high dignitary, the title above probably refers to the rank of the Army

23 *Iványi* 1943. 79; Theatrum Europaeum 4. 879; ZMVL 10; *Széchy* I. 1896. 118–120.

24 ÖStA KA Bestallung Prot. Reg. Bd. 2. 1630–1663. Nr. 1371. fol. 4; *Tusor* 1996. 712–715.

25 *Kincses* 2017. 212–216.

26 *Pálffy* 2007. 53; *Pálffy* 2014. 874; *Kincses* 2017. 210.

27 ÖStA KA Bestallung Prot. Reg. Bd. 2. 1639–1685. Nr. 7. The invalidity of the appointment was suggested by *Hausner* 2017. 114.

28 *Tusor* 2015. 135; ÖStA KA HKR Prot. Reg. Bd. 291; 9 July 1644. Nr. fol. 305; ZMVL 10.

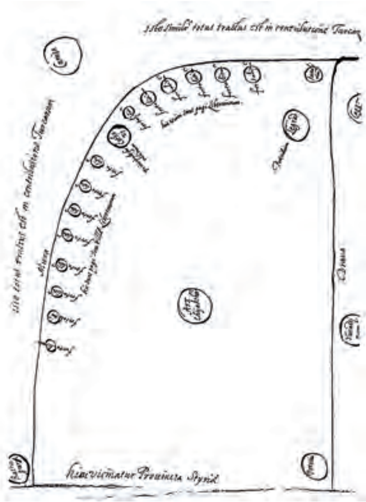

Figure 1.
Outposts defending Muraköz as shown by an ink sketch attached to a letter of Miklós Zrínyi to Ferdinand III in early March 1641

Source: Kovács 1998. 917.

General of Croatia, which was later used by Zrínyi.[29] It is uncertain, however, what kind of service was meant when he called himself *főstrázsamester* (‘Quartermaster General’) in Hungary, the contemporary Hungarian equivalent of *Generalfeldwachtmeister.*[30] The document of his appointment did not survive, and this rank was not mentioned, either, when he commanded a major imperial army in the first half of the 1660s.

Real military and political power was obtained by Zrínyi, when he was appointed the Ban of Croatia and Slavonia, the third highest national dignitary in the Kingdom of Hungary. He led the armed forces of Croatia, and he also commanded the 500-strong army stationed near the Kulpa River. His political influence increased not only in the national assemblies of Croatia and Hungary, but also in his relations with Inner Austria. Although he did not succeed in obtaining the rank of Palatine at the 1655 Diet of Hungary, he reached the pinnacle of his political career a few years later. At the end of 1659, Zrínyi was appointed Privy Councillor by the new monarch, Leopold I (1657–1705), and became a member of the Privy Council *(Geheimrat),* the supreme governing body of the Habsburg Empire.[31] Zrínyi was not accepted into this body through his office, but in recognition of his military and political merits.

As mentioned above, the defence of the “island” of Muraköz was based on royal garrisons, which had plenty of soldiers.[32] Due to their *familiares, servitores, libertines,*

[29] *Kincses* 2017. 217, 219–220; ÖStA KA HKR Prot. Exp. March 1656. Nr. 224.

[30] ZMVL 29.

[31] *Pálffy* 2014. 874.

[32] *Czigány* 2013. 76–77. At the end of 1634, the garrisons were filled up with soldiers to 97%. ÖStA HKA HFU RN 168. Konv. December 1643. fol. 84, 91. At this time, Zrínyi received 197 Forints and 30 Denars as his three months’ pay.

and soldier-peasants, the Zrínyi brothers were able to amass an army of over one thousand soldiers from their estates found in Muraköz. The soldiers of the watchtowers along the Mura and the Drava came from the armed members of the population, and soldiers serving along the palisades were also recruited from them when needed.[33]

In addition to the militia defending his estates, Miklós Zrínyi also had military units, made up of mainly professional soldiers, with whom he could launch major military campaigns to the borderland of Transdanubia. The core of these was formed by the royal army made up of *familiares* and *servitores,* and a troop of about one hundred dragoons predominantly made up of German mercenaries. The main body consisted of soldiers stationed in royal strongholds who could be sent to the battlefield, as well as the temporarily hired mercenaries.

Figure 2.
The defence of Muraköz

Note: A Muraköz védelme – En: The defence of Muraköz; A Habsburg Birodalom határa – En: The border of the Habsburg Empire; A Magyar Királyság határa – En: The border of the Hungarian Kingdom; Főkapitányság határa – En: The border of the Generalate; A Muraközi Kapitányság határa – En: The border of the Muraköz Captaincy; Főbb–kisebb magyar várak – En: Main–lesser Hungarian fortresses; Főbb–kisebb török várak – En: Main–lesser Ottoman fortresses; Egyéb települések – En: Other settlements; Górék – En: Watchtowers; Ismeretlen helyű górék – En: Watchtowers at unidentified places; Habsburg Birodalom – En: The Habsburg Empire; Magyar Királyság – En: The Hungarian Kingdom; Győri Főkapitányság – En: The Győr Generalate; Kanizsával szembeni Főkapitányság – En: The Generalate facing Kanizsa; Kanizsai Szandzsák – En: The Sanjak of Kanizsa; Muraközi Kapitányság – En: The Muraköz Captaincy; Kanizsai Pasalik – En: The Pashalik of Kanizsa; Varasdi Főkapitányság – En: Varaždin Generalate; Török Birodalom – En: The Ottoman Empire

Source: Perjés 1965.

[33] *Perjés* 1965. 87–93; *N. Kiss* 1983. 346–351; *Végh* 2017. 227–236.

In the first half of the 1640s, it dawned on Miklós Zrínyi that he would not be able to repel the raids launched by the Ottomans from Kanizsa effectively, in spite of the fact that he had increased the number of outposts along the Mura and the size of militia forces defending his estates.[34] The solution was to increase the number of trained soldiers and to tighten control over the opposite bank of the Mura River. In September 1647, he was granted permission to hire dragoon soldiers, and one month later he requested Captain General Ádám Batthyány I (1644–1669) to transfer to him command over the fortress of Alsó-Lendva (today Lendava, Slovenia), Letenye and Szécsisziget temporarily.[35] In 1648, he bought the estate of Szécsisziget presumably partly to reach his goal. Soon afterwards, he became the Captain of Szécsisziget and gained command over a 150-strong garrison. After the Ottomans failed to occupy Kiskomárom (on 15 August 1651), the punitive expedition against Segesd started, and 1,100 soldiers of the 7,500-strong imperial army were commanded to the camp by Miklós Zrínyi. There were soldiers from the fortresses of Szécsisziget, Lenti and Lendva (today Lendava, Slovenia), suggesting that the Ban of Croatia gained some sort of command post in the region of fortresses along the Kerka Stream.[36]

In addition to the raids launched by the Ottomans from Kanizsa, Zrínyi was also concerned about the war (1644–1669) between the Ottoman Empire and the Republic of Venice over the possession of the Island of Kandia (Crete). After the Ottoman fleet suffered a series of defeats and the Venetian ships were under Constantinople, the Ottoman military leaders decided to launch an attack on the Venetian territories through Dalmatia. However, the well-built Venetian fortresses proved to be a tough nut to crack. The other military plan was to reach Venice through the borderland of Croatia and Slavonia. From the beginning, Zrínyi was accused of providing Venice with military support. In 1648, for example, the rumour was spread that he captured Klissza (today Klis, Croatia). His person became a sting in the eyes of Ottoman leaders in the border fortress district when, in early 1646, he turned down the request of the Pasha of Kanizsa to let him pass through Croatia.[37] Although the news of raids on the Venetian province of Friuli was occasionally spread, the war plan was never carried out, because the Ottomans had thirteen grand viziers over a period of nine years. Following the accession of Köprülü Mehmed to the post of Grand Vizier (in 1656) and the break of the Venetian blockade on Constantinople, the war plan was renewed. At the beginning of 1657, he requested Ferdinand III through the imperial envoy to allow the Sultan's army march through the estate of Count Zrínyi. He believed they would be able to carry out this without much damage in merely three to four days.[38] The Ban of Croatia was among the first to hear this news and he was informed that the Ottomans wanted to cross the Vinodol Valley and Buccari (today Bakar, Croatia), which belonged to his brother. He took into account that in the event of a military action against Venice, the Ottoman forces from Kanizsa would launch an attack against his estates in Muraköz, so he asked the Styrian Estates help him turn Csáktornya into a "real borderland fortress".[39]

34 The ink sketch attached to the letter written by Miklós Zrínyi to Ferdinand III at the beginning of March 1641 showed fourteen outposts along the Mura River. *Kovács* 1998. 917.

35 *Végh* 2017. 233; ZMÖM 2003. 521.

36 MNL OL Batthyány család lt. P 1315, Batthyány I. Ádám másolati könyve/b. fol. 337–343.

37 ÖStA HHStA Staatenabteilungen Türkei I. Kt. 119. Konv. 2. 1646 fol. 33–40.

38 ÖStA HHStA Staatenabteilungen Türkei I. Kt. 128. Konv. C. fol. 16–20; *Papp* 2009. 149–150.

39 ZMÖM 2003. 677–680.

The fortifications planned by Zrínyi complied with the plans of the War Council of Vienna and Graz to strengthen the military frontiers of Slavonia and Croatia. Due to the Ottoman plans to attack Venice by land, a significant number of troops had been deployed to the provinces of Inner Austria in the previous years. At the beginning of 1657, the mapping of the Croatian, Styrian and Slavonian fortresses started. Their condition was surveyed, and – depending on the financial possibilities – the fortification works began.[40] The mapping was directed by Captain Martin Stier, military engineer, and his subordinate was Guislain Segers d'Ideghem, military engineer.

The Dutch military engineer, whose name comprised the noble surname von Wassenhoffen in the records of the Inner Austrian War Council, was not unknown in the border fortress district facing Kanizsa. In July 1653, Ideghem was hired as a military engineer for the Fortress of Kiskomárom on the recommendation of Count Ferenc Nádasdy III (1623–1671).[41] In February 1654, he was transferred to Styria. However, at the end of the same year, he applied for a military engineer post in Bohemia that became vacant due to Johann Peroni's death.[42] Decision-making was postponed for years, because there were several candidates for the post, including Martin Stier. Although in early 1658, Ideghem gained the post of military engineer in Bohemia, he eventually accepted the post of military engineer in the province of Inner Austria.[43] In this capacity he contributed to the fortification of Csáktornya, and later, in the summer of 1661, he took part in the construction of Zrínyi-Újvár.

The construction of Zrínyi-Újvár

Why was Zrínyi-Újvár built? The answer for this question was offered by the builder himself to the Imperial War Council. His argumentation was unusual for the generals who were accustomed to formal warfare. Nevertheless, it was relevant from the logic and in the context of border wars.[44] Zrínyi's interpretation that he built the fortress on his own estate fit into the practice employed in the Ottoman borderland. As mentioned above, the border zone was interpreted broadly. Thus, from the aspect of dual ownership and the practice of royal jurisdiction in the Ottoman borderland, the magnate's reasoning was correct. The "inaccuracy" of the ban's argumentation lies in that, in this case, it was not the question of taxation of one or two villages, but the construction of a fortress.[45]

In other words, the construction of the stronghold was forced by *ratio belli*, that is, military tactics. Zrínyi originally built a bridgehead fortress to serve his raids and

40 *Pálffy* 2000. 60–65.

41 ÖStA KA HKR Prot. Exp. Bd. 307. July 1653. Nr. 38. fol. 168v.; ÖStA KA HKR Prot. Exp. Bd. 307. August 1653. Nr. 20. fol. 184.

42 ÖStA KA HKR Prot. Exp. Bd. 307. February 1654. Nr. 27. fol. 24v.; March 1654. Nr. 23. fol. 460; November 1654. fol. 334.

43 ÖStA KA HKR Prot. Exp. Bd. 318. January 1658. fol. 2; ÖStA KA HKR Prot. Reg. Bd. 319. 29 January 1658. Nr. 82. fol. 18. For the activity of Ideghem von Wassenhoven (Wassenhoffen), see also *Domokos* 2012. 43–52.

44 ZMÖM 725–729. Géza Perjés and József Kelenik studied in detail the arguments raised by Miklós Zrínyi for the construction of the fortress. *Perjés* 1989. 39–41; *Kelenik* 2012. 21–28.

45 The king and the palatine donated properties throughout the Ottoman period. *Szakály* 1997. 25–36.

the defence of the left bank of the Mura. In the summer of 1661, it probably did not even cross his mind that the fortress would be besieged by the Sultan's army. In his letter addressed to Giovanni Sagredo, the envoy of Venice to Vienna, in spring 1663, he compared the fortress of Kapronca to his own fortress fortified with the help of the ruler nearly two years before.[46] In the beginning, Zrínyi-Újvár was just one link in the chain of defence that needed to be renewed in the mid-1650s.

Figure 3.
Muraköz in 1670, on a map by Giuseppe Spalla
Source: OSZK TK 255

The final impetus for this probably came from the Ottoman siege against Radkersburg in the spring of 1655. While Ádám Batthyány and Miklós Zrínyi accompanied by a large military escort attended the diet in Pozsony, two thousand Ottoman soldiers assailed the town of Radkersburg, set fire to the villages of Kaltenbrunn (Vashidegkút, today Cankova, Slovenia) and Zelting, and plundered them.[47] The defence system and intelligence of the southern fortress district along the Kerka strengthened with newly recruited Hungarian horsemen and German soldiers in 1652 failed, in spite of the fact that the three fortresses (Lenti, Lendva [today Lendava, Slovenia] and Szécsisziget) in the way of the raiders were manned with 750 guards, altogether.[48]

Following the attack, the monarch immediately ordered the reinforcement of Radkersburg and the closure of the Szentmiklós Pass between Lenti and Lendva (today Lendava, Slovenia). Colonel Johann Schaff and Martin Stier, military engineer, were charged with this task. The Zrínyis and Inner Austrian government bodies had to organise the blocking of roads between Muraköz and Radkersburg, as well as the construction and

46 In 1644, the garrison of Kapronca had 240 soldiers altogether. ÖStA KA AFA 1644/13/6.

47 ÖStA KA HKR Prot. Exp. Bd. 311. March 1655. Nr. 59. fol. 87v–88; ÖStA KA HKR Prot. Reg. Bd. 312. 22 March 1655. Nr. 52 fol. 47v–48.

48 200 German soldiers (100 horsemen and 100 infantrymen) were posted in Lenti. MNL OL Batthyány család lt. P 1315, Batthyány I. Ádám másolati könyve/a. fol. 140.

maintenance of watchtowers along the Drava and Mura. A decree was issued that every village and estate had to support the building of ramparts with free labour twice a year.[49] The royal garrisons of the Muraköz "island" were strengthened. Fifty horsemen were stationed in Légrád, and further two hundred infantrymen and fifty horsemen were posted in the interfluve fortifications.[50]

Over the next few years, Zrínyi primarily focused on the modernisation of the defences of Csáktornya, and its supply with appropriate arms and military materials. For this, he received valuable aid from Graz and Vienna. He was given weapons, materiel, workmen for digging the ramparts, a water pump for extinguishing fire, and, last but not least, money – 2,000 forints for the reinforcements, and 3,000 forints for casting new cannons.[51] In the summer of 1657, a rampart was erected on the left bank of the Mura, at a ford "near Kanizsa", manned with twenty guards to secure the crossing of raiding troops. It was probably a ferry port at Szemenye or Lenti, from where the Ban of Croatia wanted to support Lendva (today Lendava, Slovenia) and Lenti.[52] In the absence of more data, we can only speculate whether the construction of the bridgehead is connected to the enforcement of Csáktornya or the extension of the defence system built along the Mura. There is no information about the protest of the Ottomans, although the structure still existed in autumn.

Zrínyi was, therefore, considering bringing the opposite bank of the Mura possessed by the Ottomans under his control somehow as early as 1657. The outposts along the Mura were presumably also visited by Ideghem von Wassenhoffen, who participated in the fortification of Csáktornya. He might have drawn attention to securing the hills on the opposite bank. In his letter addressed to the Styrian Estates, the count argued that the movement of the Ottomans could be better watched over from that place, which contributed to the security of the province.[53]

In June 1661, the construction of Zrínyi-Újvár was carried out in a rather delicate situation in terms of foreign and military policy. The war between the Principality of Transylvania and the Ottoman Empire had been going on for four years, and it was then that the Viennese Court decided to urge the Hungarian Estates to help the principality. The Ottoman troops were already on their way to depose János Kemény (1661–1662), the Prince of Transylvania supported by Leopold I, but the army headed by Raimondo Montecuccoli was also marching towards Transylvania to keep the prince in power.

Although Zrínyi started building his fortress without informing the monarch about his plans, in a situation balancing on the edge of war and peace, this finally turned out to be useful for the Viennese Court in the game of diplomacy. Field Marshal Walter Leslie, Captain General of the Slavonian borderland, visited the fortification under construction in the summer of 1661. He advised the monarch not to respond to the Ottoman protests, but rather pretend as if nothing had happened.[54]

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49 ÖStA KA HKR Prot. Exp. Bd. 311. March 1655. Nr. 59. fol. 87v–88; ÖStA KA HKR Prot. Reg. Bd. 312. 22 March 1655. Nr. 52. fol. 47v–48; ÖStA KA HKR Prot. Reg. Bd. 312. 4 July 1655. Nr. 20. fol. 133v–134.

50 ÖStA HKR Prot. Exp. Bd. 311. July 1655. Nr. 15. fol. 237; ÖStA KA HKR Prot. Reg. Bd. 312. 3 July 1655. fol. 133v.

51 ÖStA KA HKR Prot. Exp. Bd. 316. March 1657. Nr. 61. fol. 140v.; ÖStA KA HKR Prot. Reg. Bd. 317. 7 March 1657. Nr. 65, Nr. 70. fol. 113–114.

52 Zrínyi and Ferenc Nádasdy, who owned the Fortress of Lenti, had a dispute over the construction of the rampart. *Fabó* XV. 1871. 65, 116.

53 ZMÖM 726–727.

54 *Domokos* 2012. 46.

There were many examples of such breaks of peace by both sides. These formed the subject of diplomatic disputes for some time, and then either the builders themselves pulled down the stronghold, or the enemy demolished it. This happened to Berkigát, the Ottoman rampart erected at the crossing of the Kapos River in 1655, as well. Zrínyi referred to this case in his letter above.[55] Berkigát was located far from the border zone, between Kaposvár and Dombóvár controlled by the Ottomans, and its military role cannot be compared to that of Zrínyi-Újvár.

Although Leopold I pointed out that Zrínyi had committed an infringement by the unauthorised construction of the fortress, strangely enough, he entrusted the magnate himself with its demolition. This was not the first time that Zrínyi had violated royal authority. Between March and July 1656, he made a formal truce (or peace, according to other interpretations) with the Pasha of Kanizsa. The case finally ended with the termination of the ceasefire and an apology from Zrínyi.[56] The same must have happened in the case of Zrínyi-Újvár, and after some political wrangling, the demolition of the fortress was revoked at the end of August.[57] This option was also raised at the local level with the involvement of German soldiers, but the proposal was abandoned because of its possible political consequences, such as Zrínyi's potential surrender to the Ottomans.[58]

Leslie, who was not only Captain General of Slavonia, but also Vice President of the Imperial War Council and a member of the Privy Council, immediately recognised the strategic importance of Zrínyi-Újvár. In his report sent to Vienna, he did not urge the demolition of the fortress. He asked the Inner Austrian Privy and War Council to support Zrínyi, and the reinforcement of the fortifications in Fürstenfeld and Radkersburg.[59]

The Pasha of Kanizsa protested against the construction of the fortress at the end of June, and there were minor demonstrations of power, as well. The garrison of Kanizsa was reinforced, and the commanders of the surrounding sanjaks were ordered to assist Grand Vizier Mehmed Pasha in preventing Zrínyi's construction of his fortress.[60] It was not long before a threat came from Constantinople that the Grand Vizier would send an army of fifteen thousand men to destroy the fortress under construction.[61]

In Vienna, major political forces supported the maintenance of Zrínyi-Újvár. These involved the leaders of the party urging a proactive stance against the Ottomans: Prince Johann Weikhard Auersperg, Principal Advisor to the Emperor, and György Lippay, Archbishop of Esztergom and High Chancellor. The Ban of Croatia, who was already a member of the Privy Council at that time, persuaded Prince Johann Ferdinand von Porcia,

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55 In the previous year, the palisade of Berkigát (today Nagyberki) at one of the crossings of the Kapos River was destroyed by the troops led by Kristóf Batthyány, Captain General of the border fortress district facing Kanizsa. *Papp* 2002. 132.

56 ÖStA KA HKR Prot. Reg. Bd. 314. 2 March 1656. Nr. 203. fol. 148v–149; 10 July 1656. Nr. 109. 273v.; ÖStA KA HKR Prot. Exp. Bd. 313. August 1656. fol. 444; ZMÖM 2003. 666.

57 *Fabó* XV. 1871. 171–172.

58 Report by Muster Commissioner Franz Anton Trautmannsdorf, Kreuz, 30 June 1661. StLA LaA Antiquum XIV Militaria 1661. Nr. 61.

59 Report by Walter Leslie, Varasd, 1 July 1661. StLA LaA Antiquum XIV Militaria 1661. Nr. 61.

60 *Fekete* 1993. 223.

61 ÖStA HKR KA Prot. Exp. August 1661. fol. 375. Report by Wolfgang Sigmund Khloss, War Councillor of Graz, Graz, 13 August 1661. StLA LaA Antiquum XIV Militaria 1661. Nr. 61.

High Seneschal and the leader of imperial politics who also had properties in Styria, Count Johann Rottal, the emperor's advisor on Hungarian affairs, as well as Chief Justice Ferenc Nádasdy III about that there was a need for the fortress.[62] Despite their tense relations, the Styrian Estates were also obliged to support him.[63] Graz seemed even inclined to use the imperial army in demolishing the fortress, because it was believed that its construction would only bring the Ottomans down on their heads.[64]

At the end of June, Zrínyi called the Croatian and Slavonian Estates in arms under his responsibility, while Field Marshal Walter Leslie instructed the soldiers of the Slavonian border fortress district to defend the territory of Muraköz. The Styrian militia forces *(Landvolk)* was also mobilised in July.[65] However, the Vice President of the Imperial War Council did not consider the insurgents powerful enough, so he commanded the Testa Piccolomini Cavalry Regiment and the Pachonkay Dragoon Regiment to Fürstenfeld and Radkersburg.[66] On his recommendation, at the northern part of Muraköz, between Luttenberg (today Ljutomer, Slovenia) and Ráckanizsa (today Razkrižje, Slovenia), a 3000-strong army consisting of two cavalry and one infantry regiments (Pachonkay, Testa Piccolomini and Spick) was deployed for the defence of Muraköz and the fortress under construction.

The Province of Styria provided them with large quantities of military materials and various tools. Among other things, 10 tonnes of gunpowder, 10 tonnes of lead, 20 tonnes of wick, 800 shovels, 800 picks, 300 cramp irons, 100 long picks, 50 axes and 8,000 cannonballs of various sizes were delivered for the regiments.[67]

The Provincial Assembly of Styria held at the end of August decided to supply arms and materiel to Fürstenfeld and Radkersburg and to raise money for military expenditures. 300 muskets and 50 pikes, as well as 2 tonnes of gunpowder, lead and wick were promised to be sent to the armouries of the two towns. There was a heated debate about the acquisition of cannons. Finally, only eight cannons could be acquired for the Fürstenfeld Castle. In addition, further military equipment was planned to be obtained in order to arm the inhabitants of towns and villages. They wanted to raise funds primarily from the extraordinary war tax sent by the Court Chamber and from the levied but still unpaid head tax *(Kopfsteuer)* of 20,000 forints.[68]

The payment of the supplies and pay arrears of the 880-strong Pachonkay Dragoon Regiment was a major problem. The delegates left this issue pending and re-opened talks on the scheduling of funding. According to the statement by Quartermaster Abraham

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[62] *Fabó* XV. 1871. 166–172; ZMÖM 2003. 730.

[63] ZMÖM 2003. 735–739.

[64] Report by Muster Commissioner Franz Anton Trautmannsdorf, Kreuz, 30 June 1661. StLA LaA Antiquum XIV Militaria 1661. Nr. 61. Protocol of the Assembly of the Styrian Estates, 29 August 1661. StLA LaA Antiquum XIV Militaria 1661. Nr. 131–136.

[65] Report by Walter Leslie, Varasd, 1 July and 4 July 1661. StLA LaA Antiquum XIV Militaria 1661. Nr. 61. One horseman had to be provided from every thirty men, and one infantryman from every twenty men. Decree of the Styrian Provincial Government, 18 July 1661. StLA LaA Antiquum XIV Militaria 1661. Nr 332.

[66] Report by Walter Leslie, Varasd, 1 July 1661. StLA LaA Antiquum XIV Militaria 1661. Nr. 61.

[67] ÖStA KA Innerösterreichische Hofkriegsrat Prot. Windica, Exp. Bd. 68. 1661–1663 Ind. et Prot. 1661. fol. 114; Report by Councillor Hans Adam Lichtenstein, 27 August 1661. StLA LaA Antiquum XIV Militaria 1661. Nr. 119–125; ÖStA KA AFA 1661/3/3; ÖStA KA Prot. Exp. August 1661. Nr. 180. fol. 395.v–396.

[68] Protocol of the Assembly of the Styrian Estates, 29 August 1661. StLA LaA Antiquum XIV Militaria 1661. Nr. 131–136.

Hoffmann, the payment of the unit was 8,778 forints per month, which should have been paid beginning with October. Furthermore, the Styrian Estates were supposed to pay an additional sum of 20,000 forints in order to reduce the pay arrears of the unit, which was altogether 79,002 forints. As a result of the negotiations, the soldiers were finally paid 7,000 forints, and were promised to receive the arrears of 20,000 forints.[69]

Due to the prolonged Transylvanian campaign, as well as the imperial regiments and Hungarian–Croatian borderland units deployed in Slavonia and in the border fortress district facing Kanizsa, the attack promised by Grand Vizier Mehmed Köprülü did not take place in the summer of 1661. Nevertheless, the demand for the demolition of Zrínyi-Újvár was put on the list of peace negotiations. The old Grand Vizier Mehmed did not live to see the siege of Zrínyi-Újvár. The first attempt was made in mid-August 1663, when the main army led by Köprülü Fazil Ahmed, the son of the deceased Grand Vizier, was preparing for the siege of Érsekújvár (today Nové Zámky, Slovakia). Yakovali Hassan, the Pasha of Kanizsa, assailed Zrínyi-Újvár with his 7,000 men immediately after the younger brother of Miklós Zrínyi had taken over the command of the fortress. However, his action ended in a serious defeat. Contemporary accounts estimated the loss of the Ottomans between 200 and 600 men. Johann Albrecht Herberstein in Radkersburg, similarly to János Patyi, the Infantry Captain of Légrád, reckoned that the death toll was 500.[70]

When Zrínyi-Újvár was besieged by the Pasha of Kanizsa, the Ban of Croatia was engaged in organising the uprising of the Transdanubian troops. His fears were confirmed that the armed forces of the estates would not be of much help. They were supposed to harass the Ottoman main army deployed for the siege of Érsekújvár (today Nové Zámky, Slovakia) and to prevent the raids of the Tartar troops. The more experienced border fortress and field units were suitable for this, as well. However, the army gathered in the camp at Vat (on 17 September 1663) almost three months later than the date proclaimed by the monarch. The disputes over authority also weakened the military morale. Eventually, Miklós Zrínyi, who was the most experienced military leader, became the National Captain General of the 8500-strong Hungarian army in Transdanubia.[71] Less than one week after the large-scale military muster (held on 25 September 1663), all the fortifications of the captaincy fell to enemy attack, except for Érsekújvár (today Nové Zámky, Slovakia) and Fülek (today Fiľakovo, Slovakia).[72] Thus, only a few victorious surprise attacks could be carried out under the command of the Ban of Croatia, but this did not substantially affect the military situation. Zrínyi bore the title of National Captain General for less than two months. Most of the insurgent army dissolved in November, and Zrínyi returned to Muraköz at the head of his troops. They involved the Pachonkay and Piccolomini Regiments, which came under his command in mid-September.[73]

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[69] Proposal by Ábrahám Hoffmann to the Inner Austrian Privy and War Council, 8 September 1661. StLA LaA Antiquum XIV Militaria 1661. Nr. 155–157. Protocol of discussions between privy councillors and the estates, 10 September 1661. StLA LaA Antiquum XIV Militaria 1661. Nr. 149–153.

[70] *Széchy* V. 1902. 28–30. Report by Johann Albrecht Herberstein, Radkersburg, 14 August 1663. StLA LaA Antiquum XIV Militaria 1663. Nr. 387.

[71] *Pálffy* 2016.

[72] *Perjés* 1961. 512–514; *Perjés* 1989. 42–57; *Czigány* 2004b.

[73] Report by War Councillor Thomas Ignaz Maurer?, Graz, 23 September 1663. StLA LaA Antiquum XIV Militaria 1663 Nr. 72–73.

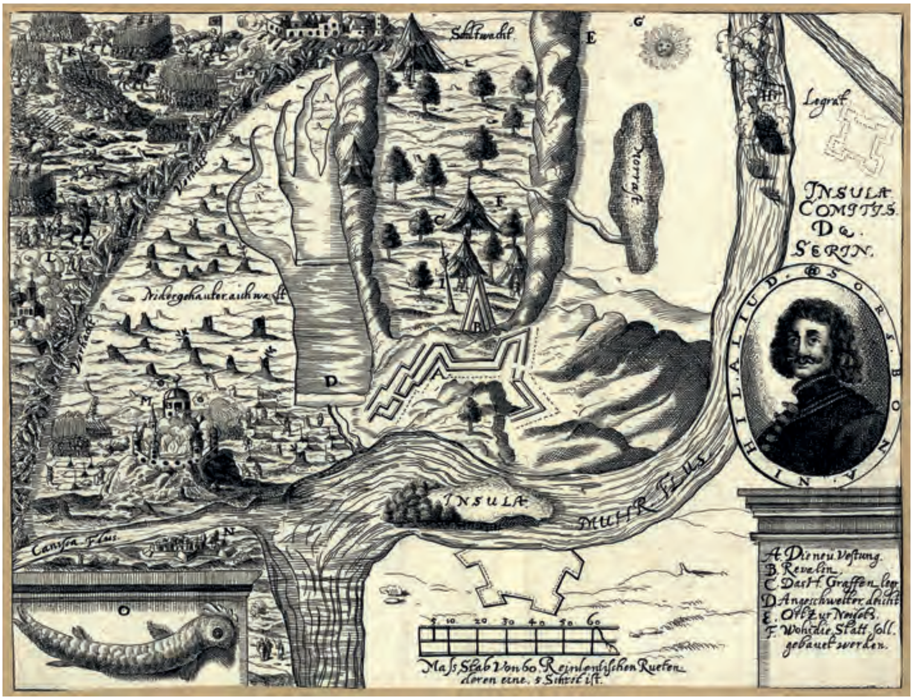

Figure 4.
Site plan of the area of Zrínyi-Újvár with the portrait of Zrínyi from 1663
Source: MNM TKCs T 1041

By the autumn of 1663, Zrínyi-Újvár had been significantly expanded by Zrínyi. In addition to his own soldiers, a considerable number of imperial guards were stationed in the fortress. In the autumn of 1661, 150 soldiers and five artillerymen arrived in the fortress from the recruits of the Wallis Infantry Regiment stationed in Inner Austria.[74] In September 1663, the imperial garrison increased to 350 men with the 200 soldiers of the Spick Infantry Regiment. A disagreement arose with the Viennese administration over the supply of this latter contingent. On the grounds that they were not obliged to support troops stationed outside the country, the Styrian Estates refused the request for this. However, the administration argued that the province would suffer no harm, as they had to pay their portions to the war-chest anyway. It was reckoned that due to the direct transfer of portions, the soldiers would receive their pay two months earlier.[75]

74 ÖStA KA Prot. Exp. November 1661. Nr. 8. fol. 489–490; ÖStA KA Prot. Reg. 6 and 7 November 1661. Nr. 30 fol. 288–289v.; report by Quartermasters Carl Sigmund Freiherr von Boisen and Friedrich von Praag about the transfer of the Wallis recruits to Zrínyi-Újvár. 26 November 1661. StLA LaA Antiquum XIV Militaria 1661. Nr. 188; report by Wolfgang Sigmund Khloss, War Councillor in Graz, Graz, 28 November 1661. XIV Militaria 1661. Nr. 189.

75 Report by War Councillor Thomas Ignaz Maurer?, Graz, 23 September 1663. StLA LaA Antiquum XIV Militaria 1663. Nr. 72–73; report by Quartermasters Friedrich von Praag and Häzl, 25 September 1663. StLA

By the beginning of 1664, Zrínyi-Újvár had become a strong fortress. Its garrison surpassed the number of soldiers of former "Berkigát" (that had been in the same "league" before its destruction) and the garrison of Kapronca supporting Muraköz.[76] It must have had considerable artillery, too. Zrínyi had many guns in Csáktornya, and had several cannons cast between 1657 and 1660. In 1690, the army recapturing Kanizsa found there altogether four cannons with the inscription "Zrínyi". These were probably seized by the Ottoman troops during the siege of Zrínyi-Újvár in 1664.[77]

Zrínyi originally built his fortress to guard the crossing and keep an eye on the area. However, as the two great powers drifted towards war that neither of them wanted, the fortress became increasingly important, and the Ban of Croatia turned into a hero, the "bane of the Ottoman Turks". He almost awaited and provoked the Ottomans, as if he had wanted to follow in his great grandfather's footsteps, yet he did not lose his sense of military reality. He was a member of the imperial elite and significant military and political power was concentrated in his hands due to his contacts with members of the Hungarian and Croatian nobility and his clever propaganda. During the apathy for the loss of Érsekújvár (today Nové Zámky, Slovakia), he achieved with a winter diversion and its appropriate domestic and international communication that the valley of the Drava River turned into the main theatre of war in 1664, and the recapture of Kanizsa became the most important military objective. Representing a constant threat, Kanizsa had been a sting in Zrínyi's eyes for a long time.[78] All his efforts were directed against that neighbouring Ottoman fortress. He obtained money, soldiers and weapons for defence, and transformed Muraköz into a real stronghold. The construction of Zrínyi-Újvár served the same purpose. If they had managed to take Kanizsa, his properties would have been delivered from direct pressure from the enemy. However, they were not able to recapture Kanizsa before the arrival of the Sultan's army, and the German imperial and French troops were still on their way to the South Transdanubian battlefield. The reinforced fortress of Zrínyi-Újvár could withstand only the local Ottoman forces, as in the summer of 1663. When retreating from Kanizsa, not many people believed that Zrínyi-Újvár could be held long against the main Ottoman army, as one of the largest fortresses of the country capitulated after thirty-six days in the previous year. Zrínyi-Újvár was not a betrayed fortress. Its defenders gained some time – three weeks – with their heroism, the pledge of later successful military operations.

LaA Antiquum XIV Militaria 1663. Nr. 25/9 (60); report by Councillor Hans Adam Lichtenstein, 1 October 1663. LA LaA Antiquum XIV Militaria 1663. Nr. (60) – 104–105; Royal Decree issued for the Spick Regiment transferred to Zrínyi-Újvár, 31 October 1663. LA LaA Antiquum XIV Militaria 1663. Nr. 137–138.

76 The garrison of Berkigát was made up of 70 infantrymen and 250 Rascian soldiers. *Papp* 2002. 130.

77 Three guns were cast in 1646, and one cannon was cast in 1657. *Szita* 1995. 60–61.

78 ZMÖM 2003. 545–546.

The Construction and Siege of Zrínyi-Újvár as Reflected by Written Sources and Contemporary Sketch Maps

Gábor Hausner – Géza Szem

Extant sources about the construction of Zrínyi-Újvár

The earliest accounts of the construction of the fortress date from June 1661.[1] According to narrative sources, in May Zrínyi inspected and took possession of the hill found in the vicinity of the confluence of the Mura River and Kanizsa Stream, which belonged to Ottoman Hungary. A fortified castle of the Kecskis, a family in very close relationship with Zrínyi's great-grandfather, once stood on this hill. Referring to that this castle was found "almost on his own estate", Zrínyi started to build his fortress there. On 5 July 1661, István Vitnyédy, one of Zrínyi's "noble servants", informed Menyhért Keczer, a leading member of the Protestant nobility of Upper Hungary and an influential supporter of the Thököly family, about the construction of the fortress: "My lord started to build a strong fortress between Légrád and Kotori, on this side of the Mura River, in the neighbourhood of the Ottomans. It was formerly called Kecskevár, and his lordship called it Új Zrínyivár ['New Zrínyi Fortress'] after himself. He is in the camp in person, and his soldiers fight there with success…" According to Vitnyédy, three bastions had been completed by that time, and it only took a few more weeks to finish the construction.[2]

Contemporary sources and later historical works have preserved the name of the new fortress in many forms. In official documents it was called 'Zerinische Schantz', 'Zerinische Castell', 'Neuen Zrinischen Vestung', 'Neuen Serinischen fortezza', or 'Neuen Zrinischen Forte'. It was occasionally also referred to as 'Zrinische Palanka', 'Posto Neue Serin', 'Serinwahr', and 'Neuen Vestung Zrin var'. Montecuccoli called it 'forte Zrini', and in the sketch of siege drawn by him in 1664, it is labelled 'Schantz Neű [sic!] Serin'. According to an account by Evliya Çelebi, the Ottoman Turks called it Jeni Kála. Zrínyi himself used the term Zrínyi-Újvár in one of his letters written in Hungarian on the spot, on 20 May 1662. That is why, we adopt this latter.[3]

1 Reports by Walter Leslie, Captain General in Varasd (today Varaždin, Croatia). ÖStA KA IHKR Vindica Prot. Bd. 68. July 1661. fol. 91–95; August 1661. fol. 100–107.

2 István Vitnyédy's letter to Menyhért Keczer, Sopron, 5 July 1661. *Fabó* XV. 1871. 157.

3 *Luraghi* II. 1988. 430; *Evlia* 1985. 571; ZMÖM 1958. 313. After Tibor Klaniczay, who wrote a monograph on Zrínyi (*Klaniczay* 1964. 703), we use the name Zrínyi-Újvár, although even Zrínyi himself called it in various ways. His letter dated 13 August 1663, written by his own hand in Italian contains the term "nova fortezza Zrin", whereas the Latin copy of his last will and testament dated 6 April 1662 comprises the form "arcem et praesidium nostrum Novum Zrin". ZMÖM 1958. 563, 610.

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Figure 1.
The portrait of Miklós Zrínyi, in the background Zrínyi-Újvár and Zrínyi's camp in the Muraköz (inscription dated 1662), copperplate engraving by an unknown German artist
Source: OSZK, App. H. 3030

The construction was financed by Zrínyi mainly from his own income. It was built up with the free work of serfs coming from Zrínyi's estates in Muraköz, and the surrounding estates, counties and towns, as well as with the work of day labourers.[4] Additionally, he also asked for (and received, according to scattered data) some money and various equipment for the construction from the neighbouring Styria and the Republic of Venice.[5]

According to Zrínyi's intention, the fortress served not only the defence of Muraköz and his own estates found there, but also that of Styria. Furthermore, it was built as a base of offensive actions from the onset, as it is testified by the letter of the above-mentioned István Vitnyédy dated August 1661: "It is certain that, if his lordship can keep it, *Kanisa* will be *Sub continua obsidione* [under constant siege]."[6]

4 See, for example, Zrínyi's letter requesting the judges and senators of Varasd for a week's serf labour, Zrínyi-Újvár, 25 July 1661, as well as his letter addressed to János Gersei Pethő, Zrínyi-Újvár, 8 August 1661. ZMVL 1997. 120, 121.

5 Miklós Zrínyi turned to the Styrian Estates and the War Council in Graz for help in his letters written at Csáktornya, on 26 March 1662. ZMVL 1997. 122–126. Radoslav Lopašić, for example, published a report dated January 1671, which lists the aid (weapons, cannon, cannonballs, ammunition and building materials) that Miklós Zrínyi received form the Styrian Estates upon his request. *Lopašić* 1883. 136–139. For the support provided by the Styrian Estates to Miklós Zrínyi, see also the study by István Czigány in the present volume.

6 István Vitnyédy to István Lenturics, Sopron, 28 August 1661. *Fabó* XV. 1871. 173.

The construction of the fortress was directly related to the events that occurred in Transylvania, namely the armed struggles led by Princes György Rákóczi II and János Kemény. Zrínyi started building the fortress after the Transylvanian Diet (held on 23 April 1661, in Beszterce [today Bistrița, Romania]) declared secession from the Sublime Porte on the proposal of Prince János Kemény, and negotiations started in Vienna about supporting Transylvania. In response, a huge Ottoman army was launched against János Kemény, under the command of Serdar Köse Ali Pasha. With the construction of Zrínyi-Újvár, Zrínyi sought to engage the Ottoman forces. So did the imperial commander Raimondo Montecuccoli, who wanted to achieve the same goal with a diversionary manoeuvre against Buda or Esztergom.[7]

Zrínyi succeeded in distracting some Ottoman forces from Transylvania with the construction of the fortress itself. As early as July 1661, Grand Vizier Ahmed Köprülü ordered Mustafa Pasha and Hassan Pasha, both of whom knew the border fortress district facing Kanizsa very well, to inhibit the construction. According to some accounts, for this reason, an Ottoman army of over 10,000 soldiers was amassed around Pécs.[8] The fortress represented an intolerable provocation in the eyes of the Ottoman Turks. This is clearly shown by the numerous attacks launched against the fortress from the very beginning of the building, as well as by the fact that during the negotiations between the Habsburgs and the Sublime Porte, one of the conditions of the agreement was the destruction of Zrínyi-Újvár. In April 1663, Köprülü Ahmed demanded again the surrender of Zrínyi-Újvár in an ultimatum, and because he did not achieve this, the fortress served as a *casus belli* for the outbreak of the Great Ottoman War of 1663–1664.[9] During this war, in August 1663, the Pashas of Bosnia and Kanizsa attacked the fortress with approximately 8,000 soldiers, which – in the absence of Zrínyi – was successfully defended by Zrínyi's younger brother, Péter Zrínyi.[10] On 27 November 1663, the Ottoman Turks, reinforced by major forces and bridge construction units, attempted crossing over the Mura River at Kotori, which was prevented by Zrínyi in a fierce fight lasting for a whole day.[11] On 21 January 1664,

7 See Montecuccoli's proposal submitted to the emperor: Umilissimo parere intorno alla conservazione dell'Ungheria, e della Transilvania (25 February 1662). ÖStA KA Nachlasse Mémoires B/492/c/8/18. Its critical edition: *Testa* 2000. 128–133. The document has already been published by Veltzé: Ausgewählte Schriften IV. 1900. 95–108. According to this, Transylvania cannot be directly assisted by the deployment of the royal army in it, because, due to the great distance, half of the army would die before its arrival. Therefore, the only possible way to help Transylvania is to carry out a diversionary manoeuvre. See also *B. Szabó* 2011.

8 ÖStA KA IHKR Vindica Prot. Bd. 68. August 1661. fol. 107r-v.; ÖStA KA HKR Prot. Bd. 324. 10 August 1661. fol. 197r.; ÖStA KA HKR Prot. Exp. Bd. 323. August 1661 fol. 375r. See also, the letter of Miklós Zrínyi to an unknown person, Martianez, 28 June 1661. ZMVL 1997. 116. According to a contemporary, "the Ottoman Turks made a resolution [decision], even if they had to leave Transylvania temporarily […] to demolish it […] completely […]". (The letter of Georg Fenth, the notary of Kőszeg, to Ferenc Mankóbüki Horváth, 17 October 1661. Cited by *Kovács* 1998. 913.) In June 1661, the Sultan allegedly executed the infamous and feared Seydi Ahmed, the Pasha of Kanizsa, because he could not prevent the construction of Zrínyi-Újvár. *Fabó* XV. 1871. 160, 163. Cf. *Sudár* 2011. 888–909.

9 *Perjés* 1999. 150–159; *R. Várkonyi* 2010. 292–293.

10 István Vitnyédy to Rottal, Sopron, 19 August 1663. *Fabó* XVI. 1871. 108–109; Historischer Loorbeer-Krantz der Christlichen Rittersleute. Nürnberg, 1664. (OSZK App. H. 909.) 142–143; *Zimmermann, Martin:* Denckwürdige Historia. Augsburg, 1665. (OSZK App. H. 942.) 12; *Gradelehn, Johann:* Hungarische, Siebenbürgische Moldau-Wallach… Chronica. Frankfurt a. Mayn, 1665. (App. H. 943.) 678–679.

11 Miklós Zrínyi to Leopold I, Légrád, 28 November 1663. ZMÖM 1958. 327–329.

WJe es mit dem glückhafften Treffen/ so Ihro Excell: Herr Graf von Serin mit den Türcken und Tartarn den 27. Novemb: dieses 1663sten Jahres bey dem Fluß Muhr gehalten/ abgelauffen/ kan auß Hochermeldten Herrn Grafen von Serin eigenem berichte/ die Er an Ihr Kays: Mayest: abgehen lassen/ abgenommen werden/ und lautet gedachter Bericht also:

Gestern seynd wir/ mittels der Barmhertzigkeit Gottes/ nicht ohne sonders Miracul, ich und die umbligende Landschafften/ auß der Barbarischen Völcker Händen nicht allein conservirt, sondern auch an ihnen gerochen worden/ denn die Türcken und Tartarn mit einer grossen und wolaußgerüsteten Armada, nicht heimlich/ sondern bey hellen liechten Tag/ anmarchiret/ mit sich ein Schiff-Brucken/ neben aller nothwendigen Munition, führend/ über selbige gehen wollen/ und zwar mit voranschickung 2000. Tartarn/ welche bemelde Schiff-Brucken/ für die nachfolgende Armee auffgeschlagen haben. Ich mit diesen wenigen Volck und Beyhülff/ so ich bey mir gehabt/ habe mich durch den Fluß der Muhr/ in ungelegene Oerter vertheilen müssen: wie ich denn selbsten mit 300. Reutern die gantze Nacht gefolget/ und auff des Feinds Intent achtung gegeben/ alßdann mit anbrechenden Tag den Feind angefallen. Vorhero ist von meiner weit-entlegenen Schildwache/ auß einem kleinen Feuer-Mörßner der Ankunfft des Feindes ein Zeichen geben worden/ nach welchen ich gleich angeritten. Die 2000. Tartarn waren schon durch das Wasser geschwommen/ weil sie meine Ankunfft gleich gemercket. In deme ich aber betrachtete/ in was verzweiffelten Stand wir/ ich und meine Insel/ uns befinden/ so hab ich mir nichts anders einbilden können/ als das alles verlohren sey: dann zuruck hab ich nicht mehr gehen können/ wäre auch nicht rathsam gewesen. Demnach hab ich hertzhaft meinen Soldaten zugesprochen/ und bin in Gottes Namen auf den Feind loßgangen. GOtt hat hierdurch erwiesen/ daß er noch der Christen Heil und Beystand sey/ und nicht dero Untergang verlange/ sondern des Feinds Kräfften und Hochmuth zu dämpfen begehre. Nach den ersten Pfallschiessen/ welche gleich wie der Schnee hinder und vor uns nidergefallen/ ist ihnen ein solche Furcht ankommen/ daß sie sich allein die Flucht und Muhr begeben. In dem Fluß seynd ihnen andere Tartarn zum Succurs entgegen kommen/ aber mit grosser Confusion und verwirrung. Sie haben alle/ gleichsam Kettenweiß aneinander hangend/ im Fluß gehalten/ daß sie weder zuruckgehen/ durchschwimmen/ noch sich wehren können. Ein grosser Theil des Stroms ist mit Roß und Menschen wie angesäet/ zusehen gewesen/ also/ daß schier das Wasser von menge des Volcks und Rosse/ nicht zu unterscheiden wahr. Underdessen habe ich die Occasion nicht versaumet/ sondern hertzhaft mit den Meinigen darauf gesäbelt/ und keinen einzigen Gefangenen Quartier geben lassen. Es seynd ihrer auch wenig durch das Wasser entkommen/ sondern theils durch unser Wehr und Waffen/ theils von vielen schiessen/ erbärmlich untergangen. Wir haben ungefähr 1000. Pferdt von ihnen bekommen; die übrigen mit ihren Herren/ sind wenigsten Theils davon kommen/ sondern ersoffen. Der Vezier, welcher Sie commandirt, hat sich anfangs wenig umb diesen Verlust betrübet/ sondern gleich umb seine Fueßvölcker/ so nicht weit davon gestanden/ geschicket. Ehe aber diese ankommen/ seynd meine 300. Fuß-Knechte herzu geloffen/ welche zwey kleine Feld-Stücklein mitgebracht/ mit diesen hab ich mich defendirt, bis meine andere Soldaten auch herbey kommen seynd. Also haben wir den gantzen gestrigen Tag und Nacht/ mit Büchsen und Stücklen gefochten: bis endlich der Vezier, gantz desperat, vor der Morgenröth/ von Zorn schaumend/ und die Rach mir schwerend/ heimlich davon gangen. Gewißlich ist der gestrige Tag und Nacht/ mir und diesen Landschaften denckwürdig zuachten. Wie es aber ins künfftig mit mir weiter gehen wird/ kan ich nicht gewiß wissen: dann der Türck umb Canischa sein Läger völlig geschlagen/ und wird schwerlich ohne revanche abziehen. Wie starck aber der Feind ist/ kan ich auch nicht gewiß schreiben/ aus Ursachen/ weiln ich keinen Gefangene lebendig gelassen. So viel aber von den gemeinen Volck spargiret wird/ sollen die Türcken und Tartarn bis in 40000. gewesen seyn: und so viel ich selbst über das Wasser ersehen können/ seyn auf 10000. in allem gehalten. Dero Meinung aber ist klar und lauter/ daß sie sich wider mich des Schadens/ so ich ihnen zu Comorn gethan haben rächen wollen/ und nicht allein mein Insel/ sondern auch gantz Steyermarck/ bis nacher Grätz streiffend/ verheeren und verbrennen/ hernachmahls ihren march, durch des Grafen Pudiani Güter/ zurück nehmen wollen.

Andeutung des Kupferblats.

A. Das Treffen der Tartarn mit den Serinischen Völckern.
B. Die Flucht der Tartarn gegen der Muhr.
C. Die Türckische Armada über die Muhr.
D. Die Vestung Serinwar. E. Canischa. F. Neu Serinwar.
G. Morast umb Neu Serinwar.
H. Abgehackt und zusammen geflochtener Wald.

Figure 2.

A contemporary pamphlet on the clash between Miklós Zrínyi and Ali Pasha in November 1663, with the depiction of Zrínyi-Újvár in the upper left corner of the image

Source: MNM TKCs T 1040

the reinforcement troops of the Rhenish Alliance led by Julius Hohenlohe and the army of Zrínyi gathered under Zrínyi-Újvár, and launched their winter campaign from there, which was meant to be the first action of their offensive war against the Ottomans.[12]

The strategic importance of the construction of Zrínyi-Újvár was also known in the Viennese Court. High Seneschal Duke Portia, President of the Privy Council, who supported peace with the Ottoman Turks, condemned Zrínyi. However, those who urged to take action against the Ottoman Turks welcomed the construction of the fortress.[13] In 1661, even Raimondo Montecuccoli, Zrínyi's later opponent, acknowledged the role that the fortress had in the blockade of Kanizsa. Moreover, in 1662, he himself considered launching an attack southwards on Kanizsa.[14] The judgement about Zrínyi-Újvár in the Imperial Court was influenced by fights between the so-called "Spanish" (pro-peace) party and the "Italian" (pro-war) party with alternating outcome.[15] In the summer of 1661, the supporters of the Ottoman war became temporarily stronger in Vienna, – in July 1661, even Montecuccoli was sent to Transylvania to help János Kemény[16] – and thus Zrínyi was allowed (without formal permission) to build a fortress on Ottoman land. Additionally, Guislain Segers d'Ideghem von Wassenhoven, an experienced Dutch military engineer of the Imperial War Council was also sent to his aid,[17] and even one and a half hundred musketeers were posted in the fortress, under the command of Zrínyi.[18]

The construction of the fortress was, therefore, not the individual act of a single lord, as it was held by historiography based on Montecuccoli's later works, especially his memoirs written for Emperor Leopold I in 1670, during the dissolution of the conspiracy of the estates organised by Zrínyi and Frangepán *(Della guerra col Turco in Ungheria),* as well as the representative biography of Leopold I by Gualdo Priorato *(Historia di Leopoldo Cesare)* reflecting Montecuccoli's views. Instead, (at least in 1661) it was an enterprise, supported by the Imperial Court, Venice and the Styrian Estates, connected to and fitting well into the international struggles against the Ottoman Empire, and above all the Ottoman–Venetian War that had already been fought for over a decade in the Mediterranean region.[19] All this is well reflected in the great international attention it received. Dozens of pamphlets

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12 *Perjés* 1989. 37–41, 59–60; *Perjés* 2002. 373–382.

13 *R. Várkonyi* 1985. II. 1089.

14 *Marczali* 1880. 754. Montecuccoli considered a possible attack against Kanizsa and/or Esztergom in his proposal entitled *Combinazione della guerra contr'al Turco in Transilvania, ed Ungheria,* formulated on 9 March 1662. ÖStA KA Nachlasse Mémoires B/492/c/8/20. Kart. 3. fol. 3r.; *Testa* 2000. 137.

15 *R. Várkonyi* 1985. II. 1089; *Bérenger* 2004. 156–161.

16 For this, more recently, see *B. Szabó* 2011. 930–933.

17 As early as 1654, Wassenhoven received a monthly pay of 50 forints, on the ruler's order. ÖStA KA HKR Prot. Exp. Bd. 307. 1653–1654. fol. 429r. 28 March 1654. Domokos 2012. 48. Zrínyi asked the Styrian Estates already in 1657 "to order the Dutch military engineer, who was otherwise hired for the needs of the province", to assist the fortification work of the Csáktornya Fortress as soon as possible. The letter of Miklós Zrínyi to the Styrian Estates, March 1657. ZMVL 1997. 96.

18 For transferring 150 musketeers of the Wallis Regiment to Zrínyi-Újvár, see ÖStA KA IHKR Vindica Prot. Bd. 68. September 1661 fol. 148; ÖStA KA HKR Reg. Prot. Bd. 324. 7 November 1661. fol. 289v.; ÖStA KA HKR Prot. Exp. Bd. 323. 7 November 1661. fol. 479a; István Vitnyédy to Menyhért Keczer, Sopron, 23 November 1661. *Fabó* XV. 1871. 175.

19 *R. Várkonyi* 2010. 292–293. For this, see also the study by István Czigány published in the present volume.

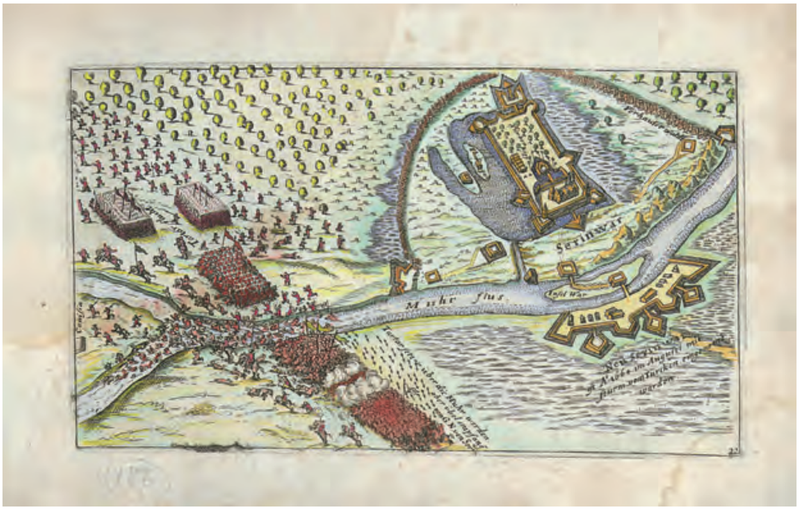

Figure 3.
Csáktornya (Serinwar) and Zrínyi-Újvár (Neu Serin war) on the other side of the Mura, coloured copperplate engraving from 1663

Source: MNM TKCs 58.2478

Figure 4.
The sieges of Zrínyi-Újvár and Kolozsvár represented together with the bust of Zrínyi, on a contemporary German copperplate engraving

Source: MNM TKCs T 4655

and reports dealt with the events of 1663 and 1664, and approximately sixty pictorial representations have remained of it.[20]

The irregularly shaped earth and wood fortification, according to our current knowledge, could originally take in 300 guards.[21] It was later extended, and an advanced defensive work and ditches had been added to it by 1664. In 1662, while work on the fortification was still in full swing,[22] Colonel Jacob von Holst, military engineer, was sent to Zrínyi-Újvár by the Imperial War Council because of the protest of the Sublime Porte. He was charged with inspecting the site from the perspective of defence against the Ottoman Turks. Holst found it indefensible from a large army and reported that "because of his location, it could not be improved, either".[23] Subsequently, under the pressure of the strengthened pro-peace party and the repeated Ottoman demand,[24] the ruler ordered the demolition of the fortress. However, Zrínyi refused it, and did not carry out the order. On the contrary, he expressed his firm conviction that Zrínyi-Újvár was an establishment "that served the benefit of the entire Christendom" and continued the building. In early 1662, he had a wide fishpond dug to the east of the fortress – implementing a late sixteenth-century plan – that was filled up by leading the water of the Mura River into Visszafolyó-patak [Backflow Stream], and building a sluice on it.[25] We do not know exactly when, but presumably sometime in 1664, after the arrival of French military engineer Dubois D'Avancourt, a triangular advanced defensive work was constructed in the dry ditch, on the western side of

20 For the former, see *G. Etényi* 2003; for the latter, see *Cennerné* 1997. 172–177; *Szalai–Szántai* II. 2006. 158–161. (It contains fifty-nine pictorial representations of Zrínyi-Újvár.) Nevertheless, some of the engraved representations, vedutas, labelled Serinwar, in reality, depict one of Zrínyi's strongholds in Muraköz, the well-constructed Csáktornya. This had previously misled even researchers. The cover of a representative volume on Zrínyi-Újvár published in Croatia in 2001, for example, shows a fictitious view entitled "Serinwar" by J. W. Valvasor, which, in fact, represents Csáktornya. *Petrić–Feletar–Feletar* 2001. cover and 34–35.

21 According to Zrínyi's memoir written to Emperor Leopold I in Vienna on 17 July 1664, the fortress was previously defended by 120 German and 150 Hungarian soldiers (ZMVL 1997. 221.). Priorato also writes about 300 soldiers (*Priorato* II. 1670. 407.), while a Viennese account dated July 1661 records a 500-strong garrison. *Marczali* 1880. 754.

22 In his last will and testament dated 6 April 1662, Zrínyi also writes about further plans to fortify Zrínyi-Újvár. ZMÖM 1958. II. 391, 611.

23 The commission of Holst: ÖStA KA HKR Reg. Prot. Bd. 326. 12 April 1662. fol. 78v. He sent his report ("Holst Relation Zrinische Vestungen und Stätt") to the Imperial War Council in July: ÖStA KA HKR Exp. Prot. Bd. 325. fol. 286r. See also: *Priorato* II. 1672. 106.

24 During the peace negotiations in May and June 1662, the Grand Vizier told Reniger, the legate sent to the Porte, that the destruction of the fortress was one of their conditions for maintaining the Habsburg–Ottoman peace. In May and June, several conferences were held on peace conditions in Vienna, headed by Duke Portia. ÖStA KA HKR Exp. Prot. Bd. 325. July 1662. fol. 287r-v.

25 The ditch leading the water of the Mura River into the Kanizsa Stream (and thus raising its water level) was completed in April 1662. István Vitnyédy to István Rabby, Locsmánd (today Lutzmannsburg, Austria), 8 April 1662. *Fabó* XVI. 1871. 195. It is also shown on the sketches by Holst and Esterházy: „ff. Gräben, so der graff von Zrin machen lassen den wald vor die guarnison zu versichern vnd zu gebrauchen." *Hrenkó* 1979. 127. Raising the water level of the Kanizsa Stream at Kakony with the water of the Mura was proposed by the *Muster Comission,* made up of war councillors and border fortress captains (including György Zrínyi IV!, the grandfather of Miklós Zrínyi) supervising the border fortress district of Kanizsa, as early as 1577. They found that the Ottomans could easily cross the stream both on horseback and on foot because of the low water level. *Kelenik* 2005a. 353; *Hausner–Négyesi–Papp* 2005. 836.

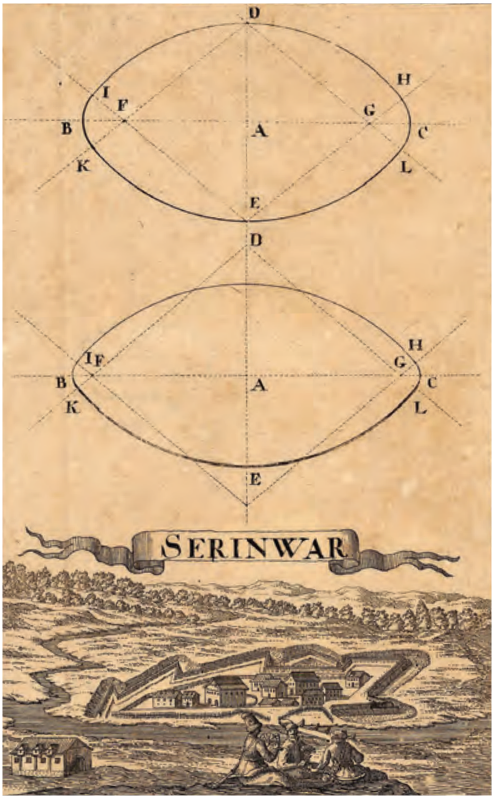

Figure 5.
Zrínyi-Újvár in a copperplate engraving by Justus van der Nyport
Source: Birckenstein 1686. (OSZK, App. H. 1217)

the fortress. Additionally, on the other side of the Mura – that is on the right bank of the river – a bridgehead *(redoute)* was established with a capacity of about fifty men, which was connected to the other bank by a bridge.[26]

[26] For the capacity of the *redoute,* see *Priorato* II. 1670. 407. According to a letter of Márk Forstall, the court priest of Zrínyi, D'Avancuort "made excellent defences and mines for the fortress": Manuscripts of the National Széchényi Library OSZK KT Fol. Gall. 75. II. fol. 184a–187a. Published by *Bíró* 1989. 197. The fact that the expansion of the defences of the fortress above was executed by him is also indirectly confirmed by a letter written by a military engineer called Damian von Niedeggen to Montecuccoli in November 1663. He then regarded the fact that the defences of the fortress were completely open to the River Mura as one of its weaknesses, and suggested that defensive posts should be built against the Ottoman attacks below the fortress, on the island of the Mura. Consequently, the *redoute* on the other side and the palisade running to the river still did not exist in November 1663. They were probably established after the arrival of D'Avancourt, and under his direction. (Nevertheless, Niedeggen believed that – in spite of its deficiencies – Zrínyi-Újvár was stronger than Érsekújvár [today Nové Zámky, Slovakia] due to the surrounding forests and marshes! ÖStA KA AFA 1663/11/6. fol. 441v. *Domokos* 2012. 45.) On the activity of D'Avancourt during the siege of Zrínyi-Újvár: ÖStA KA HKR Prot. Exp. Bd. 328. fol. 307r., 336r-v., 340v.

The extant letters written by Miklós Zrínyi contain very little information about the construction of the fortress and its geographical environment. On 5 July 1661, Zrínyi informed members of the Imperial War Council about military reasons for the building. Unfortunately, the suitable location of the fortress was presented only verbally (and presumably with a drawing) by the military engineer Wassenhoven, who was involved in the construction, but that drawing did not survive.[27] In addition to his letter addressed to the Imperial War Council, Zrínyi wrote about the fortress in three other letters and in his last will and testament drawn up in April 1662. His letters, particularly the one written to the ruler on 27 June 1664, describing the camp in the Muraköz and blaming Montecuccoli for his military strategy, as well as his bitter memoir made in Vienna on 17 July 1664, after the fall of the fortress, can be used as sources about the siege of Zrínyi-Újvár.[28]

From the narrative sources, only those are worth considering the authors of which took part in the siege, that is, personally visited the site. We are in a fortunate situation, because we know three authors (two from the Christian camp, and one from the camp of the besieging Ottoman Turks) who left behind relatively long, evaluable descriptions of the fortress and the events that occurred there. What is more, these include sketches and accounts by Raimondo Montecuccoli, the Imperial Commander-in-Chief leading the defence: "This fortress had been built to serve as a bridgehead for a bridge that allowed crossing over the Mura River towards Kanizsa, and to secure the retreat of troops returning from raids in peacetime. If the raiders were pursued by the Ottoman Turks, they could find shelter there with their loot, and could easily cross the bridge. This place was insignificant because it had no ditches, no covered paths, no form and no wings, either. Its defensive lines were very short. The level of construction was low and sloping, but the earthen embankment was high and very narrow. Nevertheless, it was dominated by one hill, and the Ottoman Turks set up their battery on it. Inside [the fortress], there was neither land, nor space. It was open on both sides, because the walls were not built to the water. An open area was left between the walls and the water. Therefore, from the very first moment to the last, there was equally a danger that it would be occupied in close combat."[29]

The given description offered by Montecuccoli – as it was emphasised by the Hungarian scholarship decades ago – should be treated with strong source criticism. He wrote all this in 1670, during the dissolution of the Wesselényi Conspiracy, in his memoirs compiled for Emperor Leopold I. The main purpose of this work was to justify the Peace of Vasvár, and to transfer responsibility to the Hungarians.[30]

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27 Miklós Zrínyi to the Imperial War Council, Légrád, 5 July 1661. ZMVL 1997. 117–118.

28 Ibid. 159–162, 213–222.

29 *Raimondo Montecuccoli:* Della guerra col Turco in Ungheria. In: *Luraghi* 1988. II. 428–431. *Montecuccoli* 2019. 214. In his report written to Emperor Leopold in 1664, Montecuccoli also disparaged the fortress: "It was therefore an insignificant, small place: it had no ditches, no contrascarpa, no shape, no wings and no earthen rampart inside, either. It was completely open to the water, so it was likely to fall already in the first hour of a siege, let alone in the last. It was also unsuitable for raids because of the steep parts and the opposite hill. Additionally, it was so confined that only a few men could fit in without causing too much confusion, and hindering one another. So it was not worth defending it at all." *Raimondo Montecuccoli:* Relazione della campagna dell'Armata Cesarea nell'Anno MDCLXIV. ÖStA KA AFA 1664/13/29. fol. 6r.

30 *R. Várkonyi* 1975. 90; *Perjés* 1961. 180.

The other description of Zrínyi-Újvár was left for the posterity by the young Pál Esterházy, a devoted follower of Zrínyi. His memoir entitled *Mars Hungaricus* was written in Latin shortly after the fall of the fortress. In the summer of 1664, Esterházy was himself at the head of his 900-strong army in the camp of the Hungarians set up next to Kotor (today Kotoriba, Croatia on the right bank of the River Mura. (On the sketch by Montecuccoli, he appears by the name.) According to the testimony of his letters addressed to his wife, he was personally present in the besieged stronghold. Esterházy first entered Zrínyi-Újvár on 23 June. He walked around the fortress, and had it even drawn: "I walked everywhere" – he wrote to his wife on the following day – "and I am sending to you its *delineatio.*" In his letter dated 30 June, he again mentions his visit to the fortress. On 14 July, he inspected the remains of the defences which had already been blown up and burnt down by the Ottoman Turks, and he also took a look at the Ottoman gun emplacements. His letters confirm and here and there complete with useful pieces of information (such as a reference to the "lower fence" of the fortress) what he wrote in *Mars Hungaricus.* The source analysis of his memoir shows that Esterházy gave a more or less accurate account of the events in which he himself had participated, using his own notes and contemporary documents.[31]

The Christian sources above are well complemented by the description of Zrínyi-Újvár and its siege provided by Evliya Çelebi, the Ottoman world traveller. In the spring of 1664, Evliya rushed from Bosnia to Hungary in order to participate in the Ottoman campaign. Except for a period of about eight to ten days, he was present during the whole siege. By that time, he had travelled almost all over the Ottoman Empire (*nota bene:* in 1660, he even visited Zrínyi at Csáktornya). In his work entitled *Seyahâtnâme* [Book of Travels], he summarised the experiences he had had during his travels. In Volume 6 he writes about the location and shape of Zrínyi-Újvár (*Jeni kala* in Turkish), and the events of the siege.[32] According to Çelebi: "It was built by Zerin oglu […] when Sohrab Mehmed Pasha was the Vali of Kanizsa and Kanizsa was burnt down, with the aim to occupy Kanizsa, on this side of the Mura River, on the land belonging to Kanizsa, in a distance of three hours from Kanizsa, despite the peace treaty […]. Although Sohrab Mehmed Pasha repeatedly urged him, saying 'Demolish this fortress!', he was not willing to do so. Instead, he fortified the fortress even more, and placed twenty thousand selected soldiers in it, who kept plundering and destroying the Islamic province […]. The fortress was constructed of wood, like Kanizsa, on a wooded and shady promontory, on the bank of the Mura River. To be sure, the damn enemy rebuilt it into an Iskender fortress."[33]

31 *Hausner* 1989. 11–14. Géza Pálffy has called attention to some of Esterházy's errors, but this does not change the fact that the memoir provides an accurate picture of the events, fundamentally based on sources. *Pálffy* 2016. 33–34.

32 *Evlia* 1985. 571–576, 587–591.

33 *Evlia* 1985. 571–572.

Contemporary cartographic depictions of Zrínyi-Újvár

Figure 6.
Drawing of the siege of Zrínyi-Újvár by Raimondo Montecuccoli, 1664
Source: Montecuccoli: Relazione. ÖStA KA AFA 1664/13/29. Beilage A.

Montecuccoli attached a sketch map showing the siege of Zrínyi-Újvár to his report about the 1664 campaign.[34] It is "accurate and reliable, albeit succinct. It indicates only the main elements. It does not depict the buildings of the fortress, either. The fortress is placed on an elevation, but in a way that its floor plan is shown on the side-view picture of the row of hills."[35]

It is intriguing that the description of the siege of Zrínyi-Újvár issued in the history written by Gualdo Priorato under the supervision of Montecuccoli is not illustrated with this picture. Instead, it includes a copperplate engraving by Cornelis Meyssens, a Viennese engraver. This shows only the most important landscape features: the Mura River, the Kanizsa Stream and Visszafolyó-patak [Backflow Stream], a small fortress of irregular shape on the left side of the river, as well as a line drawing of Ottoman approaching trenches and artillery trajectories.[36] The source of this depiction is a site plan by another important chief officer of the imperial army stationed in Muraköz, namely Colonel Jacob von Holst, military engineer, who had visited the fortress on behalf of the Imperial War

34 *Montecuccoli:* Relazione. ÖStA KA AFA 1664/13/29. Beilage A.
35 *Hrenkó* 1979. 126.
36 *Priorato* II. 1672. between pages 404 and 405. Cf. *Cennerné* 1997. 175. (D 177), and *Szalai–Szántai* II. 2006. 160.

Council as early as 1662.[37] During the 1664 siege of Kanizsa, Holst was the commander of the artillery, and "before the arrival of Lieutenant General Freiherr von Sparr in the camp" under Zrínyi-Újvár, he also commanded the imperial artillery. The authentic sketch made by Holst was engraved in copperplate by Johann Martin Lerch, working in Vienna, and was published as printed graphics.[38]

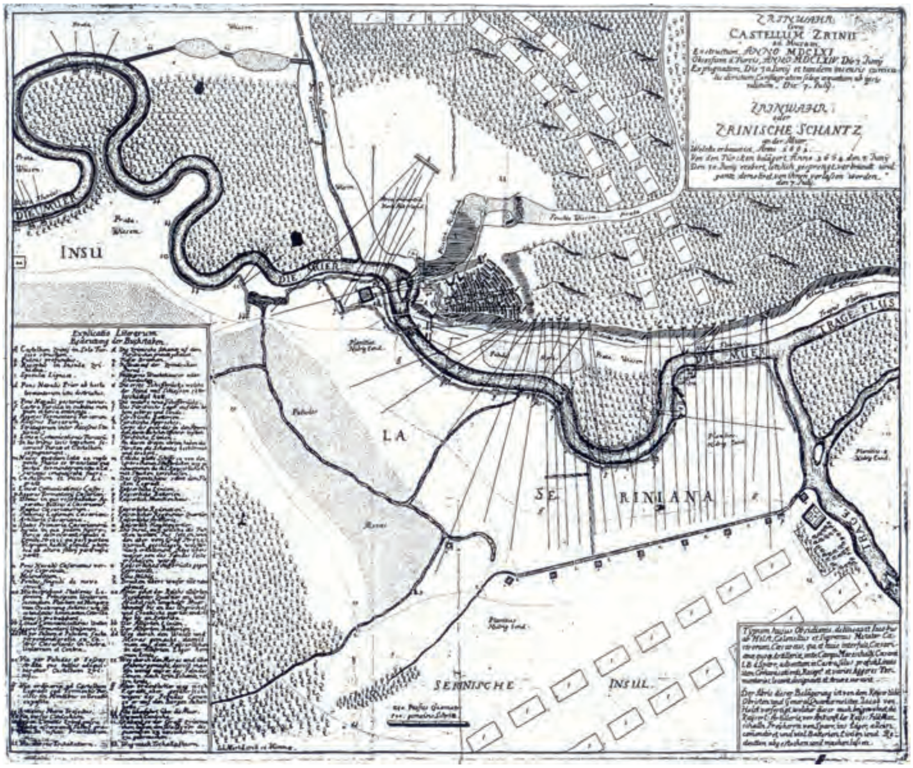

Figure 7.
Site plan of the siege engraved into copperplate by Johann Martin Lerch after a sketch by Colonel Jacob von Holst, military engineer

Source: Szalai–Szántai II. 2006. 159.

[37] Holst was also experienced in the construction of fortresses. In 1671, for example, he worked on a number of strongholds in Upper Hungary (Ecsed [Nagyecsed], Kálló [Nagykálló], Tokaj and Kassa [today Košice, Slovakia]), and participated in the fortification of the Szatmár Castle [today on the territory of Satu Mare, Romania]). A number of his castle drawings have been preserved. The images of Kővár (today part of Remetea Chioarului, Romania) and Szamosújvár (today Gherla, Romania), for instance, were included among the illustrations of Priorato's representative work. *Priorato* I. 1670. between pages 726 and 727, and between pages 728 and 729. For his activity, see *Domokos* 2006. 1059–1071.

[38] A copy that survived as a single sheet: MNM TKCs 6495 T. See also OSZK App. H. 2098, cf. *Cennerné* 1997. 175.

The nine-line Latin title of the 47.5 × 38 cm image and its nine-line long German equivalent can be read in the top right corner: *ZRINWAHR sive CASTELLUM ZRINII ad Muram, Exstructum ANNO MDCLXI, Obessum á Turcis, ANNO MDCLXIV. Die 3 Juny, Expugnatum, Die 30. Juny et tandem incensis cuniculis dirutum Conflagratum soloque aequatum ab ipsis relictum Die 7 July. / ZRINWAHR oder ZRINISCHE SHANTZ an der Muer, Welche erbauet ist Anno 1661. Von dem Türcken belägert Anno 1664. den 3 Juny, Den 30 Juny erobert, letzlich gesprengt, verbrandt und gantz demiliret, von ihnen verlassen worden, den 7 July.*

The name and titles of Jacob von Holst, the creator of the site plan, that he had in the imperial army are written in Latin and German in the lower right corner: "Typum hujus Obsidionis delineavit Iacobus ab Holst, Colonellus et Supremus Metator Castrorum Caesareus, qui et huic interfuit, Caesarianeae quoque Artilleriae, ante Campi Mareschalli Caesarei L.B. a' Sparr, adventum in Castra solus praefuit, Lineas item Communicationes Receptavit et varios Aggeres Tormentarios locavit, designavit et […] curavit. / Der Abris dieser Belägerung ist von dem Kayserlichen Obristen und General Quartiermeister Jacob von Holst verfertigt, welcher dieser auch beygewohnet, die Kayserliche Artillerie, vor Ankunft der Kayserlichen FeldMarschalln Freyherrn von Sparr, ins Läger, allein commandiret, und viel Batterien, Linien und Redoutten abgestochen und machen lassen."

Below, on the left, next to the legend running in two parallel columns, the name of the engraver was indicated, again in both Latin and German: *"Ioh.Mart:Lerch sc: Viennae".*

The depiction made by Holst is very detailed. It has a scale of 1:11,000, and its top is the east. Its key to symbols used runs from A to kk. The image shows a winding river, the plan of a fortification on the left bank of the river, the siege weapons around it and their artillery trajectories.

The appendix of the *Mars Hungaricus* by Pál Esterházy also contains a coloured sketch map in ink of the same scale, with the following caption: "Geometrical site plan and depiction of Zrínyi's fortification, Zrínyivár by the Mura River, which was occupied in 1661. The Ottoman Turks laid siege to it on 3 June 1664. They took it again on 30 June. They eventually exploded it, burnt it down, and completely erased it from the face of the earth. On 7 July, in the same year, it was abandoned."[39] The sketch is nothing other than a copy of the sketch map by Holst.[40]

According to written and pictorial sources, today it can be said about the real strength of Zrínyi-Újvár that it did not belong among the main fortresses. However, its size and the number of its guards made it one of the most important strongholds in the border fortress district of the Croatian Ban (or even the border fortress district facing Kanizsa, which was geographically closer to it). By 1663–1664, it had become capable of upsetting the local balance of power between Christendom and the Ottomans due to its strategic location and construction.[41]

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39 "Geometrische Delineation vnd abbildung des Zrinischen Schantz Zrinwahr ahn dem Muhrflusse, welche erobert worden [erbauet wardt] Anno 1661. Von dem Türcken belägert Anno 1664. den 3 Juny. Den 30 Dito erobert. Letzlich gespränget. Verbrant vndt gäntzlich demoliret. Von Ihnen verlassen worden darauff zu folgten 7. July desselbigen 1664. Jahrs." MNL OL T. 2. XXXII. 1064.

40 *Domokos–Hausner* 2008.

41 In 1661, for example, 2,884 soldiers served in the captaincy facing Kanizsa. There were ca. 450 men at Egerszeg, ca. 200 men at Lenti, ca. 650 men in Muraköz. Furthermore, 500 imperial mercenaries served

Figure 8.
Pál Esterházy's coloured sheet map showing the siege of Zrínyi-Újvár
Source: MNL OL T. 2. XXXII. 1064

The 1664 siege and fall of Zrínyi-Újvár

During the Great Ottoman War of 1663–1664, which broke out partly on the pretext of Zrínyi-Újvár, Kanizsa was besieged in accordance with the military plans of Zrínyi and his circle between April and May 1664. The Christian army lifted the siege of the castle on 1 June 1664, when hearing about the approach of the Ottoman rescue army.[42] The retreating troops crossed the Mura on 3 June. A smaller part of them occupied Zrínyi-Újvár, but most of them were stationed on the other side of the Mura. Zrínyi suggested that they should stay on the left bank and set up camp on the hills in front of the fortress in order to gain

in the ban's outposts, which were also under the command of Zrínyi. They were complemented by Zrínyi's private army (consisting of 8,000–9,000 soldiers) stationed in his estates in Muraköz. At the same time, the Fortress of Kanizsa, which had developed into an Ottoman military and administrative centre, was defended by 1,670 men. Additionally, the total number of Ottoman mercenaries serving in the fortresses of the Kanizsa Vilayet was 3,000 and a few hundred. *Czigány* 2004a. 88–90, 102–103. See also the study by István Czigány in the present volume.

42 For the antecedents to the siege, see *Perjés* 1989. 42–85; *Perjés* 2002. 377–418. We discuss the siege based on our own research and that of György Domokos. *Domokos–Hausner* 2008; *Domokos* 2011; *Domokos* 2012; *Hausner* 2012.

time with active defence, but his proposition was not accepted by the other generals.[43] Thus, the elevations of the Légrád vineyard stretching in front of the fortress were given up to the army of the Grand Vizier arriving there on the following day. The Ottoman army (at least 40,000–50,000 soldiers)[44] made several attempts to cross the Mura River by force, but these were repeatedly repulsed by the units of Generals Hohenlohe and Strozzi based in the Muraköz. At the same time, the Ottomans established gun emplacements on the occupied hills opposite Zrínyi-Újvár. On June 7, they started digging approaching trenches. On the following day, they also began firing at the fortress, that is, regular siege operations started.[45] According to a contemporary record, the Ottoman artillery fired at the fortress, the bridgehead on the other side of the river, and the bridge with six old (i.e. large) siege cannons and about 60 howitzers from well-established cannon emplacements.[46]

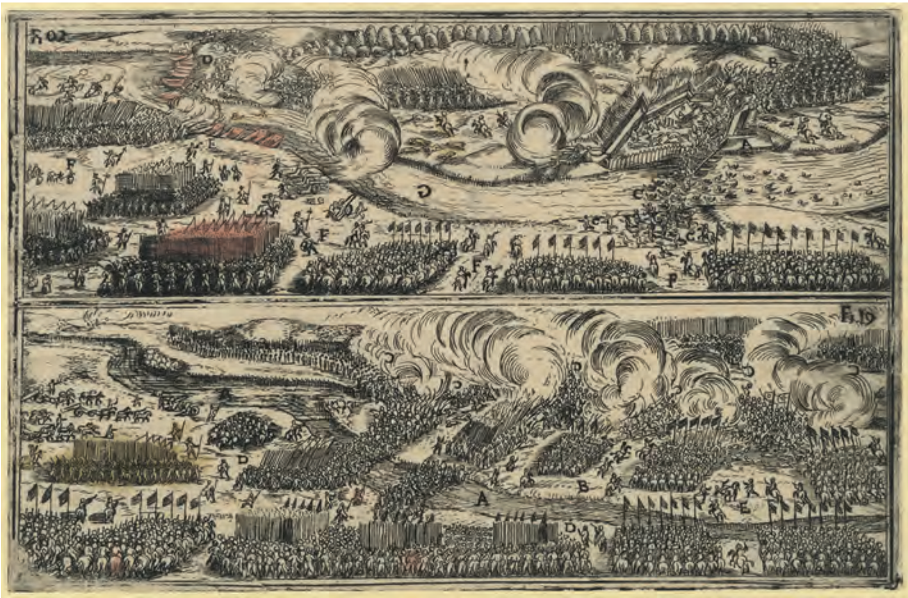

Figure 9.
The siege of Zrínyi-Újvár, copperplate engraving by an unknown German artist, 1665
Source: MNM TKCs 58.2476

[43] Walter Leslie, the Captain of the Slavonian (or Wendish) frontier district with Varasd (today Varaždin, Croatia) at its centre, suggested the same in 1661. It was therefore an acceptable, established practice in military profession. *Domokos* 2012. 46.

[44] Scouts estimated the Ottoman army relieving Kanizsa to consist of 40,000–60,000 soldiers. ÖStA KA AFA 1664/6/4 fol. 892v., 893r. However, in his memoir submitted to Leopold I in Vienna on 17 July 1664, Zrínyi considered this an overestimation. ZMÖM 1958. II. 369.

[45] On the events of the siege see *Esterházy* 1989. 162–167, 251–254; *Perjés* 2002. 408–417; *Domokos–Hausner* 2008. 252–264.

[46] *Nagy* 1877. 271–272.

In the wake of the events, military leadership in Vienna decided to redeploy the army led by Montecuccoli from the Danube to the Mura. On 4 June, Montecuccoli received the order issued by Leopold I to leave for Zrínyi-Újvár and take over the command of the allied troops. The Italian commander recorded this in a diary. According to this source, he submitted a petition to the emperor before his departure, in which he pointed out that, in his opinion, the fortress could not be defended. In spite of this, the Viennese Court decided that the fortress had to be held as long as it was possible and reasonable. Therefore, Montecuccoli did not receive a direct order to give up the fortress. The ruler relied on the military expertise of the general field marshal and his generals how long they would defend the fortress.[47] Montecuccoli arrived at the camp on 15 June. According to his diary, on 17 June, he held a council of war to determine how to keep the fortress for the longest possible period of time. At this meeting, Montecuccoli, as Commander-in-Chief, took decisive measures to organise the defence. He deposed the former commander of the fortress, who was an officer in the imperial troops. He was replaced with Lieutenant Colonel Tasso from Strozzi's Regiment, another imperial officer, who must have been more obedient to Montecuccoli. At the same time, he arranged for the deployment of troops along the rather long frontline (he commanded Zrínyi and his men to watch over the line of the Mura), and gave an order to change the exhausted defenders of the fortress every day.[48] According to a contemporary account, 1,200 men were garrisoned in the fortress, and the same number of soldiers stood by to assist them.[49]

At the war council held on 17 June, it was also resolved that they would defend the fortress in every possible way "with mines, countermines, furnaces, crossbeams, tree-trunk barricades, palisades, buried bombs, hand grenades, large grenades, counter-battery weapons and similar military tactics".[50]

After all, the fortress was able to hold up the vastly superior forces of the Ottoman Turks, with the support of the main army stationed beyond the Mura, for more than three weeks. The Ottomans could only seize the fortress in hard fight, at the expense of huge human and material losses. According to the unanimous testimony of written and visual sources, as well as our own investigations carried out at the site for many years (and the finds discovered there), the Ottomans employed the entire arsenal of contemporary fortress fight under the walls of Zrínyi-Újvár. They dug a dense system of approaching trenches around the fortress, bored mines and raised large, carefully built embankments for cannons, which even won the admiration of Pál Esterházy, who visited the site after the siege. Finally, on 27 and 29 June, a siege was launched against the ravelin. The defenders strongly resisted with well-directed firing from the walls and the other side of the river, boring and exploding countermines, and sorties aided by the main army, as described by Montecuccoli.[51] On 29 June, Lieutenant

[47] *Nagy–Hausner* 2011. 706–708, 725.

[48] See Montecuccoli's summary report written to the emperor: Relazione. ÖStA KA AFA 1664/13/29. See also *Priorato* II. 1672. 410–416; *Esterházy* 1989. 162–168, 250–257.

[49] ÖStA KA AFA 1664/6/39. fol. 961r.

[50] *Montecuccoli:* Relazione. ÖStA KA AFA 1664/13/29. fol. 7–8.

[51] A countermine blown up on the day of Pentecost (23 June) buried several Ottoman ditches, but the corporal who set off the explosives also died. ÖStA KA AFA 1664/6/33. fol. 949r., 1664/6/ad 36 ½. fol. 955r-v. At the same place, there is also information about a sortie originally planned for 22 June, which was postponed several times due to rain, and then because of the possible betrayal of an escaped soldier. A report dated 27

Figure 10.

The explosion of Zrínyi-Újvár, copperplate engraving by an unknown German artist, 1664

Source: OSZK, App. H. 909

Colonel Tasso, the commander of the defenders, reported that the fortress became so ruinous, as to be indefensible, and the Ottomans were already at the very bottom of the walls.[52] Thus, at Montecuccoli's command, the "fine artillery weapons were taken out of the fortress" on the Mura, and the undermining of the fortress began. Early in the morning, on 30 June, however, the Ottomans launched another siege, and they finally succeeded in their third attempt to capture the moat. Subsequently, the superior Ottoman army started to attack from there, and the demoralised defenders ran scared out of the fortress without blowing up the previously made mines. During the siege of 30 June and the retreat over the Mura Bridge, approximately 800 Christian defenders lost their lives. Thus, contrary to Zrínyi's opinion,[53] Zrínyi-Újvár was not abandoned, but rather seized by the Ottomans.

Following the occupation of the fortress, the Ottoman leadership was indecisive for several days. In the first days of July, they still considered retaining the fortress and even started to rebuild it, but eventually decided to demolish it,[54] which was carried out on 7 July,

June tells about a raid on the Ottoman food supply near Kotoriba. Another describes the progress of the siege. According to this, the trenches of the Ottomans were only fifteen steps away from the fortress. They set up five batteries and were incessantly firing with their cannons, albeit with little success. However, they lost many men. ÖStA KA AFA 1664/6/39 ½. fol. 961r.

52 *Montecuccoli:* Relazione. ÖStA KA AFA 1664/13/29. fol. 9v.-10r.; Ibid. 1664/7/1.

53 Miklós Zrínyi to Leopold I, Vienna, 17 July 1664. ZMÖM 1958. II. 371–372, 595–597.

54 According to a diary entry recorded by an unknown Hungarian eyewitness on 1 July: "The Ottomans are rebuilding the fortress very diligently." *Nagy* 1877. 274; *Evlia* 1985. 591.

with the mines made by the Christian defenders. According to the account by Pál Esterházy, who witnessed the events, the moat of the fortress was later filled up with earth mixed with gunpowder, and the corpses of Christians were thrown into the wells. "The whole fortress was destroyed in three days by the tireless work of the army to such extent that no trace of it remained. It did not look like an inhabited place, but rather a neglected hill. And thus, the tremendous effort made by Count Zrínyi came to nothing in three days."[55] Moreover, so that it would not cause any problems in the future, it was included in the Peace Treaty of Vasvár made on 10 August, ending the war of 1663–1664, that no party could rebuild and garrison Zrínyi-Újvár, the fortress which provoked the conflicts.

55 *Esterházy* 1989. 167; *Montecuccoli:* Relazione. ÖStA KA AFA 1664/13/29. fol. 17.

The Strategic Importance of Zrínyi-Újvár

Lajos Négyesi

Today, the easiest way to visit the ruins of Zrínyi-Újvár is to approach them from Belezna. On the roadway leading to the Belezna train station, one needs to go as long as the bridge of the Principális-csatorna [Main Channel] (hereinafter: Principális Canal). Then, taking a footpath and crossing over the Visszafolyó-patak [Backflow Stream] (hereinafter: Visszafolyó Stream), one can get to the hill of the fortress. Next to the roadway, one can see the ruins of the former Kakonya Inn. Beyond the railway line, the foundations of the former customs house are hidden beneath the bushes. The reason why the well passable footpath came into being is that the Kakonya Ford used to be found there, and one could get to Alsó-Doboru through that crossing place. It was the shortest way between Kanizsa and Csáktornya (today Čakovec, Croatia).

Figure 1.
Bridge over the Visszafolyó Stream leading to the hill of the fortress
Source: picture made by the author

https://doi.org/10.36250/00757_04

Figure 2.
A map sheet of the First Military Survey showing today's area of the fortress
Source: Map Collection of the Ministry of Defence, Institute and Museum of Military History, Budapest. Map sheet IV.17

Figure 3.
A map sheet of the Second Military Survey showing today's area of the fortress
Source: Map Collection of the Ministry of Defence, Institute and Museum of Military History, Budapest. Map sheet XXIII. 61

The history of the ford can be traced back to the late 1700s on contemporary maps. A map sheet of the First Military Survey[1] still shows the Mura River flowing in the current bed of the Principális Canal. According to a map sheet of the Second Military Survey,[2] the railway had been built by the mid-nineteenth century, and the riverbed of the Mura got beyond the railway line. This condition has not changed since then. In this period, the crossing on the Mura was placed in the extension of the line formed by the Kakonya Inn, the bridge of the Principális Canal and the Belezna railway station.

In the period preceding the First Military Survey, map sketches representing the 1664 siege of the fortress (Montecuccoli, Pál Esterházy, Holst) show the location of the crossing place. This was significantly different from the later conditions. The pontoon bridge could be approached on a road leading to the western side of Szent Mihály Hill, between the steep slope and the Mura, approximately along today's railway line. One may raise the question whether the relocation of the ford was related to the destruction of the fortress. Probably yes, but it would be difficult to find a convincing reason why the place of the crossing had to be changed because of the destruction of the stronghold.

The area lying to the north of the fortress is called Kakonya on contemporary maps. This was the name of a village destroyed in the Ottoman period, which was located on the north side of the present hazardous waste dump site, in the vicinity of the Kanizsa Stream. There was certainly a reason why this place was chosen as the site of the village. The road running along the Kanizsa Stream reached the Mura there, just like the other road in the south, running along the Visszafolyó Steam. There must have been a crossing where the two roads met. A map from 1581[3] shows a settlement called 'Agonatz' at the confluence of the Kanizsa Stream, on the left bank of the Mura. On the opposite bank of the river, there was a fortification called 'Trokgona'. It is not plausible that the name 'Agonatz' can be identified with 'Kakonya', because the location rather corresponds to the village Szentháromság. On the other hand, it is certain that 'Trokgona' on the right bank of the Mura cannot be Kakonya, but some other establishment.

Two structures can be seen on the opposite bank of the Mura on map sketches representing the 1664 siege. One is the building of the powder magazine built of stone or brick, and the other is a rectangular stronghold, a *redoute,* that could accommodate fifty guards. Both buildings disappeared without trace owing to the change of course of the Mura. It is unknown when they were built, but, based on the map, we can assume that one of the two had already been erected by the 1580s. On the basis of its location, I assume that it was the *redoute.* Taking into account the position of the 1664 pontoon bridge, the defensive function of the *redoute* is questionable. In that situation, it would not have been able to exert a direct impact on traffic over the crossing. This placement would have been advantageous if the crossing had had its later course. A map from the first half of the nineteenth century[4] shows the road leading at the foot of the *redoute* partly washed away by the Mura.

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1 The First Military Survey completed during the reign of Emperor Joseph II. Map Collection of the Ministry of Defence, Institute and Museum of Military History, Budapest. Map sheet IV.17.

2 Second Military Survey. Ibid. Map sheet XXIII. 61.

3 The map entitled "Map of Stockholm 1581" was provided to me by Lieutenant Colonel József Kelenik, for which I would like to thank him here again. See *Kisari Balla* 1996.

4 I would like to thank György Domokos for providing me with a digital copy of the map kept in the Kriegsarchiv in Vienna. Reference: ÖStA KA k7k 209.

Figure 4.

The surroundings of the confluence of the Kanizsa Stream on the 1581 map

Source: Kisari Balla 1996.

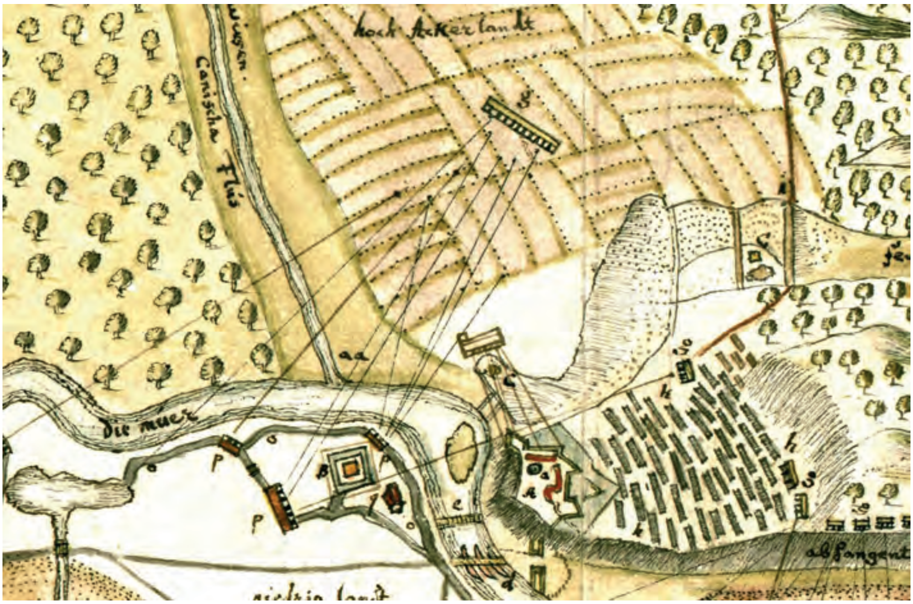

Figure 5.

A detail of the map sketch by Pál Esterházy

Source: MNL OL T 2. XXXII. 1064

Figure 6.
The crossing place on the Mura at Kakonya on a map from the first half of the nineteenth century
Source: ÖStA KA k7k 209

In the light of the above, it may seem reasonable to conclude that the crossing at Kakonya was found in the same place before the construction of Zrínyi-Újvár and after the demolition of the fortress. Therefore, the location of the original crossing changed temporarily during the existence of the fortress, and it returned to its former position after the destruction of the stronghold. In the following, I will refer to the original and, at the same time, later river crossing as Kakonya Ford, whereas the name Zrínyivár Ford will be used for of the crossing under the fortress. The courses of the two fords differed significantly. The Kakonya Ford corresponded to naturally developed crossings where the track follows the most easily passable terrain. It bypassed obstructions and sections that were temporarily impassable (e.g. covered sometimes by floods, or washed away by rain water). If an obstacle emerged somewhere, travellers would seek a direction where it was the easiest to cross and tread a new path. The most convenient place for crossing was logically situated between the confluences of the Kanizsa and Visszafolyó Streams, where the roads running along the streams reached the Mura. On the right side of the Kanizsa Stream stretched a high bank, providing a suitable setting for the road. On the left bank, there was a swampy floodplain stretching to the Mura. The Visszafolyó Stream flowed between marshy banks, worn by gullies. On the left, it was separated from the Mura by the Szent Mihály Hill. The river could be best approached in the area lying between the confluences of the two streams. This place offered the best conditions for crossing.

In contrast, the Zrínyivár Ford almost completely lacked any favourable feature for crossing. Travellers arriving from Kanizsa first had to cross the dam of the mill lake constructed by holding back the water of Visszafolyó Stream. Next, they had to climb up the eastern side of the Szent Mihály Hill, cross the plateau, and then descend on the western side of the hill. Finally, they arrived at the pontoon bridge taking the road that ran through the narrow pass formed between the steep hillside and the Mura. One can rightfully ask what motivated the translocation.

We need to consider the function and defence system of the fortress when looking for an answer to this question. Trokogna depicted on the 1581 map served the defence of the crossing place on the right bank. In 1661, there were nine outposts[5] on the border of the Zrínyi estate, along the Mura, from Légrád to Kotoriba, which were erected a little further away from the riverbank. Trokogna was probably one of these outposts, but it was built right on the bank, as it guarded the river crossing place.

In the spring of 1661, a considerable Ottoman army appeared at Kakonya, on Szent Mihály Hill. Zrínyi realised the danger, and described it in his letter addressed to the Imperial War Council as follows: "In military terms, however, I can say that this place is the shield or bastion of the whole Muraköz, and even of the entire border region of Slavonia, from here to the south beyond the Drava. The one who holds this hill, has control over the Muraköz and the two rivers, the Mura and Drava, too. And if the Ottomans would have seized this hill (as they wanted to), neither Kapronca, nor any other fortress could have withheld them from the invasion of Slavonia. The truth is that, over the last sixty years, no one has observed this place, but the current pasha, who, accompanied by two thousand men, came here last May. He personally inspected everything with the greatest attention, and would have occupied it, if I had not prevented him from doing that in time."[6]

It was imperative for Zrínyi to occupy the height and fortify it, ahead of the Ottomans. During this, his primary objective was to secure the crossing place. The fortification, which was later called a bridgehead, was not originally built with that function but as an outpost securing the crossing place, where a small number of guards could effectively control traffic. To this end, natural and man-made features were used to create conditions that would slow down and limit movement. Barricades and obstructions could have also been placed on the road leading to the Kakonya Ford, but it led in a well passable stretch of the terrain, and after the removal of these obstacles, the enemy could have continued their way unimpeded. Zrínyi chose a different solution. He did not build obstructions on the road but modified the course of the road itself in a way that the natural features of the terrain would provide impediment.

5 Miklós Zrínyi to the Imperial War Council. Légrád, 5 July 1661. See page 272 of the present volume.

6 Miklós Zrínyi to the Imperial War Council. Légrád, 5 July 1661. See page 271 of the present volume.

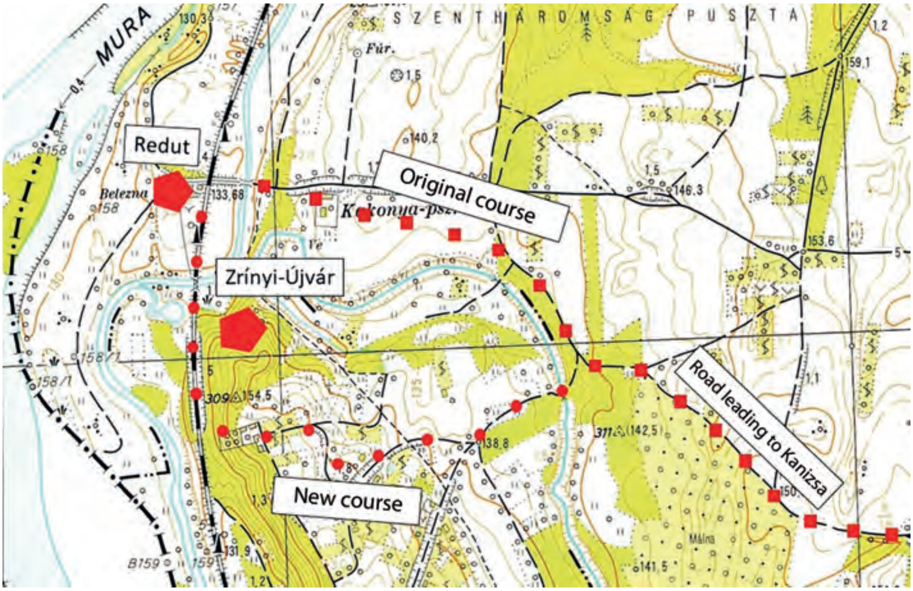

Figure 7.
The original course of the Kakonya Ford and the one modified by Zrínyi as projected on a modern map sheet

Source: drawn by the author

He terminated the former course of the ford on the eastern side of the Visszafolyó Stream. Moreover, he transformed the stream into a fishpond, which probably flooded the road and swamped its surroundings. Afterwards, he directed the road over a dam to the western side of the swamp. He led the road up to Szent Mihály Hill and brought it down on the western side of the hill, because he installed the flying bridge at the foot of the hill, where the railway line passes over the Principális Canal today. This, in the light of the contemporary traffic conditions, was completely irrational, as travellers generally sought to avoid climbing hills in order to reduce the effort required from draught animals. If it was possible to avoid ascents, they did so. They did not mark out a route where they had to climb a hill just to descend it on the other side. Here, however, this was done on purpose in order to slow down travellers arriving at the crossing place and control their movement. Those who came from the direction of Kanizsa first met the guards of the mill dam. Next, they climbed the hill and reached the bulwarks of the fortress, where they continued their way within the range of firearms. Then, they descended from the hill and entered between the steep slope and the Mura and passed through a kind of channel towards the bridge. The road was closed by a palisade there, and guards oversaw traffic movements again. Everyone had to pass through three checkpoints to the pontoon bridge. This system made the ford almost inaccessible. If the enemy still managed to get there, the flying bridge could finally be disconnected, and the guards of the *redoute* on the other side of the river could prevent the crossing.

This system made the crossing easy to control, but it was not designed at once. In 1661, the argumentation in support of the need to build the fortress mentions – though only in the fifth place – its use as a base for the army operating in the southern part of Transdanubia: “5. If there was a war with the Ottomans, there would be no other secure place in the whole borderland to accommodate an army than this fortress, from where Kanizsa, Berzence, Segesd and Szigetvár could be attacked from safety.”[7]

At that time, the emphasis was still laid on the occupation of the height dominating over the region. If the objective had been to build a bridgehead making possible the crossing and garrisoning of a significant number of soldiers, then, the existing Kakony Ford should have been strengthened. The right wing of the bridgehead would have been formed by the fortified elevation, and, connected to it, the area between the Visszafolyó and Kanizsa Streams could have been closed up with a rampart. They would have perhaps directed the Visszafolyó Stream along the rampart, and thus, linked it to the Kanizsa Stream. The fact that it is not a mere fantasy is demonstrated by a representation of the fortress, where it appears as a regularly fortified bridgehead. In 1664, Montecuccoli missed exactly these defences: “It was therefore a worthless place: with no moat, no contrascarpa, no forma, no wings, and no earth inside. It was completely open towards the water: and it was indeed very likely to fall at any hour of the attack.”[8]

In 1661, there was still a possibility for regular construction, but, in reality, the ford had to be controlled and defended continually with a small number of guards. Zrínyi was aware of this important factor, and, in his letter of 1661, he mentioned it in the third place among the reasons for building the fortress: “There are nine outposts between Légrád and Kotoriba, which I have to maintain partly at my own expense and partly from royal pay. However, the money arrives so late and it is so little as if nothing came. So I cannot defend this line at my own expense any longer. The hill saves a lot of money for me because it substitutes six outposts, and although more soldiers will be needed here than at those six outposts, the soldiers are easier to support here because they are provided with vines, arable land and everything else they need.”[9] This aspect is likely to have been increasingly emphasised during the construction of the fortifications defending the ford, and Montecuccoli’s note also suggests that it was entirely successful: “This stronghold was not built on the model of fortifications (neither its geographical location, nor the structure itself, nor the area allowed that), but to defend – together with a redoute – the bridgehead that ensured the passage over the Mura towards Kanizsa, and to cover the troops that went on raids in peacetime.”[10]

The skilled warlord and military scientist described very accurately what the fortress was suitable for in 1664. However, after the successful winter campaign in 1664, the military operations did not continue according to Zrínyi’s expectations. The capture of Kanizsa was attempted later than originally planned, and they did not launch a surprise attack but a systematic siege, out of necessity. After giving up the siege, the army retreated to Zrínyi-Újvár, but ignoring Zrínyi’s proposition, they set up their camp on the opposite side of the Mura, which they believed safe enough from the Ottoman Turks. By doing so, they

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7 Miklós Zrínyi to the Imperial War Council. Légrád, 5 July 1661. See page 272 of the present volume.

8 Raimondo Montecuccoli: Relazione della campagna dell’ Armata Cesarea nell’ Anno MDCLXIV. See page 295 of the present volume.

9 Miklós Zrínyi to the Imperial War Council. Légrád, 5 July 1661. See page 272 of the present volume.

10 Raimondo Montecuccoli: Relazione della campagna dell’ Armata Cesarea nell’ Anno MDCLXIV. See page 295 of the present volume.

deprived themselves of the possibility to initiate, for they would have needed a bridgehead that made possible rapid crossing, rallying on the other side of the river, and unimpeded sortie at a point of their choice. The structure established by Zrínyi, which served the control and slowing down of movements in the defence system of the crossing place, also limited the speed of getting to the other side of the Mura from Muraköz. It can be concluded without exaggeration that during the siege of 1664, the area around the fortress became the least suitable place for crossing. Nevertheless, mention must be made of one factor that is certainly in favour of Zrínyi. At the time of the siege, the ford could not enable the Christian army to cross the Mura, but the principal reason for this was that they let the Ottomans occupy the plateau of Szent Mihály Hill. In this way, they lost the waterlogged valley of the Visszafolyó Stream, which offered the natural protection of the eastern side. The Ottomans could seize the edge of the height overlooking the Mura, and with their artillery stationed there, they were able to fire upon the Christian forces on the opposite bank. With this, Zrínyi's nightmare of 1661 came true. Not only did the Ottomans penetrate into the defence system of the fortress, but they also managed to control the far side of the river from the hill.

Zrínyi was aware of the possibilities offered by the defence system of the fortress. It could not meet the needs of crossing, but the plateau of the Szent Mihály Hill was a suitable place for a sheltered camp, as it was defended by the fortress from the north, by the Mura from the west, and by the fishpond from the east. Additionally, it was possible to make sorties in the south. He put forward a proposition about the reasonable location of the camp already when the Christian army retreated from Kanizsa, but no one would listen to him: "When it came to where the camp should be set up, I definitely recommended that we station the infantry on the hill, in front of my fortress. This way we could still have kept Kanizsa occupied to some extent, we could have secured Zrínyi-Újvár and the Mura, and we would have had the opportunity of wreaking havoc on the enemy every day."[11]

The Ottoman army managed to occupy the plateau in front of the fortress and the hill dominating it without difficulty, from where they were able to besiege the fortress effectively – since it was the only direction from which it was not protected by a watercourse, just by a dry ditch – and control the activity of the Christian camp on the far side of the river. The Grand Vizier thus created the opportunity, seizing the initiative, to launch an attack on the territory of Muraköz, the danger of which had already been emphasised by Zrínyi in 1661, and which motivated him to erect his fortress. For the defence of Muraköz, the most important thing was not to keep the fortress, but to possess the hill. From a tactical point of view, the Christian army could withstand Ottoman attacks effectively with the defence of the fortress and the fortification system established beyond the Mura. However, by giving up the hill, they placed themselves in a highly disadvantageous position strategically. It is perhaps not too far-fetched to say that they suffered defeat. Due to the conditions of the terrain, the besieging army on the hill was in such a protected position that the Christians did not have the opportunity to concentrate enough power for a successful attack. Nevertheless, we should not ignore the fact that this advantageous position was originally supposed to have been taken up by the Christian army. Zrínyi had designed the defence system of the fortress for this purpose, but his fellow commanders gave it up. As a result, they started the fight from a highly disadvantaged position.

11 The memoirs of Miklós Zrínyi to Leopold I. Vienna, 17 June 1664. See page 286 of the present volume.

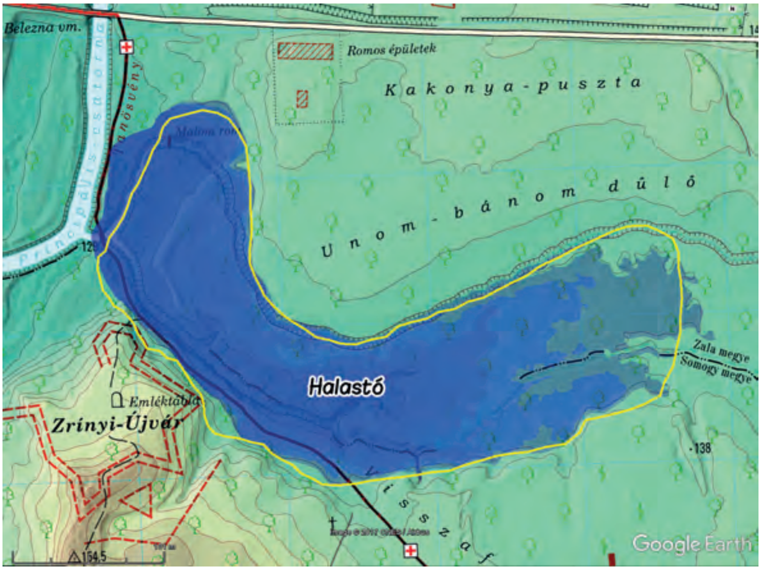

Figure 8.

The position of the fishpond made by damming the water of Visszafolyó Stream and the fortress

Note: Halastó – En: Fishpond; Emléktábla – En: Memorial plaque; Romos épületek – En: Ruined buildings

Source: compiled by the author

Figure 9.

The eastern side of the former moat today

Source: picture made by the author

It is worth examining to what extent the Ottomans were able to take advantage of this situation. Taking possession of the height offered them the opportunity to launch an unexpected attack on Muraköz when there was no significant military force present to fight against them. In the summer of 1664, however, a strong Christian army camped across the river, which significantly reduced the chance of a successful assault. Furthermore, we cannot ignore either that the Ottomans were most probably not prepared for this.

The army led by Köprülü Ahmed set out with the task of liberating Kanizsa. There was a realistic chance that the besieging army would entrench itself, protracted fights would start, and the relief army could also arrive. The Ottoman Turks originally expected fights to be fought around Kanizsa. However, by giving up the siege and falling back to the Mura, the Christians made the Grand Vizier face a new situation. He had to follow the retreating army, who, by abandoning the plateau in front of the fortress, put the Ottomans in a favourable position. Besides the capture of Zrínyi-Újvár, crossing over the Mura and the seizure of Légrád would have been a success for the 60,000-strong army of the Grand Vizier. Initially, they did not have suitable cannons for starting the siege of the fortress, as they left their siege artillery at Eszék (today Osijek, Croatia). They had seven siege cannons brought from Kanizsa, but until these arrived, they tried to cross the Mura.

In the first days of June they attempted making crossings at several places, but this was prevented by the Christian forces. First, on 4 June, they tried to build a bridge and cross the Mura above the fortress in the shelter of a forest, but their attempt was thwarted. In the evening, they made an attempt to cross at another place hidden by a forest, where the Mura had a bend towards Légrád, but this was foiled by the vigilance of Strozzi's soldiers. Parallel to this, they started to construct ramparts for the cannons opposite the fortress and on the edge of the height overlooking the Mura. During the night of 4 to 5 June and early in the morning, the Ottoman Turks placed four siege guns on the eastern side of the plateau facing the fortress, in the right wing of the local Ottoman forces, which comprised four battalions of infantry Sekbans of the chief serdar, the armed guards of Kara Mustafa Pasha (Beylerbey of Rumelia) and soldiers from the province of Rumelia, the forces of Zaims and Timariots from Anatolia, as well as 200–300 Janissaries. On the western side, the left wing comprised three siege guns, the soldiers of Ismail Pasha (Beylerbey of Bosnia), the Zaims and Timariots from the province of Sivas, as well as 200–300 Janissaries. The siege cannons were used to shoot at the fortress, whereas the large number of 2–3-pound guns set up along the edge of the plateau fired at the bend of the Mura and the area between the Drava and the Mura. The projectiles sometimes hit the imperial camp, as well. In the bend of the Mura, where there was a small island in the vicinity of Légrád, the Ottoman Turks made bulwarks and dug trenches from where most of the island could be swept. At midnight, the Ottomans made another attempt to cross the Mura with a detachment of 300 Janissaries and 300 Sekbans, and they also tried to erect a bridge. At first, 50–60 Janissaries crossed over to the island on rafts and began digging communication trenches at once. Lieutenant General Strozzi, who was nearby, immediately ordered his soldiers to go there from the neighbourhood. However, the terrain was unsuitable for the cavalry to advance. Eventually, he launched an attack with an infantry squadron. At 3 o'clock in the morning, commanded by Captain Quast, they waded across a shallow branch of the Mura – where the water reached only to the waist – but hardly had they got to the island when they were forced to return because of heavy gunfire. They repeated the attack on two more occasions, yet unsuccessfully, because the Ottomans had made strong defences. However, Strozzi had some guns brought forward, and with these, he isolated the Ottomans from their reinforcements waiting on the opposite bank. At around 6 o'clock in the morning, Lieutenant General Strozzi himself, together with Cuirassier Lieutenant Colonel Piccolomini, 25 cuirassier cavalry soldiers and 150 musketeers crossed the narrow river branch and attacked the Ottoman Turks on the island, and either put them to the sword or drove them into the river, where – except for two Turks – all of them were lost. The fight ended at around 8 o'clock in the morning. Lieutenant General Strozzi called together his remaining soldiers and thanked them for their bravery. During his speech, he was hit in the head by a shot arriving from the opposite bank of the Mura, either from the bulwarks or from the hill. Strozzi fell from his horse and died a few hours later.

The Christian forces managed to recapture the island, but they were kept under fire from the heights on the left bank of the Mura, so Hohenlohe ordered its evacuation. A new defensive line was established along the riverbank. The existing ramparts were linked with communication trenches. Furthermore, in a second line and westwards, a new fortified section of defence was built.

After the unsuccessful attempts at crossing, the Ottomans began the siege of Zrínyi-Újvár. As early as the following day, on 7 June, they started to push forward the approach trenches, which advanced only forty steps that day, but they also built two traverses while the fights continued. On 8 June, shooting at the fortress commenced, but this time without result because all the shots went too high. The following night, the commanders wanted to make a sortie with the aim of destroying the Ottoman siege trenches, but the plan finally failed for the delay of the troops. The garrison of Zrínyi-Újvár was supplemented with a 500-strong imperial infantry unit, which increased the number of defenders to 1,500. As there were not enough buildings for the soldiers to rest, they were replaced every day. General d'Avancourt was in command, and he constantly had the fortifications restored. On 9 June, Hohenlohe made another attempt to invade the aforementioned island. However, Lieutenant Colonel Zobel of Hessen, who had been appointed commander of the assault unit made up of 500 Austrian and 500 German imperial soldiers, was hit by a deadly shot during the commander's muster and thus the plan was abandoned. In the southern corner of the island, a fortification was erected, and a few guards were placed in it.

During that day, the Ottoman approach trenches advanced fifty steps. Just as night fell, the previously schemed sortie was executed, yet with only 300 soldiers instead of the originally planned 1,500 men. The commander, a Lieutenant Colonel from Cologne, penetrated the Ottoman communicating trenches and put some of the guards to the sword, but then he was forced to fall back with great loss. On 10 June, the Ottoman approach trenches were only fifty steps away from the fortress. On the following day (11 June), the Ottomans erected a terrace-like cannon emplacement on the edge of the height facing the Mura, from where they could fire at the flying bridge with two 3-pound guns. With the continuous cannoning, they not only hindered communications, but over time, they also caused the barges holding the bridge to go down in the water.[12] Hohenlohe had a footbridge made below the pontoon bridge, which was less within the range of the shots.

On 12 and 13 June, the Ottomans continued their approach and nearly reached the moat of the fortress, but the defenders thwarted all attempts, partly by sallies and partly by

12 Pál Esterházy: Mars Hungaricus. See page 290 of the present volume.

Figure 10.
The siege of Zrínyi-Újvár, copperplate engraving by an unknown German artist, 1664
Source: MNM TKCs T. 6567

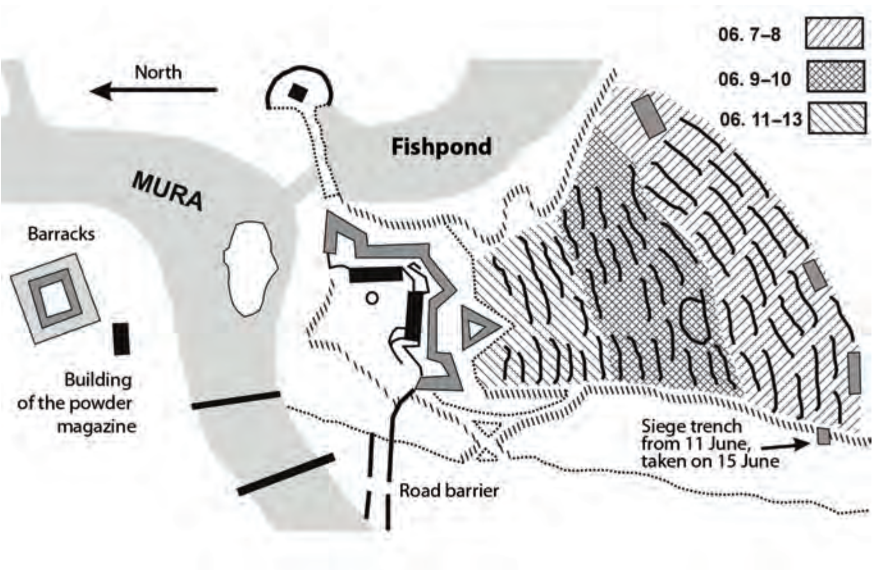

Figure 11.
The course of the siege
Source: reconstruction of the author after a sketch map by Holst

effective firing. On 14 June, the first 500-strong unit arrived from the main army stationed at Mosonmagyaróvár to augment the Spikh regiment. The Christian army thus already consisted of 10,292 soldiers. In detail, the Strozzi infantry regiment had 1,296 soldiers, the Spikh regiment had 1,037 men, the Spar regiment comprised 602 men, the Bavarians were 843, and the five Salzburg squadrons comprised 564 men. The Piccolomini and Rappach cuirassier regiments had 1,000 horsemen. Hohenlohe's German troops were made up of 3,000 infantrymen and 500 horsemen. Furthermore, there were 300 dragoons, 100–150 Bavarian horsemen and, finally, there was Zrínyi's 1,000-strong army.

On 15 June, Field Marshal Count Montecuccoli, the new Commander-in-Chief, arrived in the camp. The condition of the army was highly unfavourable, which was recorded by the imperial commander in his memoirs as follows: "I found the fortress of Zrínyivár attacked and under siege. Strozzi died in a clash in which he heroically repulsed the Ottomans who wanted to climb the walls. The army was in a miserable state, decreased and almost without officers because most of them lay either wounded or ill. They had to defend the fortress and prevent the enemy from crossing the river over a stretch of several miles. The troops could not rest and were not able to regain their strength because of the continuous and onerous duties they had to carry out on the ramparts. The left bank of the river was in the possession of the enemy. They held the forests and heights above them, and even the bends of the river were favourable to them. Our side was, on the other hand, flat, low-lying, uncovered, open, rugged and dominated. We had neither food nor ammunition, and if Styria had difficulty meeting the army's needs at a time when everything was quiet and the enemy was away, how could it have been expected to supply a larger army when everything and everyone was confused and the Ottomans were facing us?"[13]

Meanwhile, more and more reinforcements kept coming in. First, on 17 June, the Hungarian army of Count Batthyány Pál arrived, which comprised 600 Hajdús[14] and 1,400 horsemen. They were followed by the Pachonkay dragoon regiment on the same evening. These formed the advance guard of Lieutenant General Spar. On 18 June, Kutsenich's Croatian cavalry regiment and Jaquer's dragoon regiment marched in. On June 19, the 4,000-strong Croatian army of Péter Zrínyi arrived.

On 19 June, the Ottoman siege trenches ran just before the moat of the fortress. As the night fell, the defenders blew up two previously dug-out mines, which destroyed some of the Ottoman approach trenches. On 17 and 19 June, the raiding horsemen of the Christian army shattered an Ottoman cavalry unit and seized a consignment of food. It was during one of the sorties that Farkas Kis, one of the most distinguished officers of Zrínyi fell. (He had entered into the service of Zrínyi escaping from Ottoman territory, and stood out with his talent among the other soldiers.) On 20 June, the Montecuccoli, Spork, La Corona, Schneidau and Spar cavalry regiments, the Hungarian troops of Nádasdy and Esterházy (3,500 Hungarian horsemen and 1,200 Hajdús), as well as the Nassau and Kielmansegg infantry regiments arrived. The troops of Batthyány attacked an Ottoman unit, from which they captured two hundred horses, seven camels and lots of mules, and also they slayed hundreds of the Ottoman Turks.

13 *Rónai Horváth* 1891. 316–317.

14 Originally Hungarian armed herdsmen, over time becoming mercenary foot soldiers of lords and princes.

After the arrival of the enforcements, the strength of the Christian army was above 30,000 men. At a war council, Zrínyi proposed that the Ottomans should be attacked as soon as possible, since it was more and more difficult to hold the fortress. Montecuccoli, however, planned another sully for 22 June, with 2,200 German and 500 Hungarian infantrymen, as well as two battalions, comprising 600 men each. On the night of 21 June, the forces crossed the Mura and waited on the alert at the foot of the hill, below the fortress. Parallel to the sortie made from the fortress, 3,000 German and 6,000 Croatian and Hungarian soldiers, led by Péter Zrínyi, were to attack the Ottoman camp in the back, from the direction of Berzence. However, there was excessive rainfall on the following night, which soaked the soil thoroughly and thus the sortie was postponed to 23 June, but it was cancelled again, as an imperial soldier escaped and disclosed the plan to the Ottomans.

Early in the morning of 24 June, another two mines were exploded outside the fortress, which drove the Ottomans away, but, later in the morning, they got close again to the moat of the advanced defensive work. D'Avancourt withdrew the soldiers and placed some bombs in the moat, the blast of which expelled the attackers once again. At night, the Ottomans tried to set the palisades on fire, but the defenders' heavy gunfire repulsed the attack.

On 25 June, two mines were dug beneath the advanced defensive work found in the moat, and one more under the Ottoman trenches. Furthermore, two ramparts were built from where the sides of the protrusion of the advanced defensive work could be swept. At night, the Ottomans attempted a raid on the moat and slayed sixty men from the guard there, but Hohenlohe's troops arrived in time to oust the enemy from the moat again.

It must have been at this time that the catastrophic event recorded by Pál Esterházy without date must have occurred. A fire broke out in the largest bastion of the fortress, where grenades and other firearms were stored, and, in the subsequent explosion, the cannons found there were destroyed and artillerymen were also killed. András Horváth, Zrínyi's prominent officer, the commander of the fortress, was among the victims.

On 28 June, D'Avancourt was wounded by a gunshot leaving Colonel Tasso in command of the defence alone. The following day, the guard was withdrawn from the moat of the fortress after they repelled an Ottoman attack. Throughout the night, the Ottomans broke into the moat several times and managed to set fire to the fortress. At 4 o'clock in the morning, on 30 June, the Ottoman artillery opened fire on the fortress, while the infantry formed assaulting columns. Montecuccoli recorded the capture of the fortress as follows: "Early in the morning, on the 30th, the Ottomans exploded a mine below the projection of the ravelin, which partially destroyed the crescent. Field Marshal Spar and I were standing there. The enemy seized the crescent. Subsequently, their columns took their position opposite the open and defenceless sides of the main work and covered themselves with earth and brushwood all around. After making sure that there was no other means of defence in these places than a small ditch and the posts of a palisade, I told Colonel Tasso (if he can no longer defend the fortress) to have timber parts and barracks torched in good time, pull out the troops from the stronghold, have the mines drilled beneath the fortress exploded, and blow up the fortress, for it is customary to do so with works that can no longer be defended. In the end, he should lead the defenders over the bridge and demolish the bridge, while making sure that the men do not push one another causing thus confusion. – The commander of the fortress [Tasso] believed he would be able to hold the place to the following day. But hardly had we left the fortress with Spar when the enemy made such a fierce assault on the aforementioned parts of the defensive line that the defensive troops got extremely alarmed and fled. There was no time either to blow up the fortress or to demolish the bridge. Less than one-third of the 1,700 defenders, perhaps no more than 300 men, escaped. Thus, instead of 800 soldiers, nearly 1,400 were lost. Colonel Tasso suffered a fatal sword cut to the head, but he still managed to escape. The Ottomans also lost 500 men, who were killed and there were also many wounded."[15] Miklós Zrínyi reported that there were only 350 German soldiers at the ramparts as the evacuation of the fortress had already started, and when fifty Ottoman Turks armed sabres stormed out of the trenches and broke into the fortress, the defenders fled panic-stricken. They left the gate of the tunnel open which provided access to the moat, and the Ottomans could enter the fortress through that.[16]

During the siege, the defence system of the fortress hindered the defenders rather than helped them. Montecuccoli remarked annoyingly: "It was also unsuitable for sorties on account of the steep slope and the hills opposite."[17] He was right in that respect. Finally, to solve the problem, it was even suggested that "such small fortlets, which were built on the side of a river where the enemy's army camped and to where only small reinforcements could be sent under the enemy's nose, were normally given up. Baron D'Avancour repeatedly advised us to do so, committing himself to build a better one in eight days after the enemy's army left.[18]

If Zrínyi's suggestion had been accepted and the army had camped on the plateau in front of the fortress, the eastern side of the camp would have been protected by the valley of the Visszafolyó Stream, with a well-guarded crossing. On the western side, using the crossing established at the foot of Szent Mihály Hill, the troops would have been able to cross hidden from the eyes of the Ottomans and the camp could have received supplies. Southwards, the plateau of the hill would have been a terrain suitable for sallies and even major assaults.

The problem was not caused by the fortress itself, because, as an establishment securing the crossing, it was part of a well-constructed defence system. The real problem was that the commanders of the Christian army and Miklós Zrínyi were of different opinions. During the retreat from Kanizsa, the Christian leaders considered that the army could be positioned more safely beyond the Mura. They regarded the fortress as a bridgehead, which, under favourable conditions, made possible crossing the river before the attack. Zrínyi was aware of the defensive system of his fortress, and he knew that by giving up the plateau in front of the fortress, the Christian forces camping on the other side of the river would find themselves in a disadvantageous position. He was probably not able to make his fellow commanders understand that Zrínyi-Újvár, despite the fact that it secured a ford from the bank of the Mura, was not a bridgehead, but the best location for camping from a military operational perspective. Later, when the Christian commanders also recognised this, they found the building inadequate as a fortress.

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15 *Rónai Horváth* 1891. 316–317.

16 The memoirs of Miklós Zrínyi to Leopold I. See page 287 of the present volume.

17 Raimondo Montecuccoli: Relazione della campagna dell' Armata Cesarea nell' Anno MDCLXIV. See page 295 of the present volume.

18 Raimondo Montecuccoli: Relazione della campagna dell' Armata Cesarea nell' Anno MDCLXIV. See page 295 of the present volume.

Summary

The protection of Muraköz against attacks coming from areas occupied by the Ottomans was primarily provided by the Mura. Crossing over the fast-flowing river full of whirlpools was only possible after careful technical preparation and at given places. The first element in the defensive system set up by Zrínyi was the Légrád Castle built on the bank of the Drava to close up the river and prevent Ottoman ships from entering the territory of Muraköz.

From Légrád to Csáktornya, there was a chain of outposts positioned at a safe distance from the bank of the river, because on the side of Kanizsa, the forces by the riverbank could be easily attacked from the height between Őrtilos and Kakonya. Between Kanizsa and Csáktornya, the Kakonya Ford offered the best possibility for crossing and thus its safe-keeping and possession was of decisive importance. Initially, Zrínyi secured that place with a fortification erected on the right bank. However, in 1661, along with the construction of Zrínyi-Újvár, he eliminated all those natural conditions that rendered this place suitable for crossing. He flooded the road leading there in the valley of the Visszafolyó Stream and the surrounding area by building a dam on the stream. The ford established under Zrínyi-Újvár was located in a place that was hard to approach, which allowed the full control of traffic from the fortress. At the same time, I must emphasise that the Kakonya Ford, which was the best crossing place for an Ottoman assault on Muraköz from the direction of Kanizsa, became unsuitable for this purpose after 1661, due to the transformation of the area. Several decades passed after the fall of the fortress until the landscape restored to such an extent that the positive features for the crossing would appear again.

In 1664, the Ottoman army prepared to fights for the liberation of Kanizsa. As the besieging Christian army retreated to Zrínyi-Újvár, the Grand Vizier was given the opportunity to take the fortress. In the beginning, this was only regarded as a secondary objective, and the focus was rather on crossing the Mura and clashing with the Christian army that camped on the other side of the river. After the failure of this, the importance of seizing the fortress increased. Zrínyi-Újvár was an earthwork fortification of small size, the capture of which could have hardly represented a problem for an approximately 60,000-strong Ottoman army, but after a quick victory the emphasis would have been shifted to a confrontation with the Christian army behind the Mura, which was not successful until then. It was, therefore, in the interest of the Grand Vizier to present the occupation of Zrínyi-Újvár as the greatest possible accomplishment and to interpret its capture as a victory. To this end, he carried out a regular siege, with large-scale technical works, but only with seven siege cannons transported there from Kanizsa, because the guns suitable for this remained at Eszék. Since the question of Zrínyi-Újvár had been regularly raised at diplomatic talks since 1661, the general public held it to be an important stronghold. The Grand Vizier merely had to reinforce this view by carrying out a large-scale and long siege and thus increase the value of taking the fortress and make it seem like a major victory.

Ottoman Sources Concerning the Military Operations Led by Grand Vizier Fazil Ahmed Pasha in 1664

Balázs Sudár

Hungarian written records discuss the 1664 campaign led by Köprülüzade Fazil Ahmed Pasha primarily in the light of the siege of Zrínyi-Újvár and the Battle of Szentgotthárd, as if the Ottomans would have launched the campaign merely for capturing the besieged Kanizsa and Zrínyi-Újvár, which represented an enormous problem for them.[1] However, Ottoman sources reveal a completely different picture. In the following, I would like to present the morals of this, with special regard to the decisions the Grand Vizier had to make and the role Miklós Zrínyi played in them.[2]

The fights in 1663 resulted in a long-awaited breakthrough from the Ottoman point of view: they succeeded in capturing Érsekújvár (today Nové Zámky, Slovakia) and its surroundings, Léva, Nyitra and Surány (today Levice, Nitra, and Šurany, Slovakia). As a result of this, the immediate sphere of influence of Ottoman Hungary was expanded to the Vág River (today Váh River, Slovakia). Pressburg, the capital of Royal Hungary, was now only a few hours away, within a distance of fifty kilometres. The regions of Nógrád and Gömör fell into Ottoman hands again. The border of the Kingdom of Hungary was thus pushed back to the southern foothills of the Carpathians, and communication between the area of Western Hungary and the counties of Upper Hungary became extremely difficult. The territory of the country almost split into two, which, in the long run, would have helped the separatist aspirations encouraged by the Ottomans and the formation of a Kingdom of Upper Hungary (comprising mostly of today's Slovakia). Things did not change much when Péter Zrínyi defeated the troops of Chengizade Ali Pasha on the southern frontline, near Otocsác (today Otočac, Slovakia), in the late autumn of 1663. This situation was exacerbated by the fact that Grand Vizier Fazil Ahmed Pasha did not retreat with his troops. Instead, he wintered his army in the region of the Northern Balkans and Ottoman Hungary.[3] His own headquarters were set up in Belgrade. With this, he made it clear that he wanted to spend the military season of 1664 in Ottoman Hungary, and that he intended to start military operations early. This was not a good sign for the Hungarians, at all.

The winter campaign led by Miklós Zrínyi and Count Julius Hohenlohe, with the support of the Viennese War Council, was a response to this situation. On the one hand, Zrínyi tightened the blockade around Kanizsa: by capturing Berzence, Segesd and Babócsa,

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1 This question is discussed by a large number of scholarly publications. Here are a few examples: *Rónai Horváth* 1891; *Perjés* 1965; *Perjés* 1989. Most recently: *Kelenik* 2012.

2 I have published the short biographies of Ottoman historians that are relevant to the history of the campaign and analysed the relationship between their works: *Sudár* 2012b.

3 On the wintering: *Fekete* 1993. 251; *Gökçek* 2006. 185.

https://doi.org/10.36250/00757_05

he almost transformed it into a ring. On the other hand, by destroying Ottoman territories, he certainly caused sensible losses to the Ottomans,[4] and by burning the bridge of Eszék (today Osijek, Croatia) he gave considerable work to their military leaders. Of course, he could hardly have expected that by destroying the crossing, he would seriously hinder the advance of the Grand Vizier's army (he rather meant to cover his own campaign with it),[5] but based on the spring events, he must have put the Ottoman military leaders in an awkward position. The slow construction of the bridge, in reality, limited the options for action available for Fazil Ahmed. At the same time, the destruction of South Transdanubia was probably not against the Grand Vizier, who was expected to move northwards. In my view, the real message was intended for the Pasha of Kanizsa. By the summer of 1664, the centre of the province had come to a very difficult position. Zrínyi's strategy slowly started to work. The border defence system against Kanizsa, Kiskomárom and Zrínyi-Újvár effectively isolated the main Ottoman fortress, the supply of which became increasingly difficult. From this point of view, South Transdanubia was not the foreground, a staging area of the Grand Vizier, but rather the hinterland of Kanizsa. (It is true, though, that in the event of a siege, the destroyed area could also slow down the relief troops.)

Although our pieces of information are somewhat contradictory, it seems that the region was controlled by Yakovali Hasan Pasha at that time.[6] The region was perfectly familiar to him, as it was probably his birthplace, and by the 1630s, he had been the Pasha of Kanizsa for nearly ten years. But more importantly, he was not a leader living in isolation in the border fortress district. In the 1640s, Hasan disappeared from Ottoman Hungary. In the late 1650s, he is reported to have been in Istanbul as a trusted man of the distressed Köprülü Party. (There is a tendency to regard the coming to power of Köprülü Mehmed in September 1656 as an event that changed the history of the Ottoman Empire at once. In reality, however, it was not like that. Until the summer of 1659, Mehmed had to fight hard to keep his position. He was often merely a hair's breadth away from dismissal or death.)[7] He remained loyal to the Grand Vizier even when he was close to the fall: in 1658, during the revolt of Abaza Hasan. With his effective countermissions – the taking of Ankara – he contributed to the suppression of the revolt in the end.[8] Although Köprülü Mehmed heavily retaliated against the rebellion, he remembered those who were loyal to him. It was during the crisis of 1658 that a new party who were loyal to Köprülü came together: Yakovali Hasan Pasha belonged to them. His loyalty was rewarded. First, he became the Bey of Ankara, and then the Pasha of Adana, in the east.[9] It was from there that he was called for war to Ottoman Hungary in 1660. In the summer of 1663, he became the Beylerbey of Kanizsa, and he could certainly count on the support of the younger Köprülü, Fazil Ahmed, as well.

[4] *Pálffy* 2004.

[5] *Perjés* 1989. 81–83.

[6] According to Mehmed Halife, on 1 July 1663 (25 Zilkade), Grand Vizier Fazil Ahmed Pasha appointed him as the Pasha of Kanizsa in the Eszék camp, and immediately sent him off with 12,000 men to his seat. *Oral* 2000. 89. For his biography, see *Sudár* 2006. 27–34. On the identification of Yakovali and Yentür Hasan: *Sudár* 2012c. 109.

[7] Concerning this: *B. Szabó – Sudár* 2012. 972–991.

[8] Ottoman chronicles referred to him as Neyzen Hasan Pasha: *Evliyâ* 2006, 343. He became the Bey of Ankara in 1658: *Silahdâr* 1928. 139, 144, 145; *Gökçek* 2006. 88.

[9] *Evliyâ* 2002. 33, 35, 40, 43, 48.

(And, indeed, upon the first alarming reports in the middle of winter, the Ottoman forces of Ottoman Hungary were mobilised to liberate the besieged Pécs.)

Although the attacks launched by Zrínyi[10] were annoying, they little influenced the actions of the Grand Vizier who was about to head north along the Danube. According to Ottoman chronicle literature, Fazil Ahmed wanted to seize Győr and Mosonmagyaróvár.[11] However, more importantly, the preparations for the campaign and the organisation of logistics also pointed northwards. (It is common knowledge that the Ottomans carefully prepared for their military operations. The construction of the supply system indicated well the direction of the planned campaign, as research results by Szabolcs Hadnagy have recently demonstrated.[12]) The orders given by Grand Vizier Fazil Ahmed Pasha were clearly concerned with securing the route leading to Buda, and he also sent materiel there. It makes one wonder that he ordered the construction and guarding of the bridge of Esztergom as early as March, and then the transfer of grain stock from there to Újvár.[13] Újvár was not only defended by its own Pasha (Kurd), but Sari Hüseyin (the Beylerbey of Buda) was also seconded to there, certainly because of the major threat to the area, but perhaps also for preparing another campaign. It is possible, therefore, that the Grand Vizier regarded Érsekújvár (today Nové Zámky, Slovakia) as a base of operations and wanted to move on from there.

In this troubled situation, the imperial military leaders decided to employ a strategy operating with shared forces.[14] With the main forces, Montecuccoli was in position at Mosonmagyaróvár and defended the foreground of Vienna. De Souches was ready to attack from the north, while Zrínyi and Hohenlohe were to attack from the south. The Grand Vizier still did not cross the Drava when de Souches had already besieged and taken Nyitra (15 April – 3 May), while Zrínyi and Hohenhole started to lay siege to Kanizsa – with considerable delay (beginning with 30 April). Although Fazil Ahmed constantly received alarming reports,[15] he took his time leaving his camp in Belgrade. On the one hand, he announced the rally for a later date (6 May),[16] so his troops were still on their way, and the Christians were ahead of the Grand Vizier. On the other hand, the reconstruction of the bridge of Eszék had not yet been completed despite the increasingly serious menace.[17] Thus, Zrínyi's winter action had already produced results.

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10 *Perjés* 1965. 362–366.

11 Nihadi: Győr. See *Özkasap* 2004. 53. Silahdar Mehmed: Győr and Óvár. See *Silahdâr* 1928. 338.

12 *Hadnagy* 2016.

13 Order, 17–26 April 1664: From the storehouses in Esztergom, the grain of the Treasury has to be transferred to Újvár. *Fekete* 1993. 275, 277.

14 On the possibility of multi-front fights: *B. Szabó* 2011.

15 Kaplan Mustafa, based in Pozsega (today Požega, Croatia), sent the Grand Vizier news of Zrínyi and Hohenlohe preparing for Kanizsa as early as 14 April. *Silahdâr* 1928. 321. Two days later, grim news came from Gurdzhi Mehmed who spent the winter in Szigetvár. Ibid. 322. On 2 May, Yakovali Hasan Pasha, the defender of Kanizsa, had already written a letter reporting that the siege began, and he appealed for help. Ibid. 327. The first reports of the siege of Nyitra also came in mid-April. *Fekete* 1993. 276–277.

16 The Grand Vizier intended to leave the Zimony (today Zemun, part of Belgrade, Serbia) camp on the day of Hizir, that is, on 6 May: *Fekete* 1993. 275.

17 Order, 19–27 March 1664: The bridge has to be ready by 11 April. *Fekete* 1993. 266. Later (between 7 and 16 April), the date was postponed to 27 April, and those causing delays were threatened with execution. Ibid. 272. On 16 April 1664, Kibleli Mustafa Pasha, who was charged with defending and completing the bridge, reported that the bridge was half-finished. *Silahdâr* 1928. 322. The work was finally completed under the supervision of Ismail Pasha and lasted for a total of 75 days: *Özkasap* 2004. 53.

When the siege of Kanizsa began, Yakovali Hasan called for help, and he repeated it two weeks later.[18] Fazil Ahmed held a military council at Eszék sometime between 14 and 16 May. He had two choices to make: either to support Kanizsa or Újvár with his army. The former was outside the route of the planned campaign, but the latter was right on the way. Nevertheless, while Újvár had plenty of food and soldiers, and the Pasha of Buda defended it himself, Kanizsa had been in short of supply for years, and its surroundings had suffered a series of attacks. Furthermore, after the recapture of Kanizsa, the Christians would have had an open way to the Danube, which represented the backbone of Ottoman Hungary. Moreover, as winter events had clearly demonstrated, after the possible retake of Kanizsa, the Christians could have destroyed the bridge of Eszék, which would have endangered the retreat of the Muslim troops.[19] In these circumstances, the Grand Vizier decided to march speedily on Kanizsa, with the proviso that, after defeating the Christian army in the south, he would turn northwards and approach his original military targets. In the meantime, the local forces gathering in Buda were present in the northern theatre of war. Between 17 and 26 April, Grand Vizier Ahmed Pasha had already ordered the troops from Eger, Temesvár (today Timişoara, Romania), Várad (Nagyvárad, today Oradea, Romania), and Fehérvár, as well as some of the Tartars together with the Yali Agha to move to Újvár. (For various reasons, this concentration was not realised until months later.)[20] Nevertheless, the Grand Vizier did not consider changing the course of the campaign: he left his heavy equipment on ships on the Danube, and his army turned westwards with the essential impedimenta.[21] This marked a turning point in the history of the campaign: the Ottoman army deviated from their planned route leaving behind a logistical system that could have secured their supplies. In other words, the Christians took the lead, and it was no longer the Ottoman Grand Vizier who defined the course of events, but simply responded to the challenges facing him. This made an enormous difference in quality and determined the whole campaign season. So eventually, Zrínyi – probably without his deliberate intent – derailed the campaign of the Grand Vizier with his strong action against Kanizsa.

Grand Vizier Köprülüzade Fazil Ahmed was already at Szigetvár on 25 May, and he reached Kanizsa on 3 June. On hearing his approach, the Christian army fell back to Zrínyi-Újvár and beyond the Mura River on 2 June. The formerly recaptured fortresses – Babócsa, Berzence and Segesd – had already been vacated and burnt down between 29 May and 1 June. The Grand Vizier thus achieved his main objective, the relief of Kanizsa, but the Christian army retreated practically without loss. Fazil Ahmed, therefore, could not turn back, and he could not march to the north, either. He was not supposed to leave Christian forces behind him. Moreover, the imperial army was growing, as Montecuccoli was also ordered to join them. This corps slowly became the main force of the Habsburg army operating in Hungary: defeating them would have forced the Habsburgs to make peace. Fazil Ahmed could hardly do anything else but try to force the imperial forces into battle. On 5 June, he was already present in the Ottoman camp by the River Mura. At Zrínyi-Újvár, his primary goal was not the siege of the stronghold,

[18] A letter from Yentür Hasan about the attack got to the camp of the Grand Vizier on 2 May. *Silahdâr* 1928. 327. Another messenger of the pasha arrived at the Siklós camp on 17 May. Ibid. 331.

[19] A potential new attack of the bridge and the repulse of the attack sill engaged the attention of the Ottoman military leaders in the spring of 1664. News of this subject arrived at the camp on 14 April. Kibleli Mustafa Pasha was charged with the defence of the bridge under construction. *Silahdâr* 1928. 321.

[20] *Fekete* 1993. 277.

[21] *Silahdâr* 1928. 330.

but to cross the river and unleash an open battle. The establishment of the first Ottoman camp served this purpose, and the first artillery units were emplaced against the Christian camps across the river. The Grand Vizier was not interested in Zrínyi-Újvár itself, he did not care about its siege. (Of course, the occupation of the area beyond the river would have entailed the fall of the fort, as well.) To reach his objectives, Fazil Ahmed tried to build a bridgehead on the south bank of the Mura, but this was destroyed by the Christians, and the defence of the riverbank was strengthened (between 7–8 June). This made it clear for the Grand Vizier that there was no way for him to cross the river. It was then that he decided to start a regular siege. The camp was partially relocated, and the Janissaries began digging communication trenches on 10 June. In the beginning, they fired at the fortress with only seven cannons suddenly brought from Kanizsa. Although three weeks later the stronghold fell (on 30 June),[22] its seizure did not solve the basic problem of the Grand Vizier. The Christian army was still not entirely defeated, and their attempt at crossing the Mura River failed again (the Ottomans kept trying until 5 July). After capturing the castle, Fazil Ahmed spent one week in his camp. During this time, the high command decided that they did not want keep the fort, and immediately demolished it. However, in the meantime, the Christian army – now led by Montecuccoli – began to withdraw.

The Grand Vizier could take credit for new successes, but he still could not get rid of the imperial forces. Additionally, he could not remain in the region of Kanizsa much longer, as this area had already suffered a lot and was unable to supply the Ottoman army with provisions.[23] The results of Zrínyi's earlier activities, therefore, put the Grand Vizier under pressure again, and he decided to follow the Christian army and advance northwards. First, he retreated to Kanizsa, destroyed Kiskomárom (on 13 July), and then continued his way to the north. The fortresses of the border defence system facing Kanizsa fell one after the other,[24] but the River Rába halted the advance. On 25 July, Ahmed was not able to cross the river at Körmend. Seeking a ford, he started to move south-westwards along the river, in the opposite direction of his intended course. However, the Christian party could not just stand by and watch this move, either. The loss of the defensive line along the Rába would have had serious consequences. Therefore, they tried to hold it, to prevent the crossing of the Ottomans. The attempt of Köprülü Ahmed to cross the river led to the battle of Szentgotthárd (on 1 August), which was not a defeat for the Grand Vizier, but the loss of an opportunity to fight the decisive battle.[25] Despite their obvious and significant losses, the Ottoman army remained in an orderly state and was still capable of fighting. They did not leave their camp, either. It was only on 6 August (after the Christians had already left) that they started to move towards Körmend, and the ceasefire was signed at the Vasvár camp on 10 August.

If we look at this phase of the campaign, we can see that after the relief of Kanizsa the only serious aim of Fazil Ahmed was to force the Christian army in the south into battle and to expel them from the region of Kanizsa. In short, he wanted to secure Kanizsa. He fully achieved his goal, and, by the way, he finally destroyed Kiskomárom and Zrínyi-Újvár, the two

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22 For Ottoman narrative sources related to the siege see pages 301–323 of the present volume.

23 Evliya Çelebi gave a detailed picture of the famine striking the Ottoman army: *Evliyâ* 2003. 11.

24 On the border fortress district facing Kanizsa: *Kelenik* 1995a. 5–51; *Kelenik* 1995c. 23–43; *Kelenik* 2005a. 311–357. The campaign of 1664 through the eyes of the Ottomans: *Sudár* 2012. 103–120.

25 The significance of the Battle of Szentgotthárd was enormous from the psychological and propagandistic points of view, but it should not be overestimated from the military aspect. In reality, the Christian army was faced only with a minor part of the Grand Vizier's forces. For the evaluation of this: *Perjés* 1981. 117–174.

ends of the ‘pincers’ applying pressure on the provincial centre. He recaptured the fortifications lost during the winter campaign (Segesd, Babócsa and Berzence), and shattered the border defence system facing Kanizsa. That is, he secured the position of Kanizsa in the long term, which is by no means an insignificant result compared to the previous circumstances that placed the main fort in South Transdanubia in an almost untenable situation, and it was only a matter of time until the ‘blockade’ set up by Zrínyi’s hard work would reach its purpose.

Nevertheless, Fazil Ahmed must have been far from satisfied. He failed to defeat the Christian armies and even suffered heavy losses. In fact, Zrínyi’s winter campaign really showed its true impact in August: the Ottoman army was completely exhausted, suffered from chronic food shortages, and was not in a position to continue the campaign with success. Contemporary sources – e.g. accounts of the famine by Evliya Çelebi – clearly demonstrate this, and so do the subsequent events. Fazil Ahmed made his way towards Fehérvár and Esztergom as quickly as possible, where plentiful supplies awaited him, including the large amount of food that was originally accumulated for his campaign. In lack of this, the Ottoman army got into a position where they could not make use of their temporary advantage. They could have seized some of the North Transdanubian fortresses without any difficulty, but they did not even consider seriously the siege of Sümeg. In reality, they ran for food.

However, Köprülüzade Ahmed had plenty of time. Although the relief of Kanizsa and the siege of Zrínyi-Újvár took a long time, the delay was not serious because of the early start of the campaign season. Two and a half months passed between setting up their camp in Eszék and the battle of Szentgotthárd, but, during this time, the Muslim army got far in western direction. The actual loss of time was perhaps one and a half months. The fact that the Ottoman army was in Western Hungary in early August can be regarded as a remarkable achievement. Sultan Süleyman arrived in Mohács one month later, on 29 August 1526. Siklós fell on 7 July 1543. The siege of Esztergom began on 23 July 1543, and the siege of Fehérvár started in late August. The advance guard of Sinan Pasha arrived under Győr on 31 July 1594, and Damad Ibrahim began besieging Eger around 20 September 1596. Fazil Ahmed himself arrived under Érsekújvár (today Nové Zámky, Slovakia) on 16 August 1663. After Szentgotthárd, the Grand Vizier arrived in the north in time; August was the beginning of operations in the target area. The detour he made in South Transdanubia, therefore, had no fatal consequences for the Ottoman army in terms of time.

It weakened the morale and physical condition of the Muslim army all the more – and that was what turned out to be a determining factor in the end. The ruthless, consistent strategy of Miklós Zrínyi against Kanizsa yielded a strange fruit. It forced the Grand Vizier off his original course, made him face difficult supply problems, and eventually put him in an unsustainable situation. With this, he prevented a direct and well-prepared attack on Pressburg, Győr, or even Vienna. The campaign of Fazil Ahmed was derailed. When compared to its size, the campaign was completely fruitless. The only benefit for the Ottomans was the consolidation of the region of Kanizsa, while valuable areas were lost in the north. In other words, when Zrínyi ‘pulled on himself’ the main Ottoman army, he saved the country: the Grand Vizier could not beat deeper the wedge he had already hit into the territory of the Hungarian Kingdom at Érsekújvár (today Nové Zámky, Slovakia). However, Zrínyi paid a heavy price: he inflicted great suffering on Western Hungary, and got further than ever from his cherished plan of capturing Kanizsa. Paradoxically enough, that was probably how he saved Hungary from complete fragmentation and destruction.

ON-SITE INVESTIGATIONS

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Identification of the Zrínyi Ditch – An Engineer Obstacle Built in 1662[1]

József Padányi – Lajos Négyesi – László Nagy

Introduction

In recent years, several papers have been published on the field research of Zrínyi-Újvár. The authors presented the history of the fortress from its construction to the siege of 1664, the results of archival and field research, and the role of the fortress in the defence of Muraköz.[2] The publications also discussed the visual representations of the fortress, in particular, the drawings by Holst, Montecuccoli and Pál Esterházy.[3] This is why it comes as a surprise that – to the best of our knowledge – no one has been engaged in studying, interpreting the role of, or identifying in the field the ditch that can be seen on the drawing by Holst (hereinafter: Zrínyi Ditch). In the following, we will attempt to prove the existence of the Zrínyi Ditch and the possibility to identify it in the field.

"A captain who does not know the land will do little of his own will […]. A ditch, a creek, a straw often caused the fall of armies. It is, therefore, more all-important to know where the hills rise, and the meadows stretch, how the forests can be crossed, and where the waters flow."[4] This quote from Miklós Zrínyi refers to the fact that it is imperative to be familiar with the terrain in order to win a battle. The commanding activities of Zrínyi abound with examples, which prove that he not only described but also knew and used the conditions of the terrain.

One of the best-known examples of this is connected to the construction of Zrínyi-Újvár, where even the selection of location demonstrates his skills. The choice of the place of Zrínyi-Újvár has been examined by many and from lots of different angles, considering both its advantages and disadvantages. For us, those views are relevant that consider the effectiveness of the defence of the fortress and its surroundings in a complex way.

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1 The first publication of the research results was in 2018: A Kaposvári Rippl-Rónai Múzeum Közleményei, (6) 241–254.

2 Without aiming to give an exhaustive list, here are some outstanding publications on the subject: *Vándor* 1992; *Hausner–Négyesi–Papp* 2005; *Hausner–Padányi* 2012; *Hausner–Padányi* 2014.

3 The most authentic of these is the black and white drawing by Holst (the colour image of Esterházy is an incomplete copy of this). However, this survived only in the form of a copper engraving by Johann Martin Lerch: *Szalai–Szántai* II. 2006. 159, Plate 217. Originally, it was preserved in the Baden State Library, in Karlsruhe. Lajos Glaser described it in 1933, but it was destroyed during World War II. In Hungary, it was first published in the volume by Szalai–Szántai above, found in their private collection. That is why we can only refer to this. See *Domokos–Hausner* 2008. 241–264.

4 ZMÖM 2003, Vitéz hadnagy [Lieutenant Vitéz] 328.

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We agree with György Domokos that Zrínyi fully exploited the potentials of the geographical environment. He writes that: “The depictions of the siege clearly show that it was protected from the north and west by the Mura River, from the north-east by the waterlogged valley of the Kanizsa Stream, and from the east by the swamped bed of the dammed Visszafolyó [Backflow] Stream.”[5] As a result of this, although the fortress was besieged by a large number of Ottomans, they had “no access” to it. The siege was restricted to a 250-metre-wide area, allowing defenders to concentrate their forces and inflict maximum damage. This is also evidenced by our field research, which has yielded a large amount of siege finds in that zone.

Exploiting the potentials of terrain in combat

Exploiting the geographical features offered by watercourses and swamps for the purposes of defence was a common practice on the borders of Ottoman Hungary. This was no different for the Mura River and the Kanizsa Stream, either. Guards watching over the ford, outposts established along the river, and the terrain altogether formed a unit that made difficult and slowed down raids and often made them impossible to remain unobserved. The strength of the fortresses and outposts was determined not only by their fortifications but also by their position in the terrain. An example of its recognition is the 1577 session of the War Council. At the meeting there was a debate about the defence of the borderland and the Kingdom of Hungary between two parties holding different views. One focused on active offensive combat and the other on active defence.

The concept finally adopted is briefly the following: “…the most important tool is defence and the reliable and adequate supply of the border fortresses […]. And, indeed, if the enemy sees that the borderland is well occupied, there are plenty of soldiers, and everything necessary for defence and liberation is readily available and in good condition, they will be much more cautious and give up many ventures that they otherwise – if they knew there was no opposition – would undertake, all the more because those things cannot happen so quietly that the enemy would not learn about them. Accordingly, the most important thing is the good and sufficient supply and armament of the border fortresses and frontiers […] to make sure that there are enough troops everywhere on the frontier at all times to repulse the regular attacks and raids of the enemy…”.[6]

The inspection carried out in 1579 was a visible sign of the proposition associated with the name of Lazarus von Schwendi,[7] during which the inspection committee of the War Council also surveyed the valley of the Kanizsa Stream. It was not a novelty that the natural conditions of the valley were favourable for the defence. György Malakóczy, the Captain of Bajcsavár, drew the committee’s attention to the fact that it had already been planned to lead water from the Mura River into the Kanizsa Stream through an old flood gate or ditch, which would be certainly a costly undertaking, but not unfeasible. It is also stated in this report that the effectiveness of the plan should be determined by someone who is an expert

5 *Domokos* 2012. 44–45.
6 *Geöcze* 1894. 647–678.
7 Baron Lazarus von Schwendi, German commander, Imperial General, Captain General of Kassa.

on the running of the watercourses.[8] The letter of the captain of the border defence system against Kanizsa also reveals that in autumn 1578, he also inspected the place together with György Zrínyi (IV), but because of the reeds and the water covering the area, they could not see much.[9]

The essence of the proposition is that the Mura is capable of transporting such an amount of water that can provide a constant water supply to the Kanizsa Stream through damming.[10] This helps swamping, maintains continuous water flow in the riverbed, makes travel difficult and slows down crossing. All these allow the defenders to gain time and move their forces to the right place. If it is done in time, they can attack the enemy during their crossing, which offers an enormous tactical advantage. This was well known, as the riverbanks were constantly watched and occupied when needed.[11] One of Zrínyi's famous military successes is also connected to such an event. On 27 November 1663, in a fight lasting a whole day, he defeated an Ottoman troop that attempted to cross the Mura. One of the components of the success, in this case, was again that the place of crossing was discovered in time, and thus, a large part of the attackers could be hit on in the water. "Suddenly, a shot by a minor mortar from an outpost signalled the appearance of the enemy […]. They became so frightened that they started to run towards the Mura and came face to face with the Tartars in the river. It resulted in such confusion that they were unable to swim, escape, or defend themselves."[12]

In this region, the water level of the Mura and the speed of the river was determinant when military operations were planned, whether they were offensive or defensive. We have data about several cases when Zrínyi's plans were influenced by the water level of the river. He wrote, for example, the following in one of his letters addressed to Ádám Batthyány: "…I do not know whether I will be able to attend the funeral or not, for in the autumn weather, the Mura has started to fall, and your Excellency knows well our state here that we cannot leave the Muraköz whenever we want to."[13]

The Ottomans were also aware of the dangers of the Mura and tried to prepare properly for each crossing. One of Zrínyi's letters makes reference to this, too: "…the Ottomans […] keep harrying us, as they did yesterday, trying to cross over to the Muraköz by leather vessels."[14] It took time – that is, preparation – to make such floating vessels. The cattle required for the leather bags needed to be skinned and their hides had to be sewn.

8 *Kelenik* 2012. 20.

9 *Kelenik* 2012. 21.

10 It is worth noting here that, in our reading, damming is the introduction of water into the river bed, while backfilling is increasing the water surface or water level by closing up an existing watercourse.

11 "There are nine outposts between Légrád and Kotoriba, which I have to maintain partly at my own expense and partly from royal pay. However, the money arrives so late and it is so little as if nothing came. So I cannot defend this line at my own expense any longer. The hill saves a lot of money for me because it substitutes six outposts, and although more soldiers will be needed here than at those six outposts, the soldiers are easier to support here because they are provided with vines, arable land and everything else they need." Miklós Zrínyi to the Imperial War Council. Légrád, 5 July 1661. See page 272 of the present volume.

12 ZMÖM 2003. Zrínyi Miklós levelei [Letters by Miklós Zrínyi] 362, 761–762.

13 ZMÖM 2003. Zrínyi Miklós levelei [Letters by Miklós Zrínyi] 610.

14 ZMÖM 2003. Zrínyi Miklós levelei [Letters by Miklós Zrínyi] 238, 642.

Four such bags were tied to a wooden structure, which, when used as a ferry, was suitable for transporting up to 20–25 men.[15]

At another place he wrote the following: "The Mura is so shallow here that I do not remember when the Mura was so shallow in the last few years. As the Ottomans are assembling like this, I am especially vigilant, but I do not know from which direction to expect them."[16]

The Ottomans also knew that changes in the river's water level were crucially important for their success. Zrínyi wrote the following in August 1652: "Our only defensive bastion, the Mura, is now so shallow that even the infantry can cross it, and right now, as I am writing this letter, I receive the news that the Ottomans have arrived at the Mura seeking a ford, so I can expect guests tomorrow."[17]

Likewise, the occasional freezing of the river had also affected the military plans. "And the Mura has frozen so much that one can even tow cannons on it",[18] "…our Mura has frozen over, and we had to set out from our quarters, and only God knows what will be with us."[19]

The opportunities offered by the river were also decisive during the siege of Zrínyi-Újvár in 1664: "On 20 June, [*the*] defence of the Mura was [*re*]organised. A stretch of the river was assigned to each unit, and they had to defend them with trenches and guards, namely

1. the area from the confluence of the Mura and the Drava to the fortress belonged to the imperial army;
2. the area from the fortress to Kotoriba belonged to the League;
3. above Kotoriba, there was Count Zrínyi, as well as the *Hajdús* of Nádasdy and Batthyány."[20]

Anyone familiar with the area between the Mura River and the Kanizsa Stream (today's Principális [Main] Canal) – in the administrative district of Murakeresztúr – knows that linking the two watercourses required considerable expertise. The slope of the terrain is uneven, thus in the sixteenth and seventeenth centuries, the estimation of the amount of earthwork needed to lead the water of the Mura to the Kanizsa Stream whether there was enough water for it at all was only possible through experience.

This plan could be proposed only by a local, someone who was very familiar with this region and knew the relation and water regime of the Mura and Kanizsa Stream. Not surprisingly, it was Miklós Zrínyi, who – several years after his grandfather's inspecting the place in 1578 – had to put into effect this long-cherished plan in 1662.

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15 *Ludovika Akadémia Közlönye* [The Official Journal of the Ludovica Academy], 1891. II. 1277, minor publications (M. W.).

16 ZMÖM 2003. Zrínyi Miklós levelei [Letters by Miklós Zrínyi] 123, 553.

17 ZMÖM 2003. Zrínyi Miklós levelei [Letters by Miklós Zrínyi] 197, 607.

18 ZMÖM 2003. Zrínyi Miklós levelei [Letters by Miklós Zrínyi] 21, 475.

19 ZMÖM 2003. Zrínyi Miklós levelei [Letters by Miklós Zrínyi] 121, 552.

20 Raimondo Montecuccoli: Relazione della campagna dell' Armata Cesarea nell' Anno MDCLXIV. See page 296 of the present volume.

The characteristics of the Mura and the Kanizsa Stream

It is worth saying a few words about the watercourses in question. The Mura River originates in the Hohe Tauern Mountains in Austria, at an altitude of 1,764 metres. Its total length is 454 kilometres, of which only the lowest section (48 kilometres) – in fact, only its left bank – is found in the territory of Hungary. Yet, even at this lower section, it flows fast enough to change its bed in the loose soil continuously. Its valley is full of watercourses and backwaters. Sometimes the river breaks through its overgrown bends. The water level fluctuation of the Mura is little compared to other rivers. One of the reasons for this is that the snow cover in the Alps serves as a natural reservoir, which starts to thaw only when the floods caused by the spring rains are over. It is also typical of the river that it overflows quickly and recedes slowly. It takes 6–8 times longer for the river to recede than to rise. It changes its bed after almost every major flood, and there is hardly any place in its valley that would never have become a Mura bed. Its gravel sediment is covered with alluvial soils of varying thicknesses. Every type of these soils can be found here.[21]

The speed of the river water – that is, the speed measured in the streamline of the river, 30–40 centimetres below the water level – is most important from the aspect of our study. The velocity of the current depends on the gradient of the slope, the cross-section of the riverbed, the soil, as well as the depth and amount of water.[22] The streamline is not constant; it can vary and may show vast differences in a given cross-section, too.[23] According to the scholarly literature, the velocity of the current is considered slow to 0.5 m/s, medium to 1 m/s, fast to 2 m/s and very fast above 2 m/s.

Our measurements performed in the field – which are in agreement with the data of the scholarly literature – show that the speed of the river water in the streamline can reach, and in some places even exceeds 2 m/s, which means a speed above 7 km/h. At this speed, the crossing is a considerable challenge, whether on horseback, swimming, or on a human-powered floating vessel. Above 2.7 m/s, the crossing – on horseback, on foot, or by boats – is unpredictable; the current practically sweeps away everyone who tries it. [24] Crossing rivers of very high speed is not easy even in winter. On the one hand, they do not freeze easily; and on the other, the ice must reach a given thickness in order to be used safely. When crossing the frozen river, the thickness of the ice needs to be everywhere 16 cm for wagons, at least 15 cm for the cavalry and at least 9 cm for the infantry.[25]

Based on the above, crossing the Mura was a significant challenge. The time spent in the water increased, and it was difficult to predict where one would reach the other bank of the river. At this speed of river water, a swimmer can swim 10 metres in a minute, while a boat can travel with a speed of 3 to 50 metres per minute.

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21 A Víz Keretirányelv hazai megvalósítása. Vízgyűjtő-gazdálkodási Terv 3-1 Mura. [National Implementation of the Water Framework Directive. River Basin Management Plan 3-1 Mura.] Published by the Central Directorate for Water and Environment, West-Transdanubian Directorate for Environment and Water, April 2010. http://vpf.vizugy.hu/uploads/ddvizig/projekt/lezarult-fejlesztesek/ovf-es-kozos-projektek/mura_vizgyujtogazdalkodasi_terve.pdf (Accessed: 12 December 2015.)

22 The fall of the river is the difference in the height of the water level over one kilometre.

23 Vízenjárási utasítás [Water Transportation Instruction] 1958. 16.

24 Búvár utasítás [Diving Instruction] 1955. 6.

25 Módszertani segédlet [Methodology Guide] 1955. 325.

The situation is further aggravated by the uneven current of the river, and the limited number of stretches suitable for crossing. It is easy to see that these circumstances were favourable for the defenders on the riverbank, which was known and taken advantage of by both Zrínyi and the Ottomans.

An important tributary of the Mura is the Principális Canal. Its catchment area is 609 km^2 and it is 57.1 km long. It flows from north to the south and has a narrow catchment area widening at the southern end. In the 1730s, Mátyás Bél wrote the following about the Kanizsa Stream: "It forms the border of our county with Somogy. It rises below the vine-growing Bogláts Hill, then flows along Szentmiklós and merges with the Mura beyond Zerin Újvár." Today's watercourse of the Principális Canal – due to the topographic features of the investigated area – follows the line of the former Kanizsa Stream. This is also evidenced by the maps of the military surveys, on which the course of the river can be easily followed.[26]

Before looking at the barrier capacity of the Kanizsa Stream, it is worth reviewing some indicators of fording capability. The wadeability of rivers and lakes depends on their width, depth, quality of the bed, the velocity of the current, the characteristics of the banks (height, gradient, wateriness and vegetation), as well as accessibility. Under favourable bottom conditions, up to 2 m/s current velocity, the barrier can be waded across to a depth of 1 metre on foot and a depth of 1.2 metres on horseback.[27] The passability of marshes is not constant. It depends on the quality and condition of the soil surface layer, and the amount of water in the soil.

We have little data about the Kanizsa Stream at this time. Contemporary depictions show that the valley of the stream – not so much because of the volume of water but rather because of its waterlogged character – had a great restraining effect. The left bank of the stream is a high bank between Kollátszeg and Zrínyi-Újvár, which has a height difference of 10–15 metres at some places. The right bank rises only slightly from the surface of the land stretching to the Mura – that is, the flood area of the Mura. Accordingly, the frequent floods of the Mura regularly reached even the Kanizsa Stream in this section. The backwaters and oxbows of the Mura are still visible in the immediate vicinity of the Kanizsa Stream. The Kanizsa Stream can be up to 2–4 metres deep and 10–12 metres wide.

The role of the Zrínyi Ditch and identifying its location

Modern warfare still uses the concept of a technical barrier system, one element of which is the technical barrier node. The latter is such a combined barrier that is created in harmony with the natural obstacles of the terrain to close down important routes, and it is always kept under fire.

In our case, Zrínyi-Újvár and the associated artificial and natural barriers can also be considered a technical barrier node, the purpose of which was to guard the crossing of the Mura that was important from both commercial and military aspects. The obstacles included the stronghold itself, the redoute built on the other bank of the Mura, the man-made fishpond, the outposts erected along the Mura, as well as the ditch linking the Mura

26 Historical Maps of the Habsburg Empire. http://mapire.eu/hu/ (Accessed: 14 October 2019.)

27 Műszaki utasítás [Technical Instruction] 1954. 338.

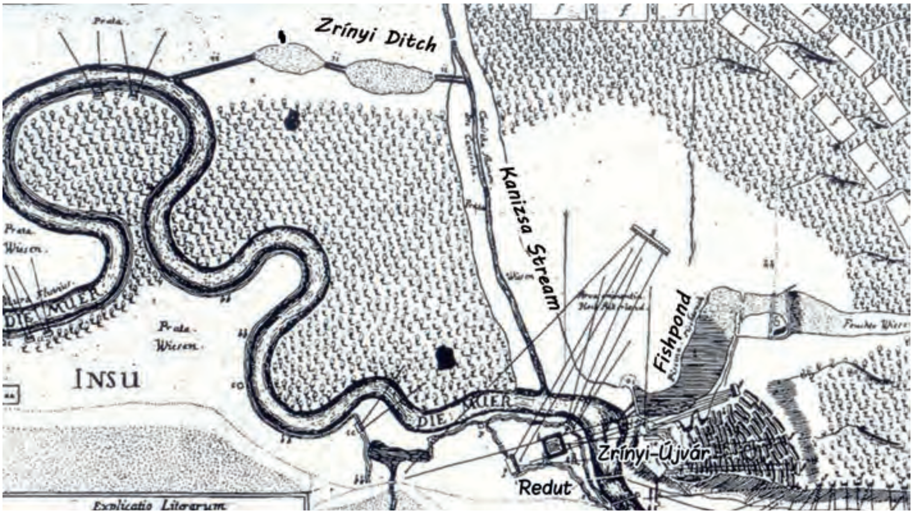

Figure 1.
The depiction by Holst
Source: Johann Martin Lerch: Zrínyi-Újvár and Its Surroundings at the Time of the 1664 Siege. Copy of the drawing by Jacob von Holst, imperial military engineer. Copper engraving. (*Szalai–Szántai* II. 2006. Plate 217. The texts of the figure translated into English for this volume.)

and the Kanizsa Stream.[28] The latter appears on the drawing by Holst – in the upper left of the image as a ditch connecting the Mura and the Kanizsa Stream *(Figure 1)* – and is mentioned by István Vitnyédy in a letter: "I arrived here rather late today, and heard about lots of things that happened since I had left. God grant that may end well. Our lord is in good health, and all his thinking is how to do harm to the Ottomans. He has recently had a great ditch dug at Ujvár, with the help of which the water of the Mura is led into the Kanizsa. This ditch and the great forest that has been buried will be for the benefit of the Ujvár. Over two thousand men were engaged in these works, all from the Muraköz."[29]

It is worth considering these lines and contemplating them, especially two statements. According to Vitnyédi, "he has recently had a great ditch dug at Ujvár". We know that the letter is dated 8 April, that is, the work was carried out in late March and early April.

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28 The ditch leading the water of the Mura into the Kanizsa (and thus raising its water level) was completed in April. István Vitnyédy to István Rabby, Locsmánd, 8 April 1662. *Fabó* XV. 1871. 195. This is shown on the sketches by Holst and by Esterházy: *„ff. Gräben, so der graff von Zrinmachenlassen den waldvor die guarnisonzuversichernvndzugebrauchen" Hrenkó* 1979. 127. The *Muster Comission* made up of war councillors and borderland captains (including György Zrínyi, Miklós Zrínyi's grandfather) made a proposal for raising the water level of the Kanizsa Stream with the water of the Mura at Kakonya as early as 1577, because, in their opinion, the Ottomans could easily cross it on horseback and on foot due to the low water level. *Kelenik* 2005a. 353; *Hausner–Négyesi–Papp* 2005. 836.

29 Zrínyi had a large ditch dug at Zerinvár against the Ottomans: István Vitnyédy to István Rabby, Locsmánd, 8 April. 1662. *Fabó* XV. 1871. 195.

By this time, the incidentally frozen ground had thawed, and agricultural works started. The spring sowing began when the ground completely or partially ceased to be frozen, and no more permanent frosts were expected. It usually started on Saint Joseph's Day (19 March) and lasted to Saint George's Day (24 April), when maize sowing began.

The other statement goes like this: "Over two thousand men were engaged in these works, all from the Muraköz." The secondment of two thousand men seems to be a substantial number at first, especially in the light of the fact that that the population of Muraköz was around 32,000 at that time.[30] It means that – taking into account primarily the physically stronger male members of average families of five – one in three men was engaged in the construction of the ditch. In that season, they were supposed to work in the fields to lay the ground for next year's crop! This raises the question, what made Zrínyi take this hard decision, when, at the same time, 500–1,000 men worked at Zrínyi-Újvár every day.[31] He certainly did not have a large workforce, as we also have information that – in line with the decision of the Croatia's Sabor on 27 February 1662 – Varasd and Körös Counties also helped build the stronghold. "Each house (smoke) should provide two workers, equipped with axes and other tools, for the construction."[32] The fact that Zrínyi-Újvár and the Zrínyi Ditch were built at the same time suggests that the function of the two, namely the defence of the Mura crossing, cannot be separated from each other. This is evidenced by the simultaneous secondment of a considerable workforce.[33]

What was so urgent for Zrínyi then? In our opinion, the answer lies with changes in the water level of the Mura. The water level of the river has two peaks: a primary one in May and June and a secondary one in November. Accordingly, the objective was that the ditch completed by the spring floods should be filled with the rising water level during the spring floods. So the discrepancy between the frozen ground, the floods and agricultural works had been resolved by Zrínyi in this way.

The quotation from Vitnyédy clearly shows that the ditch led the water of the Mura into the Kanizsa Stream. The question is how the inclination of the terrain affected the shape and depth of the ditch. Looking at the map, it is difficult to tell the lateral inclination angle of the terrain between the Mura and Kanizsa Stream. Based on cartographic data, there is no significant difference between the water levels of the Mura and Kanizsa Stream, less than three kilometres from their confluence. This is confirmed by the fact that most of the village of Kollátszeg is found within a 131.25-metre high contour line, so the terrain has no dominant slope in any direction. On a map sheet from the 1970s, however, the water in the ditch is clearly shown flowing towards the Kanizsa Stream *(Figure 2).*

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30 *Végh* 2017. 265.

31 The construction of the fishpond near the fortress – which played a very important role in the defence of the fortress – alone involved the movement of more than 56,000 m^3 of earth, let alone the earthworks of the fortress.

32 *Kalsan* 2014. 109.

33 The population of Muraköz fluctuated between 18,000 and 32,000 in the seventeenth century. Within that, the population was the largest at the time of Miklós Zrínyi (1620–1664). The population density in the Muraköz was 30–40 people/km^2, whereas the average population in the Kingdom of Hungary was 15 people/km^2. *Végh* 2017. 265.

Figure 2.
Map sheet showing the flow direction of water in the ditch
Source: compiled by the authors

A hydrological survey conducted in 1915 reveals an even more intriguing situation. The survey indicates that there is less than seventy centimetres of difference between the two watercourses, towards the Mura. Nevertheless, it shows an uneven slope. According to the survey, the ditch – labelled as the Kollátszeg Canal – descends from the bridge on the Murakeresztúr–Kollátszeg road in both directions (the vicinity of the bridge being the highest point of the canal). It is easy to see why the designing engineer proposed a significant deepening of the canal. In this case, the goal of the deepening was to facilitate the drainage of the area.

The question is how much work the digging of the ditch reported by Vitnyédi needed under such slope conditions. We know from his description that Zrínyi commanded over 2,000 men from Muraköz to work on the ditch. According to the calculation of military regulations, the standard of land extraction is 0.3 m^3/h by hand; that is, assuming that everyone works at the same time, 600 m^3 of earth can be moved by such a workforce every hour.

We do not know the size of the ditch dug on Zrínyi's order. So based on the data available to us, we can say the following. The dimensions of the ditch – on the basis of the map from 1970 and calculating with a slope of 45° – were as follows:

- distance measured along the slope edge: 3.5 metres
- depth of the ditch bottom: 1.3 metres

From the above, it can be calculated that the amount of soil to be excavated was 2.86 m^3 per running metre. The length of the ditch – measured on the map – is 1,410 metres, so the total amount of soil to be excavated was 4,032 m^3. This means that the ditch depicted in 1970 should have been made by 2,000 men in nearly 7 hours.

Seeing this ditch in the terrain, it is clear that the restraining power was not represented by the ditch itself, but by the swamping associated with the ditch as well as the dense, impenetrable vegetation. It is also evident that the ditch needed have at least the same dimensions as the Kanizsa Stream itself (which was 12 metres wide by 4 metres deep) to be able to supply the stream with water incessantly. Calculating in this way, we get a higher number: 32 m^3 per running metre, that is, 45,120 m^3 along the total length. Under the given circumstances and conditions – i.e. 2,000 men working simultaneously for 10 hours a day – it took 75 hours, that is, more than a week of tense work for the available workforce to dig the ditch *(Table 1).*

Table 1.

The sections to be dug, their length and the quantity of soil to be extracted

	The length of sections and the quantity of soil to be extracted in each section
Section 1 Western ditch	460 m
	14,720 m^3
Section 2 Western oxbow	240 m
	7,680 m^3
Section 3 Middle ditch	160 m
	5,120 m^3
Section 4 Eastern oxbow	340 m
	10,880 m^3
Section 5 Eastern ditch	210 m
	6,720 m^3
Total	1,410 m
	45,120 m^3

Source: compiled by the authors

The table above includes information about works on the three connecting canals (sections 1, 3 and 5 from the Mura towards the Kanizsa Stream), and extraction works on the oxbows (sections 2 and 4). *Figure 3* shows the course and sections of the ditch.

Let us not forget, however, that the water flowing in the Mura was of much larger mass and velocity than in the Kanizsa Stream.[34] Consequently, the water – if the ditch is connected to it at the right place and in the right angle – entered the ditch with considerable force due to its mass and speed. The junction shown in the contemporary representation seems to be ideal from this point of view.

The next question to answer is where the ditch originated and where it led to. Based on maps available to us, we cannot define the seventeenth-century course of the Mura riverbed with absolute accuracy. It is visible on the maps that the river constantly changed its course, creating new bends and oxbows. Later, human intervention also became significant, as the settlement of Kollátszeg was built out, and in the nineteenth century, the railway line was

[34] This extent of the difference can be best illustrated by comparing the volume of water transported. At 4:00 a.m., on 21 October 2016, the Mura at Letenye delivered 208 m^3 of water, while the Principális Canal at Nagykanizsa delivered 1 m^3 of water per second.

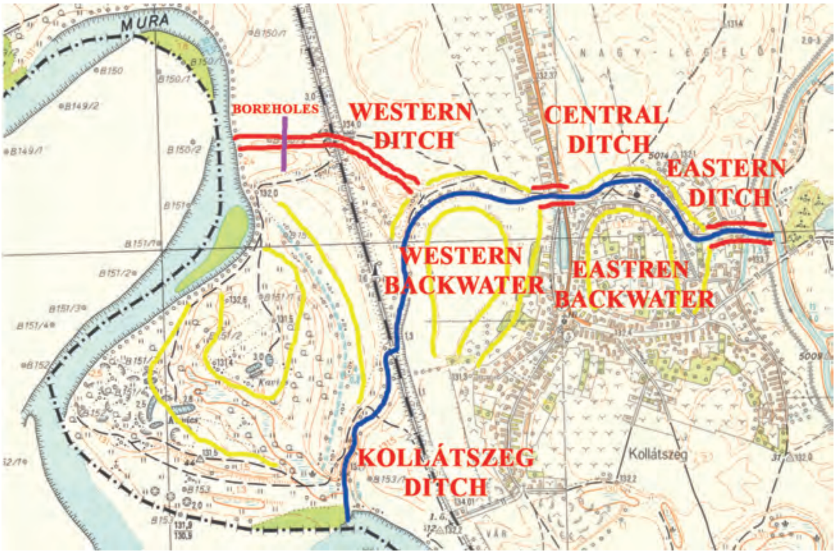

Figure 3.
The sections of the Zrínyi Ditch

Source: map made by the authors

also constructed.[35] The latter interventions set a limit to the channel migration of the Mura. The channel migration of the Mura can be described as follows.[36]

The first period of our investigation covers the sixteenth and seventeenth centuries, which is characterised by interventions protecting local interests. Unfortunately, we do not have any reliable maps from this period. The 1788 map and the surviving written documents reveal that these alterations did not affect the course of the riverbed, but were directly concerned with the protection of the banks. Due to the lack of organisation, the river could not be cut through. The first records about regulation works of the Mura date back to the second half of the eighteenth century. At that time, the alterations were limited to the protection of estates along the Mura and were carried out locally.

The second phase – in the era of the Austro–Hungarian Monarchy – saw larger-scale, coordinated work aimed at ensuring the navigability of the river. At that time, however, provincial conflicts made it difficult to implement the plans, and thus only a few cut-offs were carried out during a period of forty to fifty years. For the section of the Mura between Hungary and Styria, the first known regulation plan was completed in 1865. Thereafter, regulations were mostly restricted to the territory of Austria. It was not until 1897 that regulations started in Hungary. The aim of these was to create a unified riverbed with stabilised banks, to lower the water level, as well as to block and fill up the branches. According to the general principles

[35] The railway line between Barcs and Gyékényes was put into operation on 1 September 1868 as part of the 72-kilometre long railway line of the Southern Railway Company connecting Barcs and Murakeresztúr. The state of the railway line is still affected by changes in the riverbed of the Mura. *Kovács* 1996. 124.

[36] *Engi et al.* 2016.

of the riverbed, the radius of the smallest meander of the river had to be over 600 metres, and the width was also determined. Accordingly, the width of the riverbed had to be 100 metres from the Drava junction to the influx of the Kerka. From there to Ráckanizsa, it had to be 90 metres, and from there to Radkersburg, it had to be 75 metres wide. After 1918, the Mura became a frontier river from the Drava junction to the influx of the Kerka Stream. The regular regulation works on the part of Hungary were discontinued for a long time and served only to secure the banks and prevent excessive meandering.

The third phase, beginning with World War I, saw the most considerable change. Until then, four independent states shared the territory of the river under the control of one empire. After World War I, fundamental alterations were made on the left bank of the Mura (on the Hungarian side). In 1927, cut-offs were made at Muraszemenye, in protection of the Alsószemenye part of the settlement. In the area of Murarátka, the danger to the road was eliminated after the meander bend in the river was protected from bursting. In 1939, in the region of Letenye, shoreline defences, spurs and river closures were made in order to direct the streamline of the river towards the bridge of the public road at a favourable angle. In the area of Tótszerdahely, Molnári and Murakeresztúr, shoreline defences and regulation works were made. It was, however, only in 1940 and 1941 that flood prevention embankments (summer embankments) started to be constructed for the defence of smaller areas along the Mura. After 1950, the regionally competent Water Management Directorate took over the development and maintenance of defences built locally until then. The tendency was to integrate local interventions into a general water management plan that was completed in 1978. Nevertheless, only some of the planned riverbed protection and regulation works were carried out, and no riverbed cross-cuts were made. Based on the Austrian, Yugoslavian and Hungarian hydrological and hydrographic studies, the 1959 development programme determined the water yield of floods at 1,650 m^3/s and the distance between the embankments at 600–750 metres, and also defined the dimensions of flood prevention embankments. Initially, the defences were constructed after the surface profile belonging to water level +500 cm measured by the water level gauge at Letenye. At the time of the 1972 flood, the water level gauge at Letenye showed that the water level peak was at +514 cm, which was later regarded as the standard water level. During that flood, the embankments burst at two locations (at the Tótszerdahely and Birkitó river loops), causing significant damage. After 1972, the embankments were developed in several loops. The modern defences (flood embankments and structures) were constructed in several stages between 1965 and 2015.

For mapping the Mura riverbed in Zrínyi's age, it is worth beginning with the interpretation of the earliest representations. The earliest such representation comes from 1794, which shows the Mura between Kollátszeg and Kakonya *(Figure 4).* In this image, one can clearly identify the meanders known from the drawing by Holst, but there is no trace of the ditch in question.

The First Military Survey also shows the examined section of the Mura and distinctly depicts its oxbow and the ditch linked to it *(Figure 5).* The other end of the ditch is clearly connected to the Kanizsa Stream. It is worth noting here that there is no other ditch between Murakeresztúr and Kakonya connecting the two rivers. There is one more important point of orientation on the road from Murakeresztúr, namely the bridge above the ditch in the vicinity of Kollátszeg.

Figure 4.
The region of Kollátszeg in 1794
Source: https://maps.hungaricana.hu/hu/OSZKTerkeptar/789/
(Accessed: 25 November 2017.)

Figure 5.
The results of the First Military Survey
Source: http://mapire.eu/hu/map/firstsurvey/?layers=osm%2C1%2C73&bbox
(Accessed: 20 November 2017.)

The next drawing worth observing comes from 1816. This shows the investigated section of the riverbed with the same course as the map from 1794 *(Figure 6).* This already depicts those interventions that are indicative of the planned cross-cuts and river bend cut-offs. What is really interesting to us, though, is that it depicts the completely cut-off oxbow lake and (in its bend) the ditch in question next to Kollátszeg.

The 1855 cadastral map depicts the waterbed of the oxbow lake filled with water and the ditch linking it with the Kanizsa Stream *(Figure 7).* On it, one can again identify the bridge and several breakpoints of the ditch that is still visible today.

The Third Military Survey (1869–1887) markedly shows the ditch and its dimensions, and it demonstrates the fact that today's Kollátszeg developed on the inner side of the cut-off riverbed *(Figure 8).*

An aerial photograph taken in 1960 clearly shows both the cut-offs and the structure of the Kollátszeg settlement *(Figure 9).* In the aerial photograph, one can distinguish well the former riverbed of the Mura, two natural riverbeds very close to each other, as well as the man-made ditches and canals.

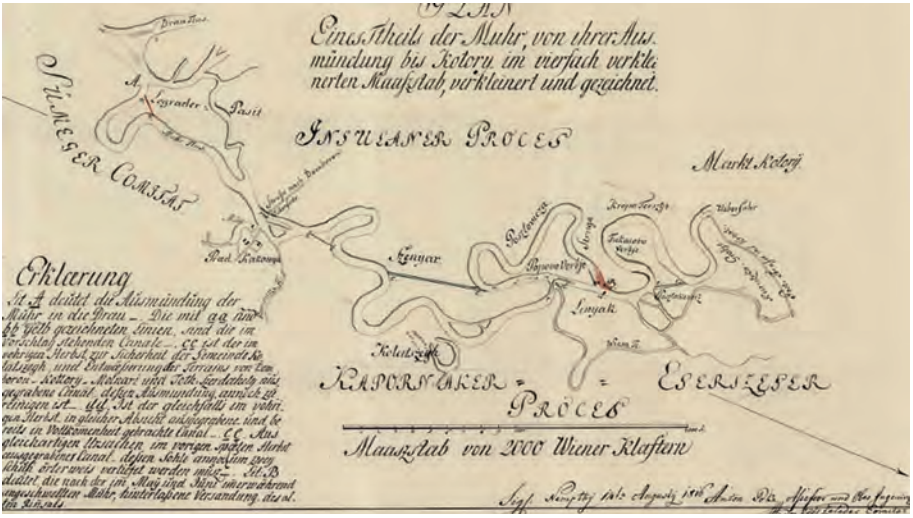

Figure 6.

Kollátszeg in 1816

Source: https://maps.hungaricana.hu/hu/MOLTerkeptar/5502/view/?bbox=-492%2C-3091%2C5596%2C-315 (Accessed: 1 December 2017.)

Figure 7.

The investigated area in 1855

Source: https://maps.hungaricana.hu/hu/MOLTerkeptar/19000/view/?pg=3&bbox=-707%2C-6800%2C9270%2C-194 (Accessed: 1 December 2017.)

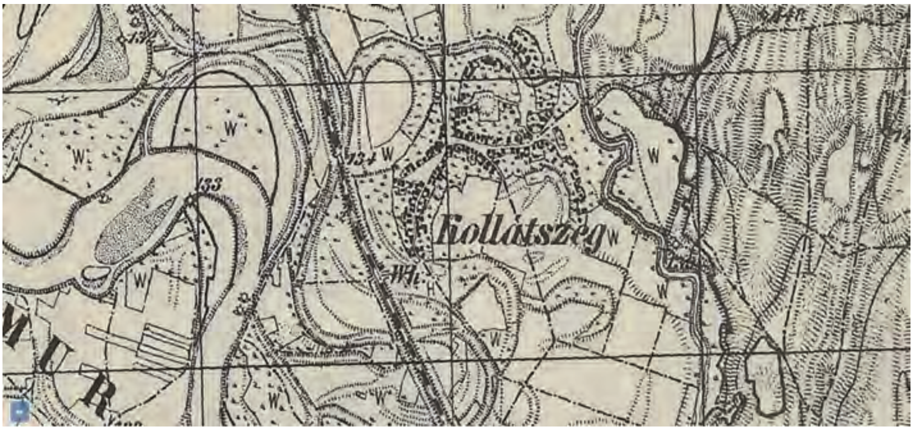

Figure 8.

The results of the Third Military Survey

Source: http://mapire.eu/hu/map/hkf_75e/?layers=osm%2C8&bbox=1865264.737865862 (Accessed: 2 December 2017.)

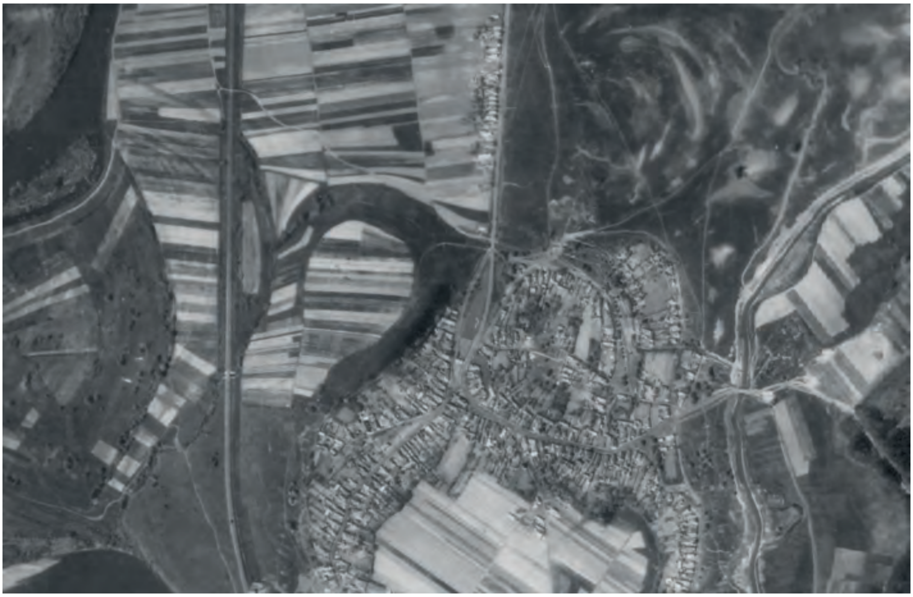

Figure 9.
Aerial photograph from 1960
Source: Ministry of Defence, Institute and Museum of Military History

The possibility of a field survey

Observing the morphology of Murakeresztúr – and within it, that of Kollátszeg –, we can see that the houses are predominantly located along the roads, which run in the higher parts of the settlement. This is typical of settlements built in areas endangered by floods. The terrace on the right bank of the Principális Canal can be identified with the former high bank of the Mura, while the flat area to the west of it has been filled up by the sediment of the river. Due to relatively high water flow rates, the varying rates of water discharge, and high amounts of sediment, the river often changes its course. However, the location of the village suggests that there were higher-lying areas in the potential floodplain that were certainly bypassed by the river, and were inundated only at times of great floods. The northern part of Murakeresztúr is found next to an east–west road. From the western end of this part of the settlement, an approximately one-kilometre-long north–south road led to Kollátszeg. This road runs on the edge of an elevated area stretching westwards to the Mura. On this relatively even land surface, we cannot see any traces of the former riverbeds, while at Kollátszeg there are three oxbows in a row, along a nearly east–west axis. Since the river was unable to hollow the hard surface of the elevation lying in the north, it made a loop eastwards in the lower-lying land area and filled it up over time. Afterwards, it moved towards west, made another loop, filled the land up at times of great floods, and moved further to the west again. The northern extension of the loops was delimited by the edge of the elevated area. Based on the relief of the ground surface, we can say that from the direction of Zrínyi-Újvár, Kollátszeg was the most remote point offering favourable conditions for interlinking the Mura and the Kanizsa Stream. Increasing the water level of the stream with water directed into it from the Mura was only one of the factors to be considered when defining the right place for constructing the Zrínyi Ditch. However, it was at least as important to occupy the forest stretching between the two watercourses and to prevent its accessibility from the north with the ditch. The current ditch connecting the Mura and the Principális Canal runs below the edge of the elevation lying in the north, which indicates that the builder tried to push the canal as far north as possible. The western part of the ditch follows the bed of the former backwater, and, turning southwards, it flows into the Mura.

The Zrínyi Ditch depicted by military engineer Holst is similar to the Kollátszeg Canal in terms of its structure. However, it is questionable whether we can tell 350 years later that a canal dug in 1662 and used for its original purpose for merely two years could leave a trace in the land remaining to this day. All the more so because, its original function was to close off the forest to the Ottomans, so there was no reason to maintain it after 1664. When Zrínyi-Újvár was destroyed, the ditch was also doomed to be filled up. Nevertheless, there are also arguments for its survival. The bed and dam of the fishpond on the eastern side of Zrínyi-Újvár are still recognisable, and the Principális Canal (Kanizsa Steam) runs in the former river bed of the Mura. All in all, we can say that a field survey can be fruitful if we know what we are looking for and where we are.

Our previous research has demonstrated that, in his sketch, military engineer Holst not only depicted the features roughly but tried to represent them in his drawing as accurately as possible. Those features, in fact, are shown in that way in his drawing because they looked like that in reality. In the present case, we can reasonably assume that he did not invent the existence of a ditch somewhere between the Mura and Kanizsa Stream, but he drew exactly what that waterworks looked like. By identifying the location of the ditch, we not only identify another structure connected to Zrínyi's activities, but we also test the authenticity of the sketch made by Holst. The accuracy of the depiction of the Zrínyi Ditch is important from a source-critical point of view, because it is far from the fortress and did not have any role in the siege, so it would even be acceptable if it had been depicted with certain inaccuracies. Was military engineer Holst really so meticulous that, even in this case, he insisted on an accurate representation insofar as possible?

The sketch shows that two irregular elliptical patches found between the Mura and Kanizsa Steam are connected by three straight lines to the Mura and Kanizsa Stream. It is not difficult to interpret the lines: these are the ditches. However, the irregularity of the patches may indicate that those are not man-made features. The Kollátszeg Canal connecting two cut-off backwaters shows this structure. The eastern and western backwaters are interconnected by the central channel. The eastern backwater is joined by the eastern channel with the Principális Canal, whereas the western backwater is joined by the western channel with the Mura. From the three channels, the western one is the longest. Following Zrínyi's line of thought, the two watercourses needed to be connected at a place where they were the closest to each other, and for this, the existing backwaters also needed to be used. At Kollátszeg, there were two backwaters next to each other, which saved a lot of labour, workforce and time. It is highly likely that the military engineer sketch probably represents the Kollátszeg ditch. Nevertheless, the current position of the channel connecting the western backwater with the Mura significantly differs from the one on the representation. We can see that this part of the Kollátszeg Canal turns sharply southwards from the western backwater, while the western ditch depicted by Holst runs to the river keeping its approximately east–west direction. One of the most important aims of the field research was to decide whether the western ditch led across the area to the west of the western backwater (the way Holst depicted it), or was the representation inaccurate? An argument for the representation by Holst may be that it was logical (though, not from hydrological considerations) for the ditch to join the upper part of the river bend, because, in this way, the current made the water run into the channel. Accordingly, the western channel should be sought somewhere to the north-west of the western backwater, where currently there is a relatively flat arable land. Yet, the edge of the higher-lying area to the north is well recognisable here as well.

During our first field survey, we observed a recess in the north-western wall of the western backwater, which (after closer examination) was identified by some members of the group as the joint of the former western channel, while others regarded it as the cutting of an access road. Although some wheel ruts were visible, indeed, we could not exclude the possibility that it being a ramp was only a secondary and later use, and originally it was the joint of the western channel. A 1:10,000 scale map of the territory and aerial photographs indicate a trench between the cutting and the Mura. In the field, under favourable conditions, one can see a longitudinal depression in the ploughland under the edge of the higher-lying ground. We would be able to investigate whether this is a ditch by digging one or more test trenches across it, hoping that the section wall reveals traces of the ditch. As we did not have a possibility to do it, we drilled holes along a fifty-metre straight line (see *Figure 3*) and tried to infer the structure of the soil from the extracted soil samples.

The drilling of the holes along a roughly north–south line was started at the distinctive high bank in the north. Heading southwards, we took samples from the deeper-lying section of the presumed ditch, as well as from its presumed southern bank. The top layer of soil is formed by sandy soil everywhere, which had a depth of ca. 50 cm at the top of the high bank in the north, and increased up to 100 cm in the ditch. Underneath, there is a heavily cohesive, impervious layer of clay. We took a sample from this at one place in the area of the ditch and found blue clay under it. The depth of the impervious layer proves that the ditch-like depression that is also perceptible on the surface truly indicates an approximately one metre deeper ditch. The edge of the southern side could not be identified well because of the erosive effect of the Mura. Nevertheless, the two samples taken five metres apart from the bottom of the ditch revealed that below the 100 cm deep soil layer, there was a layer of loose, yellowish river sand in a thickness of 5–10 cm, above the impervious layer. This suggests that water was constantly moving in a narrow stretch of the area – in other words, the water was flowing in the canal – but it stopped after a while, and the ditch was filled up.

Regarding its history, the ditch served its original function for two years, and during that period, it was most likely to be maintained continuously. Due to its position, the erosive effect mainly took place on the southern side of the ditch, and after its maintenance was terminated after 1664, the water kept pulling down its southern bank in the direction of the western backwater, resulting in a periodic lowland overflow.

As the description of investigations in the field demonstrates, the analysis of micro-morphology plays an important role in identifying the line of the ditch. The largest scale map (1:10,000) available to us shows a 0.5-metre difference of level. We need a higher definition than that. That is why, at the beginning of the research, we decided to carry out a LIDAR (Light Detection and Ranging) surveying of the area, if we had the financial resources for that. The application of this method considerably helped our work during our investigation of Zrínyi-Újvár.[37] As a matter of fact, every field research where micro-morphological features may be significant should begin with LIDAR surveying. However, the sum of money that is required for this is rarely available at the start of the work. We received help in this from the West-Transdanubian Water Management Directorate that had previously surveyed the area with this method and provided us with their data set.[38] The assessed images clearly show the interventions made in the field. Based on this, we received further confirmation, which is demonstrated in *Figure 10.*

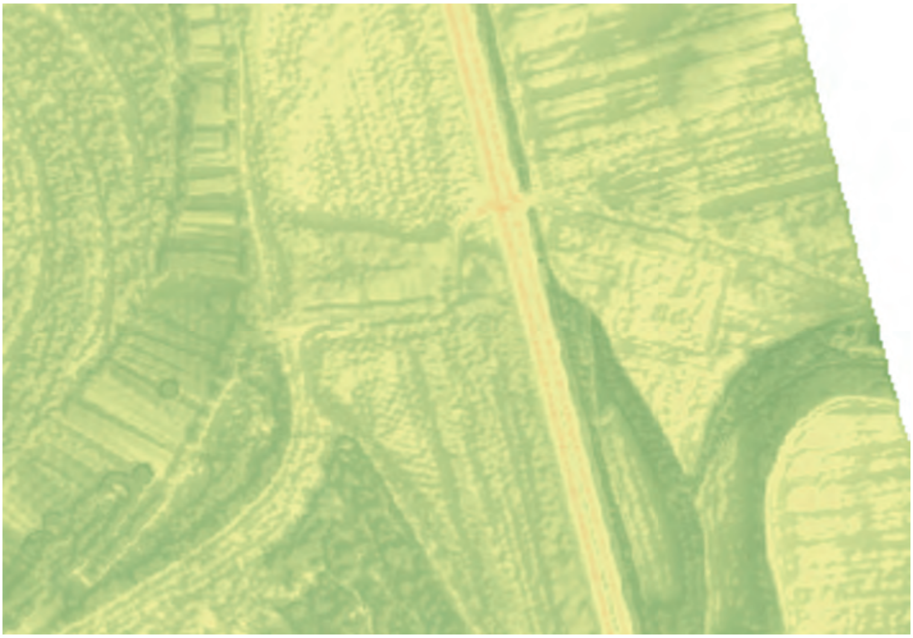

Figure 10.

Details of the Zrínyi Ditch identified on the LIDAR image

Source: West-Transdanubian Water Management Directorate

[37] Airborne Laser Scanning (LIDAR) is an active remote sensing technology that can collect large amounts of remote sensing data over a very short period of time. One of the main advantages of LIDAR is that it is able to collect data from areas where ground-based geodesy surveying would require high resources. (See in detail: www.fataj.hu/2015/05/183/201505183_Erdo-taverzekeles.php [Accessed: 10 December 2017.]).

[38] We would like to thank Dr. Zsuzsanna Engi, a certified civil engineer, Head of the Department of Water Management and Irrigation of the West-Transdanubian Water Management Directorate for her selfless support and professional help.

Magnetometer surveying[39]

In May 2018, a magnetometer survey was carried out in the area investigated with field surveys and soil drilling and sampling.[40] This method is highly suitable for observing man-made features – especially in areas that were not disturbed or were only slightly disturbed later – such as the ditches supposed to exist here. We used a Sensys MXPDA measuring instrument with Fluxgate gradiometer sensors. During the survey, the sensors were fifty centimetres from each other, and the distance between the measuring points was ten centimetres. The data were recorded with an accuracy of one to three centimetres, which were collected by JAVAD Triumph-1 receivers connected in a base/rover configuration.

The resulting image (depicted on a colour scale from –5 to 5 nT/m; *Figure 11*) shows a distinct, approximately 175-metre-long anomaly directed north-west–south-east suggestive of a ditch in the middle of the image. In the south-east, it was divided into two 85-metre-long branches running parallel to each other *(Figure 12).* The average width of its cross-section varies between five and nine metres. Its depth cannot be determined from the picture. The feature certainly continues beyond the survey area in both directions. Its north-western end must have been connected to the Mura flowing there in the past, but this could not be investigated due to the vegetation along its banks. In the south-eastern direction, it must have run towards and beyond the railway line. (In this latter case, however, it is questionable to what extent the subsequent earthworks, for example, in the vicinity of the railway line disturbed the ditch).

Based on the historical data detailed above, the topography of the area, as well as the results of on-site investigations (e.g. soil drilling), this anomaly can be identified with the former Zrínyi Ditch with great likelihood (and within that, with its north-western section closer to the Mura). At the same time, it is not clear whether the dual structure observed in the south-eastern part of the surveyed ditch can be considered the result of the original construction work in 1662, or that of later constructions. The former is also possible, but the latter is supported by the fact that the sketch by Holst mentioned above shows only one ditch. It is likely that a new ditch was dug next to the existing one (presumably with the purpose of drainage). An excavation could help to decide this and to clarify our data about the ditch(es). One or more cross-sections perpendicular to the ditches would provide important additional data.

[39] The report of the magnetometer surveying was made by László Nagy (archaeologist, Buda Castle Estate Development and Operation Nonprofit Ltd., Site Diagnostics Department).

[40] The survey was conducted by László Nagy and Ferenc Somogyi (archaeological technician, Buda Castle Estate Development and Operation Nonprofit Ltd., Site Diagnostics Department).

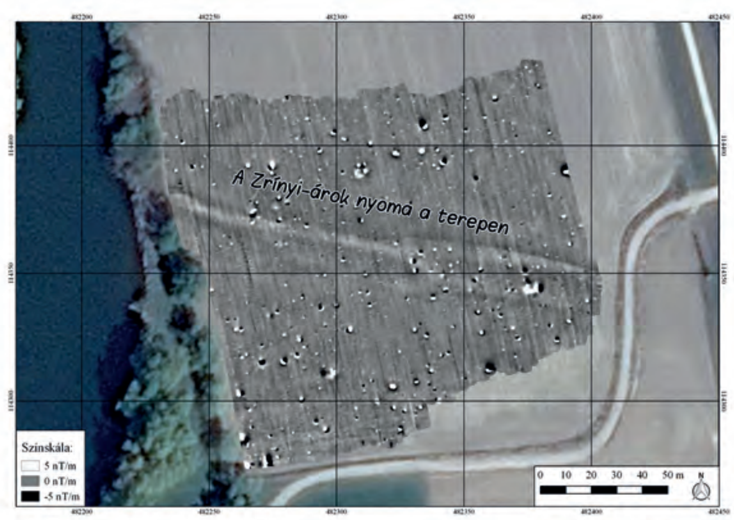

Figure 11.
The location of the magnetometer survey on the overview map of the area
Source: László Nagy archaeologist and Ferenc Somogyi archaeological technician, Buda Castle Estate Development and Operation Nonprofit Ltd., Site Diagnostics Department

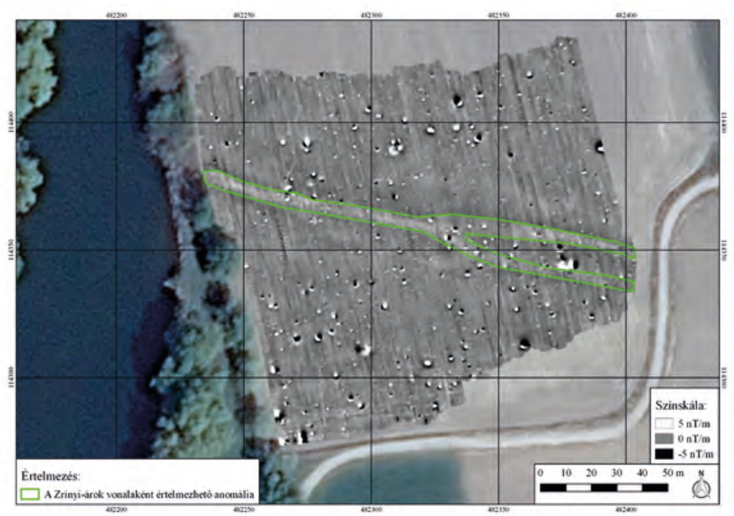

Figure 12.
The interpretation of the results of the magnetometer surveying (the green colour is used to highlight the anomaly interpreted as the remains of the Zrínyi Ditch)
Source: Pethe Mihály geophysicist, Buda Castle Estate Development and Operation Nonprofit Ltd., Site Diagnostics Department

Summary

Historical sources have preserved the memory of Miklós Zrínyi connecting the Mura and the Kanizsa Stream with a ditch in 1662. Engineer Holst depicted the ditch in a sketch, but it can also be observed that two catchment areas were also joined to the system. The analysis of the GIS material available from the area reveals the remains of the Zrínyi Ditch that still exists at Kollátszeg. Today, it still interlinks the river and the stream and crosses two adjacent backwaters, from which the one on the right can be recognised only after the street system of the settlement.

The current course of the ditch on the west differs from the one depicted by Holst military engineer. Our field survey showed that this section of the Zrínyi Ditch has been filled up by now, but there are still some recognisable traces of it in the morphology and micro-morphology of the area.

The significance of the research is that the ditch is the second construction in Hungary – after Zrínyi-Újvár – that is directly connected to the person of Miklós Zrínyi. This structure again proves that Zrínyi was far ahead of his time in this field, too. Recognising and using the potentials of the terrain to a high degree, he increased the effectiveness of defence protecting his beloved homeland.

Locating, Excavating and Reconstructing the Ramparts of Zrínyi-Újvár

László Költő – Lajos Négyesi – Gábor Bertók –
József Padányi – András Szabó

The remains of Zrínyi-Újvár are located on the border of Somogy and Zala Counties (between the settlements of Őrtilos and Belezna), at the north end of Szent Mihály Hill stretching parallel with the Mura in Őrtilos. The exact location of the fortress has been debated until recently by historians. Many of them located it on the right bank of the Mura in today's Croatia,[1] while Hungarian historians believed to have found it on the left bank of the river, on Szent Mihály Hill in Őrtilos.

A military engineer sketch from the legacy of Pál Esterházy represented a considerable step forward in the question above. With this sketch, cartography historian Pál Hrenkó identified the possible location of the fortress,[2] which was confirmed by László Vándor based on late medieval pottery shards discovered during the field survey of the site.

A site plan annexed to *Mars Hungaricus* by Pál Esterházy and a sketch drawn by Montecuccoli during the siege provided useful data for the layout of the fortress. Of these, the map issued by Esterházy yielded the most useful clues for the location of the bastions, the ditch, the ravelin in the ditch, the two buildings within the fortress and the well.

The uncertainties were primarily caused by the large-scale destruction of the fortress, also described by contemporaries, as well as the defensive earthwork built against Yugoslavia in the 1950s. The involvement of battlefield researchers in the investigations and the results of instrumental surveys around the fortress considerably helped eliminate the uncertainties.[3]

A group of faculty members and students at the Zrínyi Miklós University of National Defence, the Section of Battlefield and Conflict Archaeology at the Hungarian Association of Military Science, and the Institute and Museum of Military History formed a joint research team, which (supported by the Directorates of Somogy and Zala County Museums and the Mayor's Offices of Belezna and Őrtilos) endeavoured to identify the traces of the 1664 siege of Zrínyi-Újvár.

The question was finally decided by battlefield exploration, geophysical surveys and archaeological research carried out at the site. They demonstrated that the previous localisation based on historical data and the results of field-walking was appropriate.

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1 *Petric–Feletar–Feletar* 2001.

2 *Hrenkó* 1979. 131.

3 A detailed research history of the fortress is found in our monograph published in 2012: *Hausner–Padányi* 2012.

https://doi.org/10.36250/00757_07

Investigations in the territory of the former fortification system of the fortress

The exploration of the fortress and the siege area represent a complex archaeological issue, which is partly due to the size of the area covering nearly 20,000 m², the dense vegetation and the rugged terrain. Our experience, so far, shows that the inner bailey at the heart of the fortress offers favourable conditions for excavations, whereas the extensive area of the siege can be surveyed with metal detectors. In the case of the system of fortifications stretching between the two areas, the research method to be used was not so obvious. Cutting through the rampart can provide information about its structure. As a preparation for this, in 2007, we examined one of the cross-sections of the rampart by drilling holes in it. As a result of this, we found that in the case of the ramparts, the changes were not only caused by destruction, but also by subsequent constructions on the top of it, mainly caused by fortification work in the 1950s. This factor further complicates the difficult task of investigating the rampart, because the earthwork – being of fundamental importance for the fortress – was destroyed by the Ottomans after the end of the siege, according to contemporary sources.[4] The contours of the levelled rampart can be still observed today, but it is unknown if there are any remains of the timber structure. As the area is covered with a forest, it is not possible to use earth-moving machines. Consequently, the rampart can only be cut through with manual tools. This entails digging an approximately fifty-metre-long trench, with a depth of five metres at some places. It will reveal the stratigraphy of the rampart, but there is no guarantee that traces of the timber structure will also be discovered. For the reasons above, the excavation of the rampart was postponed to a later date.

Evliya Çelebi wrote the following about the fortifications of the fortress: "The posts were dug into the ground in a row, and the earth filling was strengthened in a Khorasan [style] with lime, which swallowed up thousands of human-head-sized balls fired from balyemez cannons night and day, as if it had been honey."[5] Since our research team obtained deep seeking metal detectors in 2010, we had the opportunity to explore metal objects lying in greater depth. The search of cannonballs hidden in the ground in the area of the fortifications was formulated as a possible research objective, the importance of which is that the composition of Ottoman siege artillery can be determined on the basis of the projectiles.

During the survey, we used Lorenz Deepmax X6[6] deep search metal detectors made in Germany and ORION[7] metal detectors developed in Hungary, equipped with a 1 × 1 m frame antenna. According to the manufacturer's data, the instruments are able to detect metal objects of approximately 100 cm² up to 1.5 metres depth below the ground level, which corresponds to the size of the cannonballs sought for by us. It is a favourable property of the instruments that they do not sense small metal objects near the ground surface, which makes work more efficient. Over time, we improved our working methods, as well. At places where the frame of the metal detector gave a strong signal, we first removed the upper, 10 to

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4 *Pál Esterházy:* Mars Hungaricus. See page 293 of the present volume.

5 *Evliya Çelebi:* Book of Travels. Translated into Hungarian by *Balázs Sudár*. For the English translation see pages 310–311 of the present volume.

6 www.metaldetectors.de/uk/products_deepmax_x6.htm (Accessed: 17 February 2014.)

7 www.metaldetector.hu/orion.html (Accessed: 17 February 2014.)

20 cm thick layer of the soil. If the signal strength did not change, that is, if the signal was not caused by scrap metal items buried in the soil, we marked the spot and used a less sensitive GARETT 2500[8] metal detector with a 20 cm diameter search head to screen the ground. If it did not give any signals, the metal object was certainly buried deeper than 80 cm. In other cases, the display of the GARETT showed the size and location of the target object. Afterwards, we started to remove the soil, but we dug only a narrow trench – approximately 25–30 cm in diameter – towards the object to minimise the destruction of the soil structure caused by the digging. From time to time, we refined the position of the metal object with the search head of the GARETT. If we identified the centre of the signal properly, the signal had to become stronger and stronger. We used the GARETT Pro Pointer in the final phase of the search, which gave signals only when the target had been approached to within a few centimetres. After the extraction of the cannonball, we measured the depth of the object, and recorded the coordinates of the spot with a GPS.

As a result of the search, several cannonballs were detected, which formed two groups. They could be distinguished by their size – weighing 12.5 kg and 14 kg – and also by the place of their discovery. The balls of different sizes were found in two groups, far apart from each another. This phenomenon can be interpreted in a way that the siege guns were primarily targeted at the artillery of the defenders. Since in forts with earth-filled bastions the cannons primarily stood on the bastions, this finding represents an important progress in investigation of fortresses, as the place of the bastions can be determined from the location of the fired cannonballs. By mapping the finds, we were able to pinpoint the presumed sites of two bastions.

The other assumption was based on the relative position of the balls. We observed that the group of seven balls weighing 12.5 kg were found along a straight line. From this, we – erroneously – inferred that this straight line points in the direction of the siege guns. In the current state of the area – being a gradual upward slope – this seemed logical, but we did not take into account that the balls hitting the façade of a 5 to 6 m high rampart would not be buried at a variable depth forming a straight line when viewed from above. In reality, this could have happened if the gun had been brought closer and closer to the fortress, and the balls had been fired from roughly the same lane. It was only later that we found out the real reason for the scatter of cannonballs along a straight line.

In the spring of 2011, when screening the area with a deep search metal detector, we discovered the empty shell of an iron hand grenade at the bottom of the slope, in the continuation of the group of 12.5 kg bullets. From the aspect of the research, this was one of the most important discoveries. Fortunately, due to its size of 7–8 cm diameter, it was large enough for the detector to sense it at a depth of 50 cm.[9] In such depths, a metal object of this size can also be detected with a GARETT 2500 primarily used for screening the siege area. However, because the area of the rampart was scattered with a lot of scrap iron owing to former agricultural cultivation, this instrument was not used there in itself, but only as a complement to the deep search detector.

During the extraction of the find, we found that the clay around it was hard, red and had patches burnt black. We observed a similarity with the burnt layers of the courtyard of

[8] www.garrett.com/hobbysite/hbby_gti2500_key_features.aspx (Accessed: 17 February 2014.)

[9] It is nearly at the bottom of the perceptible surface, so minor objects are not observed by the deep search metal detector.

the fortress. Since we had previously determined that one of the bastions must have been there, we assumed that the burnt remains of the timber structure were covered with the soil. When identifying the feature, we took into account the assumption that the timber structure of the rampart was destroyed by the Ottomans by setting it on fire. When the timber structure filled with earth and the palisade burnt down, erosion made the earth spread out. However, at the bottom of the rampart, parts of the burnt timber structure could remain, since the sliding earth covered them and protected them from destruction. On the basis of a burnt mark found in a 30 × 30 cm pit, this was certainly a bold conclusion, as the burnt clay could get there for many other reasons. Since the archaeological excavation of the rampart was not sufficiently justified, we sought a different method to verify our hypothesis.

Geophysical surveys and evaluation of the results

Based on the results of former geophysical surveys in the area of the fortress, we decided to carry out a magnetometer survey. When surveying the courtyard, the magnetometer reacted very sensitively to the burnt layers. As the area is covered with a thick layer of burnt daub, no significant anomaly could be observed, even though some patterns were recognisable. In contrast, in the area of the earthwork – if our assumption is correct – there is only a relatively homogeneous earth filling in the vicinity of the burnt patch preserved at the base of the rampart, which can be interpreted as the material of the former rampart. So, ideally, the burn mark forms a straight line, which indicates the baseline of the external side of the rampart. Continuing this train of thought, we also considered possible that we would be able to precisely map the ground plan of the rampart due to the successful magnetometer survey.

The archaeological geophysical survey was conducted on 9 March 2012, by Béla Simon and Róbert Loki, co-workers of the Ecthelion Bt. based in Pécs, led by Gábor Bertók. They used a GSM 19 Overhauser magnetometer in a gradiometer configuration (0.01 nT resolution and 0.2 nT absolute accuracy).[10]

The steep slope of the surveyed area, the vegetation and the character of the expected features (presumably burnt structures) justified the use of the survey method, which was undertaken in a 0.5 × 0.5 m grid.

The survey area of 14 × 15 m was marked out on the slope of the presumed rampart, where we sought traces of the former palisade. The survey indicated significant anomalies compared to the 1–2 nT signals of undisturbed soil at two places *(Figure 17).* At the northern edge of the surveyed area, there is an approximately 2 m wide strip running transversely across the site, causing 15–20 nT signals, which is suggestive of a burnt feature. This seems to be confirmed by a burnt layer found at a depth of 50–60 cm during a metal detector search. Based on its shape and nature, it seemed conceivable that this anomaly indicated the remains of the defensive works.

We can see in the image displaying the magnetic anomalies that the distinctive band indicating the burned layer disappears after a while. This can be interpreted in a way that there are no burn marks in the upper parts, but a faint shadow may suggest that they are found at a greater depth here. Currently, there is a contiguous sloping hillside at this place,

10 For further technical details see www.gemsys.ca/prod_overhauser.htm (Accessed: 16 February 2014.)

but originally the bastions projected outward from the curtain wall. The layer of earth spreading out at the feet of the bastions was the thickest over the lower part of the curtain wall, while towards the projecting structures, it got thinner and thinner. The base of the earthwork was almost at the same level, but compared to the height of the present hill, the former rampart was higher and narrower. The earth falling from its top formed the present hillside. Accordingly, it must be taken into account during the reconstruction that at the lower part of the hill (where the cover layer is 40–50 cm thick) there was an originally 5 to 6 m high rampart, and the height of the curtain wall at the base of the bastions was the same. At that place, the soil cover above the burnt layer may be up to 3–4 m thick.

On superimposing the map of cannonballs found during previous metal detecting surveys and the results of geophysical measurements, it became visible that the straight line formed by the cannonballs was parallel to the red band running at the base of the rampart. Our earlier assumption – namely that the linear scattering of cannonballs pointed towards the siege guns – had to be reconsidered, since cannonballs discovered at about the same distance from the presumed sidewall of the rampart suggest that they were fired at the long side of the palisade and penetrated into the rampart at approximately the same depth. Accordingly, the siege artillery unit was not set up along the extension of the marked line but, on the contrary, perpendicular to that. Taking into account the relief of the ground surface, a visibility test might (in principle) help us determine its location. Nevertheless, it should also be borne in mind that – according to Esterházy – the Ottoman siege cannons were placed on embankments, which were (with great likelihood) demolished later. Since we can roughly determine the place of the cannons, we can use the visibility test to estimate the height of the embankments of cannons.

The results of archaeological investigations – The first attempt to reconstruct the post structure of the spur bastion

Excavations started in the area of the fortress in 2010, under the supervision of László Vándor and László Költő, and with the participation of Gyula Nováki, Máté Varga and Balázs Polgár. Apart from an attempt at cutting through the rampart in 2006, this was fundamentally carried out at two locations before 2012, inside the fortress, and also outside, in its foreground. The excavations were supported by the National Cultural Fund of Hungary, the settlements of Belezna and Őrtilos, the Ministry of Defence, Institute and Museum of Military History, the Zrínyi Miklós University of National Defence (today National University of Public Service), the Directorate of Zala County Museums (Göcsej Museum), and the Directorate of Somogy County Museums (Rippl-Rónai Museum).[11]

Based on the results of the surveys, it was reasonable to excavate the place of the anomaly in the territory of the rampart in the summer of 2013. Our trench No. 2013/5 – that was about 1.5 m wide and about 2.5 m long – was marked out above the line of

[11] Researchers presented the results of complex investigations up to 2012 in a volume edited by Gábor Hausner and József Padányi (*Hausner–Padányi* 2012). For the archaeological finds, comprising mainly stove tiles, discovered in the place of the building that once stood in the courtyard of the fortress, and the structure of the building see *Vándor* 2012. 84–98.

the burnt rampart observed during the geophysical survey, in a way that the line of the anomaly shown by the magnetometric map would preferably be in the middle of the trench *(Figure 5).* During the excavation of the trench, we could observe the structure of a support system consisting of three rows of posts *(Figures 6–10).*

According to our observations based on the current results of the excavation, the earthwork (i.e. the bastions) had a structure consisting of two parallel rows of relatively thick posts with mainly circular cross-sections. The external row of posts was supported by thinner beams leaned diagonally against the posts. In some places, the vertical posts were placed (for unknown reasons) on horizontal planks or beams, which might have connected the two rows of posts. These planks ran either under the other row of posts or between the two rows of columns, serving as a support for the earth heaped up into the rampart and certainly rammed down.

Due to the lack of financial resources and the short period of time available to us, we were, unfortunately, not able to complete the excavation of the rampart. The inner structure of the rampart described above can, therefore, not be considered an accurate reconstruction. We only wanted to demonstrate one possible variant *(Figures 11–12).* Nevertheless, on the basis of this, it is still certain that the rampart was supported by a triple-row post structure. Inside of it, there must have been a cassette-like system formed by planks and beams running under or between the upright posts.

We still cannot tell with certainty what technique was used to erect the posts, either.[12] It is very likely that in this case (as in general) the pits of the posts or beams were not dug individually, but rather two ditches – or perhaps one common and, in this case, rather wide ditch – could have been dug, or (making use of the original differences of the terrain) narrow "terraces" were formed, and the posts were erected inside it – or, in the latter case, on it – and rammed down. Stability during construction and a better support of the earth was achieved through connecting the posts with planks. The reason for the use of the outer supporting row of posts is that the posts of the structure had to hold the mass of the earth filling of the bastion in a relatively high and steep slope.

The structures discovered, for example, at Barcs[13] (with a palisade made up of multiple rows of posts) and Marótpuszta[14] (with a single row of posts) provide good examples of placing posts into pre-dug ditches *(Figures 13a–b–14).* At the moment, it cannot be excluded either (because of the cannonballs hitting the rampart) that we found a section of the wall that had to be repaired during the siege.

Based on the conditions of the terrain and geodetic surveys, the detail of the fortification found in the excavation trench must be the base of the so-called spur bastion built between the north-eastern and south-eastern bastions. Locally, it can be the east–west-oriented section connected to the south-eastern bastion *(Figures 15–16).*

We did not put the soil back into the trench, but we tried to cover it safely for the next excavation season. We wish to extend the trench westwards to find the edge of the presumed ditch of posts and the inner row of posts. We are going to make longitudinal and transverse sections in order to reconstruct the post structure more accurately. We also hope that we will be able to follow the results of the new magnetometric surveys and, thus, determine

12 For the building methods of palisades see *Tolnai* 2011. 15–23.

13 *Kovács–Rózsás* 1996. 163–182.

14 *Költő–Dobó* 2004. 237–255.

the position of the discovered part of the rampart (bastion) in relation to contemporary depictions.

Summary

The process outlined above is only an interim result of the investigations that have been carried out in the territory of the fortress for several years. In the case of a defensive facility, however, the excavation of the ramparts represents one of our most important tasks. This can be achieved by excavating the entire area (about 600–700 m²), but, in this case, only manual force could be applied due to the vegetation and the rugged terrain.

In the process presented above, the search of cannonballs with the proper application of various research methods, the evaluation of interim results and the formulation of new tasks led to the excavation of the rampart. Based on the evaluation of the observed phenomena, new hypotheses had to be made, and during the related research, appropriate methods and tools had to be adopted. In this way, we were able to achieve spectacular results with less energy input and slight disturbance of the area.

The archaeological excavations in 2013 confirmed that a group of cannonballs and a linear anomaly detected by a magnetometer show the place of the ramparts of the fortress. Accordingly, in November 2013, another survey was carried out in the area, which resulted in the identification of a section of the western bastion *(Figure 18).* We are going to continue our investigation where the vegetation allows it. We hope that we will be able to identify the exact location of further parts of the rampart in the field. These results can be compared with the depictions of contemporary military engineer sketches and may serve as a basis for the reconstruction of the fortification system of the fortress.

Figure 1.
Preparations for the survey

Source: picture made by the authors

Figure 2.
Magnetometer surveying

Source: picture made by the authors

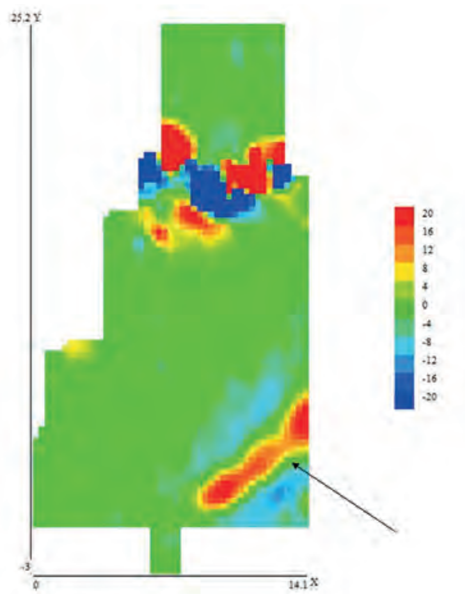

Figure 3.
The line of the burnt down fortification on the magnetometer map

Source: picture made by the authors

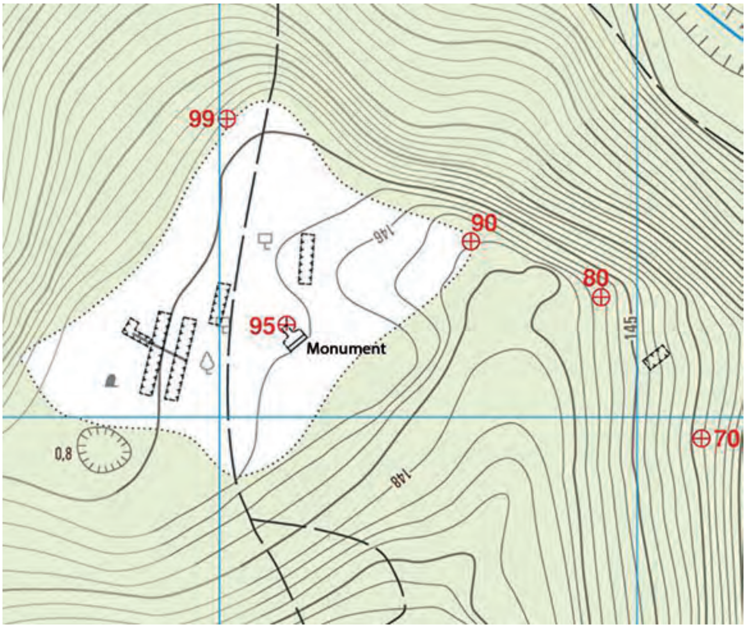

Figure 4.
Trenches of the excavation in 2013
Source: picture made by the authors

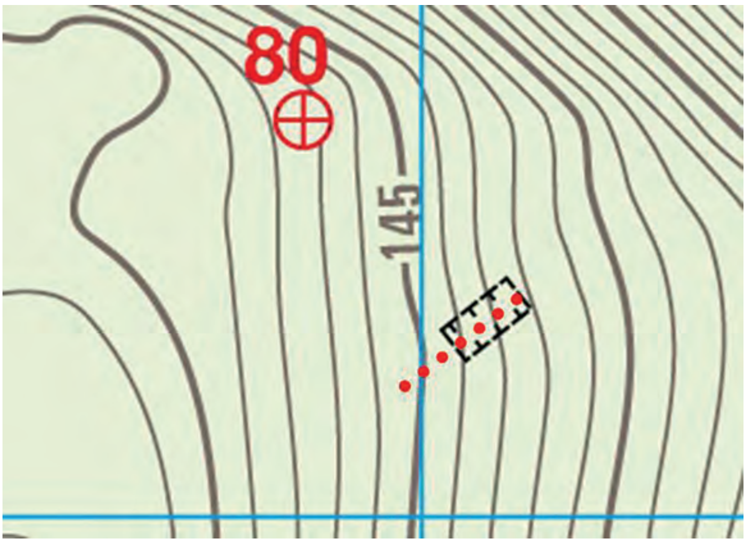

Figure 5.
Trench No. 2013/5 above the rampart detected with geophysical survey
Source: picture made by the authors

Figure 6.
The structure of the burnt down rampart during excavation (from the south)
Source: picture made by the authors

Figure 7.
The uncovered structure of the burnt down rampart (from the north)
Source: picture made by the authors

Figure 8.
The uncovered structure of the burnt down rampart (from the east)
Source: picture made by the authors

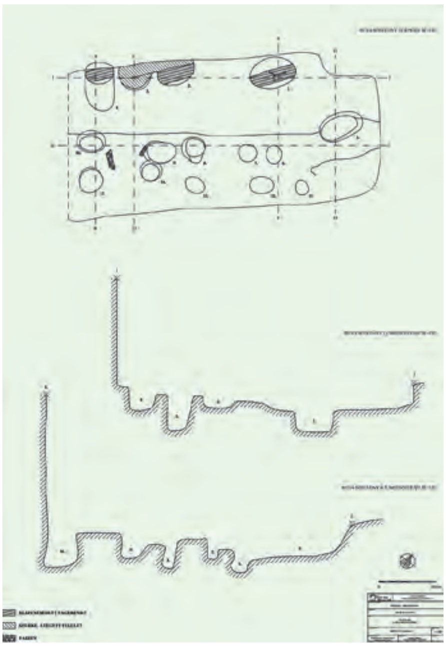

Figure 9.
Drawings of the structure of the rampart, Trench No. 2013/5
Source: Drawings of the ground plan and section walls by Edit Ambrus and Zsolt Nyári

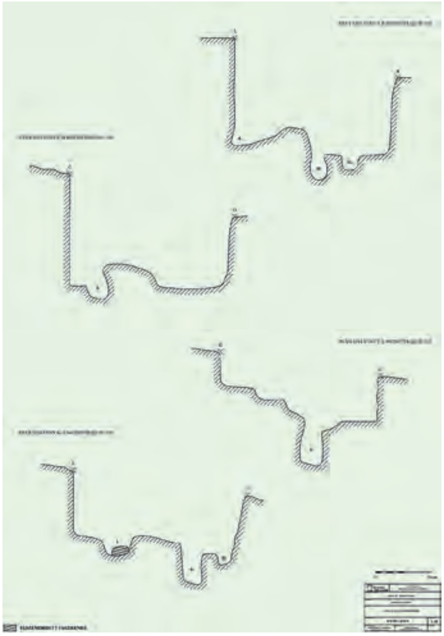

Figure 10.
Drawings of the structure of the rampart, Trench No. 2013/5
Source: Drawings of the section walls by Edit Ambrus and Zsolt Nyári

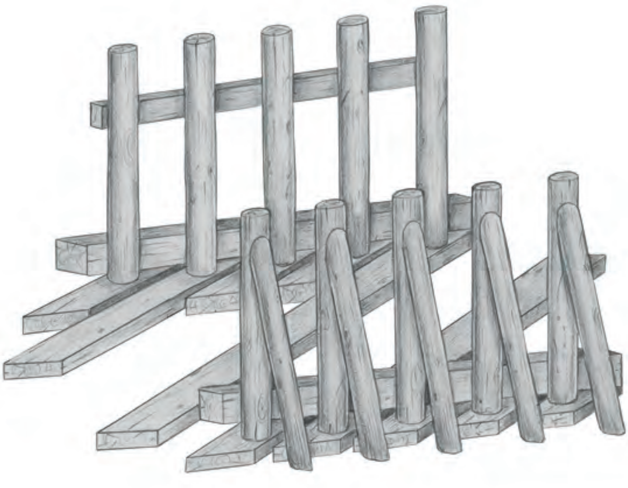

Figure 11.
A possible reconstruction of the post structure of the rampart
Source: drawn by Zsolt Nyári

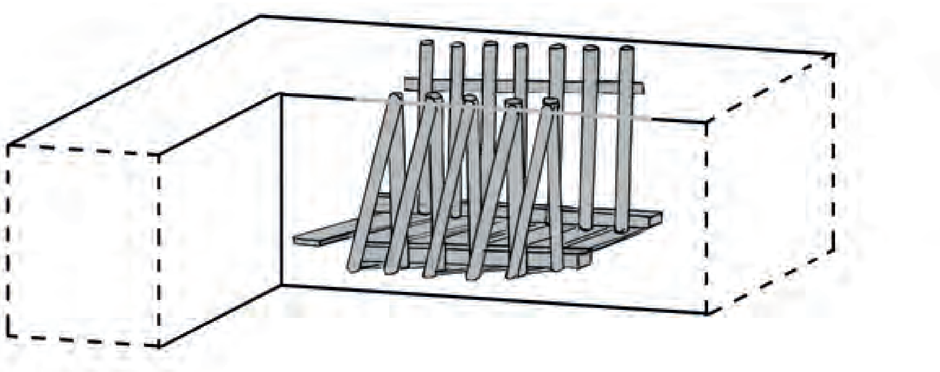

Figure 12.
The position of the post structure within the earthwork
Source: drawn by Zsolt Nyári

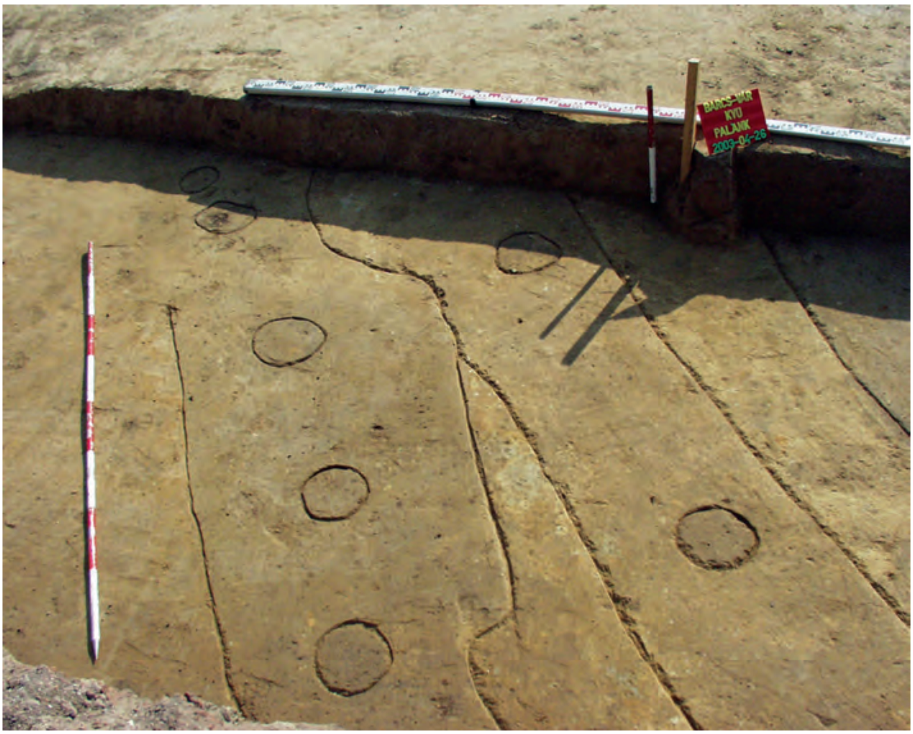

Figure 13a.
The ditch made for the multiple rows of posts of the rampart at Barcs
Source: picture made by László Költő

Figure 13b.
The section of the post rammed around can be seen well in the post ditch
Source: picture made by László Költő

Figure 14.
The north-eastern bastion of the fort of Marót (today Morović, Serbia)
with the row of posts of the palisade connected to it
Source: picture made by László Költő

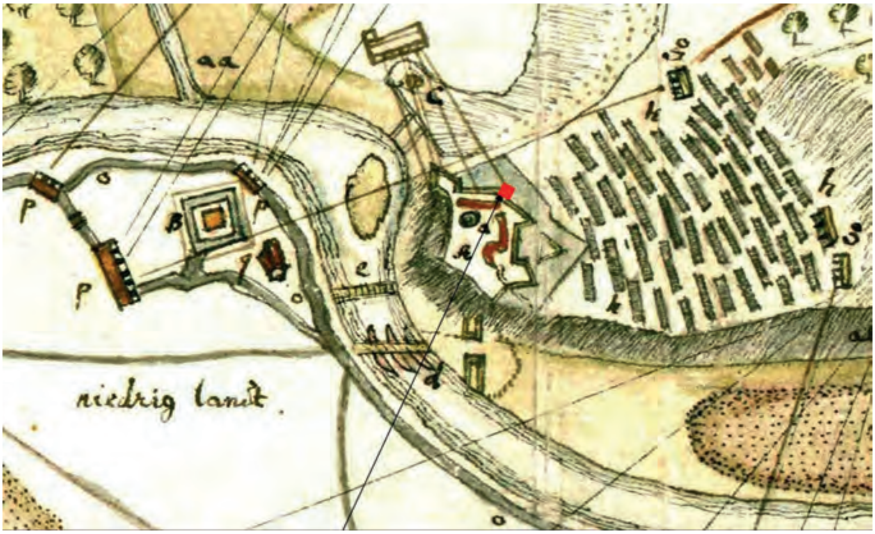

Figure 15.

Probable location of the discovered part of the rampart on the contemporary Esterházy map

Source: compiled by the authors

Figure 16.

Probable location of the discovered part of the rampart on the model built by the modellers of the Zrínyi Miklós University of National Defence

Source: compiled by the authors

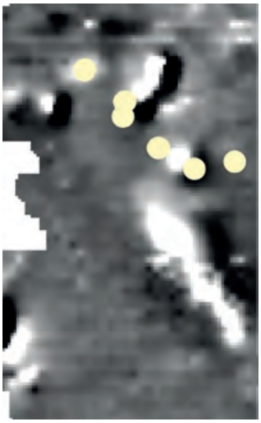

Figure 17.

The scattering of cannonballs over geophysical anomalies

Note: A white line starting in the lower right corner indicates the external side of the rampart. The cannonballs (white circles) penetrated into the rampart 2 m deep on average.

Source: compiled by the authors

Figure 18.

Results of a geophysical survey carried out in November 2013

Note: A part of the western bastion can be seen in the upper left corner.

Source: picture made by the authors

The Excavation of the Well in the Fortress

László Vándor

The construction of the fortress of Count Miklós Zrínyi, Ban of Croatia, who held the area lying between the Drava and Mura Rivers (the so-called Muraköz) began in June 1661, and the building was destroyed by the Ottomans on 7 July 1664. The remains of the fortress were archaeologically identified in the 1970s and 1980s – and were later subjected to battleground investigations in 2005 – between the villages of Őrtilos (Somogy County) and Belezna (Zala County), near the frontier of Croatia and Hungary. They were found in a wooded area at the northern end of a hill ridge rising near the confluence of the Mura and Drava Rivers.[1]

The fortress played a vital role in the Ottoman–Habsburg War of 1663–1664. It was, in fact, a *casus belli* since Miklós Zrínyi had it built on the northern side of the Mura River, which was under Ottoman suzerainty. The primary purpose of the bridge head-like fortress was to make easier the access of Kanizsa – held by the Ottomans since 1600 – for Hungarian troops over the Mura. This would enable them to cut off the supply routes leading to the westernmost provincial seat of the Ottoman Empire, and carry out its occupation worked out by Zrínyi.[2] It was from this stronghold that the winter campaign led by Miklós Zrínyi and Julius Hohenlohe (giving rise to a major European response) was launched in January 1664, and this was also the base for the siege of Kanizsa in 1664.

Following the 2006 test excavation of Zrínyi-Újvár, the area has been subjected to regular archaeological investigations since 2010. Their results have been published in several papers so far.[3] Numerous publications have also been dedicated to battleground investigations and instrumental surveys in and around the fortress, as well as the metal find analyses closely connected to the archaeological research.[4]

The archaeological research has been carried out by László Költő and Máté Varga, from the Ripp-Rónai Municipal Museum with County Scope (Kaposvár), and László Vándor, from the Göcsej Museum (Zalaegerszeg), supported by the National University of Public Service (Budapest), and the municipalities of Őrtilos and Belezna.

After a quite long preparatory phase, the exploration of Zrínyi-Újvár was continued with a test excavation (2006), and systematic excavations (2010–2016) were conducted within the fortress. A building divided into seven parts has been uncovered. There were six rooms

1 *Vándor* 2012; *Hausner–Négyesi–Papp* 2005.
2 *Kelenik* 2012; *Domokos* 2012; *Vándor* 2015.
3 *Vándor* 2012. 84–98, Figures 1–18; *Vándor* 2014; *Költő– Bertók–Négyesi–Padányi–Szabó* 2014; *Vándor* 2017.
4 The most important ones: *Hausner–Padányi* 2012; Határok fölött. Tanulmányok a költő, katona, államférfi Zrínyi Miklósról [Above the Borders. Studies on the Poet, Soldier and Statesman Miklós Zrínyi]. Eds. *Sándor Bene – Pál Fodor – Gábor Hausner – József Padányi*. Budapest, 2017.

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with roughly the same floor area, which served as living quarters. A large one in the middle must have had a communal function. The walls of the timber-framed *(Fachwerk)* building were filled with wattle-and-daub between the uprights, and each room was heated with a tile stove.

The stoves were constructed of relief-decorated and cup-shaped tiles. The decorated stove tiles were unglazed, and most of them were the copies of tiles made around the middle and in the second half of the sixteenth century (and included some types unknown before). A smaller part of them dates to the seventeenth century, and has mainly well-known motifs. The stove tile with sixteenth-century motifs come from the age of the fortress-builder Miklós Zrínyi's great-grandfather (the hero who fell at Szigetvár, and who was also called Miklós Zrínyi), and from the time of his grandfather, György Zrínyi.[5] One type of the latter is known from the nearby Bajcsa Fortress, commanded by György Zrínyi and built by the Styrian Estates.[6]

Although the building was evacuated during the siege of the fortress in 1664, and, except for the stoves, all the valuable furnishings were removed from it, some exceptional items (the fragments of Persian faience and Haban pottery) were scattered on the floor and pressed into the ground, which suggests that these were used by the officers of the fortress.[7]

Figure 1.
Some types of stove tiles from the building with seven rooms
Source: picture made by the author

Archaeological test pits dug to the north-east of the building suggest the existence of another building (or perhaps even more buildings) in this direction, but the full exploration of these areas still remains a task for the near future.

In parallel with the investigation of the building, we paid special attention to finding and excavating the well of the fortress.[8] To the south-west of the seven-part building, the excavation of a large recess (section No. 2010/3) has already started. At the beginning of the work, we already assumed that the well of the fortress was there. The recess was excavated to about two metres from its bottom (more than three metres from the ground level of the courtyard), when it became evident that – in case, we truly found the well – we would not be able to uncover

5 *Vándor* 2012. 94–97.
6 Weitschawar/Bajcsa-vár 2002. 70, 123.
7 *Vándor* 2012. 94.
8 In line with the historical sources, the excavation of the well was included as an issue of high priority in the memorandum of cooperation signed by ten institutions and municipalities on 30 September 2007, planning the investigation and utilisation of the fortress. *Papp* 2012. 129–131.

it with conventional archaeological methods because of its depth. The gradual narrowing of the recess and later its shape increasingly suggested that it was the site of the expected feature, but the large amount of late-eighteenth- and nineteenth-century finds in its backfill gave rise to some uncertainty. Nevertheless, we assumed already then that farmers working in vineyards (planted in the territory of the fortress beginning with the eighteenth century) were dumping their waste into the pit that came into being due to the collapse of the well. There was also a wine press house nearby, and we discovered its foundations.

As the subsequent excavation of the well would have required a skilled person, special equipment, and, last but not least, substantial financial resources that were not available to us, we postponed its digging and focused on the excavation of the building and reconstructing the plan of the defences.

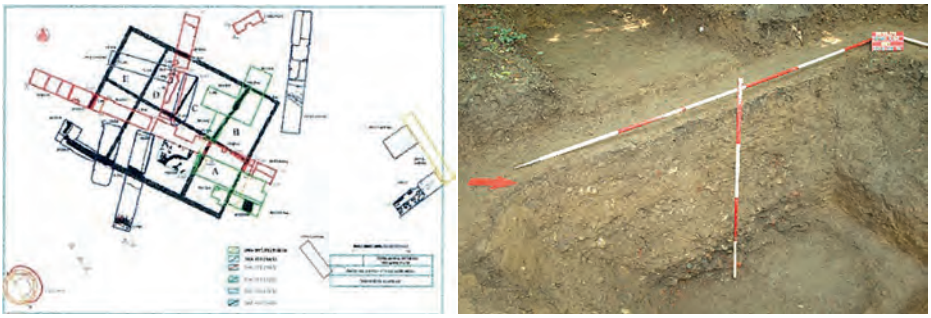

Figure 2.
The plan of the excavated building and the well
Source: picture made by the author

Investigation of the well in 2010

As the defenders placed mines under the defensive works of the fortress during the siege[9] but had no time to explode them, the destruction was carried out by the Ottomans who seized the fortress. The Ottoman sappers did careful work when blowing up the fortress, which, together with the terrain covered with forest, made our investigation rather difficult. The remains of the fortress defences visible above the ground were further destroyed in the first half of the 1950s when a fortification system was constructed towards Yugoslavia. Eventually, the remains of the burnt palisade wall were detected by battlefield investigations and geophysical surveys, and the excavation conducted there was also successful. A wall section on the southern side of the former spur tower was discovered, which enabled us to reconstruct the wall structure. Furthermore, the projectiles discovered there showed the activity of the artillery besieging this part of the fortress.[10]

Excavations up to 2016 clarified the layout of the interior of the fortress and its relation to the well located in the centre of the fortress.

9 *Domokos* 2012. 63.

10 *Költő–Bertók–Négyesi–Padányi–Szabó* 2014.

Afterwards, we focused on excavating the well. It seemed crucially important to determine the real depth of the feature found earlier (in 2010), which was identified as a well, as this could help confirm its function. First, we tried drilling manually with the assistance and equipment of the National University of Public Service. However, we were not able to reach the required depth and achieve our goal.

We were about to continue our research with an engine-powered drill in the summer of 2016, but our plan had been dropped, as we had the possibility to conduct a ground-penetrating radar archaeological survey due to the support of the university. The results of this survey demonstrated that the well dug sometime between 1661 and 1664 was found, indeed, in section No. 2010/3. When evaluating the data of radar surveys, it turned out that there was a deep feature at that place. Owing to the backfill mixed with debris, the image made by the radar in the upper layers was unclear. At a depth of 7–8 m, however, it showed a blurred but more or less regular, round or polygonal form. Furthermore, on one side, the wooden lining of the feature was also perceptible in the form of a beam-like band. Now that we had ascertained the correctness of our earlier assumption and that we had found the site of the former well, we had to determine how to proceed with the work. We decided to fully excavate the well using a well-digging method, for which we managed to find a specialist.[11]

The well in historical sources

First and foremost, we need to explain – as it is referred to above – why this part of the work was highly important beyond what is generally expected from the uncovering of wells, and what significance the excavation of the feature had in reconstructing the history of the fortress and even the course of events in Hungary between 1663 and 1664. This can be highlighted with the help of contemporary sources.

Both Ottoman and Hungarian written records are available to us about the well.

Evliya Çelebi, who witnessed the siege of the fortress, wrote the following: "The perimeter of the fortress is three thousand seven hundred steps, and there is a water-well in the middle of it. On the top of the timber-shingle dome covering the well, there was a glossy golden flag stolen from the fortified Türbe where the internal organs of Suleiman Khan were buried. The Grand Vizier had the flag removed and sent it back to the Türbe. He commissioned the Bey of Mohács and the Bey of Pécs to restore the glorious Türbe and its fortification."[12]

Pál Esterházy, who was also present during the siege, recorded the events following the Ottoman occupation of the fortress, and described the destruction of the well as follows: "In the morning following the discussion […] all this was not enough, the well of the fortress providing excellent drinking water was filled with the corpses of Christians […]. The fortress was destroyed with the tireless work of the army in three days to such an extent that it disappeared without a trace."[13] Since Esterházy witnessed all this not simply from across the Mura but "on the day when the enemy left, [he] went to the site of the destroyed

[11] The well was dug by well-digging master Balázs Tóth and his team from Kaposvár.

[12] *Evlia* 1985. 591.

[13] *Esterházy* 1989. 167.

fortress" and "carefully observed" the place, including the Ottoman siege ramparts. He gave the most authentic contemporary description of the well.

The third most important source of the existence of the well is the site plan attached to Pál Esterházy's *Mars Hungaricus*, which depicts a feature identifiable with the well approximately at the site of our excavation.[14]

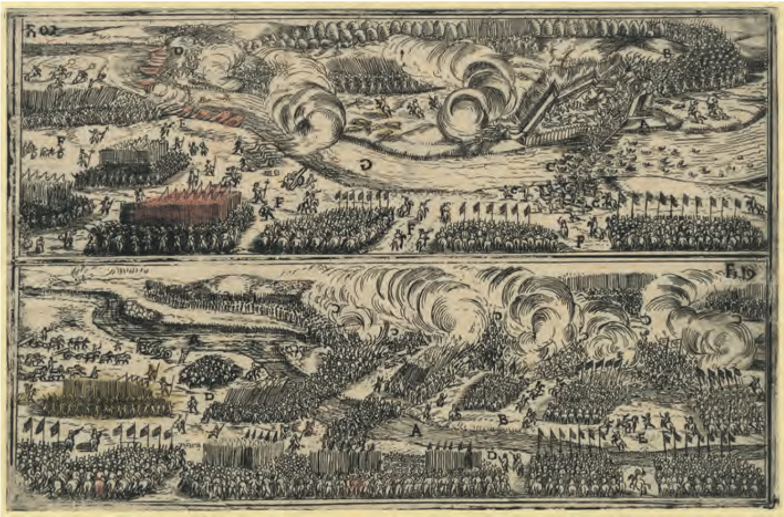

Figure 3.
Map by Pál Esterházy depicting the well in the middle of the fortress
Source: MNL OL T. 2. XXXII. 1064

The sources highlight the prominent role that the drinking-well played in the history of the fortress. The dome ornament taken from the sepulchral monument of Sultan Suleiman in Türbék during the winter campaign decorated the timber-shingle dome over the well of the fortress, which was built by Zrínyi as a symbol of his victory over the Ottomans. Later, in retaliation, the Ottomans threw the corpses of the defeated defenders into the well.

Because of this, the excavation and display of the well was designed as a central element of the memorial site.

The excavation of the well[15]

We began the excavation of the well in a usual round shape after clearing the area and removing the collapsed wall. Below a depth of three metres, modern materials disappeared from the backfill of the well. The small number of finds coming to light was dated to

14 MNL OL T. 2. XXXII. 1064. Master with initials M. I. O. Site plan of the 1664 siege of Zrínyi-Újvár.

15 A short summary of the excavation: *Költő–Vándor–Varga* 2018.

the seventeenth century and was apparently drifted from the surface into the pit when the walls of the well collapsed.

During our excavation, it was the first time that we found green-glazed stove tiles or their shards. They may come from a major – still uncovered – building located in the vicinity of the well.

Figure 4.
The first phase of digging deeper in the well
Source: picture made by the author

After reaching a depth of about four metres, we continued the excavation with the construction of a post structure around the area and making a three-legged iron ladder to allow the well-digger descend and ascend with the soil.

Figure 5.
The well during excavation and the tools of the excavation
Source: picture made by the author

Getting as far as six metres deep in the well, we found that – due to the collapse of the well wall – we had somewhat diverged from the central vertical axis, so we had to make corrections to the excavation pit.

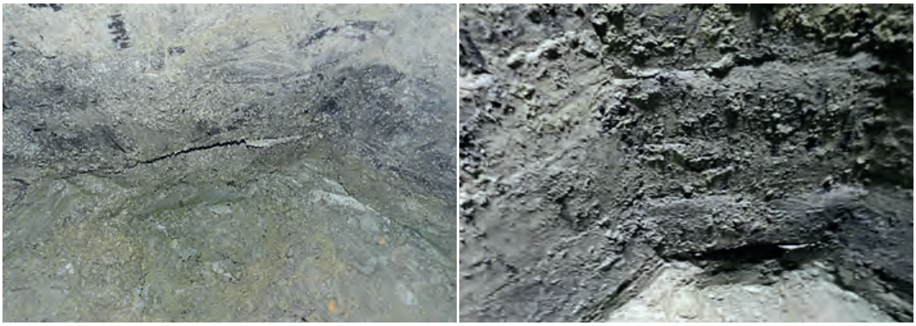

Figure 6.
The bottom of the well
Source: picture made by the author

Shortly afterwards, at about seven metres deep, the wooden lining of the well appeared, first as a discolouration, and then, in reality. We could also observe that the shape of the well was octagonal, rather than round.

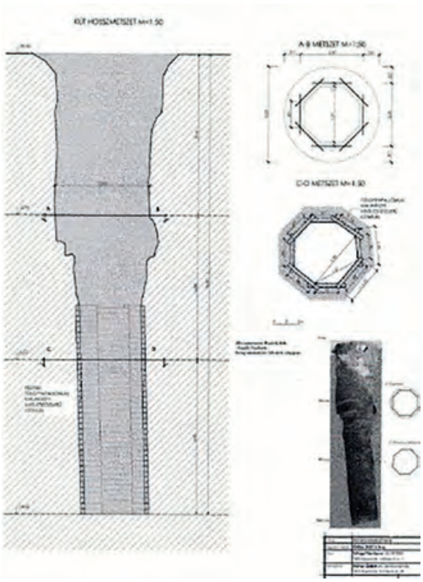

Figure 7.
Archaeological records of the well:
Vertical and horizontal section drawings and 3D survey made by Pazirik Ltd.
Source: Pazirik Ltd.

After the shape of the well had been clarified, and the well-preserved wooden lining was found at a depth of 7.8 m, we continued the excavation within the lining. Little more than one metre deeper, we found timber elements (including very large pieces) in the backfill, which were in good condition just as the lining of the well. At the top, there was a huge piece of wood that looked like a tree trunk. It stood upright leaning against the lining. The lifting of this find in one piece proved to be a rather difficult – but ultimately successful – task. After bringing it up to the surface, it turned out that we found a drinking trough hollowed out of a tree trunk, which once stood next to the well. Based on its position, this was the last item to be thrown into the well by the Ottomans during the demolition of the well.

Figure 8.
The drinking trough in the well, during lifting and after cleaning
Source: picture made by the author

After the trough was lifted, the excavation was only complicated by large quantities of wood thrown into the well, including a beam that was more than four metres long. However, the bulk of the wood clearly belonged to the structure of the well. We found parts of the well lining and fragments that could be identified as parts of the well curb. We were able to identify structural items required for water extraction, and some pieces of the protective structure above the well (called 'dome' in the sources) also came to light.

Stuck between the pieces of wood, there were – though in a small quantity – human remains (bits of skulls, jaws and long bones).

Additionally, there were remains of clothing (mainly pieces of leather garments surviving in better condition and a few clothing ornaments), as well as some items belonging to the weaponry.

The objects found in the bottom layer of the well included mainly items that got into the well during its use or those that fell in it during the construction of the well or rather the well house.

We found the bottom of the well at a depth of 14.62 m, where we reached the bottom of the lining that rested on the clayey soil without any support.

The structure and parts of the well

The construction of the original well started with the construction of a shaft of three metres in diameter. Inside the shaft, an octagonal wooden lining was built in the full depth of the well. The sides of the lining currently form a more or less regular octagon, the sides of which vary from 76 cm to 93 cm in length. The distance between the nearly parallel side panels is 200–220 cm.

The lining of the octagonal well was made of oak planks with sawn ends for easy joining. The elements of the lining were designed to be easily fitted into one another and the imprecisions of the pre-made pieces at the joints would not cause any problems. Due to this method, the lining could be excavated very quickly.

The large amount of wood found during the excavation (which must have belonged to the structure erected above the well) was severely damaged and burnt, suggesting that they got into the well during or after the burn.

The well curb could be reconstructed from a few pieces. The structure above the surface was built of elements identical to the lining, which was closed with pieces of wide, horizontal planks. Water was fetched with the help of a cylindrical structure used at wheel wells. The drum was held by upright beams that were drilled through, and both of its ends were reinforced with iron bands, fastened with iron pin nails. Unfortunately, the structure (either a wheel or a rod handle) used for moving the cylinder has not been found.

Figure 9.

The end of the wheel cylinder with an iron band and iron pin nail, as well as the iron pin nail

Source: picture made by the author

The structure erected above the well could not be fully reconstructed from the discovered elements. Based on contemporary records, however, it seems that it was dome-shaped, and it was covered with timber shingles. The data of written sources have been supported by the finds discovered at the site.[16] The dome must have had a round or rectangular base. According to experts in the woodworking industry, the carpentry technique employed is suggestive of a rectangular base. Based on the sawn timber planks, there could have been a beautifully made protective fence above the well.

[16] The well was dug by well-digging master Balázs Tóth and his team from Kaposvár.

The finds

Since the restoration of the finds has not been completed by our writing the preliminary report and the conservation of the surviving timber material is also in progress, we can provide only a general overview that cannot be regarded as comprehensive or final in any way. As the finds discovered in the well are also in different stages of restoration and conservation, I am going to present all of them with photographs taken during the excavation.

The greatest amount of finds comprised the elements of the well house, the well curb and the collapsed lining, which must have been mixed with artefacts coming from the surrounding buildings.

Figure 10.
Timber items uncovered from the well and parts of the well lining
Source: picture made by the author

Outstanding items from clearly identifiable finds include the burnt fragments of the well drum discussed above, a fragment of one of the beams supporting it, pieces of the well curb and the well lining, timber shingles belonging to the dome (including intact pieces), as well as some sawn, intact or fragmented decorative elements.

The identifiable items of the wooden material were recorded in drawing in detail.

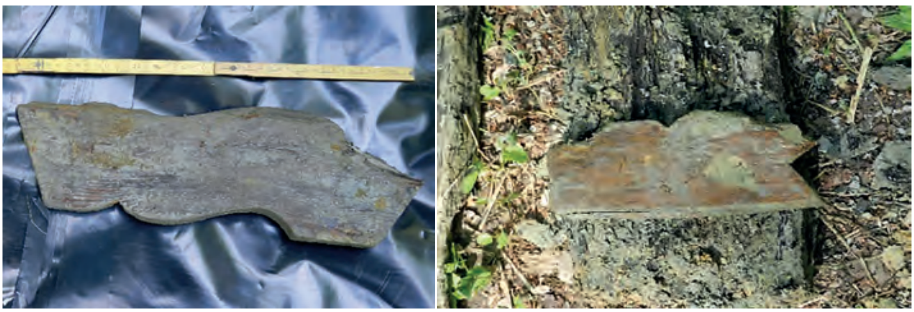

Figure 11.
Shaped pine board pieces from the structure erected above the well
Source: picture made by the author

The largest wooden object was a drinking trough that once stood next to the well. Based on its position, it was the last object to have been thrown into the well. The softwood trough hollowed out of a single tree trunk came to light almost intact.

Figure 12.
The drinking trough after lifting from the well
Source: picture made by the author

The Waterworks Company of Zala County took care of the preservation of the wooden finds until their final conservation.

From the metal objects, mention must be made of weapons (a sabre with a slightly curved blade the tip of which broke off, and a western-type helmet), two pieces of solid iron, a large number of ceramic cannonballs of different calibre, as well as lead gun bullets.

Figure 13.
A helmet, a sabre, as well as iron and ceramic cannonballs discovered in the well
Source: picture made by the author

Figure 14.
Gunstock bearing the initials of its owner's name
Source: picture made by the author

The most interesting and unique group of finds were the well-preserved wooden gunstocks. Apparently, the gun barrels were broken off by the Ottomans, who used a different type of stock. They evidently reused the barrels and cast the gunstocks into the well. One of them bore letters, probably the initials of its owner's name.

Figure 15.
Gold appliqué and a clasp, and a bronze button
Source: picture made by the author

The items of clothing must have got into the well together with the corpses cast into it. Unfortunately, the textile items were almost completely destroyed, and only a few tangled threads indicated their existence. However, the leather one remained in very good condition. In addition to the various pieces of straps, there were other items, such as a nearly complete leather cap that must have been worn under the helmet, as well as the uppers and soles of boots, including a beautifully decorated boot upper.

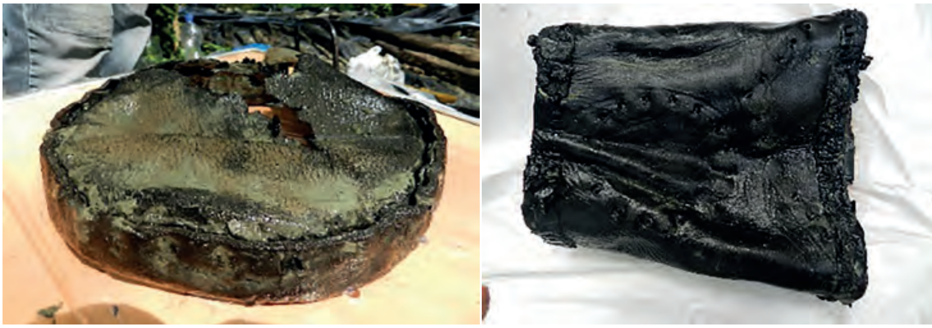

Figure 16.
A leather cap and a decorated boot upper from the well
Source: picture made by the author

Getting closer to the bottom of the well, we expected the appearance of objects that fell into the well during its usage. Due to the very short lifespan of the well, these finds were, unfortunately, quite small in number. In addition to the pottery, it is worth mentioning a small wooden barrel that was originally held together with a band of wicker.

Figure 17.
Pieces of the small wooden barrel
Source: picture made by the author

At the bottom of the well, there were three objects that could have fallen into it while the well was constructed. These are an 18 cm long carpenter's hatchet with a nail puller, a wooden hammer and an iron drill bit.

Figure 18.

A hatchet, a wooden hammer and a drill bit found at the bottom of the well

Source: picture made by the author

The analysis of the wood material

Samples were taken from the wooden finds for dendrochronological analysis and tree species identification. The excavated wood material was analysed by András Grynaeus. The results of the analysis are in full accordance with historical data on the construction of Zrínyi-Újvár, according to which the trees were felled and the timber was used after 1658 for the construction of the well. Predominantly oak trees were used for building the well, and fir trees were used for covering and for decoration, but other species were also applied, such as elm trees.

The restoration of the well (a reconstruction plan)

Following the conservation plan approved during the excavation, we filled back the well with the extracted soil to the height of the surviving wooden lining (between –14.62 m and ca. –5.5 m) to preserve for posterity the timber structure that remained in its original state.

The uncovered feature can be reconstructed. Its partial restoration and display under a protective building can be carried out on the basis of conservation plans approved during the excavation. Accordingly, the well will be displayed after the reconstruction of the wooden lining from a depth of 5–5.5 m (measured from the original ground level) to approximately one metre above the surface. It will be covered with an iron grid. A dome with timber shingles has been designed above the well after its historical description, which can also serve as a rain shelter for visitors to the memorial site.

The feature has been covered with a stable, temporary structure to the finishing of the planned reconstruction.

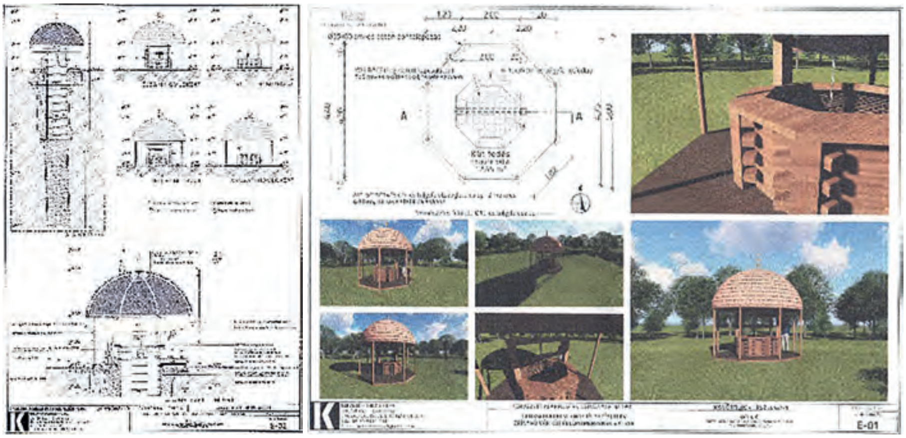

Figure 19.
Details of the reconstruction plans of the well
Source: Erika Kondor architect, Zalaegerszeg

Summary

During the short-term use of the well, a few objects fell into it, which were connected to the use of the fortress and its soldiers. The majority of the finds, however, were related to the destruction of the fortress and its well.

The excavation of the well confirmed the data of written sources describing that the Ottomans seizing the fortress strived to make the well completely unusable, like the fortress. The pieces of the well house show burn marks, which may have been caused by the siege, but it is also likely that the Ottomans set it to fire when they destroyed the fortress. Nevertheless, it is certain that pieces of the partially burnt, disassembled and smashed structure were deliberately cast into the well, along with the drinking trough associated with the well.

Esterházy's report of the site and that the Ottomans threw the bodies of the defenders who had fallen during the siege of the fortress into the well must be regarded as testified by the uncovered remains. The question why there were so few human remains is answered by their character and a group of finds. Apart from a skull fragment, the human remains were mostly long bones and a jaw, which are the most easily detachable parts of the body. After the Ottomans had retreated, many soldiers from the army defending the riverbank from the other side of the Mura certainly visited the destroyed fortress (like Pál Esterházy) to observe what had remained of it. When they saw what happened to their fellow soldiers thrown into the well, they must have taken them out so that they could bury them properly. During this operation, some parts of the bodies trapped in the wooden structure of the well may have come off. Our assumption is confirmed by the items of clothing found among the wooden remains of the well, the position of which would otherwise be hard to explain.

The leather and therefore preserved items and the unfortunately decayed remains of textile garments must have been torn off from the corpses, like the parts of the bodies, when they were lifted out.

There must have been two reasons why the Ottomans threw the bodies into the well. One is the revenge for the desecrating the burial place of Sultan Suleiman the Magnificent by removing its dome ornament and placing it on the well. The other is that the water of the well was infected with the dead bodies, which would make difficult its reuse in case the locals wanted to rebuild the fortress and the well in it after the retreat of the Ottomans.

Beyond all these, the importance of the excavated 14.62 m deep well is that in the territory of present-day Hungary it is the only built monument directly related to Miklós Zrínyi, a prominent figure of Hungarian history, which has been preserved and can be displayed. Furthermore, the significance of the research is that during the excavation, we could record a well structure and building method that is unparalleled based on our current knowledge.

The finds discovered in the well have contributed significantly to our knowledge about the history of Zrínyi-Újvár and confirmed the authenticity of the contemporary descriptions of the siege. It is the first time that artefacts directly associated with the defenders of the fortress (unique items of clothing and small arms) have been found.

Last but not least, the excavation of the well also provided direction for further investigations. The quality of the stove tiles discovered there differed from the already known ones, which indicated the existence of a prominent building (presumably, the captain's residence) in the vicinity of the well. Based on the conditions of the terrain, it must have been built somewhere to the south of the well, in the middle of the courtyard.

FINDS, RESEARCH METHODS AND TECHNOLOGIES

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Spatial Analysis in Military Archaeology Research, with Special Regard to the Retrospective Landscape Modelling of Zrínyi-Újvár with Geographic Information Systems

Attila Kállai

Introduction

The GIS-based analysis of geographic factors relevant to historical research, and the digital modelling of the position and environment of artefacts became widely available to the researchers of this field in the 1990s.[1] The spread of technical equipment complying with high computational and graphic resource requirements also affected professions and disciplines employing spatial analysis. Archaeology soon recognised[2] the potentials of GIS, and exploited its vast data storage, data processing and analysing, as well as diverse visualisation capacities, and also utilised algorithms and tools capable to analyse the relationships of spatial phenomena.

Geographic Information Systems (GIS) is an interdisciplinary tool and method focusing on the characteristic, determinant and essential components of space. It has contributed to the development of many professions and disciplines, and due to the synthesis of informatics and Earth sciences, it makes possible the development of new concepts and methods. It is uniquely suited for modelling space, for the complex, analytical determination of its components, as well as for developing IT systems focusing on a diverse set of tasks in collecting, managing, processing, analysing and displaying spatial data.

In the following, we are presenting the possibilities of applying the currently available GIS toolbox in archaeological research (including military archaeology) through some specific examples for application. Of the numerous ways of application, this time we highlight retrospective GIS modelling, a relatively rarely employed method, which can also be used in military archaeology with great success.

The tools of Geographic Information Systems

Collecting, analysing and displaying geographically located spatial data had already existed before the introduction of GIS. It was an activity performed at a high level, with the use of an extensive array of tools and methods. The traditional mapping methods and cartographic

1 *Connoly–Lake* 2006.

2 The first examples of practical applications appeared in the early 1990s. Ibid. 7–8.

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tools have always provided the necessary conditions for performing the tasks of spatial navigation, planning, organisation, leading and controlling by meeting the requirements of visualisation and spatial data communication, that is, functioning as a part of expert systems.

Mapping is a highly developed abstraction capability unique to the human race, the first manifestations of which are contemporary to the emergence of the early civilisations. Maps not only enabled orientation and the identification of landmarks (and still do so), but also a structured spatial thinking, or (in today's parlance) the making of spatial decisions.

In the historical development of cartographic representation, a number of significant technological milestones have led from the depictions on the Mesopotamian clay tablets to the development of modern mapping techniques. The flat representation of the Earth's curved surface, the depiction of dynamically changing phenomena, or even the mapping of the terrain can only be partially fulfilled with traditional representation techniques. Nevertheless, the toolbox of cartography, which have been refined over the centuries, have proved to be sufficient to reflect the characteristic features of the geographical space in a measurable, assessable and analysable way.

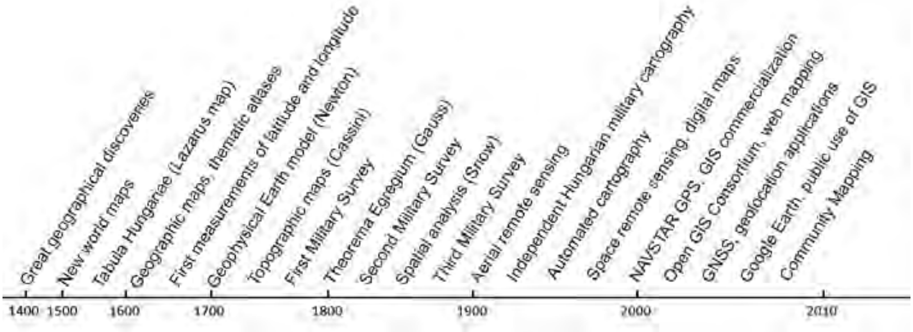

Figure 1.
Major milestones in the historical development of cartography and GIS
Source: compiled by the author

Information revolution beginning in the second half of the twentieth century transformed, or at least significantly affected all areas of fundamental human activities due to the emergence of infocommunication technologies and digitalisation, and later due to the emergence of an information sharing network. In a relatively short period of time, fundamental changes have occurred in the processing, storage and sharing of information, which have led to the birth of the information society, forming a new milestone in the development of human civilisation. The structure of this type of society is characterised by the fact that all its fundamental elements (production, economics, commerce, political organisation, public administration, communication, culture, etc.) are interwoven and determined by the importance of information, the central role of information technology, the direct and rapid access to information, and, ultimately, by a strong dependence on them.

The information revolution inherently affected the development of *cartographic communication,* too. By the last millennium, it has become evident that – because of their being a static medium for information recording – analogue, traditional paper-based maps will not be able to meet the challenges of the exponentially increasing amount of information in a dynamically changing environment in the digital era. Apparently, *digital maps* represent the solution to an advanced management of spatial data, but this concept has now a number of significantly different interpretations, depending on which expert system uses them. The digital modelling of geographic space has led to various development branches, which have gained, and still have a new, integrative meaning within a unified systems theory of GIS.

Digital terrain models[3] were the first representatives of the geographic space modelling for defensive purposes. Their raison d'être increased when manoeuvring aircraft capable of following the land surface appeared in the 1970s. Afterwards, they became more widely used in the field of studying the terrestrial radio wave propagation,[4] followed by various land relief analyses. Digital terrain models are of paramount importance in all terrain-related tasks with defensive purposes, whether they are terrain passability surveys, modelling for inundation with water, simulation exercises for destroying terrestrial targets, planning communication links, signal propagation modelling for radio-electronic combats (detection, interference), the efficiency analysis of ABC weapons, as well as studying the spread of polluting materials.

The *Digital Surface Model*[5] is a more advanced version of the terrain model, which not only represents the terrain ruggedness but also the land coverage with a good approximation. In other words, it shows the vertical dimensional properties of all relevant and permanent cultural features along with the geomorphological features. Digital surface models extend the analytical capabilities of digital terrain models by considering the real-world visibility conditions of the terrain and other obstacles to the passability of the terrain. Furthermore, they make possible the analysis of those characteristics of the terrain that affect the electromagnetic imaging in addition to the optical visibility. Digital terrain models offer a three-dimensional, realistic visualisation of the terrain by combining the data of high-resolution digital images made of the terrain and the real-world surface forms of features *(Figure 2).*

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[3] In Hungary, the abbreviation DDM is used, but in international terminology the technical term *Digital Elevation Model* (DEM) is applied. It is also worth mentioning the term *Digital Terrain Model* (DTM), as well. Its Hungarian translation ('digitális terepmodell') may be ambiguous, as the terrain ('terep') and the terrain model ('terepmodell') based on this refer to the ground surface together with the natural and cultural features on it. The difference between DTM and DEM is that the former is enhanced with the breaklines of defining terrain features (drainage divides, catchment basins, benches, inflection points and lines) that are particularly important in *Cross Country Movement* (CCM) surveys.

[4] In Hungary, the Experimental Institute of the Post Office (*Posta Kísérleti Intézet,* PKI) made the first national digital terrain model in the 1970s under the name DTM-200 for designing telecommunication networks.

[5] The term *Digital Surface Model* is used widely in international terminology and it is abbreviated as DSM.

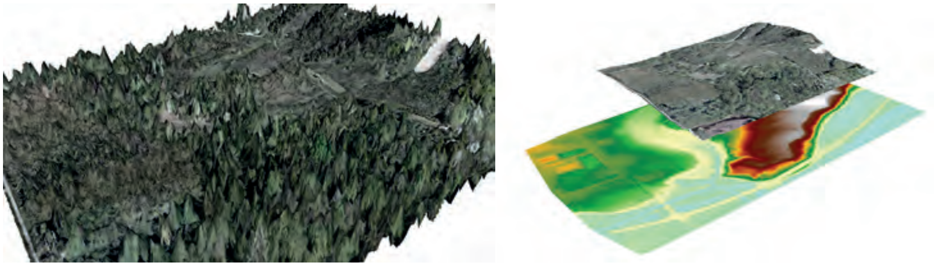

Figure 2.

Digital modelling of the same territory based on the elevation data of the real land surface and geomorphological features found in the research area of Zrínyi-Újvár

Source: compiled by the author based on the LIDAR[6] survey data collected by the Remote Sensing and Rural Development Institute of the Károly Róbert University College in 2013

One of the biggest challenges of designing digital surface models is the changeability of surface objects. In case of digital terrain models, we do not encounter such a problem because geomorphological features are the most static elements of the terrain. A significant part of the surface objects, on the other hand, undergo varying degrees of transformation over time. These changes demand the updating of digital surface models from time to time so that we could gain accurate information about the real elements of the terrain during defence uses.

High-resolution *digital images* are also significant elements of making a virtual reconstruction of the terrain. In GIS, these are *raster map datasets*[7] created with state-of-the-art remote sensing tools. In practice, remote sensing datasets normally comprise various digital aerial photographs, satellite imagery, LIDAR, SAR and other types of radar imagery. By changing the width and complexity of the imaging wavelength range (infra-, multi-, and hyperspectral imaging) hidden features of the geographic space can also be detected *(Figure 3).*

6 LIDAR stands for *Light Detection and Ranging,* which is a remote sensing method using light in the form of a pulsed laser for detection. Its operating principle is based on the fact that laser beams are concentrated and have a uniform wavelength, which is well suited for measuring ranges (that is, variable distances) between the instrument emitting the light pulses and the solid surface to be scanned and, thus, for detecting the relative differences of the height of the surface. LIDAR technology can be used effectively in the field of GIS data collection for the rapid survey of geographically rugged terrain, especially when it is covered.

7 They are the main components of digital mapping databases that capture the characteristics of the Earth's surface in a grid model structure. Concerning the geometry of the grid, raster data models with a square grid structure are the most common in GIS systems. However, tessellation grid models with other shapes also exist. A specific part of the grid element carries the characteristics of the terrain typical of that grid element. The grid structure consisting of the grid elements and the complex data make the raster dataset itself. If this dataset also comprises image data, then the grid elements are the pixels (i.e. elementary units) of the given digital raster image.

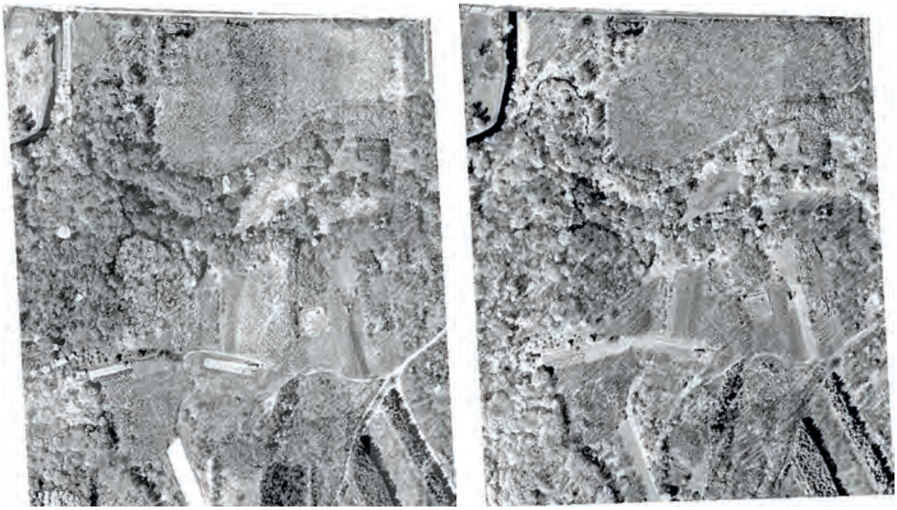

Figure 3.
The panchromatic and near-infrared (NIR) aerial images of the excavation area of Zrínyi-Újvár
Note: Infrared light is scattered less due to the humidity of the air, which makes some terrain features appear much sharper. Water surfaces are particularly easier to identify.
Source: compiled by the author based on images made by the Remote Sensing and Rural Development Institute of the Károly Róbert University College using a Leica RCD30 airborne camera with 60 megapixel resolution

Colour and multispectral satellite images with a resolution of a few metres are advantageous for general surveys of larger areas and the partial exploration of certain geographical factors. Panchromatic satellite images, according to current technical development, are capable of displaying the Earth's surface with a resolution of less than one metre, which is sufficient for the topographical investigation of geological landforms of medium and large size.[8] At the same time, in the case of archaeological research, a great emphasis is placed on studying the micro-relief of the surface. The detection of even a few centimetres of difference in height can be useful in the discovery of morphological features that are partially or wholly below the ground, if they can be observed over large distances or areas. Therefore, in case of detailed geomorphological surveys, remote sensing – and within that the LIDAR technology that is capable of exploring the micro-relief features of the terrain – can provide satisfactory conditions for data collection.

For this reason, aerial remote sensing – especially LIDAR technology that is capable of exploring the characteristics of micro-relief – provides satisfactory conditions for data collection for detailed geomorphological investigations.

[8] Based on the technical data published in the first half of 2019 by the currently leading commercial remote sensing data providers (Airbus Defense and Space – www.intelligence-airbusds.com; DigitalGlobe – www.digitalglobe.com; SI Imaging Services – www.si-imaging.com; SpaceWill – en.spacewillinfo.com).

Nevertheless, satellite remote sensing has the advantage of offering relatively frequent periodicity, as a result of which multiple recordings of the same areas may be available from different times. The number of Earth observation satellites has increased in linear proportion to the cost-effectiveness of satellite technology. The current development trends of larger companies interested in producing satellite imagery point towards the possible availability of weekly or even daily updated satellite images covering the entire surface of the Earth. Keeping track of changes in geographical factors, and defining trends and processes, is a major issue in GIS – as we will see further on.

It is important to know, however, that raw data files obtained through different image capturing methods need to be subjected to complex *image processing transformations* so that they would have all the radiometric and geometric features, which make them usable for GIS purposes. Users normally get remote sensing datasets modified by image corrections in a digital georeferenced raster image format, but certainly, there is also a possibility to create traditional (paper-based) orthophotos.

The availability of the GIS data models listed above is an essential but not sufficient condition for establishing the conditions of the objective and authentic evaluation of geographical factors (whether natural, social, economic, or defensive). A comprehensive spatial analysis, taking into account all relevant geographical factors, requires a much more abstract approach of the geographical space. This can be accomplished through the process of GIS modelling, where first the theoretical, next the logical and then the physical models of geographical features must be designed. The model created in this process is a simplified, abstract representation of geographical space, which can highlight the distinctive, characteristic features of spatial processes and phenomena through the toolbox of GIS.

The construction of the theoretical model begins with defining the entity, the basic unit of mapping. This includes the geometric (size, position) and descriptive (attribute) properties of the entity, as well as its relationships and the possible classification of the same types of entities. The criteria to be met during model building include, but are not limited to, simultaneity, clarity, required level of detail, positional accuracy, compliance with reality, actuality, compatibility, as well as the management of rights.

During GIS modelling, the abstract simplification of space is also extended to spatial dimensions. While the exact positions of entities and objects in a logical model are well-defined according to the depth of the modelling, their representation entails a loss of dimension. Spatial modelling can thus produce 2-, 2 + 1-, or even 2.5-dimensional models.[9]

The use of GIS models is primarily advantageous in the exploration and analysis of the operational mechanisms of multi-factor, geographically-related, complex systems, and in studying the interactions between the components of the system. Modelling itself, however, is a lengthy and costly process, although – by speeding up complex analysis operations to a great extent and by enhancing their complexity tolerance – ready-made models could make decision-making processes more cost-effective and significantly more operational than traditional methods. The use of the conditional mode is particularly valid here, as the criteria above depend on the appropriateness of the model. Nevertheless, it is not possible to design a model that is perfect in every respect. The model itself is the result of abstraction, that is, a simplified, typified and generalised copy of reality. The suitability of the GIS model

[9] *Detrekői–Szabó* 2013.

is ultimately determined by the results of the analyses. Increasing their appropriateness is one of the key aspects in modelling.

In the light of the above, it can be said that GIS has a fairly rich toolbox to answer the questions raised in applied sciences. These questions are, obviously, related to the investigated space, and belong to five main groups of questions according to the present state of the discipline:[10]

1. Location – What is located at a particular point?
2. The state and circumstances – Where is a given thing found? Where is a given condition fulfilled?
3. Changes, trends and processes – What has changed, to what extent and due to what interactions?
2. Basic questions concerning distribution and patterns – What relationships are there between the groups of phenomena or entities with a spatially variable distribution/pattern?
3. Modelling spatial and temporal processes, which allows understanding the real causes and possible courses of the processes, and exploring their consequences.

In the context of GIS analyses, the term digital map typically does not refer to the digital copy of a traditional paper-based map, but to the graphical representation of digital cartographic databases modelling a geographical area and the digital dataset that it is based on. The main characteristics distinguishing digital maps from conventional (analogue) maps are, accordingly, as follows:

- the data of geographical space, including the reference systems used (geodetic base, elevation data, projection system, coordinate system) and the visualisation are separated, and these data are no longer included in the map
- the density of data and the level of the definition of entities are decisive rather than the scale of the map
- the top view and projection of the map are no longer essential requirements, and both the position of the viewpoint and the features of the mapping can be dynamically changed during the visualisation

In case of digital maps, the data are stored in a structured manner, typically in a digital mapping database, and the visualisation can be dynamically generated by means of querying, as well as analysis tools and methods. In contrast, conventional (analogue) maps implement the storage and representation of cartographic data on a single surface, on the material of the map itself, in a static manner. In terms of their format, digital maps can be raster, vector and hybrid. In digital cartography and GIS, their practical applicability depends on data exchange standards.

[10] *Detrekői–Szabó* 2013.

Using GIS in military archaeology

Every discipline dealing with spatial phenomena and geographical factors requires accurate and efficient solutions for managing spatial data. A basic requirement for these investigations is the capability to handle large masses of spatially-related data of diverse format obtained from various archival sources and field surveys in a common structure available for analyses. Another important aspect is the reliable archiving capability, which not only offers a higher level of data security than traditional systems of data storage and management, but also makes possible the quick querying of data, and the preparation of summaries and analyses. The state-of-the-art IT solutions used today comply with all these requirements.

The involvement of GIS tools into military archaeological research is particularly reasonable because of its numerous advantageous features. Among these, special mention must be made of the multifunctional and flexible applicability due to the digitisation of spatial data and the ability to process and manage large amounts of field data efficiently. This flexibility makes possible the performance of many complex analytical operations on spatial modelling that could not have been carried out with conventional cartographic techniques at all, or only with the help of lengthy editing and computation methods. The variation of basic parameters and environmental factors allows for more sophisticated modelling procedures than ever before.

The problem of managing a vast amount of data yielded by archaeological excavations is by no means negligible. Computer-aided processing provides lots of effective solutions for unified and convenient data recording and storage methods.[11] GIS, however, not only supports the recording of data sets yielded by archaeological excavations, but also highlighting complex inter-linkages and carrying out detailed assessments through the spatial analysis of data. The rapid development of information technology and the availability of increasingly sophisticated devices have led to the emergence of new research objectives and analytical capabilities, such as:

- a detailed and accurate spatial location of points marking the shape of features investigated during archaeological excavations
- fast recording and efficient management of the spatial data of artefacts occurring in large numbers
- marking points and lines (boundaries, directions, etc.) in the field
- calculating the volume of the extracted soil for engineering works, as well as the water-holding capacity of major depressions and catchment areas
- comprehensive survey of the relief and main features of the terrain, and, based on this, the design of a detailed terrain model
- studying visibility from one point of the area to another, the visibility of areas, the movement of surface water, the exposure of slopes, and erosive processes, based on the terrain model
- marking out areas for archaeological excavations and planning the preparation of field work

[11] *Eke–Frankovics–Kvassay* 2007.

It is no exaggeration to say that the GIS toolbox not only represents a qualitative step forward for archaeologists in the collection of primary (field) and secondary (archival) data, and in the methods of data processing and presentation, but it has also affected the way they think about geographic space. For this reason, it should be regarded as a scientific method rather than a simple technical tool.

One of the first examples of military archaeological investigation in Hungary is the GIS reconstruction of extensive fortification systems (the Árpád Line[12] in the Eastern Carpathians, and the Attila Line[13] to the east of the capital) built by the Royal Hungarian Army for defensive purposes during the Second World War. Furthermore, mention should be made of the special method for data collection[14] employed in the underwater archaeological survey of the Austrian barge that sunk at Gönyű in 1849, as well as the GIS-based investigations carried out in the region of the Szigetvár fortress *(Figure 4).* Last but not least, GIS was also used to support the excavation and reconstruction works[15] in the area of the fortress built by Miklós Zrínyi, poet and military leader, near the confluence of the Mura and Drava, which is also the main topic of the present collection of studies.

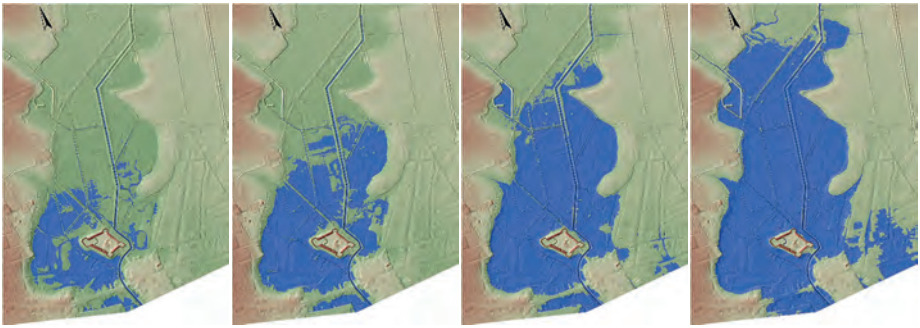

Figure 4.

Some phase images of the animation made during modelling the flooding of the area around the fortress of Szigetvár

Source: compiled by the author based on the LIDAR survey data collected by the Remote Sensing and Rural Development Institute of the Károly Róbert University College

All the components of the GIS workflow described above are present in military archaeology. These will be highlighted in the following through some specific practical examples, especially through the tools and methods used in the military archaeological investigation of Zrínyi-Újvár.

[12] *Szabó* 2005.

[13] *Juhász–Mihályi* 2003. 33–37.

[14] *Polgár–Schmidtmayer* 2013. 167–176.

[15] *Hausner–Négyesi–Padányi* 2012. 189–218.

Spatial data acquisition

Data collection for GIS purposes involves the identification of all those geographic features that may be important for modelling, the subsequent GIS analysis and the presentation of relevant geographical factors. Spatial data collection is a rather complex system of procedures, but it can be clearly divided into two main types.

The first type involves direct or *primary GIS data capture techniques,* which are used mainly when little or no initial cartographic data are available about the subject of the study (i.e. the region to be explored), and their reliability is poor due to their outdated character and the known inaccuracies in previous data collection. In such cases, it is advisable to choose such primary data collection methods or techniques that are the most relevant for all the aspects of the study.

Direct data capture techniques are normally technology intensive and, consequently, quite expensive. This way of data acquisition requires the most up-to-date technical methods. The use of inappropriate procedures can generate a significant number of unnecessary or *redundant data* that will not provide useful results during subsequent analyses. On the contrary, increasing the need of data processing capacity will reduce the operational efficiency of analytical work processes. With regard to the high costs of primary data capture techniques, it is particularly important for military archaeological investigations to formulate clear and clean-cut research hypotheses, as well as to plan and prepare the work carefully.

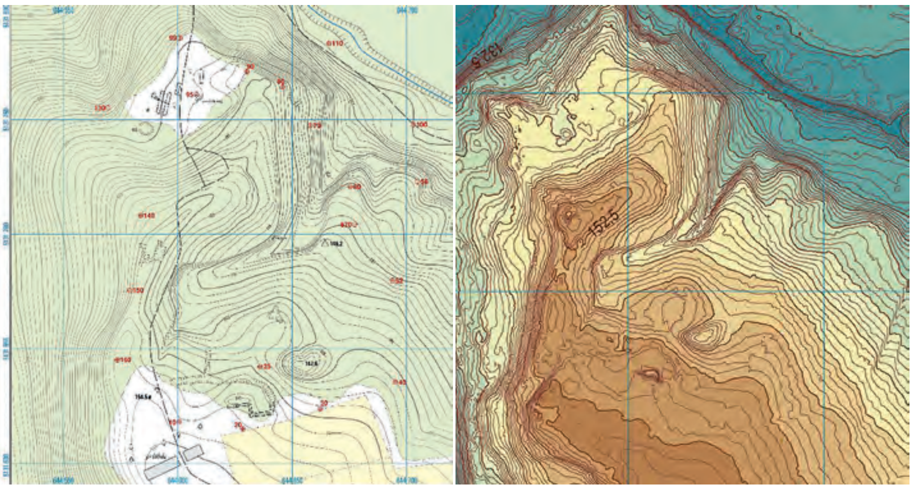

Figure 5.

The results of the excavation of Zrínyi-Újvár surveyed with traditional methods and remote sensing processes based on LIDAR technology

Source: compiled by the author

There are a wide range of primary data collection methods, the representative components of which are the geodetic survey stations, GNNS-based[16] survey methods, normal, spectral and multispectral image recorders, laser (LIDAR) and radio-wave (SAR[17]) scanning detectors, as well as mobile mapping systems. These devices can be operated with a markedly different set of conditions, operativeness and accuracy. The results obtained also differ significantly. In general, the greatest number and most diverse spatial data within a given unit of time are provided by remote sensing technologies, which can be combined or complemented, if necessary, with ground survey techniques. At the same time, we also need to take into account the significant cost implications of remote sensing devices,[18] the impact of periods and parts of the day suitable for remote sensing, and other constraining factors (for example, weather), as well as prohibitions on the use of airspace.

Indirect or *secondary GIS data capture techniques,* on the other hand, ignore the indirect collection of spatial data, which may have two main reasons. The conditions for the use of primary data collection do not exist, while an adequate number of and good quality maps and geographic data are available. Furthermore, geographical data collection has a retrospective character, that is, it studies the expression of environmental features in the past.

Secondary methods are cost-effective and can be easily automated with appropriate cartographic materials, but their accuracy and credibility depend on the quality of the source data. The correlation of cartographic solutions used in traditional map representations with the entities of theoretical GIS data model and the relations between them represents a significant problem. A typical case of this is the depiction of crossings over water. In traditional cartographic representations, the map reader can interpret the relationship between these two topographic features (watercourses and overland roads), even if they do not get the appropriate graphical expression (bridge, tunnel, ferry, shallow, etc.). By contrast, a GIS database creates a logical connection between two entities suitable for subsequent analysis (and in this way another entity to which attribute data can be assigned) if the database topology comprises this connection. A simple vector graphic conversion of traditional linear map representations, the result of which is aptly called a spaghetti model, is thus unsuitable to serve as a basis for complex GIS analyses.

The fulfilment of spatial data requirements of military archaeological investigations normally begins with indirect GIS data capture methods, whereby the available archival data are selected and then digitised. The raw materials used are mainly contemporary maps or other map-like depictions and sketches, which must be handled with appropriate source criticism. In case of large-scale cartographic representations, no projection corrections

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16 *Global Navigation Satellite System* (GNSS) is a collective term applied to all positioning systems based on artificial satellites.

17 *Synthetic Aperture Radar* (SAR) imaging is a radio detection and ranging technique measuring the relative position of the radar device and the surface (e.g. the Earth's surface). In the case of SAR-based radio remote sensing, the image of the observed part of the terrain is made up of signals collected by multiple sensors or by one sensor that is in motion.

18 Digital devices suitable for taking aerial photographs for mapping purposes cost a nine-digit sum, while the LIDAR detection devices cost an eight-digit sum in Hungarian forints. Furthermore, the flying hours and the surveys of a few hectares cost seven-digit sums. In contrast with ground survey procedures, however, they are able to collect data quickly, which are suitable for various analyses.

were applied until the eighteenth century. Consequently, the maps show varying degrees of geometric distortion. These are not evenly distributed in the map content, and in some cases even the adjacent map sections do not match exactly *(Figure 6).*

At these times, it was a common practice in military engineering to depict the sites of clashes and battles in a clinogonal (cavalier) or military perspective – especially when they took place at fortifications. If this was done according to the rules of axonometric projection representation, the planar projection transformation of the depictions can be carried out during secondary data acquisition. However, most of the manuscript map sketches did not closely follow these rules, and they did even attempt to show the fortresses with a correct shape. The obvious reason for this was that not all imagery was based on a preliminary survey, so the sketchers relied on oral information and their own imagination when drawing the map sketch.

Figure 6.
A detail of four adjacent map sheets (IV-16, IV-17, V-22 and V-23) of the First Military Survey from 1784 compared to the satellite image of the same area

Note: It is characteristic of the cartographic works of the First Military Survey that the map sheets were fit to one another without any projection system or geodetic calculations, which resulted in major errors in the adjustment of the map content. These errors are rectified graphically, which along with changes of the terrain, makes the georeferencing of the base material difficult.

Source: compiled by the author based on the Első Katonai Felmérés – Magyar Királyság [First Military Survey – Hungarian Kingdom] (DVD-ROM, Arcanum, 30 September 2004), as well as satellite image (ArcGIS Basemap Online)

Data processing and analysis

Military archaeological investigations typically begin with secondary GIS data acquisition, during which all available archival and state data are processed with an appropriate level of source criticism. Various military engineering and other sketches of Zrínyi-Újvár have been found in the archives. Due to the short-lived existence of the fortress (1661–1664), relatively few authentic engineering images have remained about it. Of these, the sketch found in the legacy of Count Pál Esterházy (1635–1713) seemed to be the most suitable material in terms of its elaboration and detail *(Figure 7).*

Due to the structural features of the fortress, the brittleness of the building materials used, the total destruction of the fortress after its seizure, the subsequent agricultural cultivation, as well as the earthmoving works connected to the fortification system erected on this site in the 1950s, there was little hope that the walls of the fortress would be found. Consequently, during the excavation of the fortress the indirect methods of battlefield investigation came to the fore. In this, we determined the position of the key points of the defensive walls by identifying the traces of the siege instead of that of the fortress itself.[19]

One of the most important tasks of data processing arising during secondary GIS data capture is *georeferencing,* that is, placing the digitised spatial representations in the appropriate reference system. In each case, the GIS database defines the geometrical characteristics of landscape features (their shape points and extension) according to a known spatial reference system based on mathematical rules. Nevertheless, the currently widely known and standard geometric reference systems were not available in all ages. Therefore, going backwards in time, more and more geometric irregularities can be encountered during data processing. The solution to eliminate irregular geometric distortions, besides source criticism mentioned above, is offered by the unique transformation procedures that often require lengthy processing.

For a detailed study of the terrain, neither the military nor the civilian topographic maps of the largest available scale (1:25,000 and 1:10,000, respectively) were adequate. Due to their relatively small scale and outdated data content, these raw materials could therefore only be used to overview the area. Data from a topo-geodetic survey conducted from 2006 to 2009 served as a basis for the detailed modelling of the fortress and its foreground. The reliability of the data was strongly affected by the circumstances of the survey, such as the highly fragmented character and land coverage of the surveyed area, the repeated one-week long field surveys in summer, as well as the involvement of students of military cartography as part of their summer apprenticeship. Against this background, the size of the area surveyed from the 35 small base points set up in the field was already over five hectares by 2009.

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[19] *Négyesi* 2013 and *Hausner–Négyesi–Padányi* 2012. 189–218.

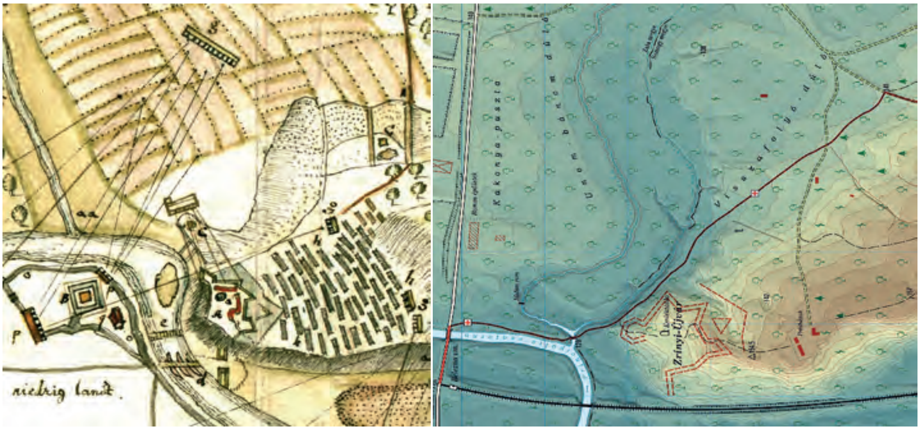

Figure 7.

Detail from the sketch depicting the 1664 siege of Zrínyi-Újvár and the map made in 2014 on the basis of direct field survey of the same area

Source: sketch by Master M. I. O. (?) from the legacy of Count Pál Esterházy (1635–1713), MNL OL T. 2. XXXII. 1064, as well as compiled by the author

However, further ground survey of the area did not seem to be reasonable. It became increasingly evident that the errors in measuring the elevation, which were significantly greater than errors in horizontal measurements, could no longer be effectively eliminated by methods used until then. In order to survey the terrain uniformly and with minimal distortion, a more accurate method had to be found.

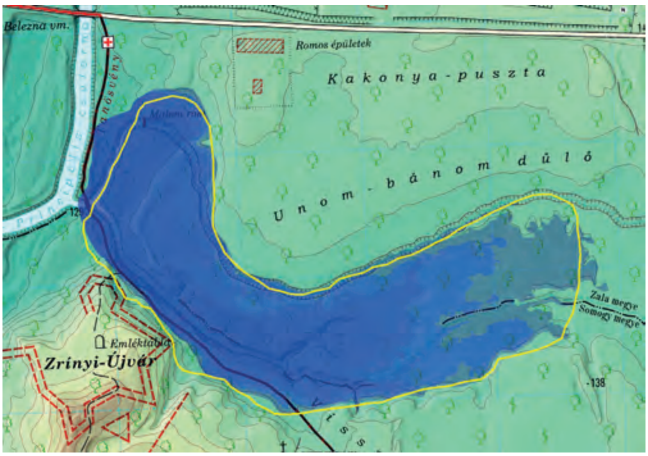

Figure 8.

Investigation of the extent of the flooded area defending the fortress from the north-east

Note: The yellow line is the hypothetical boundary based on archival data, while the size of the blue patch is the result of terrain modelling

Source: compiled by the author

In 2013, it was possible to employ LIDAR technology in the archaeological investigation of Zrínyi-Újvár supported with GIS methods. Not only did laser scanning of the area result in a more reliable and accurate data set of the terrain, but it also made possible to carry out detailed field modelling tasks that we had not done before or with insufficient reliability. Of these, special mention must be made about the investigation of the extent of the lake to the north and north-east of the fortress the water level of which was artificially raised before the siege. As a result of this, we gained a reliable picture of the size of the flooded area and the possible location of the Ottoman siege bases *(Figure 8).* A similar research was made about the firing efficiency of the guns of the Ottoman troops arriving from the south-east during the siege of the fortress.

The potentials of retrospective modelling in military archaeology

The modelling potentials of GIS cover not only the spatial relationships of the real world, but also time that is defined as the fourth dimension. Changes in geographical factors and the trends and processes that can be deducted from them are at the focus of archaeological research. Granting special attention to time in GIS modelling has many advantages. As an attribute connected to spatial data, it provides information on whether the data are still relevant or outdated. It also makes possible the identification of topological anomalies by making the content correctness of spatial databases of adjacent and overlapping territories with different time reference verifiable. Furthermore, it renders the dynamic changes and processes occurring in space and time clearly detectable, assessable and analysable.

The most common applications of GIS analyses considering time factors are the *predictive* or inferential analyses. The predictive analytical method is based on the premise that – in terms of their geographical position – the distribution of spatial data from the past is not even, but not even random, but determined by relevant geographical factors. As such, is suitable to define the distribution or the probability of the occurrence of events based on conclusions and predictions concerning possible future patterns.

During the predictive modelling of spatial events, there are fundamentally two methods to determine the probability of the occurrence of a certain element. If the qualitative characteristics describing a given element – which are compatible with the exact parameters of the geographical space (slope, exposure, coverage, soil type, etc.) – are available, the distribution pattern of this element can be determined (predicted). This is the so-called *deductive modelling* process whereby basically subjective quality evaluations are emphasised. Consequently, the professional relevance of the analyses is of paramount importance for drawing the right conclusions. In contrast to the deductive modelling process, *inductive modelling* is a method of examining the spatial relationship of the occurrences of certain elements in the past and geographic factors, which can be traced back to empirical facts. In the case of this method, predictive modelling is based on conclusions drawn from statistical regularities instead of subjective assessment by an expert.[20]

[20] *Beauvais–Keinath et al.* 2006. www.uwyo.edu/wyndd/_files/docs/reports/wynddreports/u06bea02wyus.pdf (Accessed: 19 December 2018.)

Both methods make possible for us to draw predicting conclusions from past data. However, this is not always the goal. In the archaeological application of GIS, we try to open up perspectives in the inverse of the time scale, that is, to reconstruct past events and the environment. The purpose of retrospective GIS modelling is to detect inevitable changes in the geographical environment compared to an assumed starting point, and to analyse its interactions with other factors under investigation.

The input data of retrospective modelling (qualitative and quantitative features of the finds, their spatial distribution and interrelationships), as well as the characteristics of the geographical environment make it possible to employ fundamentally deductive and inductive modelling methods, similarly to predictive modelling methods.

In the field of retrospective modelling, the greatest challenge is inherently exploring changes in the geographical environment. In the case of Zrínyi-Újvár, due to the explosion of the fortress by the Ottomans on 7 July 1664, and the subsequent destruction lasting three days, the ground surface of the fortress and its surroundings transformed significantly. The surface changed further due to soil erosion caused by rainfall (and to a lesser extent by wind), which mainly affected the ground surface uncovered by vegetation, and that was exacerbated by the relief (e.g. steep slopes).

The area surrounding the Mura–Drava confluence is one of the rainiest regions in Hungary. Its amount of precipitation is normally above the national average. Of course, we do not have reliable data concerning the precipitation conditions existing centuries ago, but it is reasonable to assume that soil erosion was – at least initially – a determining factor in shaping the landscape. It was only the intensive cultivation of vineyards in the area that could bring an end to this erosion, which – according to the testimony of the 1784 map sheet of the First Military Survey – was already carried out on the hill stretching from the projection of the demolished palisade towards south-east, along the Mura, as long as Látóhegy (‘Watching Hill’) belonging to Zákány. Maps from later periods also show signs of viticulture, which has preserved the terrain features of the ground surface to some extent. A major decrease in the cultivation of the area was brought about by the new frontiers of the country stipulated by the Treaty of Trianon, which was further lessened by the establishment of the frontier defence system after World War II. The vineyards were gradually replaced by a naturally-developing forest. Afterwards, the ground surface did not change considerably.

The walls of the palisade fortress, as well as the remains of its inner and outer structures were investigated by several methods (trench excavations, geoelectric soil resistivity and ground penetrating radar surveying), while taking into account the position of finds connected to the final battle shown on planimetric maps and relative to the surface level. The results of the LIDAR survey revealing the detailed geomorphological map of the landscape helped us connect distant pieces of the puzzle.

Summary

The development of information technology over the past two decades has also had an impact on military archaeology. Due to this development, researchers need to cope with much more detailed and diverse sets of data. Information technology offers full-fledged procedures for the processing of these data. In terms of spatial analysis, geographic information systems provide effective support from data collection and management to building a model environment and performing complex evaluations, simulations.

Extensive technical support is now available for designing one or more possible variations of landscape image, tailored to a given period or even a specific time. Retrospective modelling tools necessary for the virtual development and transformation of the terrain, vegetation, and hydrographic features of the investigated area provide immense help for the reconstruction of past conditions from current data. Due to the necessary geographical, geomorphological, and topographical data, these can create an environment close to reality for the reconstruction of certain features or events.

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Instrumental Surveys Related to the Siege of Zrínyi-Újvár

András Németh – András Szabó

Due to the development processes in the scientific world, an interesting phenomenon can be observed today. As a result of this, there is a tendency to the specialisation of various disciplines and separation caused by that. However, an increasing interdisciplinary character (the merge of disciplines) can also be observed, which is normally reflected by the application of various scientific results in different fields of study. Computer-aided data processing and visualisation, the information sharing possibilities offered by telecommunication, as well as sophisticated remote sensing and signal processing technologies have created new approaches in almost every field of life. As a result, research areas in the social sciences with centuries-old traditions and well-established research methods, such as archaeology, as well as the more recent interdisciplinary battlefield research seem to be equally striving to make the most of the technical achievements of our time.

One of the primary aims of our paper is to introduce techniques and methods based on different measurement principles and their potential fields of applications, which can provide us with information without disturbing the ground for detecting, investigating, evaluating and interpreting underground anomalies of archaeological interest. Along these lines, we present procedures based on metal detectors used in practice, as well as magnetometer, radar and soil resistivity measuring, together with their limitations and some alternatives for solving the problems that may arise.

We illustrate the above in practice, through presenting the investigations carried out by our research team in recent years, as well as our experience and findings obtained during the engineering and technical support of the archaeological works conducted at the site of the siege of Zrínyi-Újvár. By the targeted handling of the arising anomalies, we managed to increase the efficiency of our archaeological work. Nevertheless, during the research, we were able to pinpoint a number of other areas where our findings may also come useful, such as soil surveying before engineering earthworks, the control of public roads and utilities, or the assessment of the condition of embankments and dams in connection with flood defence works.

Before turning to the examination of each method, it is worth presenting some data about the background and circumstances of the surveys undertaken. Since 2005, our research team – the members of which are basically former and current lecturers at the Faculty of Military Sciences and Officer Training of the National University of Public Service, and its predecessor, the Zrínyi Miklós University of National Defence – has been conducting battlefield investigations in the territory of the fortress built by Miklós Zrínyi, poet and military leader, to defend his estate in Muraköz. It is located in the close vicinity of the current border between Croatia and Hungary. The excavations of the remains

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of Zrínyi-Újvár (the rammed clay fortification of strategic importance built by taking advantage of the favourable terrain and other natural features of the area) and the traces of the 1664 Ottoman siege have been explored in many phases over several years. By now, we have had the possibility to try out a number of non-destructive methods that have offered us with enough experience to test their applicability and effectiveness. Due to the geographical conditions of the area, the necessary surveys and measurements had to be carried out mainly on hillsides covered with dense undergrowth. The speciality of the investigation was that – based on historical data – there were fights in this area only during the Ottoman siege of the fortress, so the finds could be dated with great certainty. Nevertheless, the ground was disturbed in several places by military engineering works (border fortification) in the 1950s. Additionally, the territory of the battlefield has been subjected to agricultural cultivation (viticulture) for decades. That is why, we also discovered objects and tools dated to these periods.

Analytical methods

Stabbing and cutting arms, firearms, artillery and other fighting tools, projectiles, as well as protective equipment used in the history of warfare have continuously evolved in accordance with the technological level of the given era in order to increase the effectiveness of their offensive and defensive functions. One of their most important common properties is the material they were made of. During their manufacture, specialists have always strived to use materials that were mechanically resistant, hard and relatively easy to form, which requirements were mostly met by metals. As a result, the various types of metal detectors are among the most essential instruments used in battlefield research. Besides old weaponry, they are, certainly, suitable for detecting the position of all other metal objects, such as jewellery, decorative objects, coins, tools and household utensils, depending on their settings.

However, there are many further ways for detecting artefacts, rocks, or other ‘anomalies’ hidden in the ground. The applicable methods and tools can be grouped, among other things, according to the material properties (e.g. conductivity), physical dimensions and the depth that the sought feature is found at. In terms of material structure, we can differentiate among artefacts or geological formations with detectable metal content that can be localised with metal detectors, magnetisable objects that can be detected with magnetometers, as well as non-magnetisable metal artefacts that can be identified with electrical soil resistivity measuring. In case of non-metallic features or structures, we can carry out ground-penetrating radar measuring in addition to ground resistivity testing. Furthermore, seismic and LIDAR[1] surveys, as well as aerial orthophotographs can also be employed, which are suitable for photogrammetry-based 3D modelling, vegetation analysis, thermal mapping[2] and many other purposes.

1 Light Detection and Ranging.

2 It can be used to identify strips of soil of different composition and disturbed ground, because they warm up or cool down at different speeds. In this way, we can demonstrate the presence of any different substance in the soil and the fact of earthmoving in the past.

Further evaluation criteria may be the speed of the surveying (that is, the size of the area that can be surveyed in one day), the size of the territory or soil depth that can be explored during each survey, as well as the accuracy and – horizontal and vertical – resolution of the measurement. Additionally, important aspects can be the level of expertise required for the measuring (for the use of the device and the evaluation of the results), the speed of evaluation (in situ or requiring lengthy post-processing), various factors affecting/limiting the use,[3] the possibility of sensor integration (joint analysis of multiple sensor results), the possibilities of post-processing by software programmes (e.g. filtering, statistical evaluation), and, during each measuring, the platform and manufacturer independence of the technology employed.

Various geophysical surveys can be ordered in Hungary as a service, so one does not have to purchase the special tools and software required by them that are often very pricey. Archaeological application, however, means much more than the professional use of the instruments. Effective collaboration between experts in different disciplines is fundamentally important, because determining the range of instrumental surveys that are needed for the successful solution of a certain archaeological question is a complex task. After formulating the question, the purpose of the survey should be clearly defined and the technologies to be used must be determined. It is important to note here that these methods of surveying alone cannot identify unambiguously the object hidden in the ground and the feature causing the anomaly. In other words, we cannot "see" into the ground with them, instruments can typically detect only one or more physical properties. During a surveying process, we can perform statistical analyses using the results of repeated tests, which can be used to determine the cause of the anomaly. In order to improve the efficiency of the evaluation of the tests and to avoid erroneous measurements, it is advisable to carry out reference tests beforehand in areas with known parameters or target objects. In the course of these tests, it is worth identifying the characteristics of the examined area and the properties of the sought objects (e.g. artefacts, structures, remains) by means of known properties under controlled conditions. Reference tests can be done on previously explored or excavated sites, or on a "test area" designed by us. It is advisable to simulate the implications of various possible interferences (e.g. radio frequency disturbances, utility lines) and how metal waste scattered on the ground, various soil composition, as well as objects placed in different depths affect the results of the measurements. As a rule, one should adapt the principles of measuring to the given survey and measure the probability parameters of "false positive" and "false negative" test results, and the correct detection of an object/feature. Preliminary investigations can also be carried out to determine the depth of detection, the size of the objects, the material and selectivity (that is, the distinguishability of underground features), as well as their relationship, the results of which can later be used to optimise the calibration of instruments.

In the following, we present the tools, technologies and methods that we used in our research in the territory of Zrínyi-Újvár.

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3 Weather, terrain, vegetation, etc.

Surveying with metal detectors

Following the early pioneers (Alexander Graham Bell, Gerhard Fischer), metal detectors began to be developed primarily for military use during World War II, and it was only later that – similarly to many other technologies – the possibilities of their civilian utilisation were considered. At the beginning, military instruments were used in archaeology. It was due to the expanding demand (requirements) that later more and more companies specialised themselves in developing such devices.

Today, possibilities offered by metal detectors are utilised in many fields of life, including preliminary surveys in the construction industry (e.g. for finding metal wires, utilities and substructures), or exploration in metal mining, security technology, law enforcement and many other areas. Depending on the financial resources available, both professional and home-made tools can be used for metal search and detection. In terms of their design and functionality, these instruments are available optimised for a specific purpose, but there are also universal devices with greater degrees of freedom to be used by experts.

According to their operational principles, metal detectors[4] can be instruments based on secondary induction (VLF[5]), pulse induction (PI[6]), and interference measurment (BFO[7]). Their operational principles will be summarised below without any in-depth technical analysis.

In case of metal detectors using the *VLF technology,*[8] two coils found in the instrument head and the associated circuits provide the physical background for operation. The outer coil loop[9] is an excited coil carrying alternating current. This (according to the Biot–Savart law) creates an alternating magnetic field around the coil, and the lines of electric field and induction surround the coil in a closed loop. When the detector head is held parallel to the ground, these lines penetrate the ground perpendicularly. If the path of this primary magnetic field is crossed by a metal object with electrical conductivity while the head of metal detector is moved parallel to the ground, (according to the Faraday–Lenz law) a voltage is induced in it due to the alternating magnetic field. It causes an electric current[10] in the target object, which tries to block the induction process above. As a result of this alternating current, a secondary magnetic field develops around the target object, the lines of which are crossed by the secondary coil[11] as the head of the detector is moved, in which a current starts to flow due to the induced voltage. That is how the metal object is detected. If we calibrate the detector before beginning the survey, we can obtain additional information about the material and physical dimensions of the target object and its relative vertical position below the ground surface by examining the characteristics of the secondary circuit, that is, by an analysis using different processing circuits. Since the material of the target object determines its electrical properties and conductivity, which in turn affects

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4 *Gee:* Metal detectors.
5 Very Low Frequency, 3–30 kHz.
6 Pulse Induction.
7 Beat-Frequency Oscillation.
8 *Neice* 2016.
9 Transmitter Coil.
10 Eddy Current.
11 Receiver Coil.

the magnitude of the excited secondary magnetic field and induction, it is possible to determine (discriminate) the types of metals based on the rate of electric current generated in the secondary coil before removing them from the ground.[12]

In case of *pulse induction*[13] detectors, we generate hundreds of current pulses per second using two or more loops in the transmitter coil. We are able to detect the secondary induction generated by the impulses in the target object with the receiver coil. Since the magnetic properties of various metals and, therefore, the duration of secondary magnetic excitation field around them differ (e.g. it lasts longer in case of highly magnetisable materials), it is possible to deduce from the temporal distribution of the collapsed magnetic field the material of the target object, whereas the delay of the "response impulses" indicates their depth. In practice, by detecting the "echo" of substances, we can perceive and identify different target objects.

Detectors based on interference measurment[14] represent the cheapest, but, at the same time, the least reliable and least efficient solution. In this case, two separate antennas of different lengths are placed in the detector head. The smaller one is connected to the analyser input and the larger one serves as a transmitter. The coils of both antennas are excited at the same frequency from a common oscillator, as a result of which hundreds of current pulses are emitted per second through the transmitter coil, similarly to the pulse induction metal detectors. However, in this case, due to excitation at the same frequency, the magnetic field generated by the transmitter and analyser coils will interfere with each other, the magnitude of which will change in the proximity of a metallic target object found in the ground. The receiver can detect this change of interference and will signal it to the operator with an audible signal or an indicator. Using a more sophisticated digital processing unit, the indicator will infer from the extent and nature of the change the material properties or even the size of the target object.

The range of devices operating on the basis of secondary magnetic induction detection, that is, the depth at which the target object can be detected depend on the frequency of induction and collapse of the alternating magnetic field,[15] the physical dimensions of the detecting probe (the size of the transmitter/receiver antenna), and the field strength (magnitude) of the excited magnetic field.

In terms of the size and transmit power, we distinguish between short, medium and long range deep seeking detectors. These devices are not interchangeable during a complex field surveying task because of their operational features and properties. They are used in different phases of the surveying process, depending on which layer of the soil is being investigated. The increase of transmit power does not necessarily mean the enhancement of efficiency, since due to a higher transmit power, the metal content or inhomogeneous distributions of salt in the soil, as well as metal waste and pollution of different size in the upper layers or on the surface of the ground can also cause secondary induction of such extent that may lead to false detection, or – in the case of an overload saturation in

12 Due to this property, we can either limit the amount of metals we discover in a targeted investigation, or, by proper calibration, prevent the detection of metal waste found near the ground surface.

13 *Neice* 2016.

14 Ibid.

15 The extent of soil damping increases as frequency gets higher, while the depth of penetration decreases.

the receiver – it can cause excitement and malfunction. Larger probes do not necessarily result in efficiency enhancement, either. In proportion to the enhancement of the receiver antenna gain, there is a growing likelihood of receiving interference signals, the exact position (direction and distance) of the detected target object becomes more difficult to determine, and the differentiation (induced magnetic field separation) of target objects found next to each other becomes harder.

Our practical experience shows that it is advisable to use detectors of different sizes for complex investigations and for the most thorough exploration of a site. Instruments with a large seeking head or frame antenna can provide an extensive survey of a given area and detect the position of larger anomalies with an accuracy of half to one metre. It can be a particularly effective tool when looking for larger metal objects (e.g. cannonballs, body armour) found deeper underground. Devices with a smaller seeking head can be used to determine the direction and depth of a specific target object with an accuracy of 5 to 30 cm. These instruments can be used effectively to locate small artefacts (e.g. musket bullets, arrowheads, coins) close to the ground surface. Hand-held detectors and pointers can help us determine the exact position of smaller artefacts in an already excavated "research pit" from a distance of a few centimetres.

Figure 1.
Surveying with metal detectors
Source: picture made by the authors

In the case of a target object, the depth in which the detection can be effective is influenced by its properties and condition, as well as by many environmental parameters and circumstances. These may include the instantaneous conductivity of the soil (e.g. composition, water and salt content), the existence of electromagnetic interference (e.g. mobile base stations, radio transmitters, high-voltage wires, vehicles), as well as the presence of highly conductive materials (metal waste) in the soil. Concerning the sought object, its material, physical dimensions, geometry, homogeneity, degree of corrosion (oxide layer), and its orientation in relation to the power lines of the magnetic field generated by the metal detector equally influence the results.

From metal detectors applied in the investigation of the site of the siege of Zrínyi-Újvár, we used primarily the various measuring devices of the *Deepmax*[16] family of instruments manufactured by the company called *Lorenz* to survey extensive areas and to locate large artefacts and tools at great depths. The Deepmax X6 metal detector is an advanced, pulse induction deep seeking detector supported by digital signal processing (PGBS[17]), which is less sensitive to local changes in the composition, temperature and mineral content of the soil. The possibility to change the transmitter frequency offers protection against interference generated by equipment operating at the same frequency or generating harmonics there; thus, we are able to minimise harmful interference in a given test environment while undertaking the survey. Pulse mode allows measurements to be carried out at different depths by activating the receiver circuit after a certain time after radiation. In this way, the device does not detect secondary induction generated by objects found near the ground surface, but only signals arriving from a greater depth, after a longer delay. This function proved to be particularly useful during battlefield investigations, at places where – due to subsequent agricultural cultivation or other human activities – we expected the occurrence of metal waste near the ground surface, so the topsoil could be excluded from the survey.[18] At the same time, the device is also able to classify target objects according to their composition (discrimination) by determining their electrical conductivity. We concluded from the measurement carried out in practice that during the A/D conversion, the device automatically adjusts the quantisation steps to a range of values between the signal maximum and the signal minimum thereby enhancing its capacity of target object discrimination.

The results shown by *Figure 2* were obtained by surveying an area of 6 × 8 m with a large frame detector. In the case of the group of six images on the left, there was no target object in the soil, so there was only a slight difference between the maximum and minimum signal levels. That is the reason why the instrument indicated even the slightest differences with striking colouring (red areas), but it also showed during the evaluation of the data that – based on the results – the target object was unlikely to be in the soil. In the case of the group of images on the right, there were real target objects below the ground surface, the conductivity of which significantly exceeded that of their surroundings. Therefore,

16 www.metaldetectors.de/download/deepmax_x5_x6_manual_uk.pdf (Accessed: 25 July 2017.)

17 Pulse Ground Balancing System.

18 On the basis of soil structure surveys conducted during previous investigations (a test trench was dug in 2006), the rammed clay walls of the fortress are found below the 20–30 cm thick layer of soil, so the upper layer should be considered to be of no archaeological interest.

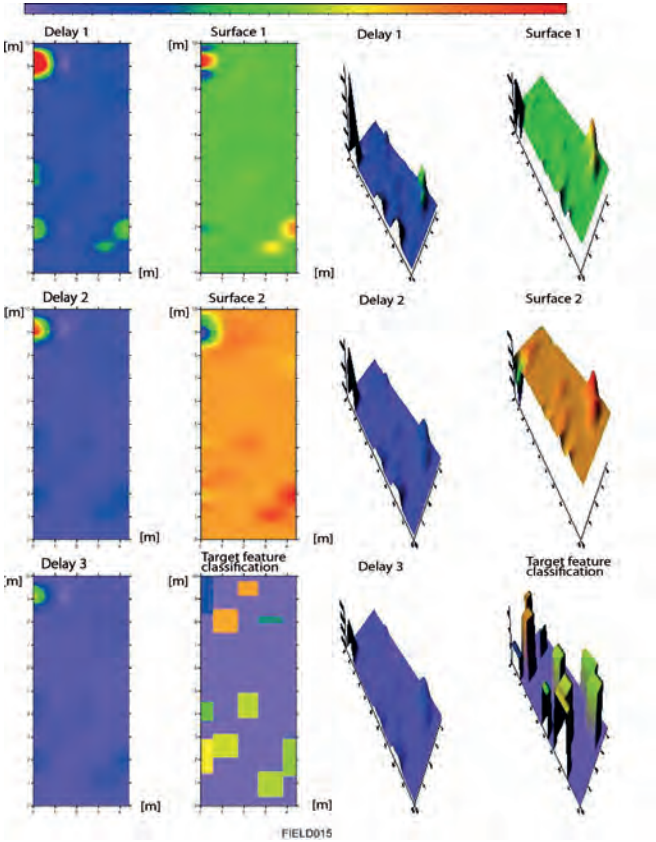

Figure 2.

2D and 3D representation of the results of the survey

Source: compiled by the authors

the instrument compensated for small conductivity fluctuations and strongly differentiated the sought objects from their background. Subsequently, it identified the material of these objects and represented them on the area on the basis of a colour code.

In addition to the frame, the instruments can be fitted with coils of various sizes and types. This allows us to scan the area with a coil that is the most suitable for the nature of the survey task. The size of the seeking head defines the magnitude of the excited magnetic field and, therefore, the theoretical limit of the scanning depth. Antennas in the seeking head can be targeted less or more, depending on the character of the research, that is, whether the primary goal is the scanning of a large area or accurate detecting in a given site.

The instrument can be used in both reconnaissance and "mapping" modes. The latter is possible only if a special measuring frame is used, since we need to identify the position and orientation of the area to draw the "map". In *reconnaissance mode,* the device can equally be used with a conventional double "D" search coil and with a deep seeking frame. In this case, we identify the horizontal position, as well as the estimated depth and

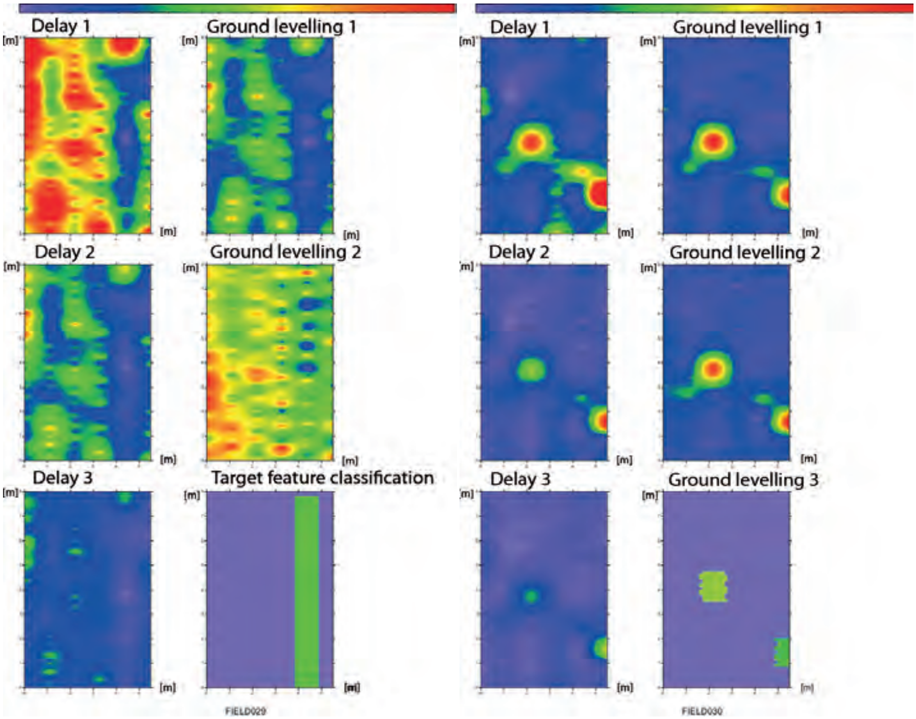

Figure 3.

The results of surveying at a site without any target object (left) and with a target object (right)

Source: compiled by the authors

material of the artefacts. By contrast, in *mapping mode,* the instrument offers the systematic examination of a pre-defined area. It records the results of the survey (measured values) and the coordinates of the surveyed site (when a GPS unit is connected), analyses them with the help of a computer data processing application, and displays them visually, in the form of colour 2D or 3D images *(Figure 3).* In this mode, the instrument automatically adjusts its parameters (receiver sensitivity, ground levelling and delay) according to a sequence of measuring.

During the use of the device, we sought effective answers to questions related to the management and analysis of the results, such as increasing the efficiency of surveying procedures and instruments, the planning and preparation of the surveying, the non-perturbed operation of different metal detectors at the same time, improving the accuracy of target object recognition, as well as the methods of analysing the measurement results and displaying the processed data.

From the aspect of the accuracy of the measurement results, it is important to delineate precisely the area to be surveyed and also to maintain the direction and speed of detection throughout the survey. If these conditions are met, whether the survey is performed with a hand-held metal detector head or with a deep seeking frame supplied with a carrying strap, the errors resulting from the management can be significantly reduced. In the case of our survey conducted in the area of Zrínyi-Újvár, we examined the applicability of the following methods: marking out the site with laser, the use of a conventional, hand-held GPS device, the application of a built-in solution (GPS module), recording the coordinates of the site corner points with a GPS, as well as indicating strips of the area with signal poles or cordons.

The disadvantage of marking out the borders of the site with laser was that the visibility of the light source was often poor when working at daylight. The GPS receiver offered precise and reliable navigation, but because the receiver itself contains electronic parts and circuits, as well as other metal components, it can be considered an external source of interference from the aspect of the survey. At the same time, the device has its own GPS unit designed for this purpose that can be optionally connected. In practice, however, it often proved to be insufficient as its horizontal accuracy was below three metres, even when the sky was almost completely visible. In addition, it was supposed to record the position of the operator, instead of the position of the frame, but it could only be attached to the carrying strap of the frame.

Although marking out the survey area with "traditional" methods was the most time-consuming and labour-intensive process, due to its accuracy, the use of signal poles and cordons proved to be the most effective solution.

Practical experience has shown that the pre-use calibration of the receiver of the detecting instruments and the removal of perturbing signals and the metal content of the soil by setting the device are important, as well (also for the accuracy of the measuring). The setting must be done over a flat area that does not contain any target objects and metal waste, which can be pre-checked with a hand-held device. Before the survey, it is also worth checking the settings for acoustic and visual signals – sound effect and displayed values – for target objects (e.g. keys, pocket knives, musket balls and other formerly discovered artefacts) with known wave forms to prevent the need for a repeated measuring due to the application of incorrect configuration. The accuracy of the measurement can be greatly enhanced if we make sure that the detecting frame is held parallel to the ground surface and that its distance from the ground is constant while we walk through the area.

When planning the measuring, the following points are worth to be considered to minimise the risk of errors resulting from incorrect handling by the operator, even when using multiple instruments at the same time. One of the most crucial issues in this case is to allow enough space – that is, minimum interference protection distance – between the individual instruments so that their detection processes would not be affected by the primary magnetic fields of other metal detectors used next to them. It is also important to consider in advance what types of objects we seek and how the ground surface looks like, because the detector head needs to be selected accordingly. Furthermore, if the site requires it, it is advisable to "clean up" the ground before the survey (that is, to remove the undergrowth, fallen leaves, waste and debris). It is important to make sure that there is no physical obstruction or restraint when swinging the instrument parallel to the ground surface, because it would result in skipping a small area and thus pose risk that some target objects in the ground remain undetected. In case of uneven ground surface, it is advisable to change the orientation of the head of the metal detector several times during the survey, and thus examine a given place from multiple directions, since the responses to induction vectors arriving from different directions may differ depending on the location of the target object. Consequently, it may occur in some cases that the receiver is not able to undertake the detection from every direction.

In order to *improve the reliability and accuracy of our measurements and the detection of target objects,* we went beyond the automated execution of the points listed in the operation manual of the device and by interpreting the responses of the instrument as closely as possible and paying careful attention to the operational principles, we carried out test measurements under controlled circumstances. During this, we placed control objects of known composition (electrical conductivity), and of various sizes and geometries on a pre-defined and cleaned "field", at different depths and distances (distributions). Afterwards, we passed over them several times at different speeds, using different head positions, and recorded the data collected in this way. We have also conducted these tests at different places with different types of soil in order to have as much information as possible about the actual operation of the device. For example, the slime pit of Lake Velence at Gárdony was selected as the site of such a validation measurement. During our first measurements conducted there, we observed the automatic scaling system of the device, which has already been shown, illustrated by the images above. The types of survey to be presented below can be used effectively to learn about the characteristics of other instruments, as well. In modern metal detectors, the *operating frequency* can be changed to avoid interference caused by the simultaneous use of multiple devices or other sources, and to minimise their effects. According to our experience, the probability of detecting metal objects of different conductivity and the extent of secondary induction may depend significantly on the relation between the wavelength of the frequency applied and the physical size of the target object, which also influences, among other things, the depth of detection. During the analysis of the *travel speed,* we have gained experience that is also logically foreseeable, namely that the resolution decreases in proportion to the horizontal velocity of the detector head, while the likelihood of measurement error increases. Slower speed allows for more accurate and reliable measurements, but it considerably restricts the size of the area that can be scanned over a given period of time. In case of hand-held instruments, the *oscillation speed* (that is, the velocity of swinging movement perpendicular to the direction of travel), also has a major effect on the detection of the target object. If the excitation and collapse of the secondary magnetic field in the vicinity of the target is too fast or too slow, the detection of the object may become uncertain or completely impossible. Depending on the relation between the spatial orientation of the target object and the vector of the primary magnetic induction, *the angle formed by the plane of the detector head and the ground surface* defines the magnitude of the secondary magnetic field in the soil and, consequently, the probability of detection. On hilly terrain and where dense undergrowth makes movement difficult, measurement errors are also likely to occur.

In case of hand-held instruments, the degree of overlap between swings fundamentally defines the resolution of the measurement. The lower the travel speed in relation to the oscillation speed, the greater the overlap (that is, the more often the detector head passes over the target object), which thus increases the probability of detecting smaller metal objects (e.g. coins). Consequently, the operator must try to achieve a higher oscillation speed than the travel speed so that the target object would cross the path of the magnetic field more often. This will, of course, also restrict the size of the area that can be scanned over a given unit of time. *Scanning depth* refers to the depth at which a target object can be still reliably and unambiguously detected. Besides the orientation of the target object and the frequency used, this also depends greatly on the physical size and material of the object. In case of equal excitation, materials with good magnetic conductivity and large metallic objects create a larger secondary magnetic field around them and can, therefore, be detected at greater depths. Modern digital instruments, with almost no exceptions, have *filtering functions* of different extent. When activated, these functions can constrain the detection of metals that are considered irrelevant. However, when using such a function, it should be borne in mind that this filtering will also reduce sensitivity towards the sought metal type in each case, and thus the probability of detecting these will also decrease. *Discrimination* can refer to differentiation by material type, as mentioned above, but this term can also be used for spatial separation. In the latter case, we studied the distinguishability of objects found close to one another in space, at different depths and distances. This may be significant, for example, to recognise the phenomenon of "artefact shielding", when a small metal object near the surface reflects a stronger signal leaving another artefact lying deeper in the ground undiscovered. This test is also advisable to be performed with the same and different types of metal finds (and "metal waste"). A single instrument used in a single mode of operation is unlikely to solve this problem, but using multiple instruments with different properties and sensitivities, we may draw conclusions about this question, as well.

In addition to the circumstances under which the measurements are performed, it may also be significant to consider how we can *process and visualise the results* available to us. The deep seeking metal detector we used was capable of capturing the data during a continuous measurement process and geo-referencing them, which made possible the non-destructive investigation of extensive areas and subsequent systematic analysis of the measurement data. Although archaeological investigations carried out with metal detectors my offer relevant information locally by themselves, statistical data obtained from a database comprising the data of a large number of artefacts with their exact location coordinates and characteristics (size, intactness, soil composition, depth) allow us to draw more complex conclusions, whether about the siege or the position of the fortification walls.

Since the incidental measurement errors can only be spotted after the completion of a surveying cycle, during data processing, it is not advisable to scan areas in dimensions of hundreds of metres in a single survey. It is worth dividing the entire survey area into grids of 20 × 20 m or 25 × 25 m size and merging the results later. It is also advisable to adopt this solution if the resources of the processing computer (laptop) are limited. Planning a survey with a hand-held instrument after deep seeking metal detecting is also easier if we need to scan a site divided into smaller parts beforehand. The Deepmax deep seeking metal detector creates 80–100 bytes of data in a single discrete measurement, on average. Since it takes samples sixteen times per second, a ten-minute surveying[19] can produce a data file up to 3–4 MB. In cases of files significantly exceeding this size, software processing and visualisation may tie up significant resources (CPU usage, memory allocation, etc.). The processing of data directly after the working in the field is fundamentally important for verification, because we can determine only in this way whether the survey was conducted

[19] Depending on the conditions of the terrain and the qualifications of the operators, an area of 16 × 12 m can be surveyed during this period of time, in general.

correctly and all data needed for the analysis of the results were recorded.[20] It may also turn out whether the surveying needs to be repeated, using a different configuration setting.

When we need to integrate (merge) the results of several surveys conducted over an extensive area, we will find that *Surfer 9* data processing software offered for the instrument is not capable of performing this task. We have worked out two methods to solve the problem in such cases. In the first case, the raw data of the survey must be joined in a semantically correct form before processing, as a result of which we receive a large input file. It will take a long time to process this file, but if this procedure is carried out correctly, the result will be accurate. The other solution is to match the images obtained after processing similarly to map sheets. If it is performed with due diligence, this procedure is hardly perceptible in the end result, and we can expect only minor inaccuracies where the pieces meet.

Although the first solution is not documented by the manufacturer, the analysis of raw data of the survey demonstrated that the instrument captures the GPS coordinates of the site together with the discrete survey data (x, y, z coordinates, magnetic field strength, electrical conductivity of the target object), and records the number of the given strip as shown in *Figure 4*.

A	B	C	D	E	F	G	H	I	J	K	L
0	0	8389234	8398645	2098756	8377461	8399268	0	4729.5601	N	1906.7491	E

Figure 4.

The structure of the recorded measurement data

Source: compiled by the authors

When visualising data collected over large areas, the need may also arise to show the results on maps (e.g. old map sheets, orthophotographs, satellite imagery, digital maps). This cannot be a problem, because the data records above include the latitude and longitude coordinates recorded by the GPS. Nevertheless, during the development of the software, the application was not prepared to use these data.

During the examination of the structure and format of the records, the format of the coordinates could be determined. Thus, after conversion, they can be used in other GIS applications, as well. *Figure 5* shows the transformation of the coordinates of a target object stored in a measurement record, which is then placed on an online GIS background as shown in *Figure 6.* (The image shows one of the sites chosen for validation tests; namely, a detail of the sports field of the Zrínyi Miklós Barracks and University Campus.) We used the free online Google Maps application for representation, but in knowledge of the format, it is also easy to depict it with any other mapping platform.

[20] If, due to the inaccuracies of the surveying, there are larger than 0.5 to 1 m wide "holes" between the surveyed strips of land, the software cannot process the data of the measurement. It leads to inconsistencies in the database, and the software cannot add a spectrum of colours corresponding to the data records of the incomplete parts of the area, which makes the software stop running.

Latitude	N47°29.5601'
Longitude	E19°6.7491'

Calculated Values - based on Degrees Lat Long to seven decimal places.

Position Type	Lat Lon
Degrees Lat Long	47.4926683°, 019.1124850°
Degrees Minutes	47°29.56010', 019°06.74910'
Degrees Minutes Seconds	47°29'33.6059", 019°06'44.9460"
UTM	34T 357827mE 5261642mN
MGRS	34TCT5782761642
Grid North	-1.4°
GEOREF	PKEC06742956

Figure 5.

Conversion of the coordinates stored in a measurement record

Note: We used the Earth Point online application to carry out the conversion: www.earthpoint.us/Convert.aspx (Accessed: 25 July 2018.)

Source: compiled by the authors

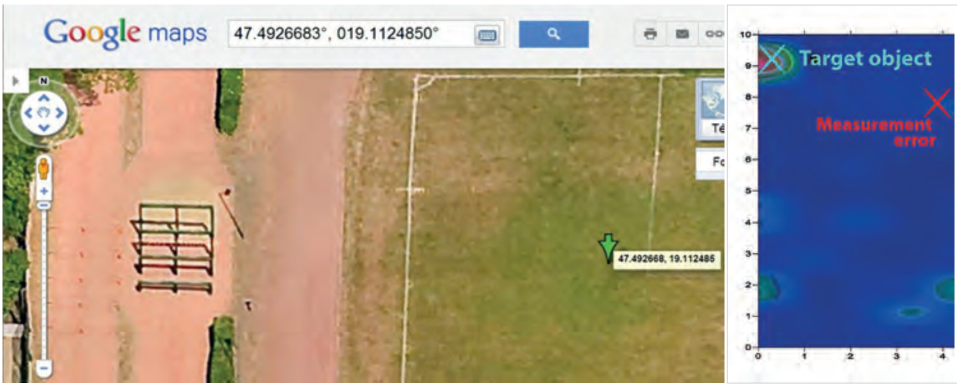

Figure 6.

Representation of coordinates obtained from the measurement data (left) and the result of superposing the information layers (delay, target classification) of the images (right)

Source: http://maps.google.hu (Accessed: 30 July 2018.)

Another advantage of the post-processing of images is that the target objects observed in the same area with different settings (delay, ground levelling) can be assessed by the interpolation of the images, and objects detected incorrectly due to measurement error can be filtered out statistically *(Figure 6).*

The excavations conducted on the territory of Zrínyi-Újvár and along the walls of the fortification imposed considerable strain on our instruments, since the terrain and the undergrowth often made it very difficult to work with them. Under such unfavourable circumstances, many measurements had to be repeated because of the erroneous or incomplete results. We are positive that there are still a great number of undiscovered metal artefacts hidden in the ground that are connected to the siege. However, due to the systematic investigations carried out over the past nearly one and a half decades, we have found hundreds of musket bullets, pieces of shrapnel, cannonballs and other metal objects, which provided us with a great deal of valuable information concerning the events of 1664. What is more, it is fundamentally thanks to these tools that we could confirm positively the existence of a stronghold near Belezna and Őrtilos.

Soil resistivity testing

If we need more information about the sub-surface soil structure in order to determine the position of former ditches, wells and other artificial structures, as well as natural formations, without digging long and deep trial trenches with physically demanding work or carrying out test drilling, soil resistivity testing can offer one of the most effective solutions. In the case of Zrínyi-Újvár, this method was used to prove our assumption that, in addition to the well discovered in 2017, there was another possibility to draw water in the fortress courtyard.

The use of soil resistivity testing (also known as geoelectrical measurement) makes possible the identification of geological formations and features above and below the ground surface by measuring their electrical conductivity. The measuring is normally conducted by placing electrodes at selected points along parallel or sometimes perpendicular lines, and excitation can be performed using either direct or alternating current. The principle and outline of the measurement are shown in *Figure 7.*

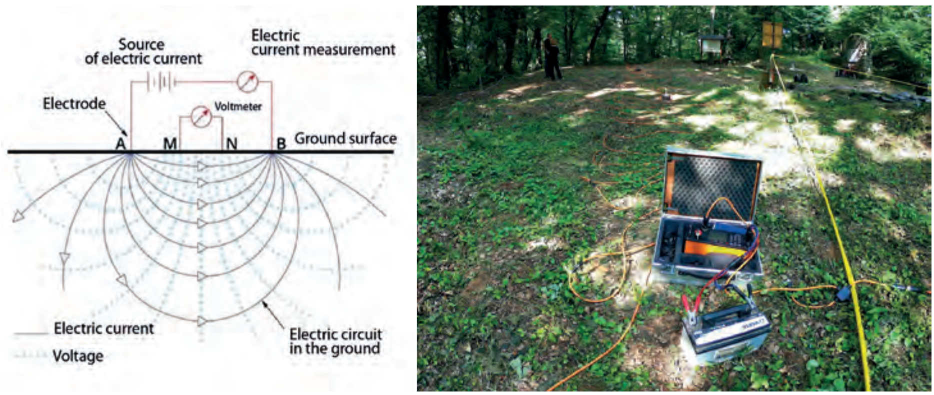

Figure 7.

The principle of geoelectrical measurement (left) and its implementation on the site in practice (right)

Source: www.researchgate.net/publication/322367522_Using_Electrical_Resistance_Tomography_to_Detect_Leaks_in_Landfills (Accessed: 30 July 2018), as well as picture made by the authors

The resistivity of soils of different composition is different, which can be calculated with the help of Ohm's law, in knowledge of the difference of electrical potential caused by the excitation current in the soil. The degree of electrical resistivity[21] of the soil depends on the electrical resistivity of its components (e.g. rocks, soil), the morphological properties of the soil particles and rocks, the structural properties of the ground and rocks, the porosity of the soil, the moisture content of the soil, the quality and concentration of the dissolved salts and minerals, as well as the temperature of the ground and rocks. The characteristic resistivity values[22] of some soil types, the arrangement of the electrodes used for the measuring, and the results of the surveying carried out in the courtyard of Zrínyi-Újvár in the spring of 2018 are shown in *Figure 8.*

Table 1.
The soil resistivity of different materials

Material	Soil resistivity (Ohmm)
granite	200–10,000
limestone, dolomite	100–5,000
basalt, andesite	200–10,000
tertiary limestone	100–1,000
sandstone	100–2,000
dry/wet gravel	100–10,000/50–1,000
dry/wet sand	50–1,000/15–100
clay marl, marl	5–50
clay	5–30
bentonite, kaolin	1–10

Note: Ohmm = Ohm-metre.

Source: compiled by the authors

Figure 8 shows a characteristic vertically oriented anomaly with low resistivity (in colour blue). It may as well indicate the site of another hypothetical well, but the results of the subsequent test drillings suggested that we discovered the remains of a natural geological formation rather than a filled-up well. Consequently, we have not yet been able to prove our assumption. *Figure 9* shows the results of parallel measuring lines projected onto a LIDAR image after matching.

[21] The electrical resistivity of the ground depends on the different soil types of the studied area. It was measured between two opposing faces of a cube with edges one metre in length. www.kbfi-triasz.hu/Meresi-modszer/8/ (Accessed: 3 August 2018.)

[22] www.kbfi-triasz.hu/Meresi-modszer/8/ (Accessed: 3 August 2018.)

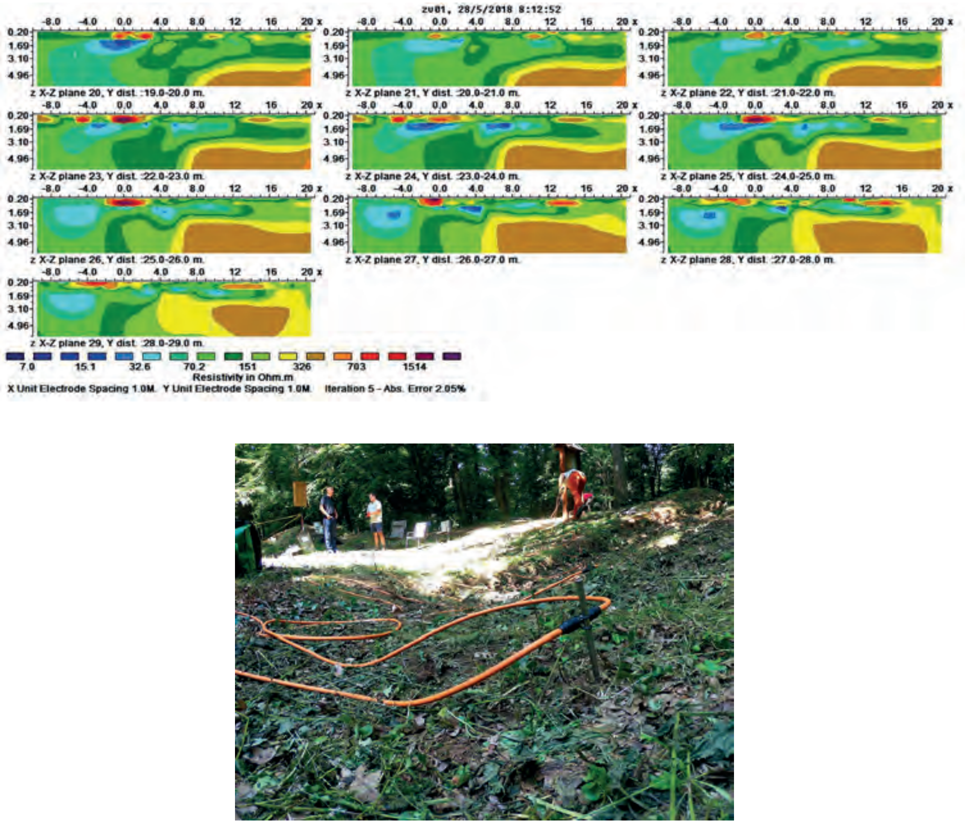

Figure 8.

Characteristic values of soil resistivity (top left) and the arrangement of measuring electrodes (below)

Source: compiled and picture made by the authors

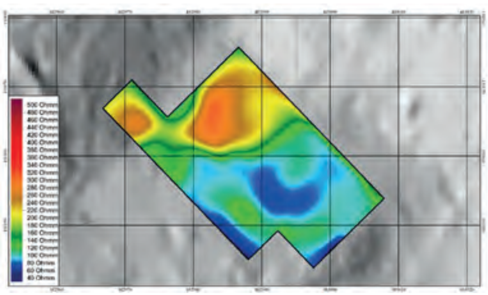

Figure 9.

The results of parallel geoelectrical measurement lines joined together

Source: compiled by the authors

Measuring with a ground penetrating radar

Another important method of geophysical surveying is measuring with ground penetrating radars (GPR[23]), which can be effective instruments of sub-surface investigations. During their operation, they normally use radio frequencies of the electromagnetic spectrum in the range 25 MHz to 2 GHz. The system comprises a transmitter and a receiver, as well as antennas connected to them, the geometric parameters of which determine the dominant operating frequency. The typically pulse-like signal generated by the transmitter penetrates deep into the ground, which is reflected at boundaries between materials having different permittivities, and the significantly weakened return signal is recorded by the receiving antenna *(Figure 10).* The processing and imaging module connected to the receiver is able to display underground features, cavities, cracks, traces of previous human activities, soil disturbances, as well as various geological anomalies by analysing the relationship between the transmitted and return signals.[24] The depth of effective surveying, as well as the physical size and extent of detectable anomalies are determined by the operating frequency selected. Due to the damping properties of the soil as a transfer medium, in case of archaeological and geological surveys, the lower 20–25% of the electromagnetic spectrum (that is, the range 25 to 400 MHz) can be used, which usually allows surveying to a depth of 10–25 m. For the survey of the top 1–2 m thick layer and for various concrete structures, constructions and support structures (building-related applications), the range between 500 MHz and 2 GHz can be used effectively. The results of the surveying can be evaluated or displayed in 2D (using a single horizontal measured strip) or in 3D (matching multiple measured strips).

Figure 10.
The operational principle of ground penetrating radars[25] (left) and their use in practice (right)
Source: compiled and picture made by the authors

[23] Ground Penetrating Radar.
[24] Ground Penetrating Radar Theory 2009.
[25] www.geomega.hu/mergeo/?page_id=29&lang=en (Accessed: 17 August 2018.)

Ground penetrating radar surveys were conducted several times in the area of Zrínyi-Újvár to detect the burnt remains of the fortress wall, as well as to find the “dark gate” and the well of the fortress. This method proved to be successful in detecting sections of the fortress wall and in identifying the site of the well *(Figure 11).* However, we still need to demonstrate the existence of the hypothesised “dark gate” and identify its location.[26]

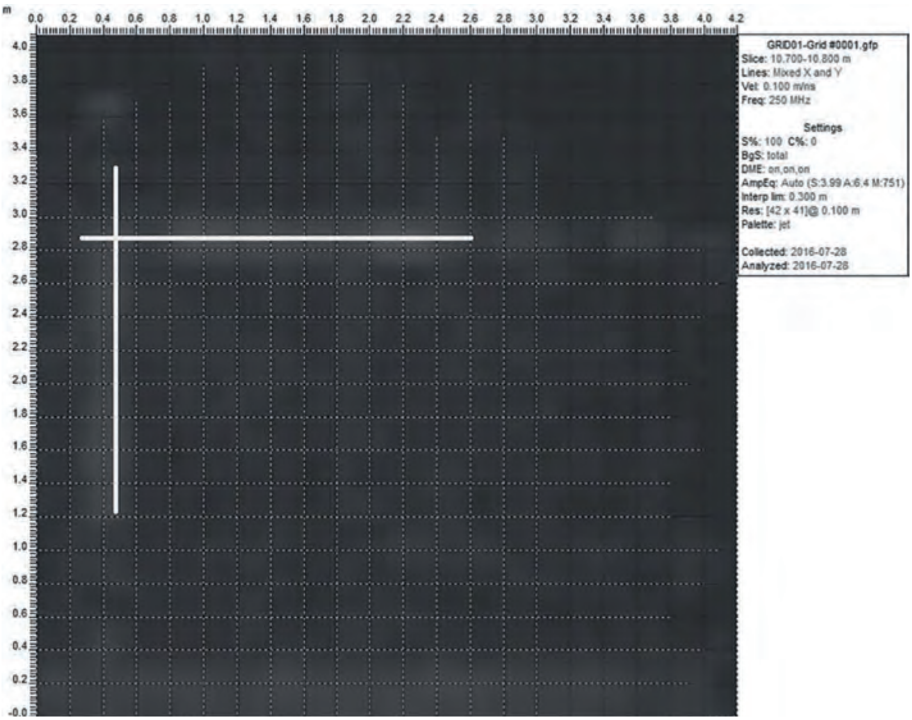

Figure 11.

Image produced by a ground penetrating radar about the well at a depth of 10.7 metre

Source: Padányi 2016. 103.

Measuring with a magnetometer

In contrast with the above, magnetometer surveying is a passive sensing method. Applying this, we can map local anomalies of natural or cultural origin in the magnetic field of the Earth, due to the fact that every material has magnetic properties. We can differentiate between inductive magnetisation, which develops in the presence of an external magnetic field and collapses when it terminates, and remanent magnetisation, which is caused by the magnetic moment of the material. Thermoremanent magnetisation (TRM) is the most common form of natural remanent magnetisation (NRM), where the magnetisation of

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[26] *Padányi* 2016. 94–104.

magnetic minerals depends on their temperature. Above the Curie Temperature, they lose their magnetic properties, but when they cool below this temperature, their dipoles align themselves so that their moments point in the direction of the external magnetic field. Below the blocking temperature, the magnetic field "freezes" in the rocks. At the level of the atoms, the source of the magnetic moment of materials can be the spin of the electrons, the orbital movement of the electrons around the nucleus, as well as the number of electrons on the unfilled shells.[27]

Soil layers containing various materials, geological anomalies and objects made of different types of metal can be detected or distinguished by their magnetic properties. In case of diamagnetic substances (e.g. quartz), we cannot speak of spontaneous magnetisation because they have no uncompensated spin. Paramagnetic materials (e.g. olivine) have this, but their orientation is disordered. In case of ferromagnets (e.g. iron, nickel, cobalt), due to the uncompensated spins, the magnetic moments generated in the atoms are coupled in the domains.[28] In addition to the above, there are also antiferromagnets (e.g. hematite) and ferrimagnets (e.g. magnetite, ilmenite).

In terms of the operational principle, there are several types of instruments that can detect anomalies caused by the magnetic properties of substances in the magnetic field of the Earth, such as fluxgate (with an accuracy of 1 nT[29]), proton precession, overhauser (0.1 nT) and alkali vapour (0.01 nT) magnetometer.[30] During gradient measuring, we assess the composition of the studied area or its deviation from its surroundings reflected by the local changes in the magnetic field. With this method, we can detect materials with induced magnetisation (e.g. ductile iron, certain volcanic and metamorphic rocks, bricks) and remanent magnetisation (e.g. steel, certain volcanic rocks, bricks, daub), and – due to the decreasing magnetisation – various changes (e.g. earthmoving, backfilling) in the composition of the soil.[31] One can also measure the difference in the values of the magnetic fields by placing two probes above one another, which, divided by the distance of the probes, shows the magnitude of the vertical gradient of the magnetic field. This method is inexpensive and makes possible significantly faster surveying than others. It is often used for delineating various underground features (e.g. pits, trenches, ditches, sunken houses, ovens, fireplaces).

We also conducted such surveys several times at the site of the siege of Zrínyi-Újvár and along the fortress walls, seeking the Ottoman siege trenches and the "dark gate". The process of the survey and the analysed results of the magnetometer measuring are shown by *Figure 12.* It clearly displays a buried ditch and various pieces of metal waste appearing as spot-like noise in the area.

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27 http://geophysics.elte.hu/magneses1.pdf (Accessed: 26 August 2018.)

28 www.fke.bme.hu/oktatas/Hudson_Nelson/Fizika33_Anyag_magneses_tulajdonsagai.pdf (Accessed: 30 August 2018.)

29 Nanotesla.

30 http://geophysics.elte.hu/magneses1.pdf (Accessed: 30 August 2018.)

31 *Lenkey:* Measurements.

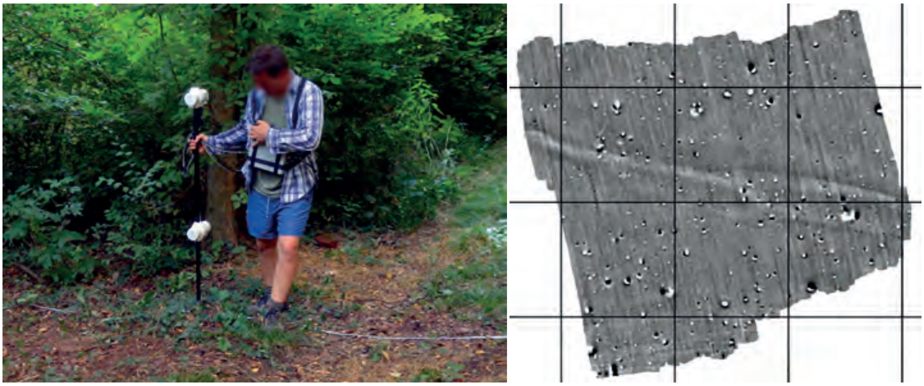


Figure 12.
The process of measuring (left) and the result obtained by merging the data of several measurements (right)
Source: compiled and picture made by the authors

Summary

Over the past one and a half decades, we used numerous state-of-the-art technical solutions, instruments and research methods for the investigation of Zrínyi-Újvár to obtain as comprehensive and accurate a picture of the fortress, its surroundings and the 1664 siege as possible. In the present study, we have mainly introduced those non-destructive testing methods, with the help of which we can conduct a preliminary survey of the sub-surface "world" without long and laborious physical work in order to answer research questions (raised in scholarly literature and in the field) and to prepare and plan the necessary earthmoving and archaeological work effectively. One of the most outstanding examples of this is the exact location of the well of the fortress *(Figure 13)* with the help of a ground penetrating radar. Thanks to this, in 2017, we could completely excavate[32] this specially constructed and strategically important water drawing place. Although the remains and weapons of soldiers defending the fortress – who are also mentioned in stories related to the well – were not found in large numbers, the discovered finds still added new, important pieces of information to the expansion of the "legacy of Zrínyi".

Nevertheless, the greatest help was provided by the use of metal detectors. Their use in archaeology and battlefield investigations offered us a wealth of knowledge and important practical experience that could be incorporated in our excavations, and thus gradually enhance the efficiency of our activity. As a result of this, we managed to demonstrate the existence of Zrínyi-Újvár, to find its exact location and identify typical features in the battlefield (gun emplacements, siege trenches, etc.), and to obtain plenty of data to prepare a miniature and complex 3D model of the area. At the same time, the huge amount of information we have today about the fortress and the siege has been yielded by several technical-based research methods, which have been assessed in a complex way, based on collective knowledge. The experience gained during the research process will be transferable

[32] *Költő–Vándor–Varga* 2018.

to other similar projects in the future. Additionally, the efficiency of the applied methods may further increase due to the development of technology and technical equipment.

Figure 13.
The well of the fortress in Zrínyi-Újvár during its excavation from the upper perspective (left) and from the lower perspective (right)

Source: pictures made by the authors

Two Mortar Bombs from June 1664

Lajos Négyesi

Sampling and material analysis

In the spring of 2008, four cannonballs were discovered during earthmoving in the area. The finders handed them over to Lajos Jancsecz, Mayor of Belezna, who sent them to the Museum of Military History. Based on the types and finding places of the projectiles, it is supposed that they got there during the siege of Zrínyi-Újvár in 1664. Based on their size, the two balls with a diameter of 26 cm were identified as mortar bombs. Additionally, they both had a well-recognisable ignition hole, one of which was opened up by the finders. When moved, the remains of gunpowder fell out of the ball in the form of black lumps. The sample thus obtained was subjected to a material analysis. According to the analysis, this material could no longer be regarded as gunpowder, since saltpetre and sulphur had completely transformed over the centuries, so there was no danger of explosion. The second bomb was completely intact, so we tried to find a testing method that would provide the most information for science. The nearly 6 cm thick wall of the bomb made X-ray examination impracticable. First, we designed a tubular drill probe with which we wanted to remove the fuse together with a sample of gunpowder beneath. This solution would have left the iron bullet intact, but would have made only partial examination possible. Finally, we chose the easiest method and cut the bomb in half. The size of the ball did not allow laser cutting. We also ruled out cutting with plasma and water jet because it could have damaged the fine powder. Eventually, the easiest solution remained; namely, cutting the bomb in half with a disc, which was carried out by researchers of the Bay Zoltán Institute of Materials Science and Technology. The extremely hard wall was cut in half and then split in two. In this way, crystalline inclusions that developed in the iron shell structure while the cast was cooling became visible. The section of the bomb showed clearly that moisture seeping through the ignition hole had dissolved the particles of gunpowder. Afterwards, various substances were concentrated at certain parts of the interior of the bomb. This was suggested by the coloured stripes visible on the cross-section and precipitation that appeared a few days later.

We were pleased to discover that the gunpowder was preserved in its original granulated state on one side of the ignition tube. The sample taken from there made possible the material analysis of the gunpowder.

The marks seen on the cross-section proved that it was the right decision to cut the ball in two. The sample taken with the originally designed probe tube would not have given representative results for the original filling due to the uneven distribution of the material.

Besides the two mortar bombs, two balls with a diameter of 17 cm were also taken to the museum. It was not until May 2009 that they were cleaned, because they were first believed to be solid iron balls used with siege cannons. Their diameter was the same, but the weighting caused a surprise, as one of them was 6 kg lighter. A closer examination revealed the outlines

https://doi.org/10.36250/00757_11

of the casting spine and the ignition hole, which was indicative of another mortar bomb. Due to our previous results, there was no doubt that we should cut this one in two, as well. In the meantime, our institution acquired the necessary equipment, so the work was carried out by József Prím, a restorer at the Museum of Military History. We were surprised to find that the fossilised powder had perfectly preserved the internal structure of the smaller projectile. However, after cutting the iron shell, the gunpowder filling also had to be cut with an iron saw.

The section clearly showed the wooden part of the ignition tube and the fine powder inside. In a layer of about 3 cm around the ignition tube, the grains of the originally filled-in gunpowder were preserved.

The cross sections of the bombs revealed that the crystallised incrustations got thicker towards the inner side of the iron shell. Additionally, there was an iron spike in the cast opposite the ignition hole.

Mortar cannons are the forerunners of today's rocket launchers. Their bombs fired at a steep trajectory were able to kill enemies hiding behind fortress walls and obstacles, or in ditches. Their firing range was not large. They were usually fired at targets within 300 steps, but it was this special firing mode that allowed the guns to be brought close to the enemy hiding from them behind a rampart or in a firing station dug into the ground. Their orientation was completely different from that of the cannons. While in the latter case, the barrel was aimed directly at the visible target and the projectile was fired at the target, the gunner of the mortar did not need to see the target directly, but set the barrel at a certain angle and drop the ball onto the target.

The projectiles of mortar cannons included stone balls and bombs with an iron shell. The stone balls were usually made of limestone and used during the sieges of fortresses. The steeply shot and then falling stone ball had significant kinetic energy. It was able to break through protective roofs. In case of multi-storey buildings, it could also break through every ceiling in its way to the basement. It was useful against live force, especially when it hit a hard surface on which it exploded into pieces causing terrible wounds. The most effective ones were the solid marble balls with a homogeneous structure.

The bomb has three main parts: the hollow iron ball, the powder filling and the ignition tube. The iron shell of the projectile was cast from a material with a high silicon content, which made it hard like glass, and, at the same time, burst into shrapnel more easily. The inner cavity of the ball was formed by casting around the spherical core put in the centre of the mould, which was held in place by a wooden rod led through the ignition hole. An iron tip was attached to the termination of this, which extended beyond the core and fixed it to the metal poured in during casting. After the cast had cooled, the inner sand core was removed from the sphere through the ignition hole. However, the iron tip of the fixing wooden rod was left in it melted into the cast. In practice, as a result of the forces exerted during casting, the wooden rod moved slightly, which often resulted in a lateral asymmetry in the thickness of the sidewall. In the vertical direction, there is a more marked difference in the thickness of the shell, as the side facing the ignition hole was deliberately cast thicker. The purpose of this was to keep the ignition hole upwards to prevent the ignition tube from getting damaged during the impact.

The gunpowder filling consisted of gunpowder pellets with a diameter of 2–4 mm, which indicates a high level of knowledge of the burning properties of gunpowder. Gunpowder burns in layers, that is, on its surface that was in contact with air. If the projectile body was filled with fine powder, after firing, it would flare up in a huge flame through the fuse hole like a rocket. Conversely, in the air between the powder pellets, the fire spreads quickly and the entire surface of the pellets starts to burn. The ignition proceeds gradually towards the centre of the pellet. The duration of the ignition depends on the size of the pellet: the larger its diameter, the longer the burn. From the perspective of the explosion, the quantity of the gases produced during combustion and the duration of gas formation are relevant. One litre of gunpowder produces approximately 500 litres of gas. Fine gunpowder burns up in a very short period of time producing a lot of gas quickly, so the process takes place in the form of an explosion. This explains why the projectile was filled with finely granulated gunpowder. In contrast, in case of gunpowder used for firearms, the objective is to keep gas formation continuous, at least until the projectile leaves the barrel.

The ignition tube made possible the timed burning of the gunpowder filling. Gunpowder was pressed into the borehole of the wooden tube in the same diameter as that of the tube. After setting the powder on fire, it burnt at an even speed, usually one centimetre per second. Before firing, the master gunner cut the ignition tube to a length relevant to the flying time of the projectile and then pressed it into the ignition hole using a tool dedicated to this purpose. It could not be hammered because the gunpowder pressed into it would have broken.

Before shooting, the gunpowder chamber of the mortar cannon was filled with powder, and then the bomb was placed on the powder with its ignition tube facing outwards. At the time of shooting, the ignition tube of the bomb was first lit through the mouth of the barrel, and the mortar was fired.

In truth, after several years of research, the discovery of the bombs came as no surprise. In the area of the Ottoman siege trenches the shrapnel of numerous large mortar bombs were discovered, so I secretly hoped that we would also find an unexploded projectile sooner or later. During the examination of the finds we bent a soft tin solder wire over the curved wall of the cleaned pieces of shrapnel, and with the help of the curved wire we drew the cross-section of the projectile. According to this, the armoury of the defenders comprised mortars that could fire thin- and thick-walled bombs with a diameter of 35, 30, 27, 25, 19 and 16 mm. During the investigations, we discovered 16 pieces of bomb shrapnel in one place at a depth of half a metre, which belonged to the same projectile. One part of the burst shell must have got pressed into the soil when the projectile hit the ground. Measurements have shown that the discovered pieces formed 30% of a 30 cm diameter bomb, suggesting that about 45–47 pieces of shrapnel weighing 1.2 kg on average flew apart.

No shrapnel belonging to a bomb with a 17 cm diameter was discovered in the territory of the Ottoman siege trenches, so it probably belonged to a projectile used by the Ottomans. Large bombs were found outside the fortress, but in the territory of the Ottoman siege trenches we found a piece of shrapnel with a size of this. Based on this, it is certain that the Christian army possessed and used such bombs. There are two possible answers to the question of how the two bombs came to the Ottoman siege area. They could have been booty belonging to the Christian guns left behind at Kanizsa, but the Ottomans could also take them from Zrínyivár once they seized the fortress. Pál Esterházy's diary reveals that during the days before the fall of the fortress, all the cannons were moved to the other side of the Mura. However, a part of the ammunition may have been left behind and captured by the Ottomans, who removed the usable war material before blasting the trenches. Eventually, because they did not have any mortar cannon in the size of the bombs, they left the bombs behind.

Based on the finding place of the pieces of shrapnel, their actual range was 150 m. The piece of shrapnel of the large mortar bomb was found about 200 m from the courtyard of the fortress, which corresponds to the data of 300 steps found in contemporary military books.

The data of the bombs

The larger projectile has a flattened spherical shape. It is 26.5 cm wide and 26 cm high. The thickness of the wall is 4 cm at the ignition hole, 5.5 cm at the bottom and varies between 5 and 5.5 cm at the sides. The inner chamber is a sphere with a diameter of 17 cm, into which theoretically about 4.8 kg, that is, 2.572 litres of gunpowder could be filled. It weighs about 58.5 kg. The diameter of the ignition hole is 5 cm, and the wooden plug is about 4 cm thick. The length of ignition tube is approximately 8 cm.

Figure 1.
The cross-section of a 26 cm diameter mortar shell
Source: picture made by the author

Figure 2.
The cutting of the 17 cm diameter shell
Source: picture made by the author

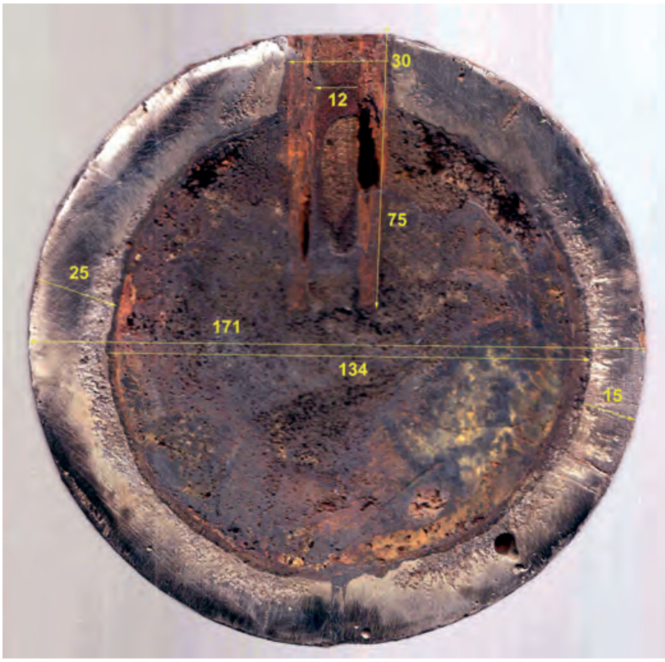


Figure 3.
The cross-section of a 17 cm diameter mortar shell with the remains of the ignition tube
Source: picture made by the author

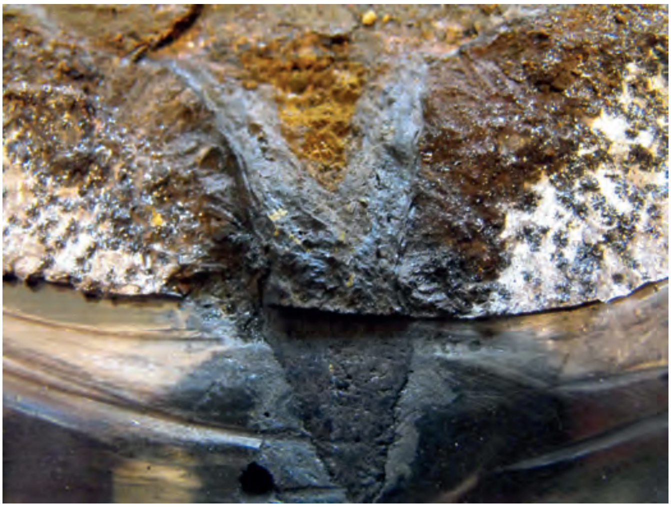
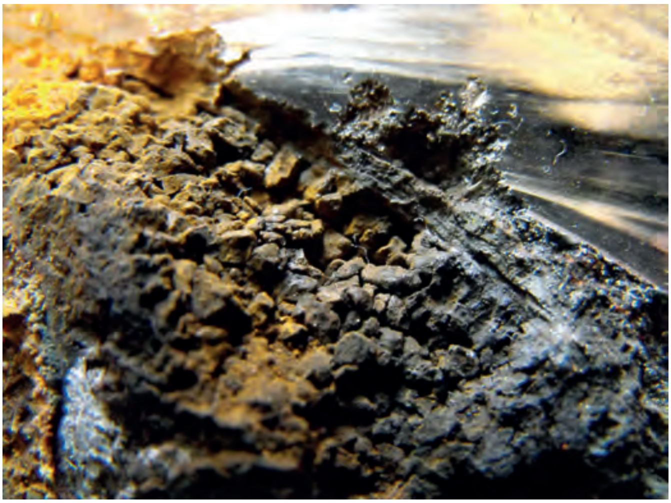
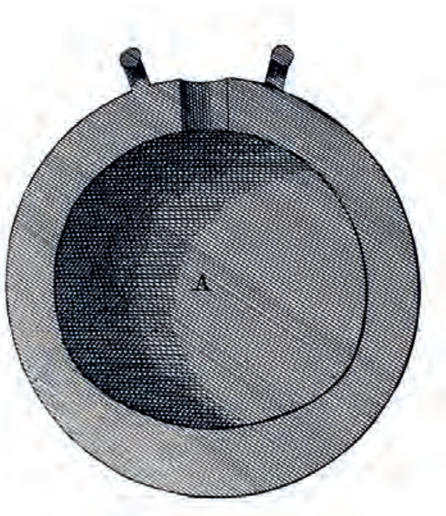


Figure 4.
The remains of the iron spike fixing the core
Source: picture made by the author

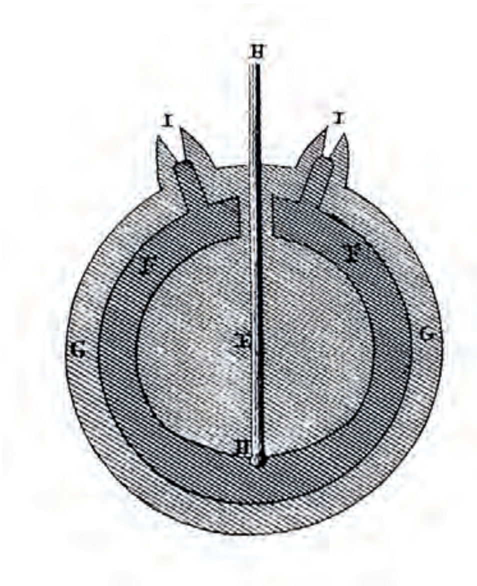
Picture 5.
The fuse hole of the 17 cm diameter shell
Source: picture made by the author



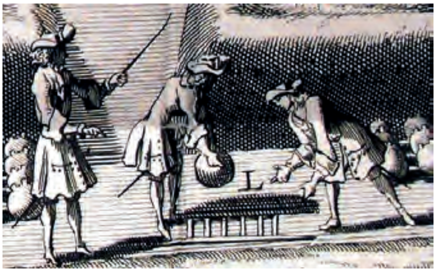
Picture 6.
The remains of gunpowder pellets on one side of the ignition tube
Source: picture made by the author



Picture 7.
The representation of a projectile in a contemporary artillery manual
Source: Surirey de Saint Remy 1702. 245.



Picture 8.
The moulding of a mortar shell, the iron spike fixing the core marked H
Source: Surirey de Saint Remy 1702. 300.



Picture 9.
Inserting the ignition tube
Source: Surirey de Saint Remy 1702. 254.

Picture 10.
Filling the mortar
Source: Surirey de Saint Remy 1702. 254.

Picture 11.
Firing the mortar
Source: Surirey de Saint Remy 1702. 254.

The Results of the Material Analysis of Artefacts Discovered at Zrínyi-Újvár and their Evaluation

Tibor Bartha

Introduction

As a result of investigations in the area of Zrínyi-Újvár, several artefacts of military significance have been discovered over the last decade, which, besides their historical significance, are also of archaeometallurgical interest. The vast majority of these finds were artillery and infantry projectiles and their shrapnel pieces, which can be connected to the 1664 Ottoman siege of Zrínyi-Újvár. The dating of the finds was greatly facilitated by the fact that there was only one siege in the area, namely the one in 1664. After the siege, the fortress (fortification)[1] was blown up by the Ottomans, and it was never rebuilt. Consequently, the mixing of finds connected to different sieges can be ruled out with absolute certainty.

Material analyses have already been carried out before 2018 on lead bullets,[2] cannonballs, mortar bombs, their shrapnel pieces, and the gunpowder filling of mortars discovered in the area of our research. The results of these investigations have already been published.[3]

During these earlier investigations, the primary objective was to gain an answer – occasionally only a confirmation – through the analysis of the chemical composition and macro- and microstructure of the samples about the materials and the technologies used for making the objects. We also investigated what specific characteristics of manufacturing can be identified or inferred in the case of each sample.

It opened a new phase in the investigations, when new finds connected to our subject were discovered in an octagonal, 15 m deep well, identified by drilling and ground penetrating radar surveying in 2016, which were excavated between 24 April and 26 May 2017. The well yielded not only the elements of the well house and well lining, planks, beams and other parts of the timber structure, but also a considerable amount of forged nails used for fitting the construction together. Many of the partially burnt, charred pieces of the timber well structure have remained in a very good condition and intact due to the preserving effect of the moist surroundings. There were also large numbers of musket balls of various diameters, sometimes concentrated.

1 Hereinafter: *fortress*.

2 Intact spherical and prism-shaped bullets, as well as bullets deformed as a result of impact.

3 *Bartha* 2013; *Bartha* 2017. It should be noted that although the latter study was already published in 2017, it predominantly presents the results gained by 2015.

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In 2018, the prime objective of our research was the archaeometric analysis of musket balls discovered during the excavation and the iron nails used for the construction of the well. Additionally, by studying the partially charred wooden remains, we came to the conclusion that the uncovered timber artefacts may also provide important information for the research. Therefore, we expanded the scope of our investigations to include the xylotomic analysis of the wooden material used for the well.

Archaeometric investigation of iron nails and lead musket balls from the archaeological excavation of Zrínyi-Újvár

Archaeometric analyses were carried out on three iron nails and three lead musket balls *(Figure 1).*[4]

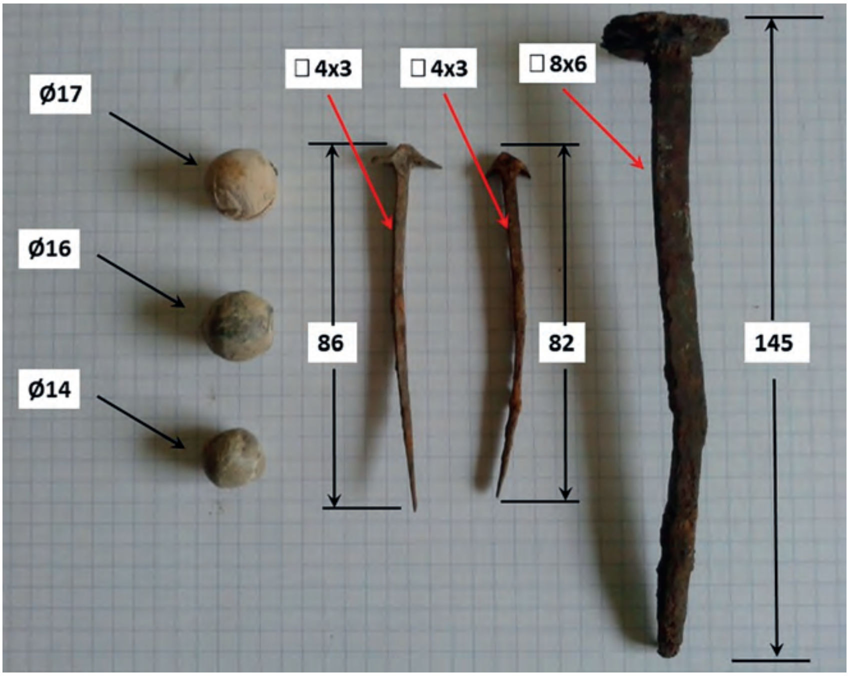

Figure 1.
The examined iron nails and lead musket balls in their original state
Source: Barkóczy–Török 2018.

[4] The examinations and the evaluation of the results were carried out by Dr. Péter Barkóczy and Dr. Béla Török, Archaeometallurgical Research Group of the University of Miskolc (ARGUM). *Barkóczi–Török* 2018.

Figure 2.
The examined iron nails after taking samples from them
Source: Barkóczy–Török 2018.

Figure 3.
Lead musket balls prepared for metallographic analysis
Source: Barkóczy–Török 2018.

The two shorter nails with a rectangular cross-section shown on *Figure 1* are 82 mm and 86 mm long. At the points indicated by the arrows, they have a rectangular cross-section measuring 4 × 3 mm. The length of the large nail is 145 mm, and at the place indicated by an arrow it has a rectangular cross-section measuring 8 × 6 mm. The diameters of the lead musket balls are 14 mm, 16 mm, and 17 mm.[5]

[5] The 17 mm lead ball was not discovered in the well, but in one of the supposed siege trenches in 2012. The 17 mm lead ball was involved in the 2018 analyses only as a test sample for "reference".

Figure 4.
The larger nail with the original wooden structural elements after the removal of the wooden peg and nail from the borehole
Source: Barkóczy–Török 2018.

The larger nail held a cylindrical peg with a diameter of 25 mm in place, in a wooden element, which probably belonged to the well house *(Figure 4).*

The primary purpose of the investigations was the metallographic analysis of the material and microstructure of each sample. Additionally, we wanted to find out the possible features of the manufacturing technology of the samples.

As we had the possibility to do destructive material testing, we cut samples from the artefacts for metallographic analyses. *Figures 1–3* show the tested nails in their original state and the samples taken from them. In the case of iron nails, the samples were cut off with a thin bakelite cutting disc, while ensuring that they do not get critically hot. In the case of lead musket balls, which proved to be very soft, we took samples by slow sawing, practically cutting the objects in half *(Figure 3).* Both groups of samples were mechanically abrased and then polished. The lead samples were so soft that particles of the abrasive material stuck into their surface. It was taken into account during the EDS (Energy Dispersive Spectrometer) analyses, and it was not disturbing during the XRF (X-ray Fluorescence Spectroscopy) analyses since the abrased and polished surface was tested. The polished surfaces were etched with a solution of 2 mass percent of natal. In the case of the lead samples, the steps of polishing and etching were repeated several times, while we tried to remove the easily developing deformed layer. Optical microscopy and mosaic images were taken of the prepared surface using a Zeiss AxioImager microscope at the Institute of Physical Metallurgy, Metal Forming and Nanotechnology, University of Miskolc. Furthermore, scanning electron microscopy (SEM) images were taken and energy-dispersive spectroscopy analyses were carried out using a Hitachi field emission microscope at the Department of Solid State Physics, University of Debrecen. The unpolished surface of the lead balls was also tested with an Oxford Instruments X-MET8000 Expert portable, energy-dispersive X-ray fluorescence (ED-XRF) spectrometer.

The two small nails could be tested freely, whereas in the case of the large nail, we had to keep in mind that the object would be restored later. For this reason, the strategy was to take samples from the head and shank of the small nails across their transversal section, which provided us with sufficient information about the technique of production. Therefore, it was enough to take only a small sample from the tip of the large nail to define the technique of its production.

The mosaic image taken of the head and shank of the small (86 mm long) nail[6] No. 1 is shown by *Figures 5–6.*

The mosaic images well illustrate the layered structure of the nail. It can be seen that layers of different carbon content were forged together forming thus a layered structure. There are several types of fabric structures ranging from completely pearlite-free, coarse, and ferritic areas to layers with ferrite and pearlite. Ferrite is the least carbonaceous element of α-iron (practically 'soft' iron). Pearlite is, on the other hand, a eutectoid of ferrite and cementite (iron carbide, FeC3); it is a harder material of evidently higher carbon content. The sample proved to be very heterogeneous, so we cannot talk about average carbon content. It is striking, however, that we cannot find areas containing significant amounts of carbon, and the proportion of ferrite is high everywhere, over the entire transversal section. The layered structure can be explained by the fact that attempts were made to homogenise the primary raw material (i.e. the iron bloom[7] full of slag inclusions), which was normally heterogeneous in terms of carbon content distribution. This means that the compacted deslagged iron bloom was hammered, folded and forge welded repeatedly – up to 10–15 times – to prepare a primary product (i.e. a thin rod or sheet) to make the subsequent shaping of the desired final product easier. It also occurred that several pieces of iron bloom were forged together and homogenised by multiple folding. However, when the final product – in our case, the iron nail – was prepared, the reheated iron retained its lamellar structure, but the traces of forge welding got blurred and disappeared due to diffusion. In case of objects

[6] The nail at the top in *Figure 2.*

[7] The production of iron bloom was one of the major milestones in the making of iron from its ores. It was an ancient technology going back to the Iron Age. Iron blooms were normally sponge-like blocks with high iron content, which also contained a large amount of slag. They were formed by the smelting of bog iron ores, without their being melted. By hammering, most of the slag could be "pressed" out of this sponge. The contaminated iron bloom was thus forged and compressed. Because the slag had a lower melting point than iron, it practically "got sputtered" from the iron during forging and the iron material completely merged and homogenised. This process was necessary because slag inclusions would have made iron brittle and breakable. The iron blooms were generally not traded, but were processed into semi-finished products in iron forging mills established next to the furnace.

Figure 5.
Mosaic image of the head of the iron nail No. 1
Source: Barkóczy–Török 2018.

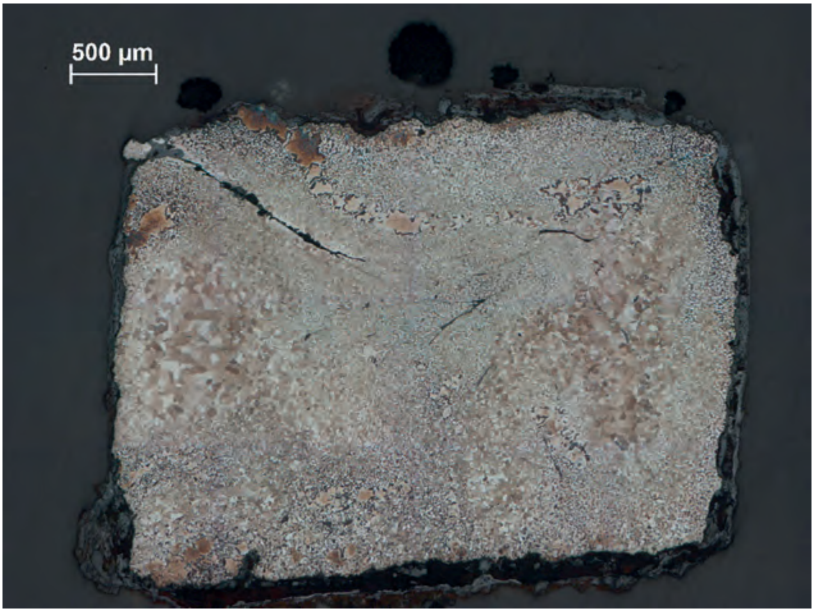

Figure 6.
Mosaic image of a transversal section from the shank of the iron nail No. 1
Source: Barkóczy–Török 2018.

with a thicker cross-section, the traces of forge welding were preserved in the middle of thicker parts, but the layers got thinner towards the surface. Thus, the raw material of the primary product itself is heterogeneous and layered. The nails were made from this raw material with the desired length of shank and cross-section.

It is particularly on the image made of the shank that we can observe an interesting structure, where coarse and fine-grained areas can be seen together. In areas where there is a large amount of pearlite *(Figure 7),* we can observe a structure reverting from partial austenitisation.[8] This suggests hot forging, which is typical when similar objects are made. Of course, partial austenitisation and reverting takes place differently in areas of different carbon content. In ferritic areas its effect is barely noticeable, only the rounded borders indicate it. However, in areas containing ferrite and pearlite, we can see non-austenitised and austenitic structures together, which are identical in terms of quality. It should be borne in mind that the transformation temperature, especially for ferrite particles near pearlite, depends on the carbon content of the immediate volume. For this reason, cooling takes place with different intensity depending on the carbon content. This is why we found regular particles in areas of low carbon content, along with pin-shaped *Widmanstätten* ferrites on the border of areas with high carbon content, containing more pearlite. In terms of fabric structure, the shaping temperature must have been somewhere between 750°C and 800°C, which is the cherry-red level on the colour scale of hot iron, and after the final phase of shaping, the object was cooled in the open air.

Figure 7.

Image taken of the head part (the "shoulder" of the head) of the iron nail No. 1

Source: Barkóczy–Török 2018.

[8] Austenite is a solid solution of iron, the constituents of which are carbon and γ-iron. It is stable at a temperature range from 730°C to 1490°C depending on its carbon content.

The preparation of the nail head is an interesting question. The head, similarly to the shank, has a layered structure. There is much more pearlite on the right side of the shank, and more pearlite can be observed on the same side of the head, as well. The left side of the head is almost completely ferritic, and the shank is likewise. If we regard the running of the layers as a strand orientation, it can be observed that the strand orientation of the shank shows an inclination in the head part due to jumping. It bends backwards to the right where the joining of the head is longer and contains more material. Based on this, we can name jumping as the technology used for shaping the head, which has been a traditional method in nail making for centuries.

The SEM/EDS analysis detected no element other than iron and carbon in the material of the nail *(Table 1).* The material structure contained relatively few inclusions extended in the direction of formation *(Figure 8).* The results of EDS analyses in *Tables 2 and 3* show that the inclusions have very high iron oxide content. Fayalite (2FeO SiO_2), which is common in iron smelting slags, is apparently not dominant here. These inclusions reflect the general composition of typically Ca–Fe silicate smithing slags with a significant wüstite phase (FeO). The relatively small amounts of aluminium, magnesium and potassium are probably components of complex oxides.

Table 1.

The element composition of the base material of the iron nail No. 1

Element	C weight [wt.%]	C atom [at.%]
C 6	0.59	2.61
O 8	1.15	3.82
Fe 26	98.26	93.56
Total	**100.00**	**100.00**

Source: Barkóczy–Török 2018.

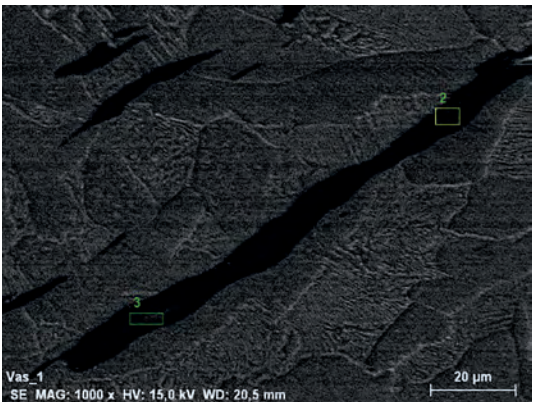

Figure 8.

SEM/EDS analysis of the long (elongated) inclusions (labelled with numbers 2 and 3) in the iron nail No. 1

Source: Barkóczy–Török 2018.

Table 2.
The analysis of area 2 in the selected inclusion of the iron nail No. 1

Element	C weight [wt.%]	C atom [at.%]
C 6	0.06	0.19
O 8	10.40	24.31
Mg 12	3.68	5.66
Al 13	3.32	4.60
Si 14	10.24	13.63
K 19	1.09	1.04
Ca 20	10.99	10.25
Fe 26	60.22	40.31
Total	**100.00**	**100.00**

Source: Barkóczy–Török 2018.

Table 3.
The analysis of area 3 in the selected inclusion of the iron nail No. 1

Element	C weight [wt.%]	C atom [at.%]
C 6	0.23	0.74
O 8	9.80	23.55
Mg 12	2.83	4.48
Al 13	2.47	3.52
Si 14	9.30	12.74
K 19	0.62	0.61
Ca 20	10.55	10.12
Fe 26	64.21	44.23
Total	**100.00**	**100.00**

Source: Barkóczy–Török 2018.

In the following, we will analyse similarities to and deviations from the above-mentioned properties of nail No. 1 in nails No. 2 and No. 3. The analysis of the head part of – the 82 mm long – nail No. 2 (i.e. the nail in the middle in *Figure 2*) revealed an even more characteristic layered structure and a specific texture, which developed due to the homogenisation of the primary product *(Figures 9–10).* At some places, there is an extensive diffusion zone between the layers with low and high pearlite content, while at other places, this layer is quite thin. The large diffusion zone is caused by the carbon diffusion that developed in the iron bloom, whereas the narrow diffusion zone goes back to the diffusion that developed at the boundaries of the homogenising fold in the heat of forging. In this nail, we also found evidence that the forging was carried out only in a semi-austenitised state *(Figure 11).* Furthermore, we could again observe areas rich in ferrite and pearlite, suggestive of free cooling.

The texture of nail No. 2 clearly demonstrates that the nail head was formed by jumping the material of the nail itself. In this nail, we could also find completely pearlitic areas, which could not be observed in the previous case. The microstructure is heterogeneous here, as well.

Therefore, it is not worth determining the average carbon content. The SEM/EDS analysis *(Figure 12 and Table 4)* did not show significant contamination in this nail either; in fact, it is an almost pure iron-carbon alloy. The two nails are significantly similar to each other in terms of the manufacturing technology and the basic microstructural properties of the material.

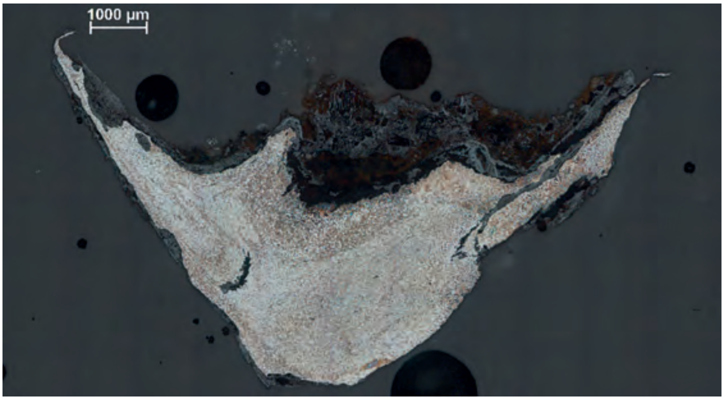

Figure 9.
Mosaic image of the head part of the iron nail No. 2
Source: Barkóczy–Török 2018.

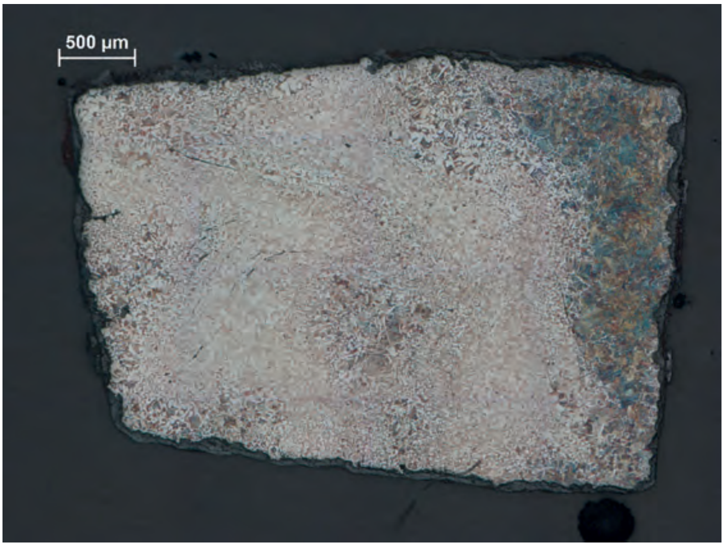

Figure 10.
Mosaic image of the transversal section from the shank of the iron nail No. 2
Source: Barkóczy–Török 2018.

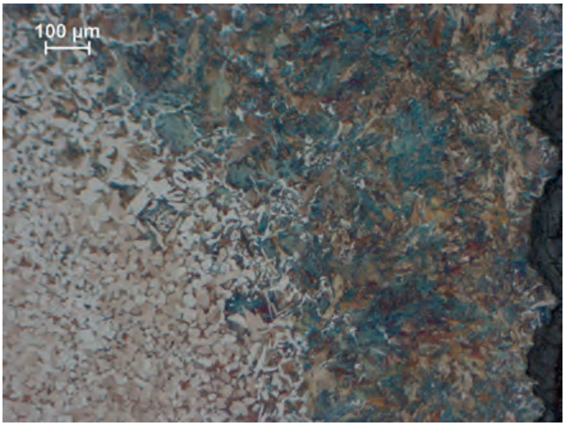

Figure 11.
Image of the transversal section from the shank of the iron nail No. 2
Source: Barkóczy–Török 2018.

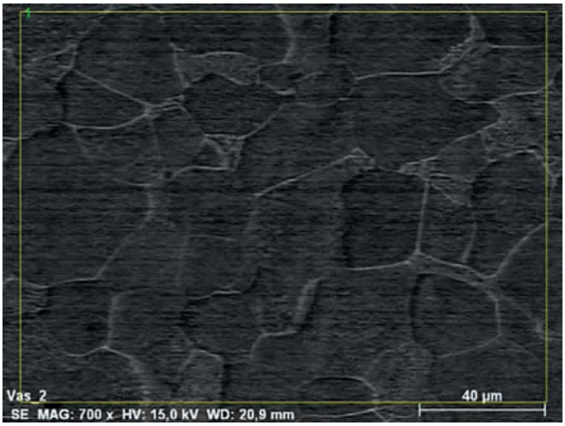

Figure 12.
The composition analysis of the base material of the iron nail No. 2
Source: Barkóczy–Török 2018.

Table 4.
The element composition of the base material of the iron nail No. 2

Element	C eight [wt.%]	C atom [at.%]
C 6	0.62	2.8
Fe 26	99.38	97.2
Total	**100.00**	**100.00**

Source: Barkóczy–Török 2018.

Elongated inclusions also appeared in the tissue of the iron nail No. 2 in the direction of shaping, but smaller, spherical (i.e. undistorted) inclusions can also be observed. The microstructure revealed by the etching of one of the examined inclusions clearly shows two phases. Both areas were subjected to SEM/EDS analyses *(Figure 13 and Tables 5–7).* The light phase consists mainly of iron oxide. The dark phase around it has a composition similar to that of the iron nail No. 1, except that it has a higher silicon content and less calcium can be measured in it. This inclusion can also be regarded as a remnant of a smithing slag, as it is suggested by the high iron oxide content. The unique use of the former blacksmithing additive may also contribute to the change in the basicity of the slag inclusions (CaO/SiO_2), that is, to a certain degree of heterogeneity between the inclusions.

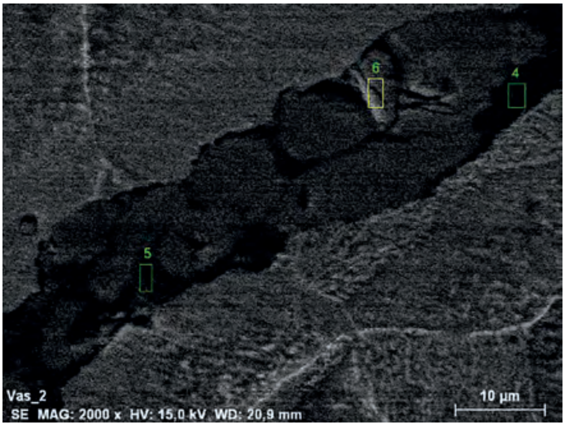

Figure 13.

SEM/EDS analysis of the long (elongated) inclusions (labelled with numbers 4–6) in the iron nail No. 2

Source: Barkóczy–Török 2018.

Table 5.

The analysis of area 4 in the selected inclusion of the iron nail No. 2

Element	C weight [wt.%]	C atom [at.%]
C 6	0.13	0.36
O 8	19.57	38.88
Al 13	5.03	5.92
Si 14	16.64	18.60
P 15	0.98	1.00
K 19	5.12	4.16
Ca 20	4.65	3.69
Mn 25	2.30	1.33
Fe 26	45.77	26.05
Total	**100.00**	**100.00**

Source: Barkóczy–Török 2018.

Table 6.

The analysis of area 5 in the selected inclusion of the iron nail No. 2

Element	C weight [wt.%]	C atom [at.%]
C 6	0.29	0.68
O 8	26.71	47.88
Mg 12	0.94	1.11
Al 13	5.21	5.54
Si 14	16.15	16.49
P 15	0.77	0.71
K 19	4.54	3.33
Ca 20	4.60	3.29
Mn 25	1.63	0.85
Fe 26	39.16	20.11
Total	**100.00**	**100.00**

Source: Barkóczy–Török 2018.

Table 7.

The analysis of area 6 in the selected inclusion of the iron nail No. 2

Element	C weight [wt.%]	C atom [at.%]
C 6	1.12	3.35
O 8	20.81	46.58
Fe 26	78.07	50.06
Total	**100.00**	**100.00**

Source: Barkóczy–Török 2018.

According to the testing strategy, the smallest sample was taken from the large nail (the nail at the bottom in *Figure 2*) with great care. In this case, our experience gained from the former analysis of the two shorter nails was fundamentally used for comparison. Only a transversal sample was taken from the end of the shank, close to the tip of the nail, so that it could be restored easily. This, of course, also means that the sample is not representative in all respects, but it still adequately reflects the properties relevant to our study. In the mosaic image of the large nail *(Figure 14),* large-grained ferrite can be seen over a significant part of the transversal section, which is suggestive of low carbon content. The lower part of the transversal section shows a layer of large carbon content, which is similar to the nails described above. On the right side of the transversal section, one can see elongated particles, the longitudinal axis of which is parallel to the given side. This indicates a moderately warm or possibly cold shaping. The elongated shape of the particles presumably developed when the nail was made, but it cannot be ruled out either that it was formed when the object was in use, already in a cold state. On the right of the transversal section, there is a cavity containing a series of inclusions, which may have evolved during the manufacturing process and it testifies to the relatively rapid, simple and not very thorough forging of a simple product, which is likely to have been produced in large numbers. It is certain that the technology of production was the same as in the case of the other two nails above. The SEM/EDS analysis shows in this case again a pure iron-carbon alloy without other alloying agents, in which the quantity of impurities is insignificant *(Table 8).*

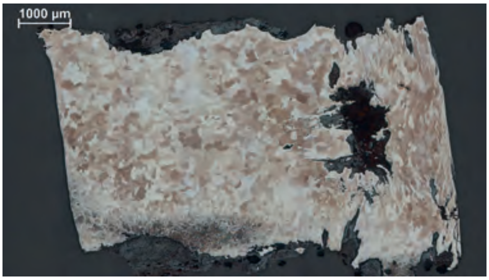

Figure 14.

Mosaic image of the transversal section of the iron nail No. 3

Source: Barkóczy–Török 2018.

Table 8.

The element composition of the base material of the large iron nail

Element	C weight [wt.%]	C atom [at.%]
C 6	0.46	2.10
Fe 26	99.54	97.90
Total	**100.00**	**100.00**

Source: Barkóczy–Török 2018.

In the examined transversal section of the large nail, we could find inclusions mainly near the cavity. The results of the analyses are shown in *Figure 15 and Tables 9–11.* The EDS results of the inclusion test show a much lower iron content compared to the compositions of the two smaller nails discussed above. Nevertheless, the Si content is slightly higher, and the Ca content is also high. The relatively high CaO/SiO_2 basicity reflected by the results of the EDS analysis does not indicate inclusions of iron smelting slags. These are probably also the remains of smithing slags, which contain a higher proportion of slag-forming and fluxing material.

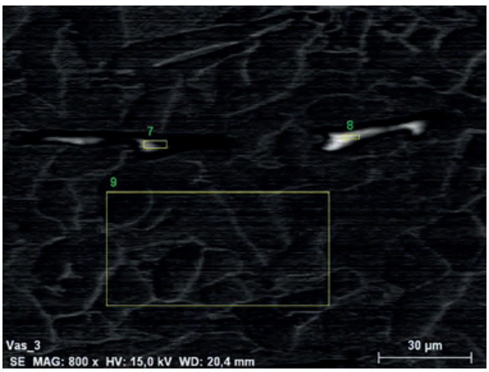

Figure 15.

SEM/EDS analysis of the long (elongated) inclusions (labelled with numbers 7–9) in the large iron nail

Source: Barkóczy–Török 2018.

Table 9.

The analysis of area 7 in the selected inclusion of the large iron nail

Element	C weight [wt.%]	C atom [at.%]
C 6	0.01	0.02
O 8	28.60	50.12
Mg 12	1.58	1.82
Al 13	3.62	3.76
Si 14	14.44	14.42
P 15	0.54	0.49
K 19	3.59	2.57
Ca 20	14.40	10.08
Mn 25	3.84	1.96
Fe 26	29.38	14.75
Total	**100.00**	**100.00**

Source: Barkóczy–Török 2018.

Table 10.

The analysis of area 8 in the selected inclusion of the large iron nail

Element	C weight [wt.%]	C atom [at.%]
C 6	0.83	1.92
O 8	28.03	48.55
Mg 12	2.57	2.93
Al 13	2.67	2.74
Si 14	14.84	14.64
P 15	0.53	0.48
K 19	2.88	2.04
Ca 20	15.47	10.70
Mn 25	4.12	2.08
Fe 26	28.06	13.92
Total	**100.00**	**100.00**

Source: Barkóczy–Török 2018.

Table 11.

The analysis of area 9 in the selected inclusion of the large iron nail

Element	C weight [wt.%]	C atom [at.%]
C 6	0.97	4.34
Fe 26	99.03	95.66
Total	**100.00**	**100.00**

Source: Barkóczy–Török 2018.

Overall, the nails were wrought by warm and semi-warm forging. Due to the heterogeneous structure of the iron bloom, heterogeneity can also be observed in the material structure of the objects, even after homogenisation. The most prominent features of the inclusions are the high iron oxide and Ca contents. The inclusions are basically remnants of by-products that developed during pre-forging and shaping.

The production technique of the three nails is the same, and their base material was also prepared with very similar care. Based on the material analyses, the production technique can be connected to contemporary work methods depicted in *Figures 16 and 17.*

A German image from 1482[9] *(Figure 16, on the left)* shows the nailer sitting on a stool and working with a hammer on a nail glowing red. The nailsmith jumps the head of a nail fitting it into a special punched tool used for forming nails. *Figure 16, on the right* (a German depiction from 1525) depicts the same process, but in this case, the background represents not only the built smithing hearth together with the primary products, but the bellow used for the smithing hearth can also be well observed. The nail depicted by the image on the left is very similar to the big iron nail investigated by us from the aspect of the shaping of the head. The image also demonstrates that this shaping of the nail heads was employed as early as the seventeenth century.

Figure 16.

Nailsmiths during work

Source: image on the left: www.nuernberger-hausbuecher.de/75-Amb-2-317-101-r (Accessed: 20 April 2019.); image on the right: www.nuernberger-hausbuecher.de/75-Amb-2-317-140-v/data (Accessed: 20 April 2019.)

9 The source (www.nuernberger-hausbuecher.de/75-Amb-2-317-101-r) also connects this representation to a work dated to 1522.

In a third German image, dated to 1572 *(Figure 17),* the nailer is in his workshop, sitting on a work block designed for this purpose. He hammers a nail from the tip of a long iron rod on an anvil. Because of the size of the product, right next to the small anvil, there is a wedge-shaped cutter ready to be used. The smith could cut off the finished tip with it. The flames in the free-standing fireplace behind him are fanned by his assistant. The finished wrought nails are stored in two 'selling bowls', and the range of products are displayed next to it.

Figure 17.

Nailer in his workshop (a German image from 1572)

Source: www.nuernberger-hausbuecher.de/75-Amb-2-317b-28-v/data (Accessed: 20 April 2019.)

In the case of lead musket balls, the exploration of the microstructure proved to be rather difficult, because lead is a very soft material, and this rendered the mechanical preparation for analysis very troublesome. Only after several cycles of polishing and etching were we able to obtain a microstructure suitable for analysis *(Figure 18).* It was noticeable that the preparation of lead balls with a small diameter was more difficult, probably because they were made of an even softer material than the large balls. The dendrite arms can be observed in the microstructure. The secondary dendrite arm spacing is approximately 10µm, which is indicative of rapid cooling. This may be due to the use of an iron/steel mould for the balls. The polyhedron black phases in the microstructure are Si-carbide particles originating from the preparation of objects for analysis, which unfortunately easily

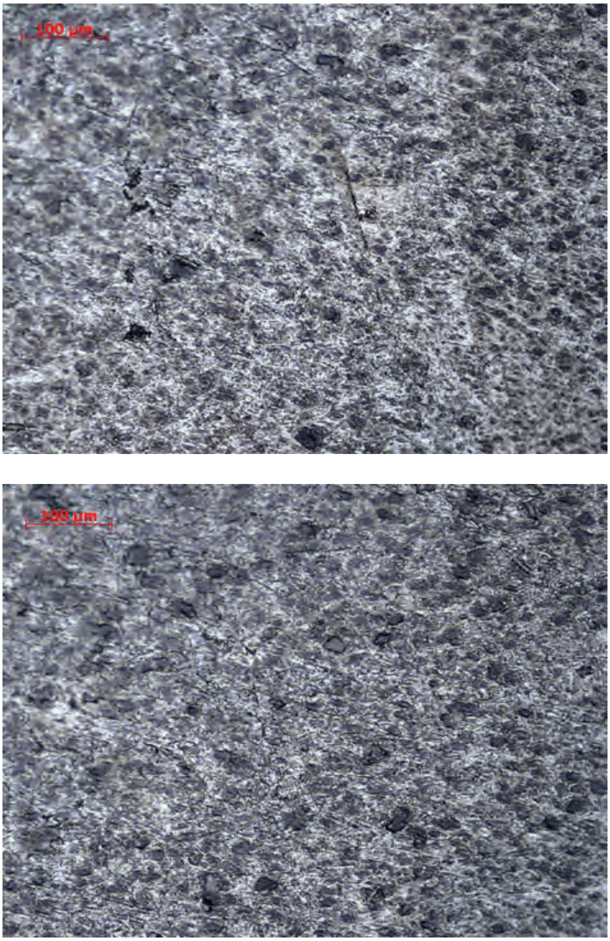

Figure 18.
Microstructure of the 16 mm (above) and the 17 mm (below) musket balls
Source: Barkóczy–Török 2018.

get stuck into the soft surface and slightly disturb the analysis. The samples clearly show the properties of casting, and the parting plane may also be well observed. We cut the balls perpendicular to the parting plane.
The SEM/EDS analysis showed that all the balls were cast from unalloyed lead. However, the 16 mm and 17 mm balls contained phases with high nickel and low phosphorus contents *(Figure 20 and Table 13).* These were clearly caused by contamination and made the composition of the lead balls slightly solider. Nickel and lead form a monotectic system, i.e. these phases get enriched and push crystallisation to a lower temperature. The 14 mm ball is made of virtually pure lead *(Figure 21 and Table 14),* with no impurities detected by the EDS analysis.

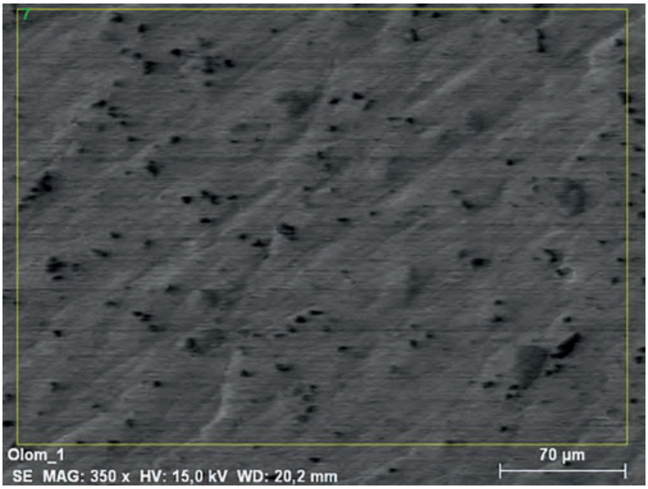

Figure 19.
Analysis of the average composition of the 16 mm lead musket ball
Source: Barkóczy–Török 2018.

Table 12.
Analysis of the average composition of the 16 mm lead musket ball

Element	C weight [wt.%]	C atom [at.%]
C 6	9.46	48.77
O 8	6.77	26.19
Pb 82	83.78	25.04
Total	**100.00**	**100.00**

Source: Barkóczy–Török 2018.

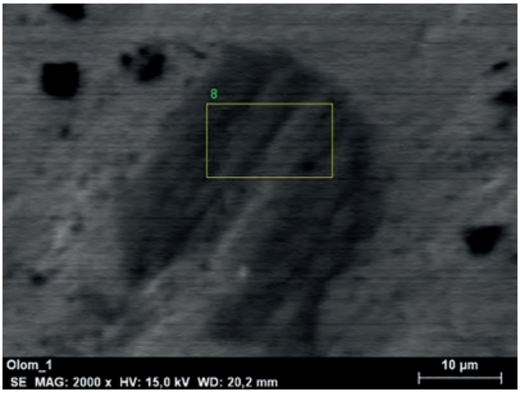

Figure 20.
Analysis of the nickel-rich phase of the 16 mm lead musket ball
Source: Barkóczy–Török 2018.

Table 13.
Analysis of the nickel-rich phase of the 16 mm lead musket ball

Element	C weight [wt.%]	C atom [at.%]
C 6	0.87	4.13
O 8	2.02	7.18
P 15	6.87	12.62
Ni 28	73.81	71.55
Pb 82	16.43	4.51
Total	**100.00**	**100.00**

Source: Barkóczy–Török 2018.

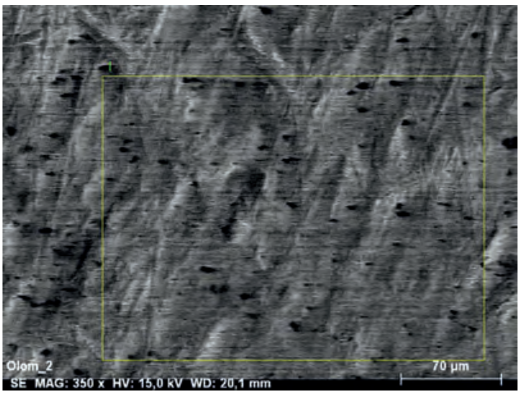

Figure 21.
Analysis of the average composition of the small, 14 mm lead musket ball
Source: Barkóczy–Török 2018.

Table 14.

Analysis of the average composition of the small, 14 mm lead musket ball

Element	C weight [wt.%]	C atom [at.%]
C 6	7.95	47.82
O 8	4.81	21.74
Pb 82	87.24	30.44
Total	**100.00**	**100.00**

Source: Barkóczy–Török 2018.

The results of the XRF tests of the unpolished halves of the lead balls cut in half are shown in *Table 15.* Nickel impurities do not appear here – the uncontaminated parts of the surface were placed under the XRF spectrometer. The indicated palladium and iridium contents are probably the result of peak overlapping caused by over-excitation and do not signal real presence of the mentioned elements. Lead is relatively difficult to excite, but this test also confirms that the balls consist of pure lead.

Table 15.

The results of the XRF analysis of the lead musket balls expressed in weight percent

Sample	Testing time (s)	Pb	Fe	Ag	Pd	Ir
Lead ball1 1	30	**98.60**	0.21	0.10	0.27	0.61
Lead ball1 2	30	**98.49**	0.27	0.07	0.33	0.61
Lead ball1 3	30	**98.67**	0.21	0.10	0.29	0.53
Lead ball2 1	30	**98.80**	0.07	0.09	0.29	0.56
Lead ball2 2	30	**98.82**	0.09	0.11	0.32	0.46
Lead ball2 3	30	**98.88**	0.07	0.09	0.31	0.43
Lead ball3 1	30	**98.43**	0.16	0.11	0.33	0.64
Lead ball3 2	30	**98.32**	0.18	0.08	0.30	0.59
Lead ball3 3	30	**98.06**	0.56	0.10	0.36	0.65

Note: The lead balls in the table are indicated as follows: Lead ball1 = 16 mm, Lead ball2 = 14 mm, Lead ball3 = 17 mm.

Source: compiled by the author

The xylotomic[10] analysis[11] of wood material discovered in the well at Zrínyi-Újvár during the archaeological investigation

Three pieces from a structural element of the well were selected for scientific xylotomic tests of wood material uncovered from the well of the Zrínyi-Újvár archaeological site. During the study of wood material, we were positive that the identification of a given species would contribute to our knowledge of plant-based raw materials and their use in a certain period, as well as to a better understanding of vegetation and, thus, the wider environment, as well.

The three tested structural elements are presumably wood materials preserved to varying degrees in partially wet and dry conditions. The samples taken from charred wood were relatively poorly preserved, whereas the preservation of samples taken from uncharred wood was considered good.

At first, we took samples from the selected wood elements using a chainsaw. Next, the transverse surface suitable for testing was formed with a belt sander and by hand sanding. The tree anatomy was studied with a stereo microscope. To measure the widths of tree rings, the samples were scanned at 1,200 dpi resolution using a calibration slide. The scanned images were processed with the QGIS 3.2.0 'Bonn' software. The actual width of the tree rings measured in the program was determined on the basis of ratios – in the knowledge of 1 mm on the calibration slide – with an accuracy of 1/1,000 mm. The conversion of the data obtained this way were converted into Heidelberg format using the TRiCYCLE 0.3.1 Dendro Data Converter program, and the lists of data were displayed with the MS Excel and Tellervo 1.0 programs.

To display the vegetation of the site – and its close surroundings – we made images with the QGIS 3.2.0 'Bonn' program, using the following sources:

- Marosi S. – Somogyi S.: Magyarország kistájainak katasztere [Inventory of Microregions in Hungary]. 1990.
- Zólyomi B.: Természetes növénytakaró [Natural Vegetation]. 1989.
- SRTM 90 m Digital Elevation Data – *Jarvis et al.* 2008.
- Első katonai felmérés [First Military Survey] – Map Collection of the Ministry of Defence, Institute and Museum of Military History, map sheets IV/17 and V/23, 1784, in 1:28,800 scale, digital edition by Arcanum 2004.
- Második katonai felmérés [Second Military Survey] – Map Collection of the Ministry of Defence, Institute and Museum of Military History, map sheets XXIII/61 and XXIV/61, 1858–1859, in 1:28,800 scale, digital edition by *Tímár et al.* 2006.
- Harmadik katonai felmérés [Third Military Survey] – Map Collection of the Ministry of Defence, Institute and Museum of Military History, map sheet 5458/3, 1879, in 1:25,000 scale, digital edition by *Biszak et al.* 2007.

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10 Xylotomic analysis is aimed at the examination of tissues from ligneous plant remains to determine tree species.

11 The examinations and evaluation of the results were carried out by Dr. Dénes Saláta, Associate Professor at the Department of Nature Conservation and Landscape Ecology, Faculty of Agriculture and Environmental Sciences, Institute of Nature Conservation and Landscape Management, Szent István University. *Saláta* 2018.

- Topográfiai térképek a II. világháború idejéből [Topographic Maps Used in World War II] – Map Collection of the Ministry of Defence, Institute and Museum of Military History, map sheet 5458/NY, 1940–1944, in 1:50,000 scale, digital edition by *Tímár et al.* 2008.

Each of the preserved samples charred in varying degrees belong to a deciduous tree (to ring-porous deciduous trees) in terms of wood anatomy.[12] With regard to the species, it can be determined that the samples belong to the oak species. Based on the large vessels found in several rows in the broad earlywood rings and the latewood vessels forming gradually narrowing, forked radial rows,[13] they presumably come from a sessile oak *(Quercus petraea)* – division of angiosperms *(Angiospermatophyta),* class of dicotyledons *(Dicotyledonopsida),* order of beeches *(Fagales),* family of beeches *(Fagales),* genus *Quercus.*[14]

It must be noted here that – according to the current international state of tree anatomy – pedunculate, sessile and pubescent oak species cannot be differentiated exclusively on the basis of their wood anatomy[15] *(Figure 22),* although some works[16] may help us do it within certain limits.

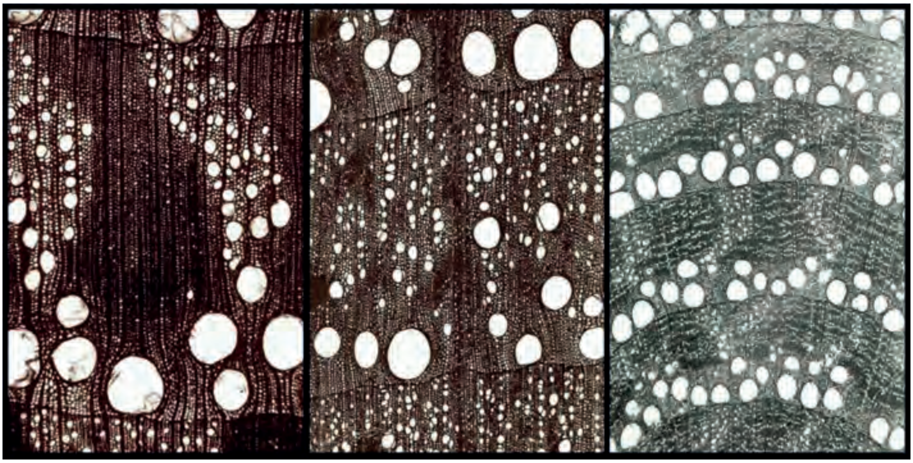

Figure 22.
Microscopic image of the transversal section of pedunculate, sessile and pubescent oak trees
Source: Schoch et al. 2004. www.woodanatomy.ch (Accessed: 20 April 2019.)

The wood sample is in a good, in fact, excellent condition. It is dry, and a part of it is slightly charred due to fire *(Figure 23).* The wood material is presumably a structural element of

[12] *Babos* 1994; *Molnár–Peszlen–Paukó* 2007.
[13] *Babos* 1994.
[14] *Simon* 2000.
[15] *Schweingruber* 1990; *Schoch–Heller–Schweingruber–Kienast* 2004.
[16] *Greguss* 1959; *Babos* 1994 or *Molnár–Peszlen–Paukó* 2007.

the well lining, comprising a wooden peg on one side necessary for joining. The burn mark suggests that the sample was exposed to fire for a short period of time – at least, in comparison with Samples 2 and 3.

Having studied the transversal section of the sample *(Figure 24),* we can conclude that the piece of wood comes from a ring-porous deciduous tree, most probably a sessile oak (v. sim.[17] *Quercus petraea*), and also that it was formed from the tree trunk.

Figure 23.
Sample 1 found in the well of the Zrínyi-Újvár archaeological site
Source: Saláta 2018.

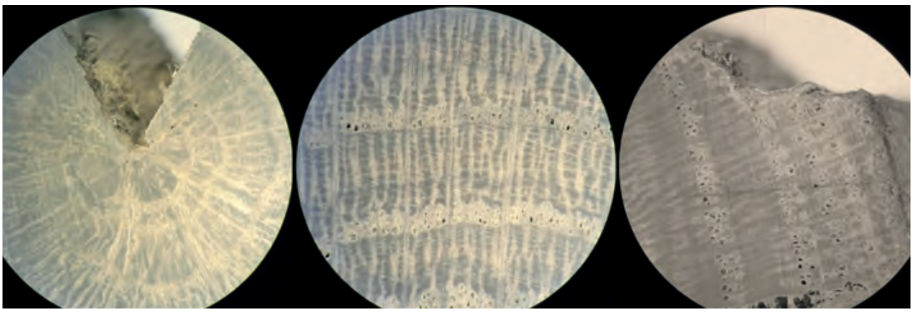

Figure 24.
Microscopic images of the characteristic transversal sections of Sample 1 found in the well of the Zrínyi-Újvár archaeological site
Source: Saláta 2018.

17 Veri simile.

The growth trend of the sample *(Figures 25 and 26)* shows that the tree grew rather unevenly in the first 10 to 12 years. In the following 20 years, the tree grew relatively significantly, apart from a 4-year period of modest growth. Subsequently, around years 30–32 a generally declining growth trend with relatively narrow, densely spaced annual rings started. The annual rings of earlywood from years 10 to 30 are quite wide (6–8 mm), so it is likely that the tree came from a habitat with favourable conditions. Furthermore, based on the image of the heartwood and the annual rings, the structural element was made from the trunk of the felled tree.

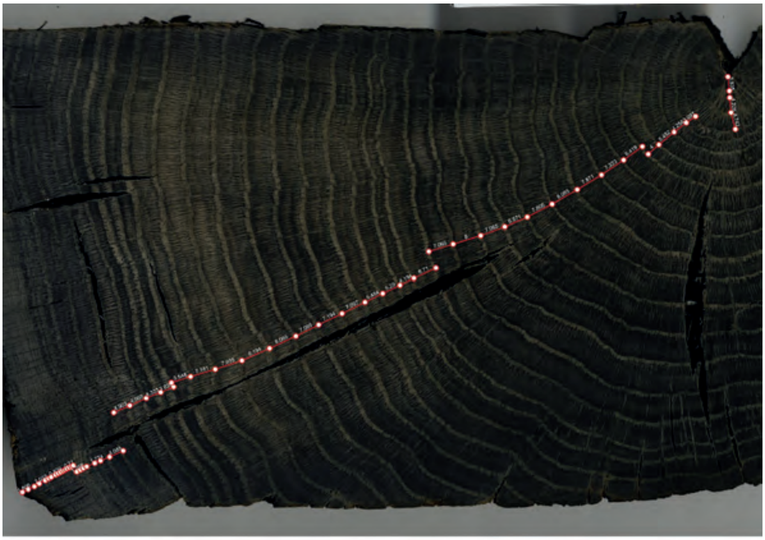

Figure 25.

Transversal section of Sample 1 discovered in the well of the Zrínyi-Újvár archaeological site displaying the widths [mm] of the annual rings, made with the QGIS 3.2.0 'Bonn' programme

Source: Saláta 2018.

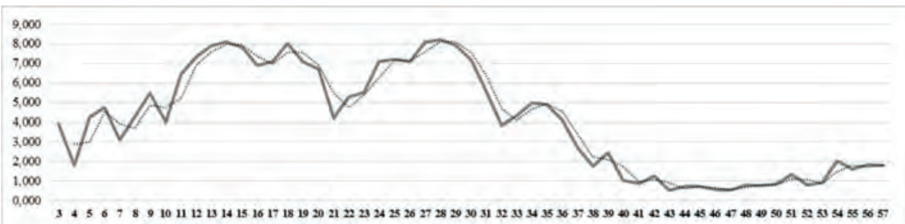

Figure 26.

Annual ring widths [mm] of Sample 1 from the well of the Zrínyi-Újvár archaeological site (continuous line), together with a two-period trendline (dashed line)

Source: Saláta 2018.

The wood sample is in good condition, dry, and its surface is charred due to fire *(Figure 27).* The wood material could have formed the well lining or even the structure of the well house. There is a carved, wrought part in the middle of the piece of wood, which probably served joining. Although the wood was considerably affected by fire, the supposed traces of carving can be seen well at both ends. It can be conferred from the burn mark that the wood was exposed to fire for a long period of time – at least, compared to Sample 1.

After studying the transversal section of the sample *(Figure 28),* we can conclude that the piece of wood belongs to a ring-porous deciduous tree, most probably a sessile oak (v. sim. *Quercus petraea*), and also that it was cut from the tree trunk.

The microscopic image of the transversal section of the sample has revealed several details that are worth being emphasised here. The left side of *Figure 29* shows a fragment of the annular rings preserved in a dry state. It is clearly visible that the large vessels of the earlywood form several rows. The image in the middle illustrates the effect of carbonisation on wood. The image on the right shows a ring-porous xylem with a few and narrow annual rings that developed in early spring, which was probably the result of some kind

Figure 27.
Sample 2 from the Zrínyi-Újvár archaeological site
Source: Saláta 2018.

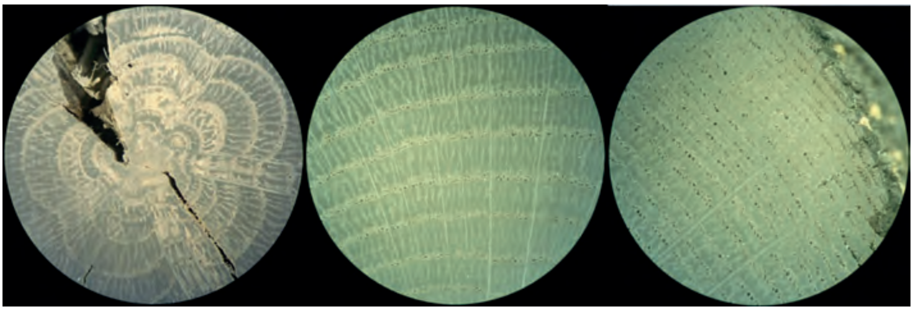

Figure 28.
Microscopic images of the characteristic transversal sections of Sample 2 found in the well of the Zrínyi-Újvár archaeological site
Source: Saláta 2018.

of deformation resulting in the transformation of the wood tissue. The recorded growth trend *(Figures 30 and 31)* demonstrates that the tree grew relatively hectically during its first 18–20 years, which was followed by a generally declining trend. Special mention must be made of the slow-growing phase in years 22–25, which is also clearly visible in the transversal section (in the middle of *Figure 30*). The annual rings of the early growth phase and those of latewood are quite wide, so the tree probably comes from a habitat with favourable conditions. Based on the image of the heartwood and the annual rings, the structural element was made from the trunk of the felled tree.

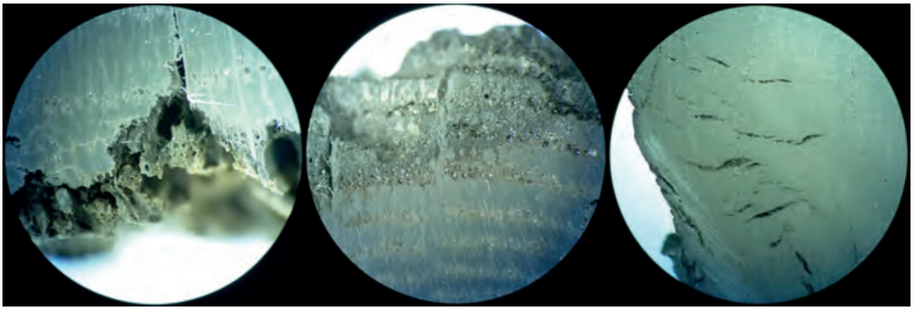

Figure 29.
Details of the transversal sections of Sample 2 found in the well of the Zrínyi-Újvár archaeological site observed under a microscope, which are worth being highlighted
Source: Saláta 2018.

Figure 30.
Transversal section of Sample 2 discovered in the well of the Zrínyi-Újvár archaeological site displaying the widths [mm] of the annual rings, made with the QGIS 3.2.0 'Bonn' programme
Source: Saláta 2018.

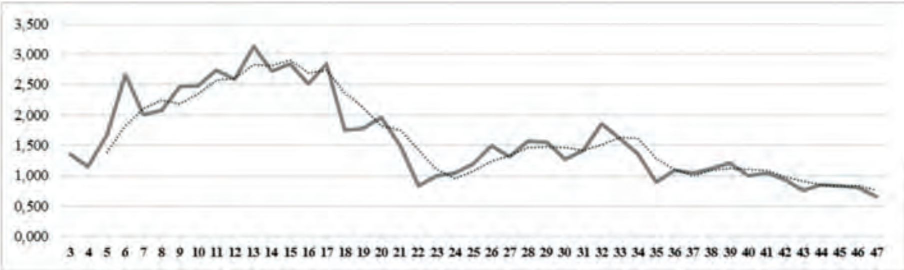

Figure 31.
Annual ring widths [mm] of Sample 2 from the well of the Zrínyi-Újvár archaeological site (continuous line), together with a two-period trendline (dashed line)

Source: Saláta 2018.

The sample is relatively well-preserved, dry, charred on the surface due to fire, and covered with clay loam and sand sediments *(Figure 32).* The wood was probably a structural element of the well lining or the well house, and although it was considerably affected by fire, it clearly shows the signs of carving on both ends. It can be inferred from the burn mark that the wood – at least, when compared to Samples 1 and 2 – was exposed to the effect of fire for a long period of time.

Having studied the transversal section of the sample *(Figure 28),* we can conclude that the piece of wood belongs to a ring-porous deciduous tree, most probably a sessile oak (v. sim. *Quercus petraea*), and also that it was cut from the tree trunk.

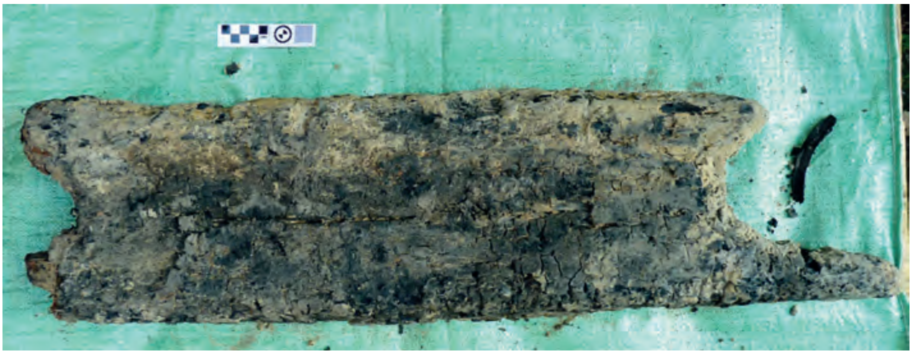

Figure 32.
Sample 3 from the Zrínyi-Újvár archaeological site

Source: Saláta 2018.

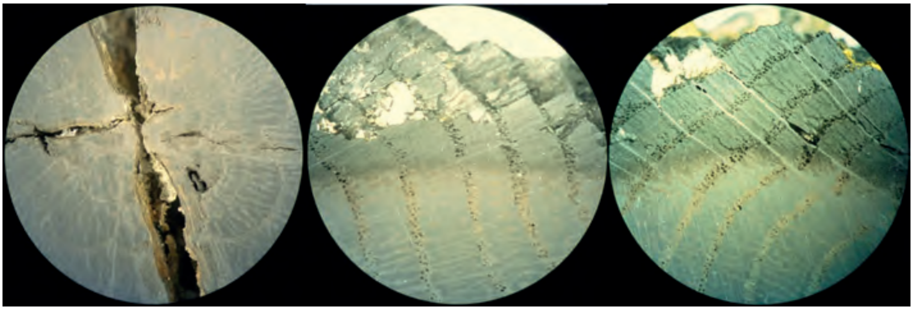

Figure 33.
Microscopic images of the characteristic transversal sections of Sample 3 found in the well of the Zrínyi-Újvár archaeological site
Source: Saláta 2018.

After studying the transversal section of the sample under a microscope, there are several details worth being emphasised. *Figure 33* shows the effect of carbonisation on wood, while *Figure 34* represents the passage caused by a pest. Its diameter is approximately 1–2 mm, so it is likely to be the woodworm hole and burrow of a common furniture beetle.[18]

The recorded growth trend *(Figures 35 and 36)* reveals that the tree grew relatively hectically in its first 18–20 years, which was presumably followed by a declining growth. However, due to the burn, we have information only about approximately 30 years. The annual rings and the latewood are quite wide, so the tree probably came from a habitat with favourable conditions. Based on the image of the heartwood and the annual rings, the structural element was made of the trunk of the felled tree.

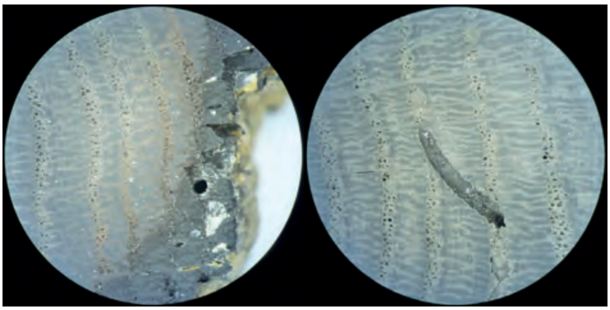

Figure 34.
Details of the transversal sections of Sample 3 found in the well of the Zrínyi-Újvár archaeological site observed under a microscope, which are worth being highlighted
Source: Saláta 2018.

[18] The habitats of the death watch beetle *(Xestobium rufovillosum Deg.)* and the common furniture beetle *(Anobium pertinax L.)* are equally connected to oak trees. – Family *Anobiidae* in *Brehm's* Life of Animals.

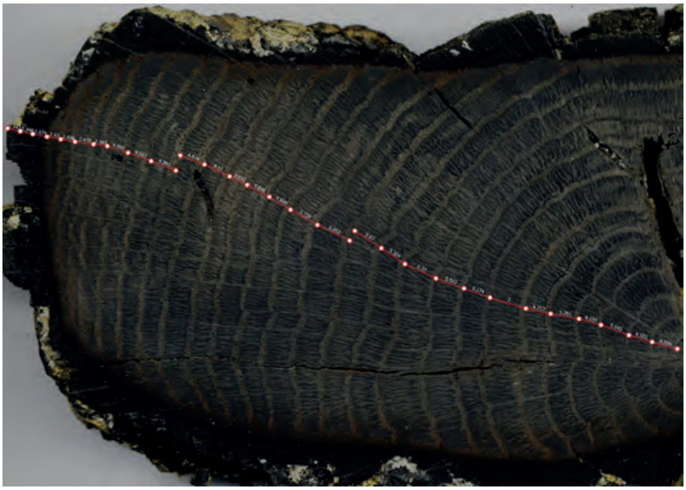

Figure 35.
Transversal section of Sample 3 discovered in the well of the Zrínyi-Újvár archaeological site displaying the widths [mm] of the annual rings, made with the QGIS 3.2.0 'Bonn' programme
Source: Saláta 2018.

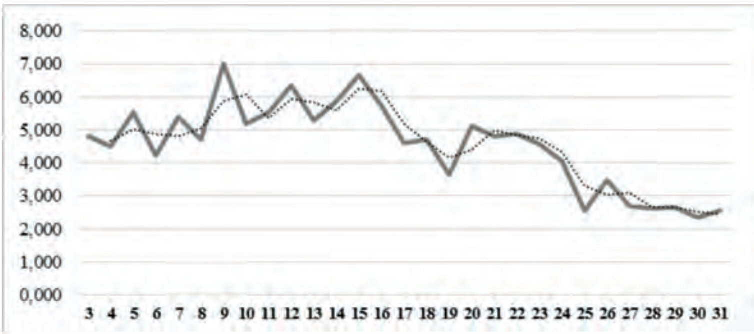

Figure 36.
Annual ring widths [mm] of Sample 3 from the well of the Zrínyi-Újvár archaeological site (continuous line), together with a two-period trendline (dashed line)
Source: Saláta 2018.

The investigated pieces of wood discovered in the archaeological site are highly likely to belong to the drought-tolerant sessile oak species. Based on the site, they can be dated to the seventeenth century, which period – in terms of climate and vegetation change – belongs to the Subatlantic climate period, or beech phase 2.[19]

[19] *Járainé* 2006.

We are in the same phase today, so the map[20] by Bálint Zólyomi representing the possible natural vegetation is extremely relevant and important for the question of vegetation in the examined area *(Figure 37).* It should be noted, however, that due to human activity, the vegetation cover may have significantly changed since the seventeenth century. The natural vegetation of the mountains consisted (and still consists) of oak forests, mixed hornbeam and oak forests and beech forests, while the characteristic flora of the Great Plain was the oak forest steppe.[21]

The investigated area is located on the border of the micro-regions Zalaapáti-hát (‘Zalaapáti High Plains’) and Mura-balparti sík (‘Plains on the Left Bank of the Mura’), in the meso-region of Zalai-dombság (‘Zala Hills’) belonging to the West Hungarian Border Region. The whole of the former micro-region is a potential forest area with hornbeam trees, and secondarily with shrub-sessile oak trees in its lower parts. The vegetation of the latter micro-region is varied, and it has groves consisting of oak, ash, and elm trees on its more elevated parts.

The map by Zólyomi indicates that the close surroundings of the site must have had floodplain grove forests, mixed Illyrian hornbeam and oak forests, Balkanic Turkey oak and sessile oak forests, sand oak forests, as well as Illyrian beech forests.

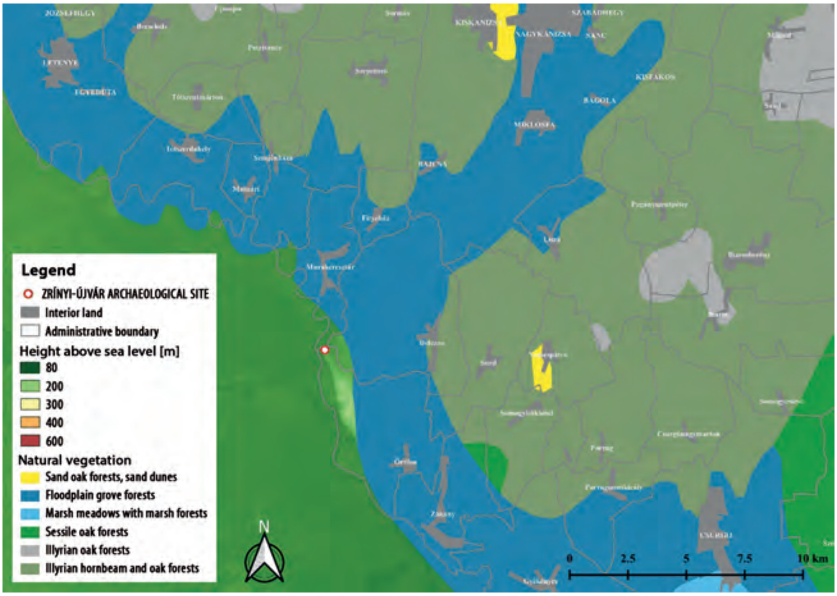

Figure 37.

Natural vegetation in the wider environment of the archaeological site

Source: made by the author with the QGIS 3.2.0 ‘Bonn’ program and the OTAB database based on *Zólyomi* 1989 using an SRTM 90 m Digital Elevation Model (*Jarvis et al.* 2008. http://srtm.csi.cgiar.org [Accessed: 20 April 2019.])

[20] *Zólyomi* 1989. 89.

[21] *Járainé* 2006.

The identified species correspond to the potential tree types on the possible vegetation map and the current distribution data of the species.[22] It is a common species in mesophilic and xero-mezophilic oak forests (e.g. hornbeam and sessile oak forests,[23] as well as scrub and low forests[24]).

Taking a look at the surroundings of the site depicted by the First, Second, and Third Military Surveys and topographic maps made before World War II, we find that the vegetation of the area had significantly changed by the eighteenth century. However, there were still accessible forests in riverside areas and on higher terrain, even within distances of 2 to 5 km. Therefore, the obtaining of timber for construction of the well could not have caused any difficulties.

Reviewing the results of the wood analysis, it can be concluded that the examined elements of the well were probably made from the trunks of sessile oak specimens. These trees presumably grew in an area of favourable conditions. What is more, it is also imaginable that they came from the same habitat – based on the growth trends indicated by the widths of annular rings *(Figure 38). Table 16* displays the annual ring widths of the examined specimens in a table format, numbered from core to bark.

The data of the xylotomic analysis are in line with the results of the research carried out by András Grynaeus on the wood remains discovered in the well of Zrínyi-Újvár.[25] Nevertheless, Grynaeus carried out not only a xylotomic but also a dendrochronological analysis.[26] From the results of dating, Grynaeus concluded that the tree the object was made from had most likely been felled after 1658.

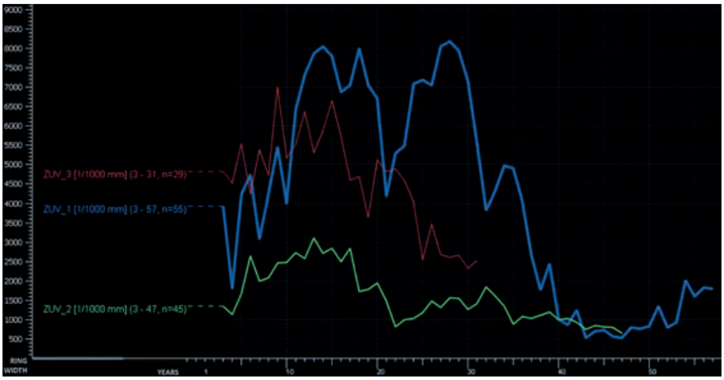

Figure 38.

Annual ring widths of the three samples from the well of the Zrínyi-Újvár archaeological site, and the growth trends calculated from them from core to bark

Source: Saláta 2018.

22 *Bartha et al.* 2015.

23 *Engloner–Penksza–Szerdahelyi* 2001; *Bölöni–Molnár–Kun* 2011.

24 *Simon* 2000.

25 *Grynaeus* 2018.

26 Dendrochronology is a natural scientific auxiliary discipline to archaeology that can identify the age of wood remains with the help of annual rings preserved in trees.

Table 16.
The widths of annual rings numbered from the core to bark [data given in 1/1,000 mm]

Years	Sample 1	Sample 2	Sample 3
3	3,935	1,362	4,826
4	1,806	1,149	4,522
5	4,226	1,681	5,543
6	4,742	2,660	4,239
7	3,097	2,000	5,391
8	4,258	2,085	4,717
9	5,452	2,468	7,000
10	4,000	2,489	5,174
11	6,419	2,745	5,522
12	7,323	2,596	6,370
13	7,871	3,128	5,304
14	8,065	2,723	5,870
15	7,806	2,851	6,652
16	6,871	2,511	5,739
17	7,065	2,851	4,609
18	8,000	1,745	4,696
19	7,065	1,787	3,652
20	6,710	1,957	5,130
21	4,194	1,489	4,826
22	5,290	830	4,891
23	5,484	1,000	4,587
24	7,097	1,043	4,065
25	7,194	1,191	2,565
26	7,065	1,489	3,478
27	8,065	1,319	2,696
28	8,194	1,574	2,630
29	7,935	1,553	2,674
30	7,161	1,277	2,348
31	5,548	1,426	2,543
32	3,839	1,851	
33	4,323	1,617	
34	4,968	1,362	
35	4,903	894	
36	4,065	1,085	
37	2,677	1,043	
38	1,774	1,128	
39	2,452	1,213	
40	1,032	1,000	
41	871	1,043	
42	1,258	936	
43	548	766	
44	710	851	

Years	Sample 1	Sample 2	Sample 3
45	742	830	
46	581	809	
47	548	660	
48	806		
49	774		
50	839		
51	1,355		
52	806		
53	935		
54	2,032		
55	1,613		
56	1,839		
57	1,806		

Source: Saláta 2018.

3D Virtualisation and Visualisation Technologies for Archiving the Results

András Németh – András Szabó – Ferenc Balog

Technological advances in recent decades have brought about revolutionary changes in all areas of life, which was partly due to the widespread deployment of IT-based and mobile communications solutions. Processes in the semiconductor industry have effectively supported miniaturisation efforts, resulting in smaller and more complex electronic integrated circuits, which made possible the development of IT-based devices with microprocessors of increasing capacity optimised for diverse functions. Due to the rapid increase in computing capacity and the decreasing price of new products, the tools and solutions that were previously available only to professional industrial users became accessible to a wider public, too. This has put an end to the monopoly of multinational companies in the field of IT-based innovation. Due to the spread of the so-called start-up business forms,[1] developments gained a fresh impetus in the field of both hardware and software. Thanks to this, three-dimensional (3D) technologies became an independent factor in the market, and 3D modelling, scanning, and printing started to develop dynamically and spread rapidly. Diverse 3D imaging procedures are now applied in various areas of life (medicine, cartography, architecture, engineering, education, public administration, etc.). They have also been involved in the toolkit of modern archaeology and warfare exploration, complementing the non-invasive investigation procedures and traditional research methods efficiently.

Spatial vision and spatial experience

Without going into details of the physiology and characteristics of human perception of space, it is worth noting here that the natural perception of space is the ability to determine the shape, size and position of the observed objects and their relative position in space based on two images. This is called stereoscopic vision, for which the two images are provided by the right eye and the left eye detecting radiation from the optical range (700–400 nm) of the electromagnetic spectrum. About 80% of all information from the outside world is obtained by man through eyesight. The perception of space within a short distance is based on binocular vision, that is, on measuring the convergence angle of the two eyes

[1] "Generally speaking, a business that has just been started is called a start-up if it has a high growth potential and some kind of innovation is involved in its product and operations." *Márkus* 2016.

https://doi.org/10.36250/00757_13

and the degree of lens accommodation. On the other hand, in the case of long distance, space is perceived on an empirical basis, through analysing perspective, light-shadow effects, coverages and movements.[2] This means that in the case of observation in a greater distance, the perception of space in the optical region is of prognostic, probabilistic nature, resulting in the "deceptability" of our eyes. This phenomenon of optical illusion can be made advantage of when, for instance, something is represented on a flat surface (in 2D) with the aim of creating spatial visual effects (in 3D). Nevertheless, if it can be technically solved that the same object or scene is seen by the two eyes from different angles, the brain is able to reconstruct a kind of spatial experience independently of the observer's intention. This may also be called artificial vision, which can be induced by various active and passive stereoscopic solutions (e.g. stereo slide viewer, polarised filter or anaglyph glasses,[3] VR[4] glasses) and holography.

At the same time, efforts to create a more realistic spatial experience have put 3D visualisation techniques on a new footing in recent decades. Instead of the illusory spatial representation of features (objects, living creatures, natural formations, shapes, and phenomena), today the IT-based design (imaging and making) of their 3D model is now the guiding principle, which can be then freely manipulated or animated against a real background, even in a likewise modelled environment. However, this solution goes far beyond *visualisation,* as it provides the opportunity to create imaginative spaces, locations, objects and scenes that are completely independent of reality. In other words, its application brings us into the world of *virtualisation*. Initially, these technologies emerged in the field of industrial design, video game development and Hollywood studios. Consequently, we could only follow their changes on a monitor or movie screen as passive observers, but they have now become accessible to almost anyone. The various technical solutions offered by the new technology allow us to create, among other things, accurate spatial models of damaged or fragmented artefacts from different historical ages following their 3D scanning. Afterwards, we can digitally complete them on the basis of other available sources (historical descriptions, graphics, etc.) or data. Following the required finishing, texturing and light-shadow effect adjustment, we can reconstruct them in their original state. The finished models can later be freely used for further projects on their own or as a component. They can be manipulated and animated, if necessary, or even reproduced in any number from different materials using some sort of 3D printing solution, to become visible, tactile and rotatable, but they can even be used in their original function.

Using various 3D software applications, we can create highly realistic models of fortresses, castles, palaces, as well as any building or site that existed hundreds of thousands of years ago, which are virtual replica that can be observed in space, but we also have the opportunity to make short films of complete battle scenes in nearly cinema quality. The application of 3D technologies with scientific rigour and historical loyalty, therefore, opens up entirely new perspectives in the field of historical research. It enables

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2 *Engler:* A térlátás; *Katona* 2012.

3 They are glasses that offer spatial visual effect by separating visual information intended for the right and left eye through the polarisation of light or using a colour filter.

4 Virtual Reality.

us to archive (digitally) and display our historical and cultural heritage in a way that may provide the conditions of an experience-based learning about our past for coming generations for centuries. At the same time, this method also allows us to avoid deliberate[5] or unintentional[6] modification, damage, or total destruction of certain artefacts. This paper presents the above-mentioned technologies, as well as related technical solutions and methods through the example of Zrínyi-Újvár.

3D scanning

There are many methods of 3D imaging – whether in medicine, cartography, architecture, archaeology, or material science – which use various fundamental laws of physics in their operations. 3D scanning is, in effect, a special method for examining a real feature, or the environment, whereby we collect data about its spatial extension, shape, and other properties of its appearance (e.g. colour, texture). The primary purpose of its application is generally to produce a digital 3D model of the scanned feature. The mass of information gathered as a first step is usually nothing more than a spatial point cloud the elements of which are found on the surface under investigation.[7] By fitting the points to a surface with some kind of geometric method, we get the digital spatial form of the observed feature. If we assign colour information to the point cloud during data capture, the texture and pattern of the original feature may also be recorded and displayed.

Although data acquisition can take many physical forms, including traditional measuring techniques, state-of-the-art devices are now represented by cameras mainly based on photoelectric effects (laser or structured light) that are capable of taking digital images of the observed feature from different directions (angles) in a given resolution. Resulting from their principle of operation, scanners have many similar features to digital cameras, so they normally have a cone-like field of vision and can only gather data about uncovered surfaces. On the other hand, their main function is to obtain distance information about the points of the surface of the object in question, with the help of which they can determine its spatial position within their own reference system. The texture and colour of the surface represent only secondary information for 3D modelling. The images produced by scanning and put in a common spatial reference system form a map as a result of a coordinated registration process, which contains a large amount of redundant information due to multiple overlaps. Based on the information stored in each image, a software module creates a spatial point cloud *(Figure 1)* and then reconstructs the 3D model through interpolation *(Figure 2).*

5 For example, historical sites damaged or completely destroyed by extremists. See https://news.nationalgeographic.com/2015/09/150901-isis-destruction-looting-ancient-sites-iraq-syria-archaeology/ (Accessed: 20 April 2019.)

6 For example, once the find is removed from its original site (peat bog, clayey soil, salt/sweet water, etc.), the preservative effect of its environment ceases, and therefore the natural decomposition processes begin and accelerate.

7 *Bernardini–Rushmeier* 2002.

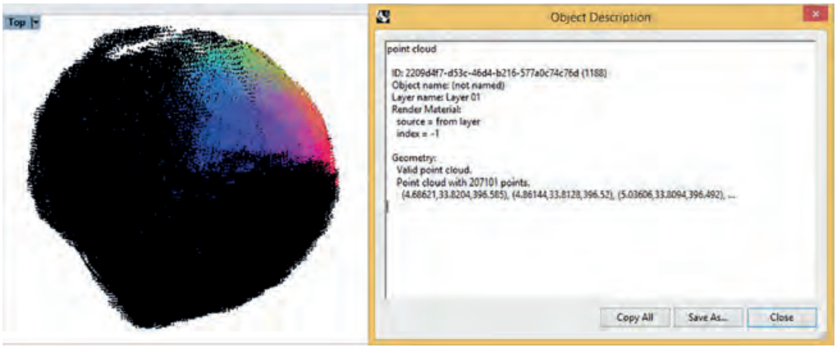

Figure 1.
Scanned 3D model of a musket ball (an unprocessed point cloud with 207,101 points)
Source: compiled by the authors

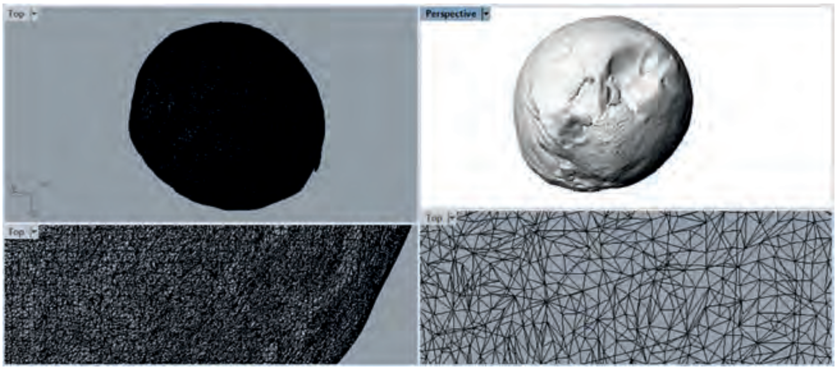

Figure 2.
Scanned 3D model of a musket ball (the polygon mesh of the surface)
Source: compiled by the authors

The features of the mathematical algorithms used in the process affect the quality of the end result to a great extent. The steps required for the reconstruction are summarised in *Figure 3* for scanners that process the distance data of points on the surface and texture information separately and combine them only at the very end of the model creation. Nevertheless, the exchange of information may also be carried out between the steps of the two processes for the sake of increasing accuracy (dashed lines). Although there are several technical solutions for generating point clouds, the most widely used active scanners apply the principle of triangulation to determine distance. The essence of this is that the surface of the object under investigation is illuminated with some source of light and the reflected light is projected through an optical system onto the surface of a photoelectric sensor. The relative position of the light source and the sensor(s) is known (recorded), and after calibration to a plane of reference, the system can detect the depth (ascent or descent) of

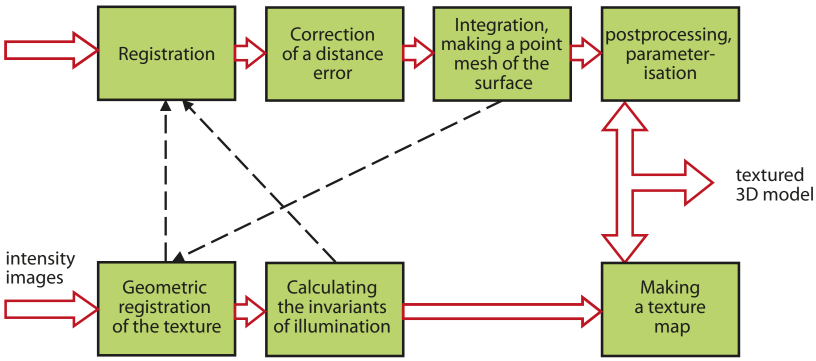

Figure 3.
The required steps for reconstructing a scanned model
Source: compiled by the authors based on *Bernardini–Rushmeier* 2002. 150.

a test point relative to its surface, as after reflection the position (Dz) of the resulting bright spot on the surface of the sensor will change according to the distance (DZ), in proportion to that *(Figure 4).* The software can convert the resulting depth values into a point in the 3D coordinate system of the scanner in knowledge of the calibrated position and orientation of the light source and sensor.[8]

In case of laser scanners, the light source projects a narrow band of light on the surface of the object and the CCD[9] sensor detects the peak of reflected laser light on each scan line, from which the 3D position of each point is calculated by intersecting the scan line with the known plane of laser light *(Figure 5).*[10]

The operation of scanners using a structured light source is slightly different, since such devices project some kind of pattern (preferably a linear one) on the examined surface, and the cameras are used to measure the magnitude of the actual distortion. The displacement of a single line can be transformed into 3D coordinates even directly, but there are also methods that project alternating patterns of band on the surface, resulting in a binary Gray code sequence that can be processed to determine differences in elements of the surface. For example, change in the width of a strip on a given surface will be proportional to the gradient of the examined surface; in other words, it is the first derivative of the depth parameter. The results of frequency and phase measurements with linear sequence can be analysed with a Fourier transformation.[11] Combining the various methods, we get a tool that is suitable for high-precision 3D digital reconstruction of the object concerned. *Figure 6* illustrates the conceptual operation of a dual-camera system, the purpose of which is to reduce errors caused by coverage due to the roughness of the surface during measurements. One of the greatest advantages of this solution is its promptness, as it does not scan the surface by points, but it can survey even the entire field of view. Because such a field-of-view

[8] *Bernardini–Rushmeier* 2002.
[9] Charge-coupled Device (photoelectric detector).
[10] *Bernardini–Rushmeier* 2002.
[11] *Peng–Gupta* 2007.

scanning phase may take place in a fraction of a second, we can scan moving objects in real time if we use the appropriate number and sensitivity of sensors and a high computing capacity processing unit.

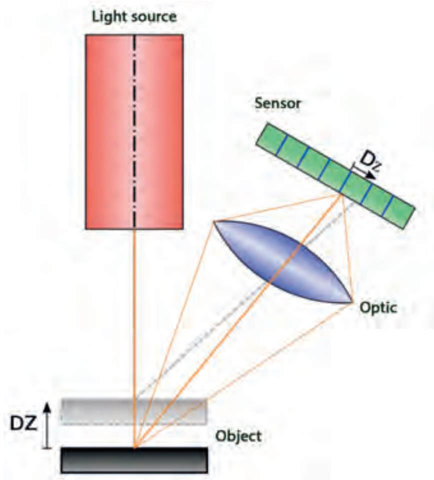

Figure 4.
The method of triangulation in measuring depth
Source: https://upload.wikimedia.org/wikipedia/commons/thumb/2/24/Laserprofilometer_EN.svg/360px-Laserprofilometer_EN.svg.png (Accessed: 20 April 2019.)

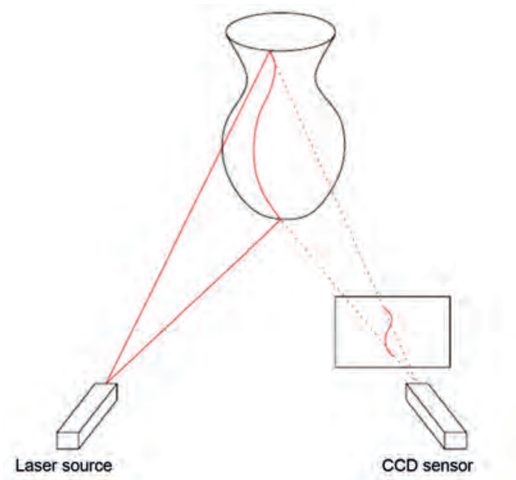

Figure 5.
The principle of laser scanning
Source: Bernardini–Rushmeier 2002. 151.

With both laser and structured light scanners, the main parameters and operational properties of the devices are influenced by a number of factors beyond the circumstances of application. From the part of the hardware, the built-in light source, the sensors, and the quality parameters of the optics have the greatest impact on the resolution and distortion of the point cloud generated by the device, whereas the control and data processing circuits – depending on the methods used – determine primarily the speed of operation. The quality of the created 3D model is determined by the operating principle and additional features of the mathematical algorithms used by the processing software, as well as its error correction capability.

Devices can generate files of different format from the respective direction of measurement. These are normally either files of point set (text files made up of x, y, z coordinates[12]) that can also be opened by other software applications *(Figure 7),* or files of manufacturer-specific formats.[13] If the texture is part of the scanning, then a bitmap can also be created (see *Figure 9*).

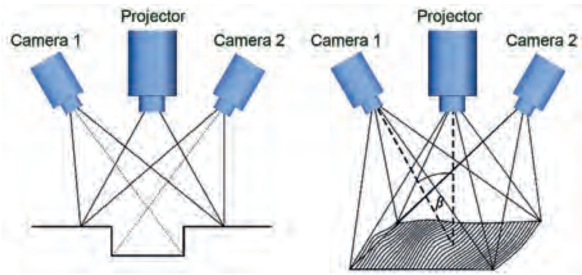

Figure 6.

Scanning with structured light

Source: https://upload.wikimedia.org/wikipedia/commons/a/aa/3-proj2cam.svg (Accessed: 20 April 2019.)

```
        x                 y                z
-6.31379 45.8204 396.585 -0.1865 -0.800412 -0.5697
-6.13856 45.8128 396.52 -0.125182 -0.821903 -0.555702
-5.96394 45.8094 396.492 -0.0709069 -0.842256 -0.534394
-5.78967 45.8093 396.491 0.121942 -0.866708 -0.48368
-5.6156 45.8094 396.493 0.191978 -0.89736 -0.397355
-5.4424 45.8175 396.564 0.076628 -0.935337 -0.345358
-5.26865 45.8174 396.564 -0.0376931 -0.955213 -0.293508
-6.30979 45.9663 396.333 -0.224425 -0.782316 -0.581047
-6.13572 45.9657 396.328 -0.165521 -0.826118 -0.538638
-5.96028 45.9558 396.244 -0.155495 -0.847306 -0.507833
```

Figure 7.

The structure of a file with .asc extension (the x, y, and z coordinates of the surface points are separated with a space in each line)

Source: compiled by the authors

[12] Generally, in the form of asc, csv, txt, pnt, xyz, and cgo_asci/cgo_ascii extensions.

[13] For example, .RGE (Shining3D), .3DD .RXP .RSP (Reigl), .3PI (ShapeGrabber), .AC (Steinbichler), .BIN .SWL (Perceptron), .BRE .CTR (Breuckmann), .PTS .PTX .PTG (Leica), .CDK .CDM .RGV .RVM .VVD (Konica Minolta).

Sets of points recorded from different angles can be merged into a single file, and (if necessary) gaps in the 3D model caused by measurement errors can be filled in during processing in order to obtain a consistent surface or printable solid shapes, and the redundant/false measurement results can be removed. For scanning smaller objects, we can apply automated object rotation (a rotary table), while for larger objects, vehicles, living creatures, or even buildings, we may use various manual devices. In the case of automated object rotation, the physical size and carrying capacity of the table may represent a limit.[14] Nevertheless, making a full model of small objects is also a challenge, as the base of the target object (the surface resting on the plate), and, in case of concave shapes, further covered parts do not appear in the model *(Figure 8).* This problem can be solved by scanning the object from different directions, followed by software post-processing.

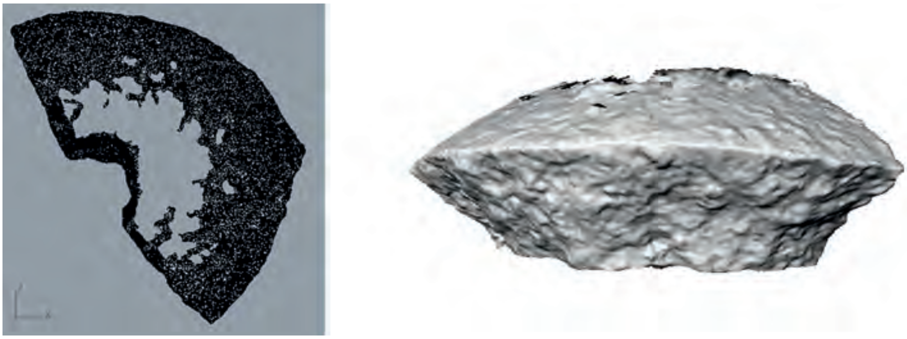

Figure 8.
The 3D model of a bomb fragment discovered at the site of the siege of Zrínyi-Újvár (left side: the polygon mesh from above, right side: a snapshot made from the plane of the cameras of the 3D scanner)
Source: pictures made by the authors

Objects that are dark,[15] shiny, glittering,[16] translucent,[17] or have light and dark details can be problematic from the aspect of scanning, so, for an optimum result, it is advisable to make them "matte" (e.g. using a crack testing aerosol) before beginning the process. With methods using structured light, the intensity and direction of the natural/artificial light sources may also affect the accuracy and outcome of scanning. We need to ensure that evenly diffused light is cast on the object throughout the process, which is relatively easy to guarantee under laboratory conditions, but it may require much more extensive preparation at the site of an archaeological excavation. In these circumstances, it is suggested to use a "light tent" with diffuse illumination – also used in photography – for smaller objects, in order to make error-free models. It is also worth making sure that the objects are not moved while their

[14] The tables are normally suitable for moving objects that are a few centimetres (less than 0.5 m) long and weigh but a few kilograms.
[15] It absorbs light.
[16] It scatters or unevenly reflects light.
[17] It transmits light.

stand is rotated, because this may result in a measurement error. The geometry and material properties of the object determine the fixing methods to be applied, which – in the simplest case – may be a double-sided adhesive or plasticine. If the condition of the find does not allow it, the use of a transparent underlay or support is recommended.

The 3D models[18] produced by scanning usually require post-processing,[19] which can be done with various 3D design/modelling software. Such programs also provide an opportunity to manipulate freely the end result afterwards.

The EinScan-SE device applied by us is suitable for indoor scanning of small-sized objects. It has a 1.3 megapixel camera with a focal length of 290–480 mm, fixed and automatic measurement options. During the scanning of the finds, we gained valuable pieces of information concerning the operation and properties of the device. With the help of its rotating table, the EinScan-SE can automatically take pictures from 8–180 directions, but before measuring, it is advisable to determine the resolution of the model to be made after studying the surface quality and geometric features of the object, and taking into account the measurement accuracy[20] of the device. Staying with the example above, there will be "false" measurement data in the point cloud of an over-sampled model, which is not easy to filter because of the high number of samples. Furthermore, the processing becomes also considerably more difficult due to the multiplied file size.[21]

Concave objects need to be photographed from various directions to minimise the proportion of shady areas. Subsequently, the resulting individual models can be merged with the help of the software. On the basis of practical experience, it can be stated that surveying with multiple object orientations and the merging of the models are both time consuming and rather cumbersome operations. Therefore, it is important to define in advance the orientations that are absolutely necessary for carrying out the task in question, thus minimising the number of scans, which can allow us to save much time, energy and storage space. For instance, if we use a prop or support made of some kind of transparent material, the target object can be raised/tilted to an optimum plane *(Figure 9).* Transparent supports will normally be invisible in the model or will lead to a small number of incorrect measurement points that can be removed with significantly less post-processing work. When using handheld devices, it is advisable to position the object in a way that it can be walked around from as many directions as possible, without interrupting the scanning process (unimpeded) from an optimum distance, because the time required for follow-up work and the size of storage space increases proportionally to the number of necessary measurements. Post-processing work after scanning can be made easier if we select reference points on the object *(Figure 10),* which can be sharp edges and textures, but we may also use patterns and markers in the background or at the base of the target object that do not cover or blend

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18 They are files consisting of spatial point clouds or a polygon mesh generated from them.

19 For example, filtering "false" measurement results (points or sets of points), generating mesh (polygonal) or NURBS surfaces from a set of points, reducing the number of polygons in meshes, and converting file types (converting to a format used by the software for the purpose of further processing).

20 The margin of error of the device we used for measuring the distance between the surface points of the studied object was below 0.1 mm.

21 Although the file size is influenced by many factors, our practical experience shows that it increases in direct proportion to the number of the images made, that is, the disk space required by the model showing the same object from 16 and 32 directions of view gets doubled.

with the target object. In the case of large, and perhaps homogeneous objects, the matching of individual measurements can also be simplified with markings (sticker markers) placed on the surface of the target objects.

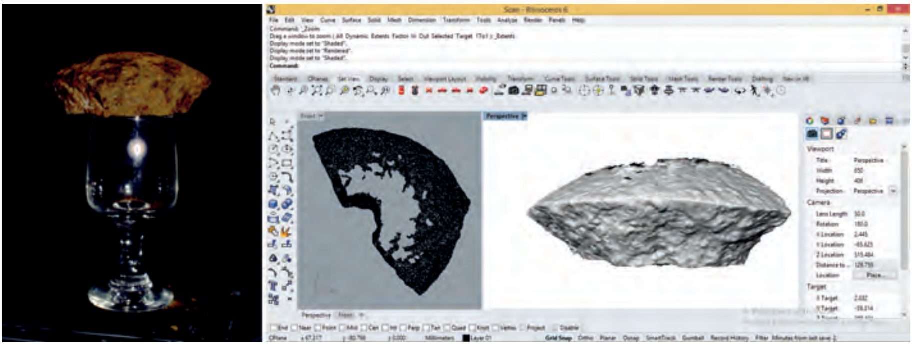

Figure 9.
Target object raised with a glass beaker
(left side: the image is a raw snapshot made by the scanner, right side:
the point cloud and the closed surface pulled over it)
Source: pictures made by the authors

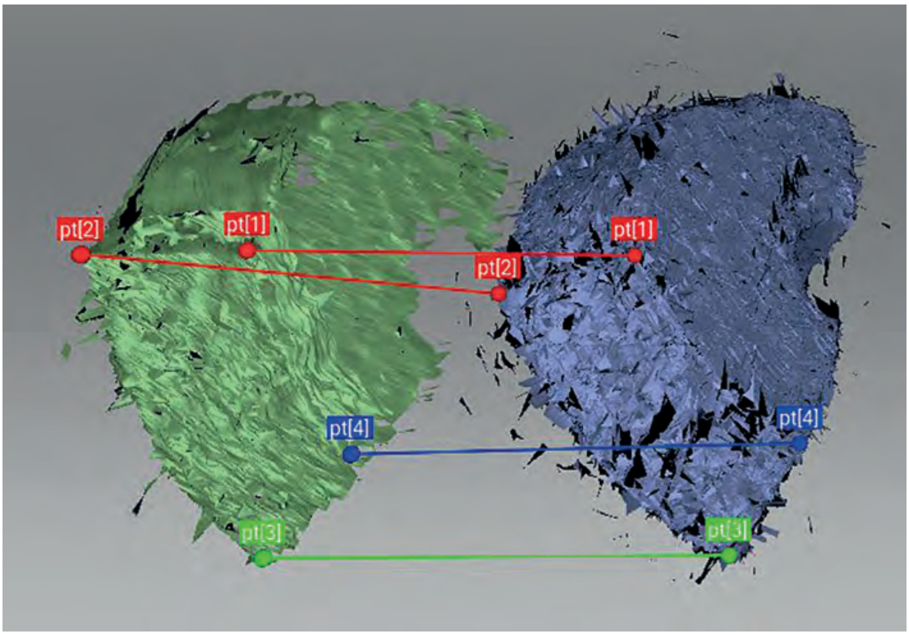

Figure 10.
Using reference points to match models scanned from two different directions
Source: picture made by the authors

The information content of digital models

Similarly to physical objects, the circumstances of making their digital representation (their 3D models) must also be recorded together with their relationship to physical objects. Professionals specialised in 3D scanning often include this information in the filename of the model when saving the file. However, this limits the amount of information to be recorded. Furthermore, ad hoc solutions (the divergent types, formats and the order of the given parameters) increase the likelihood of errors during subsequent processing. The conditions of measurement are not recorded in the files, and they are often not generated digitally by the software of the 3D scanner, either. Therefore, for archaeological applications, it is important to include some meta-information[22] in the descriptions of the files.

The need for these is going to be illustrated through a practical example in the following. *Figure 11* compares two 3D models made by two different devices (a handheld Artec Space Spider and an EinScan-SE scanner equipped with a rotating table). The extent of difference between the models is shown by colour coding in the software, where the parts coloured in red represent the greatest divergence. There are striking, nearly parallel lines at the apex of the spearhead that are visible even at first glance. These probably go back to measurement errors caused by strong lateral light falling on the target object while it is rolled around its longitudinal axis on the rotary table of the scanner. The measurement conditions and the configuration of the devices used during the scanning process could not be determined retrospectively based on the files of the 3D model.

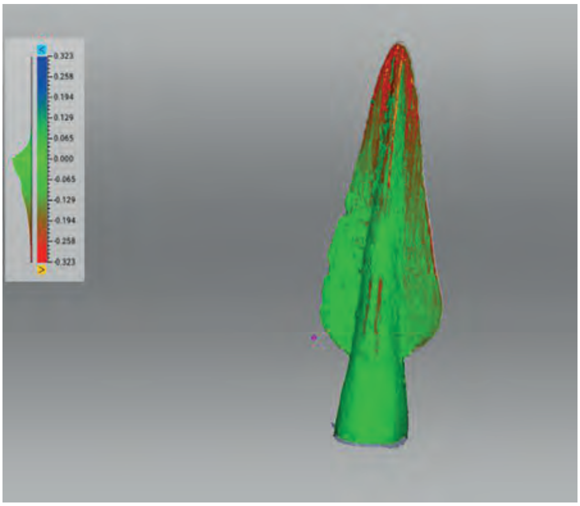

Figure 11.

Comparing the results of measurements made with two different types of scanners

Source: picture made by the authors

[22] Similarly to the "exif" information generated by digital cameras (see in more detail http://owl.phy.queensu.ca/~phil/exiftool/TagNames/EXIF.html [Accessed: 20 April 2019.]).

We can distinguish between metadata describing the circumstances of 3D scanning and recording the techniques used in post-production and data about the object (find) itself. In the former case, the data of the hardware and software used for modelling, their settings, the measurement layout and the modifications carried out during the post-production should be documented. In the latter case, besides the physical parameters (dimensions, weight and composition), the circumstances of the excavation (coordinates of the site, local reference points, etc.) may be relevant. In general, models are used in thematic virtual exhibitions, video presentations, animation and simulation. Therefore, it is worth tagging them (either with NTFS[23] or the tag system of other file systems), and it is advisable to generate a small preview file (to simplify search and management[24]).

3D visualisation and virtualisation

There are many options available today for the visualisation, manipulation and use of completed models in complex environments. Nevertheless, beside the various specialised software applications, it is worth highlighting the solutions that offer anyone an easy management of 3D objects within the most widely used operating system. Advanced 3D display/editing solutions have now been integrated into the Windows 10 software package, which, in addition to editing, are able to show a preview of every supported 3D model format[25] and their own default format (.3mf[26]), as well as to complete them with metadata *(Figure 12).* Unfortunately, these field names are predefined and cannot be modified by the user in the current version. They can only be read by the software applications of the operating system. However, the fact that the built-in applications of the operating systems are capable of displaying and editing 3D models points in the direction that 3D technology – which is still fundamentally used only by professionals – will soon be incorporated into the everyday life and work of large numbers of users, like text, image and video editing.

[23] New Technology File System. A standardised file system for the Microsoft Windows NT operating system and its later versions. Compared to previous file systems, it offers, among other things, access protection, the function of logging, and supports metadata for files.

[24] Files created by scanning objects can range in size from hundreds of MB to several GB, the loading of which may take up resources of the computer system for a long time.

[25] 3D model formats: .fbx, .3mf, .stl and .obj.

[26] https://3mf.io/specification/ (Accessed: 20 April 2019.)

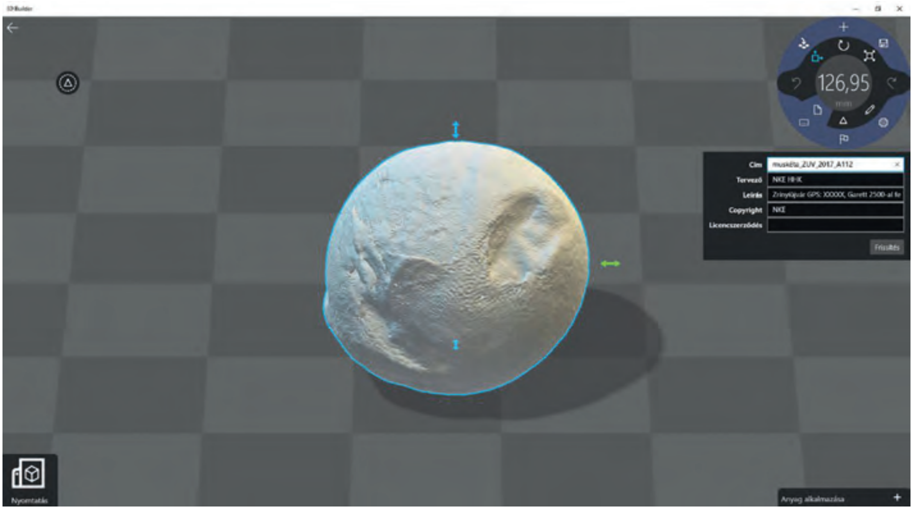

Figure 12.
Metadata fields for the 3D model format used in Windows 10
Source: picture made by the authors

The use of models based on the principle of photogrammetry

During the digitisation of objects, it may occur that the size, weight, or position[27] of the object does not make possible the use of measurement techniques described above, or their application does not demand the accuracy required by laser or structured light technology, or there may be a need for faster processing. In such cases, a 3D modelling method based on photogrammetry comes in useful for users, as illustrated in the case study below.

VR/AR[28] based solutions are useful tools for the interactive teaching of history. When developing the virtual tour of Zrínyi-Újvár, a prototype version was made, in which the user is able to walk around the landscape and the once extant defences, taking up the character of Miklós Zrínyi himself. The gamification[29] of learning can make studying history more attractive, help to envisage different historical events, and allow young people to travel through lost, distant, or inaccessible locations. Information points can be placed on the terrain model, which can be "visited" by students. They can thus learn about the everyday life of medieval people, the various aspects of life in a border fortress, as well as household objects and weapons (in the form of experience-based learning). These information points may comprise the photographs of finds taken of them in their original state, the results of their reconstruction, their 3D models, various written (historical

[27] For example, under water or in a cave.
[28] Virtual Reality/Augmented Reality.
[29] *Damsa* 2016.

sources, publications), visual (copperplates, graphics, photographs, map sheets) and video materials, as well as animations. To enhance the game character, puzzles and exercises can be connected to certain locations and events that must be done by the students during the tour. Of course, traditional teaching methods cannot be fully replaced by VR/AR based solutions, but they can be made more attractive and understandable, and the learning process might be accelerated. In case of augmented reality-based solutions, these games may also involve visiting the different locations,[30] and gathering information about them, for example, during field trips.

When designing the character of the "game" above, instead of using traditional modelling techniques, we applied a photogrammetric method to image Miklós Zrínyi after a bust exhibited in the hall of the Zrínyi Miklós Camp and University Campus housing, among other things, the Faculty of Military Science and Officer Training at the National University of Public Service.

Figure 13.
The model of Zrínyi-Újvár

Source: picture made by the authors

A free smartphone application (Autodesk 123D Design) was used for the photogrammetric processing. The software is no longer available. It has been replaced by the ReCap Pro[31] program. A total of 64 photographs were needed to make the model, which were taken with the built-in camera of the smartphone from two elevation angles – perpendicular to

30 We may also integrate the principles of popular geocaching for the sake of the game. See www.humankinetics.com/excerpts/excerpts/learn-about-the-benefits-of-geocaching (Accessed: 19 April 2019.)

31 www.autodesk.com/products/recap/overview (Accessed: 20 April 2019.)

the vertical axis of the statue and at an angle of 30° to that – in a way that the top of the head would be clearly visible. With the two series of 32 photographs, the entire surface of Zrínyi's statue was recorded. After uploading the photos to the application, its processing started and soon a high-resolution, lifelike 3D model appeared on the screen. After copying the raw model into the Autodesk Mudbox software, we first had to reduce its number of polygons and then add texture *(Figure 14).*

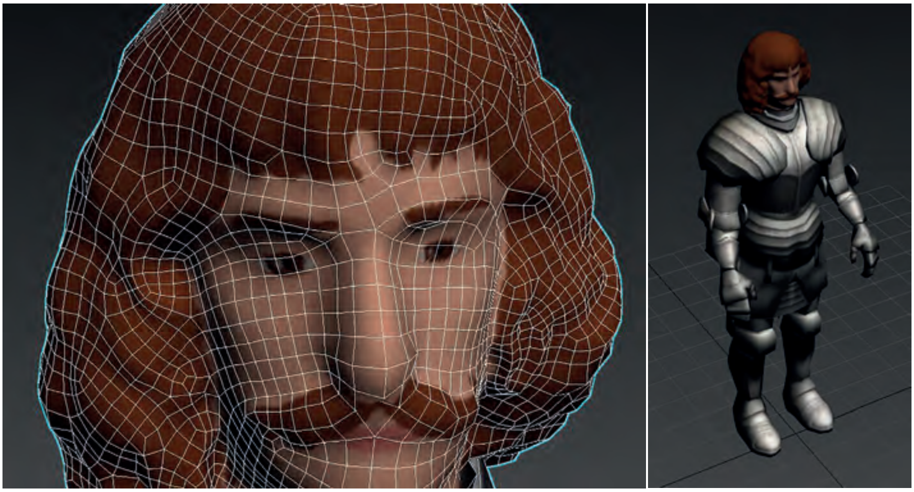

Figure 14.
The 3D model of Zrínyi Miklós

Source: picture made by the authors

The 3D model of the head was then added to a historically correct image of a full body armour suit downloaded from the Internet, creating thus the full figure of Miklós Zrínyi, which had to be subjected to a so-called rigging method[32] before being used. During this, we stretched our model on a skeleton so that during the animation, the polygons would move along with the bones, creating thus a lifelike effect.

The role of virtual and augmented reality in archaeological work

First of all, we need to clarify the meaning of the concepts above. The term virtual reality is an ambiguous term in itself, since the word "virtual" is also used in a sense contrary to (physical) reality. The terms virtual reality (VR) and augmented reality (AR) are often used interchangeably, although they have different meaning contents. VR means full simulation of the perceived/perceptible world, the imaging or artificial reproduction of various sensations

32 During the rigging, the body and limbs of the 3D model were referenced so that they could move, or be moved, in 3D space in a realistic way.

the way our sensory organs[33] detect them, whereas during the use of AR, our system adds extra information and content to the perceived reality, and therefore the real and virtual space appear simultaneously. This can be the most easily conceived as a second layer of information that does not exist in physical reality.

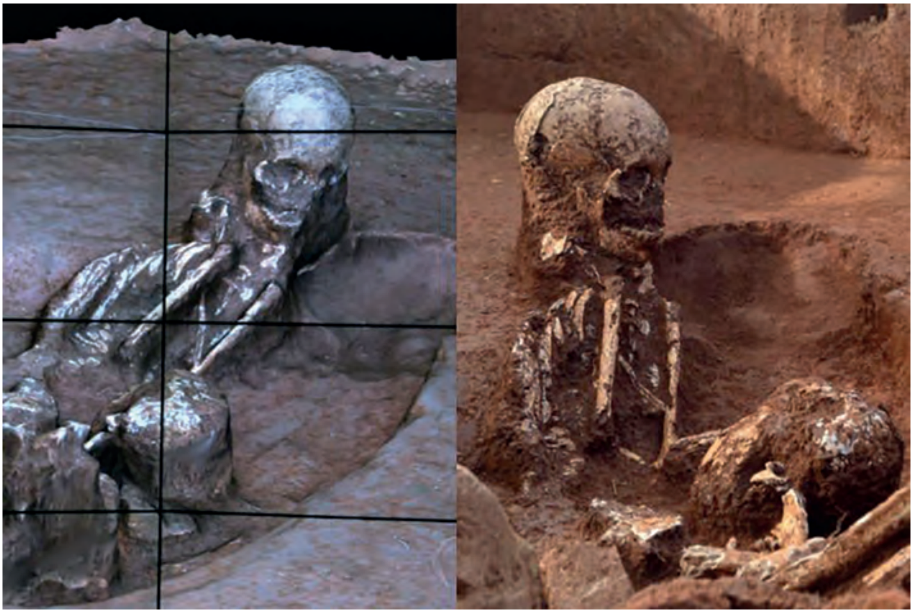

Figure 15.
Comparing a VR image and reality
Source: www.abc.net.au/news/2016-10-18/vr-and-drones-could-unlock-secrets-about-the-plain-of-jars-laos/7938520 (Accessed: 20 April 2019.)

There are many technical solutions for creating a 3D sense of space artificially, but the most widely used ones are the head-mounted displays/goggles, as well as projections[34] that partially or completely fill the field of vision.

In addition to modes of visualisation, solutions used for control (spatial navigation, interaction with the virtual environment) can also be important aspects for choosing a field of application. We can achieve a change of view or location in the environment with controllers, gestures, movements of the hand, but voice control modes are also in development. Physical barriers in space (walls, objects, etc.) may represent a limiting factor for VR solutions unless they are imaged in the virtual space (e.g. we place textures, models on a wall in a room that are visible in the virtual space).

33 Typically vision and hearing, but attempts have also been made to simulate, among other things, touch and the sense of balance.
34 This category involves the CAVE (Computer Assisted Virtual Environment) and dome projections.

Archaeological use can be diverse. For example, these solutions open up a possibility for non-invasive surveys. Furthermore, distant, hard-to-access, and intermittently accessible excavation sites can be displayed at any time, making them accessible for professionals taking part in the excavations even on a "daily basis". These models may also come in useful in the field of education and training, as in the event of less professional solutions, the occasional damage of finds can be prevented if the workflows are practiced in a virtual environment prior to the actual excavation. There are many cases when the real environment, physical conditions (size, distances, etc.) cannot be reproduced proportionally by a photograph or video, whereas in virtual space, the observer can get an experience of activities in an environment that is the closest to reality. The use of augmented reality in education is also beneficial as the workflow of an excavation can be recorded by a trained archaeologist at a real site and then the students can experience it in the classroom or at home, and may even take part interactively in the process *(Figure 15).*

Figure 16.

In a VR dome at the Plain of Jars site in South-East Asia (Phonsavan, Laos)

Source: www.youtube.com/watch?v=y9ZHw8T7ECU (Accessed: 19 April 2019.)

The application of 3D technology in archaeological workflows

3D models created during archaeological excavations and surveys can be used for many purposes. The most common ones include the reduction of the cost of expeditionary measurements at remote sites,[35] and the post-processing of the results of surveys made in

[35] *Metcalfe* 2017.

hard-to-reach, dangerous locations.[36] Find reconstruction and "preservation" is another possible use. The historically correct reconstruction of damaged artefacts from written and other sources with digital models is the most cost-effective solution. 3D technology can also facilitate long-term preservation and display, because they can be used to create (even with 3D printing) historically correct props and supports perfectly fitting to the finds. Another possible use is the test and comparison of theories related to the production and application of individual objects. For example, the pressed "bullet with a cylindrical body and globular head" empirically made during the research of Lajos Négyesi[37] could have been produced more simply and faster in the form of a digital model. Based on his research, Zoltán Bereczki[38] creates digital models of various medieval buildings, taking into account the constraints and possibilities of contemporary building methods *(Figure 17).*

Figure 17.
Visualising the steps of the construction of medieval buildings with the help of 3D technology
Source: http://bebop.hu/booklet/arnyekolt_egyben_lo.jpg (Accessed: 19 April 2019.)

In addition to the industrial quality control solutions, the created digital models can be used for controlling measurements of non-invasive surveys and other testing methods without temporal or spatial limitations, without physical touch, and even without the presence of the object. Using appropriate resolution and zooming in the model and maybe even removing the texture, one can see details – surface injuries, engravings, figures and

[36] In normal conditions, professionals can concentrate on the archaeological work itself rather than on the circumstances (e.g. monitoring diving equipment and instruments).
[37] *Négyesi* 2013.
[38] *Bereczki* 2018; *Bereczki* 2017.

inscriptions – that are otherwise invisible to the naked eye. Determining the volume of a musket ball that became irregular or deformed as a result of impact is a good example of such an examination. The result may offer great help in defining the original (production) calibre and, based on additional information, the age and weapon type. *Figure 18* shows a volumetric calculation carried out for the scanned and purified model of a musket ball that could only have been achieved as a result of a lengthy workflow if we had applied conventional measurement procedures and calculations. Importing it into the applied 3D modelling program and running a simple command line resulted in a volume of 2.825 cm,[3] which is an accuracy of 10^{-9} relative to the actual geometry of the 3D model.

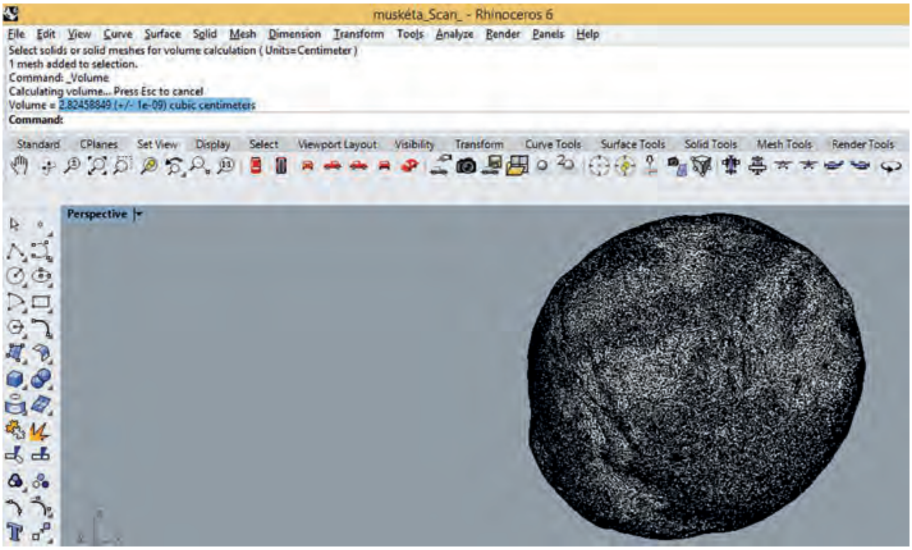

Figure 18.

Volumetric calculation on the model of a musket ball

Source: compiled by the authors

Archaeological excavations can uncover countless finds, the 3D digitisation and saving of which requires considerable storage space. The large size of the files due to recording in unnecessarily great detail and resolution may also cause difficulties in later use. That is why it is worth optimising after scanning, that is, simplifying the point cloud of the model or the number of the polygons to the necessary extent. For example, the open source and freely accessible Instant Meshes[39] software can offer an effective solution for the latter *(Figure 19).*

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39 https://github.com/wjakob/instant-meshes (Accessed: 20 April 2019.)

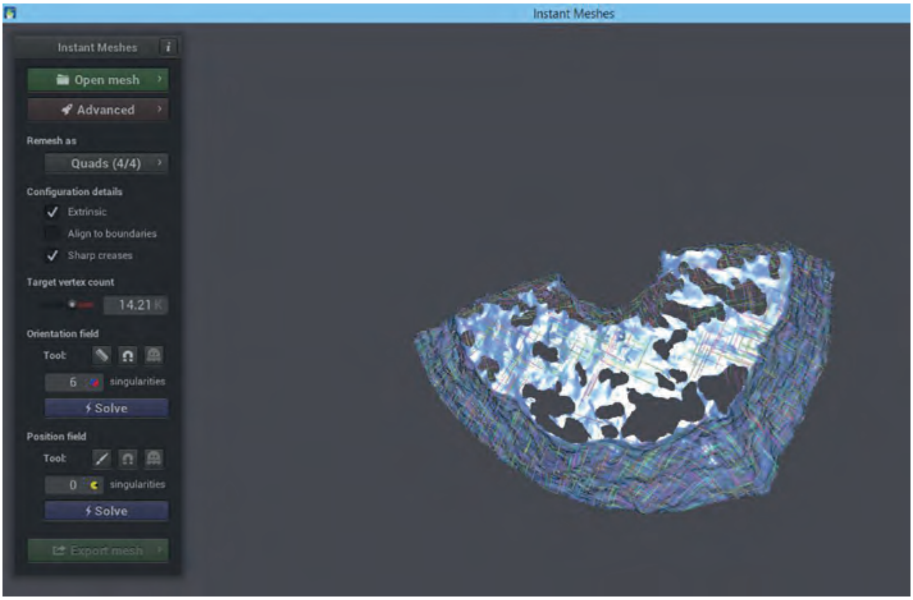

Figure 19.
The starting surface of the Instant Meshes software and the preview of the simplified model
Source: compiled by the authors

3D printing

Digital models of scanned objects and tools, or made with some 3D design software can now not only be displayed on monitors, but they can also be produced in a tangible form in a variety of materials using 3D printers. 3D printing belongs to the group of additive manufacturing techniques, since the desired forms are created by superimposing thin layers on one another instead of shaping prefabrications.[40]

In every case, the process is based on a digital three-dimensional model, which is split into thin horizontal layers using some kind of slicing software. Then we generate the control file that can be read and processed (executed) by the printer. This file contains step-by-step parameters (such as coordinates, speed and timing) for operating the device. After uploading and running the file, the printer starts to execute the instructions encoded in it. The printer constructs the item layer by layer from the selected raw material until it obtains its final form. Although, at first sight, it does not seem to be a complicated process, there are already several techniques for its execution in practice. With these, one can create almost any prototype from hobby use to professional engineering, which can be components and objects in a small or large volume made of almost any base material in a wide variety of

[40] *Husi–Szemes* 2015.

shapes and sizes. These solutions make possible the production of such complex structures that cannot be physically implemented in any other way.[41]

Of the 3D printing processes, the fused filament fabrication (also known as FDM[42]) is the most widely used and cheapest solution today. A common feature of machines operating on the basis of this principle is that the base material (some type of thermoplastic, that is, a plastic polymer material that becomes soft when heated) is available in the form of millimetre-diameter filaments reeled up. This is fed by a stepper motor into the heated extrusion head, where it is melted. The melted material is then squeezed through a nozzle a few tens of millimetres in diameter and cooled after fusing to the previous layer.[43] In a typical FDM system, the extrusion nozzle head is moved horizontally and vertically parallel to the workbench, which vertically moves apart layer by layer.

In stereolithography (also known as SLA[44]), the system works with a liquid polymer (photopolymer) that gets solidified due to light of a certain wavelength. In the process, the product is created on a workbench positioned one layer below the surface of the vat filled with photopolymer. A focused UV beam scans the surface of the liquid according to the geometry of the two-dimensional slices of the model until the polymer solidifies. Subsequently, the build platform lowers one layer deeper and the already solidified layer is recoated with another layer of liquid photopolymer. This method is repeated for each layer of the design until the 3D object reaches its final form. Depending on the geometry of the model, it may be necessary to use mechanical supports that can be removed when the production is completed. The finished products often need to be lit with UV light to achieve their final solidity.[45] This method allows the production of prototypes with significantly higher accuracy, but at a much slower speed than during fused filament fabrication.

In another manufacturing technology based on the principle of photopolymerisation, the liquid surface is illuminated by a projector (DLP[46]). These printers achieve higher speed of printing due to illuminating the entire layer at the same time. On the other hand, the maximum resolution available is limited by the resolution of the projector.[47]

SLS[48] works with a fine powdered material. The essence of its operation is that the device spreads the powered material on the work surface in a layer of desired thickness, and then the laser scans it with a beam directed by a mirror system according to the given slice of the model. The lit powder gets sintered and binds together with the adjacent particles making a solid structure. The powder bed is then lowered by one layer of thickness, and

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41 *Gál–Németh* 2019.

42 Fused Deposition Modelling.

43 3D nyomtatás különböző technológiákkal I. – az FDM eljárás [Printing with different technologies I. – The FDM method]. https://3dnyomtato.wordpress.com/2013/07/12/3d-nyomtatas-kulonbozo-technologiakkal-i-az-fdm-eljaras/ (Accessed: 20 April 2019.)

44 Stereolithography Apparatus.

45 Additív technológiák körkép [An overview of additive technologies]. www.cnc.hu/2012/12/additiv-technologiak-korkep/ (Accessed: 20 April 2019.)

46 Digital Light Processing.

47 3D printing Technology Comparison: SLA vs. DLP. https://formlabs.com/blog/3d-printing-technology-comparison-sla-dlp/ (Accessed: 20 April 2019.)

48 Selective Laser Sintering.

another layer of power is applied on top.[49] The greatest advantage of this procedure is that it is capable of printing metal objects, as well. SLM[50] and EBM[51] are similar techniques. The difference between them is that the former uses a high energy laser beam, whereas the latter uses a high energy electron beam to melt the metal powder.[52]

Special mention should be made of 3D printing processes using the "jetting" method. In the case of photopolymer jetting (PJ)[53] technology a liquid photopolymer is dripped onto the workbench, which is solidified with UV light right after it reaches the workbench. Binder jetting (BJ) technology, on the other hand, uses a special binder – pressed through the extrusion head – to bond the powdered material.[54] Both photopolymer and binder jetting procedures make possible very precise additive fabrication and result in a smooth surface, good workmanship and a reasonably long lifetime.

During the production of a laminated object (LOM[55]), a stepper (a system of feed rollers) transfers the sheets or layers of material used as the base material to the build platform. Afterwards, the inner and outer contours of a given section of the object are cut with laser light, which is followed by the binding process with the help of a heated roller. The platform is then lowered one layer deeper, and the system of feed rollers puts on the next layer.[56]

Given that our research team acquired a tool using FDM technique for the reproduction of finds discovered during investigation into the siege of Zrínyi-Újvár and other artefacts used for applicability tests, the printing process and raw materials had to be examined before the experiments began. *Figure 20* demonstrates the operating principle of FDM.

The figure illustrates that in the case of certain geometries, it may be necessary to use supports to avoid distortions. The support can be made of the base material of the printed object, which has to be removed at the end of the process. Subsequently, the superficial defects at the support points have to be smoothed (by polishing). In this case, a single extrusion head is enough, but manual finishing may take quite a long time. Alternatively, we can use two extrusion heads or a dual extruder feed device, so that while one extrusion nozzle builds the model, the other nozzle would fabricate the support from a material soluble in water (or other liquid).

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49 3D nyomtatás különböző technológiákkal II. – Az SLS eljárás [3D printing with different technologies II. – The SLS method]. https://3dnyomtato.wordpress.com/2013/08/14/3d-nyomtatas-kulonbozo-technologiakkal-ii-az-sls-eljaras/ (Accessed: 20 April 2019.)

50 Selective Laser Melting.

51 Electron Beam Melting.

52 *Palermo* 2013b.

53 Also known as PolyJet.

54 What is 3D Printing? The definitive guide to additive manufacturing. www.3dhubs.com/what-is-3d-printing#technologies (Accessed: 20 April 2019.)

55 Laminated Object Manufacturing.

56 *Palermo* 2013b.

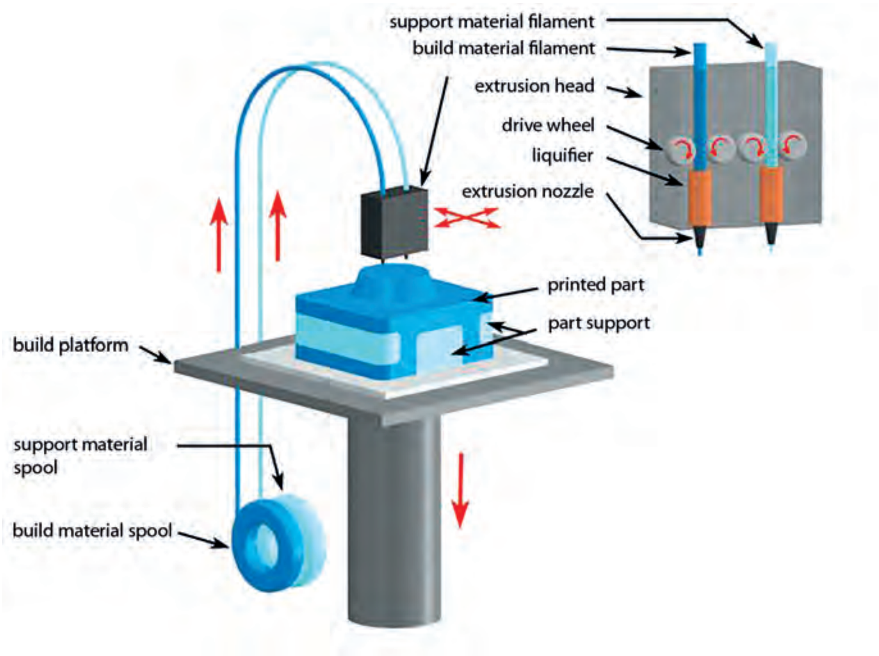

Figure 20.
The operating principle of FDM printers
Source: www.custompartnet.com/wu/fused-deposition-modeling (Accessed: 22 April 2019.)

The long continuous filaments used by the FDM printer (that are called in the same way in the textile industry) are made from a variety of raw materials sold in various packages. They have a wide range of properties due to the growing number of additives mixed to the basic component. Virtually all kinds of plastic polymer can be used as a base material that melts when heated and can be moulded (thermoplastic). They most often contain acrylonitrile butadiene styrene (ABS) and polylactic acid (PLA) filaments. The main difference between the two materials is that while ABS is a petroleum derivative, PLA is a biodegradable material that is produced from plants and can therefore be composted. When using ABS for 3D printing, it is worth heating the printer countertop to a temperature of about 110 degrees Celsius, because this material is highly sensitive to heat changes, which can cause deformation to the first layer when printed on a cold surface,[57] which renders it impossible to fabricate the product. Because of the thermal sensitivity, the print area should also be insulated from ambient air in order to minimise the amount of thermal fluctuation caused by air movements during the whole printing process. PLA, on the other hand, is a less sensitive material and can be handled in a much more flexible way, where the desktop does not require a heated environment. ABS is primarily used to manufacture objects designed

[57] 3D nyomtatás különböző technológiákkal I. – az FDM eljárás [Printing with different technologies I. – The FDM method].

for everyday use, such as parts of motor vehicles and plastic toys (including LEGO). In the automotive industry, companies such as BMW, Hyundai and Lamborghini are already using the fused filament fabrication technique, but large companies of other profiles (e.g. Nestlé) also like to use it in the field of product design or directly in production.[58] PLA, on the other hand, is suitable for the production of prototypes and devices subjected to less strain.

One of the benefits of FDM technology is speed. The model can be built quite quickly in a few hours or tens of hours, depending on the material, size and geometry of the fill, while in the case of more complicated techniques, the whole work process may take days for the same size of model. Another advantage is the potential of making larger objects. In the case of non-industrial devices, fabrications with side lengths of up to 50–60 cm can be produced, while with sintering or jetting, the side length is normally limited to 10–20 cm. The price and operating costs of printers using the FDM technology, as well as the relative cost of the basic materials used are considerably lower than in case of other devices, but in terms of the variety of materials, our possibilities are much more limited.[59] In spite of this, in addition to the aforementioned, there are also plastic-based printing filaments of 1.75 and 2.85–3 mm in diameter that can also be used for archaeological purposes.

In addition to filaments available in a wide variety, we can now work with wood-, metal-, and even stone-like materials, and the post-treatment of 3D printed objects offers further opportunities (e.g. cutting, polishing, turning, etching, drilling, reaming, sawing,[60] coating, painting, heat treatment, soaking, sanding and chemical treatment[61]).

The different types of technical filaments include mixtures with special properties that, among other things, change and improve one or more of the basic properties of PLA and ABS materials. These include, for example, heat resistant, impact resistant, flexible, abrasive and conductive/shielding[62] printer filaments.

HIPS[63] is a widely used polymer because of its hardness and heat resistance. In addition to these beneficial properties, it can also be used as a support for ABS filaments since HIPS is soluble in an organic compound, called limonene.

Filaments containing gypsum can be used to reproduce relief map tables, clay-containing objects and ceramics. They are easy to work with, like gypsum, so the end product can be polished, moulded, and the finished model can even be painted with watercolours.

Heat-resistant materials have a higher melting point than PLA, so even objects exposed to direct heat can be made of them. Typically, they also have a relatively high impact and fracture resistance, so objects, tools and show pieces exposed to greater strain should be made from such materials.

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58 *Palermo* 2013a.

59 www.cs.cmu.edu/~rapidproto/students.98/susans/project2/pros.html (Accessed: 22 April 2019.)

60 The applicability of these relies greatly on the type of material and the fill geometry of printing, as depending on these, the manufacture gets deformed due to clamping or other forces.

61 For example, in the case of ABS, keeping the item in acetone vapour for a while results in a smooth and shiny surface.

62 In general, materials with antistatic or shielding properties can be used to cover and separate electronic circuits.

63 High Impact Polystyrene.

Elastic filaments can be used, for example, to form props, lids, or supports fitting to archaeological finds. Antistatic conductive materials can be used to make overlay for instruments used in archaeological work (e.g. metal detectors) or devices that are in direct contact with them. Materials reinforced with kevlar and fibreglass have the advantage of being highly heat and wear resistant. Oil and chemical resistant materials, on the other hand, can be used to print structures and containers to store archaeological finds in them, and supports put in them.

In the case of fiberising technology, depending on the material used, but typically for bridges with more than 45 degrees of inclination or for objects without a pedestal ("hanging in the air"), it may be necessary to build supports. These supports can be subsequently removed by breaking or cutting them off the model. However, we might deform objects with thin walls (of a few fibres width) and items rich in detail, or damage them if we try to break off support towers with the same firmness. These destructions can be avoided by using water-soluble filament supports. When using fibres of special components, preparation for printing and the setting of the printer may differ from conventional PLA/ABS printing. We need to set correctly the temperature of the extruder,[64] the optimum printing speed, the rate of retraction,[65] and – in case of elastic and highly wear/impact resistant materials – the configuration of the mechanical elements (rollers)[66] used to transfer the filament (in order to avoid material jamming), and we also have to cope with the effect of thermal expansion. Harder mixtures (e.g. metal powder, kevlar, fibreglass) are likely to lead to the early wear of extruders during use either by themselves or due to the higher temperature required for their melting.

For our research workshop, we purchased a Craftbot3 3D printer[67] designed in Hungary, which has an independent dual extrusion system. Due to its resolution of 50–300 micron/layer, it can be used to reproduce archaeological finds rich in detail or to complete the damaged ones. The printer is equipped with a heated bed, which reduces the likelihood that the bottom layers will roll up or a faulty product is made when the materials used are more sensitive to temperature changes. The two extrusion heads can be freely used to print two objects simultaneously, in synchronicity or mirrored. They can also print an object together with its supports made of soluble filaments, or use two fibres of different colours and/or materials within the same object, offering thus greater freedom to users.

64 3D Printing Filament Comparison. https://static1.squarespace.com/static/57bafefc15d5dbf599092bd6/t/58a5f3e03e00be425d9b11df/1487270891027/ThreeDotZero+Filament+Comparison.pdf (Accessed: 22 April 2019.)

65 When printing non-related structures at more than one place on the workbench at the same time, it may be necessary to slightly withdraw the filament when setting the extrusion head between two work-phases to avoid dripping of the material.

66 For example, elastic filaments may slip from the drive wheels and get rolled up on their pivot, which halts the structure and/or lead to misprints and, on extreme occasions, they may even cause damage to the printer.

67 https://craftbot.com/category/craftbot-3-3d-printer (Accessed: 22 April 2019.)

Making and editing 3D models

There are several alternative software solutions for making modifications and additions to 3D models. These are generally similar in terms of their basic features and main functions and – focusing on certain dominant areas of use – the developers add further functions (e.g. computer animation, engineering, automotive, medical) to these. In practice, different professionals choose a tool for a particular task based primarily on their own professional knowledge and previous experience, rather than the actual facilities and potential of the software.

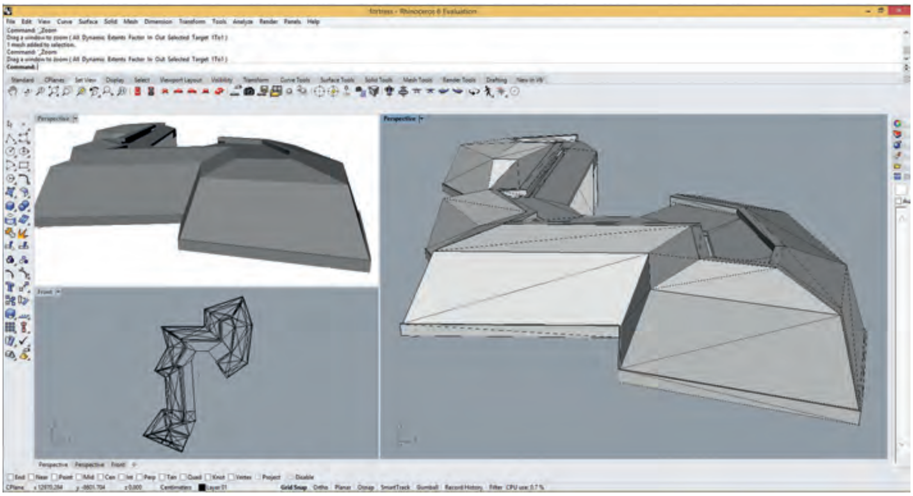

Figure 21.
Different views of the model of Zrínyí-Újvár in the Rhino software
Source: compiled by the authors

Different modelling, CAD[68] and animation software may have different interfaces and features, so switching between programs can either complicate or simplify users' task, depending on their prior knowledge and experience. In order to support the work of our research team, we opted for Rhino(ceros),[69] a professional 3D design software, because it significantly facilitates the tasks of archaeological modelling and find reconstruction due to its freeform design approach and solutions, while integrating many tools needed for parametric design and engineering modelling, and it is also suitable for complex visual designs. The software can open and edit, among other things, major types of files used in the field of 3D modelling and scanning, while different views and calculations support the analysis and processing of models. It is equally suitable for scanning, editing, and post-processing point clouds consisting of a large number of elements, the results of 3D scanning and LIDAR data. Based on 3D models, the reverse engineering[70] toolkit also offers the possibility to produce

[68] Computer Aided Design.
[69] www.rhino3d.com (Accessed: 22 April 2019.)
[70] Remodelling.

models that can be optimised, edited, or manufactured with different technologies. *Figure 21* shows the model of Zrínyi-Újvár in the user environment of the Rhino program, created with a method to be introduced below, after being scanned and visualised in the software.

Graphic design and implementation of the 3D model of Zrínyi-Újvár

The visual environment created in three dimensions with the help of a computer is based on the application of the CGI[71] graphics. One could first encounter with it in cinemas, then in commercials and television programs, but its leading sector has become the development of video games by these days. After the turn of the twentieth and twenty-first centuries, however, the computing power of personal computers (Intel Pentium III,[72] AMD Athlon[73] and Athlon 64[74]) has increased to such an extent that the visualisation of rudimentary 3D graphics created with them has also become available to the wider public both in terms of time and price. Subsequently, due to collaboration of multinational companies producing video cards and operating systems, a simple PC purchased for domestic use has also become capable of displaying much more complex visual representations rich in details (pixel shader,[75] vertex shader[76] and DirectX[77]).

Thanks to hardware manufacturers and system designers, the use of 3D graphics has spread rapidly, so separate development platforms have been designed to develop graphics software. Video game designers have also moved in this direction, as a result of which a number of software 3D engines[78] with different functions have been developed. Today they are used by designers, graphic artists, and even archaeologists and battlefield researchers during their work for creating their artwork or for visualising artefacts.

Employing the currently widely available achievements in 3D graphics, our research team has undertaken to design and build the most accurate 3D model of Zrínyi-Újvár and the visualisation of its immediate environment – based on the information available from our research in the past decades – that can be visited in an interactive way, as well. Our main purpose was to offer an experiential platform for displaying our former and future research results, as the model can be freely modified at any time based on scientifically proven data and information to be acquired in the future.

The complete visualisation of an authentic historical view based on 3D graphics requires a number of input parameters, as many as possible. They can be even redundant

[71] Computer Generated Imagery.

[72] 32-bit edition of 6th Generation Intel Core Processor with an x86 microarchitecture design (1999).

[73] 32-bit edition of 7th Generation AMD Processor with an x86 microarchitecture design (1999).

[74] 62-bit edition of 8th Generation AMD Processor with an AMD64 microarchitecture (2003).

[75] 2D technology, it allows post-processing of individual pixels.

[76] 3D technology, it allows post-processing of certain vertices displayed on the drawn canvas.

[77] It is a Microsoft package for the Windows operating system, which makes possible a faster display of multimedia applications.

[78] The 3D engine is an integrated software development environment designed to develop graphics applications. Each 3D engine is capable of drawing 2D/3D elements, detecting object collision, as well as physical space simulation and model animation.

data, historical notes, parameters, descriptions and survey results, which were fortunately already available to us at the start of the project due to the previous work of our researcher team members.

Baseline

Zrínyi-Újvár was a fortress along the Mura River, in the outskirts of today's Őrtilos in Somogy County, built by a Dutch military engineer commissioned by military leader Miklós Zrínyi[79] to strengthen the defence of Muraköz and his own estates effectively exploiting environmental and terrain conditions. The bridgehead constructed in this way could have served as a base for the recapture of the Fortress of Kanizsa and territories occupied by the Ottomans.

French General Pierre Surirey de Saint-Remy described in his *Mémoires d'artillerie* (1697) how the mortar batteries and cannon stands looked like at that time, and their layout is also presented in this work.[80] A distant view of Zrínyi-Újvár also appears among the sketches of the work *(Figure 22).* Although in this form, it did not provide us with precise information, it helped us begin the process of visualisation.

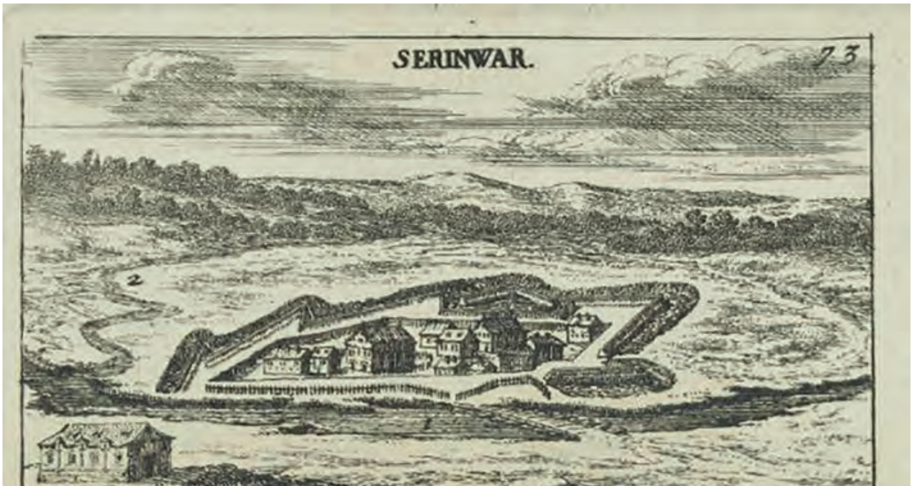

Figure 22.
Panoramic view of Zrínyi-Újvár

Source: Birken 1664.

[79] Zrínyi Miklós (in Croatian: Nikola Zrinski) was a poet, military scientist, commander and politician, who lived in the seventeenth century. He was the Ban of Croatia, Lord Lieutenant of Zala and Somogy Counties, and a high nobleman with large estates.

[80] *Saint-Remy* 1697.

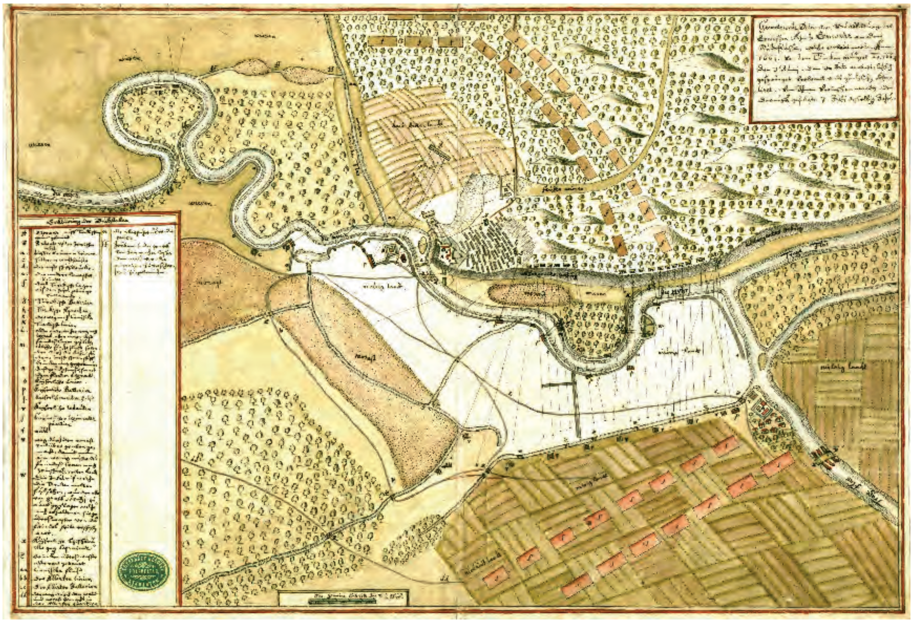

Figure 23.
Map in Pál Esterházy's work, 1664
Source: MNL OL T. 2. XXXII. 1064

Although historical records and descriptions offer us a lot of useful information, the accurate spatial localisation requires the use of maps. When planning orientation, we relied on a contemporary map shown in *Figure 22,* which clearly depicts the position of the fortress and its surroundings, including a nearby lake and the bank of the Mura River. The position of the bridges across the river and the location of the buildings can be clearly seen, and – even if schematically – the relative position of the Ottoman siege trench is also represented.

Perhaps the biggest help in planning was offered by the 2010 model reflecting the state of Zrínyi-Újvár and its surroundings on 14 June 1664, which records the conditions assumed based on the results of the research until then. Therefore, it proved to be a good idea to choose it as a starting point. A detail of this model (top left), its graphic design (right), and a sketch drawing after a contemporary map by Jacob von Holst (bottom left) used as a basis for these two are shown in *Figure 24.*

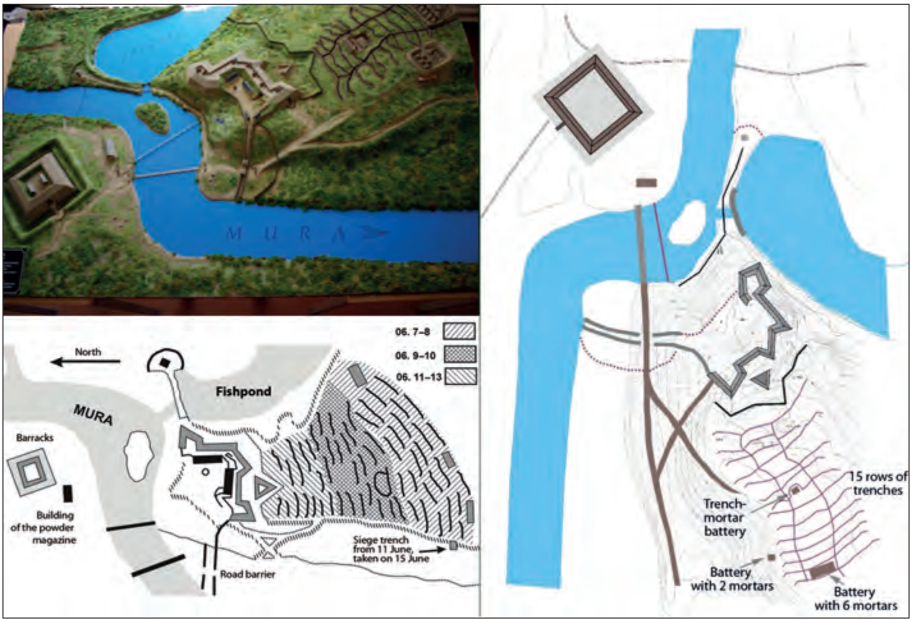

Figure 24.
A model and graphic design of Zrínyi-Újvár, as well as its sketch drawing after a map by Holst[81]
Source: compiled by the authors

Software background

The software that we used for creating the 3D visualisation was chosen on the basis of our already existing professional experience and skills in the field, as well as the potentials and limitations of the application. The Blender Foundation 3D graphic modelling platform is an open source (GNU GPL v3[82]) program and is widely used by 2D-3D graphic designers, modellers and engineers. In addition to creating models, it offers the possibility to perform animation, simulation and rendering.[83] We relied mainly on the Blender version 2.76 when creating the 3D models of some of the elements of Zrínyi-Újvár. Its main advantage is that

81 Based on contemporary sketches and field surveys, the fortress reconstruction was made by the members of the ZMNE Bólyai Scale-Model Club, László Hajba, Imre Kovács, Károly May, Ádám Nagy, Tamás Pénzes, József Réti, Balázs Somogyi, Zoltán Szabó and András Varjasi. The necessary research was conducted by the joint research group of ZMNE and HM HIM, Tibor Bartha, Gábor Hausner, Attila Kállai, Lajos Négyesi, András Németh, József Németh, József Padányi and Ferenc Papp with the assistance of university students, and the support of Belezna and Őrtilos municipalities. Scale: 1/400. The scale-model was handed over on 23 April 2010.

82 GNU General Public License Version 3. https://download.blender.org/release/GPL3-license.txt (Accessed: 25 April 2019.)

83 This is a technical term in computer graphics, which refers to displaying 3D models on the screen.

it is compatible with several 3D engines, including the Unity 3D we use, and it can export the model to a variety of formats. It offers a simple modelling process, for which there is a user's guide along with a number of useful tutorials[84] on the website of the software. The Krita[85] drawing program was a great help for us in texturing. In terms of its look and functionality, it is very similar to Adobe Photoshop professional program, but it is open source and can be accessed by anyone without restriction. We used the software called Materialize[86] for generating the different texture types which allowed us to make complex and precisely calculated bitmaps. The most important part of the technical implementation of the project was the Unity 3D[87] graphics engine, which is the leading software among 2D-3D graphics engines available on the market in the field of amateur use, but it may also be instrumental for projects like Zrínyi-Újvár where appropriate expertise is at hand. Visual Studio,[88] the software development environment of Microsoft supports, interprets and translates countless programming languages into machine code. The 2015 version of Visual Studio Community was used when writing the specific code elements for Unity 3D.

Designing the ground surface

After completing the information acquisition phase of planning, the next step was to design and implement accurately the ground surface. This process was very complicated and complex, and required multiple mappings. In the neighbourhood of Zrínyi-Újvár, the design of the ground surface was based on a recent LiDAR[89] image. Nevertheless, the 3D objects generated from the laser image did not seem to be applicable for visualisation at first attempt. The ground surface generated from the results of aerial laser scanning was available in twelve parts in OBJ[90] format, which first had to be merged in Blender *(Figure 25).* To achieve this, it was enough to create a blank scene, and when importing the tiles in it one by one, those were automatically positioned next to each other, as the coordinates of the vertices of each piece were already well set in relation to the origin. So that the pieces would make a uniform surface, the parts had to be logically merged afterwards.

Generating a height map[91] proved to be a more difficult task, since after merging, it turned out that the model contained 453,960 vertices, most of which formed intersecting planes, thus the computer was unable to display them well. The main problem was caused by the limited capacity of current video cards, as even the most powerful high-end video cards could draw at most one million vertices at a time. In order to overcome this obstacle, it was necessary to optimise the merged ground surface.

84 www.blender.org/support/tutorials/ (Accessed: 25 April 2019.)
85 https://krita.org/en/ (Accessed: 25 April 2019.)
86 http://boundingboxsoftware.com/materialize/index.php (Accessed: 25 April 2019.)
87 https://unity3d.com/ (Accessed: 25 April 2019.)
88 https://visualstudio.microsoft.com/ (Accessed: 25 April 2019.)
89 Light Detection and Ranging.
90 Wavefront Object (This is a simple and widespread 3D model format, which contains the coordinate points of vertices and their relationship in plain text).
91 This is a raster image, the pixels of which correspond to height data. White pixels represent high values, black pixels represent low values.

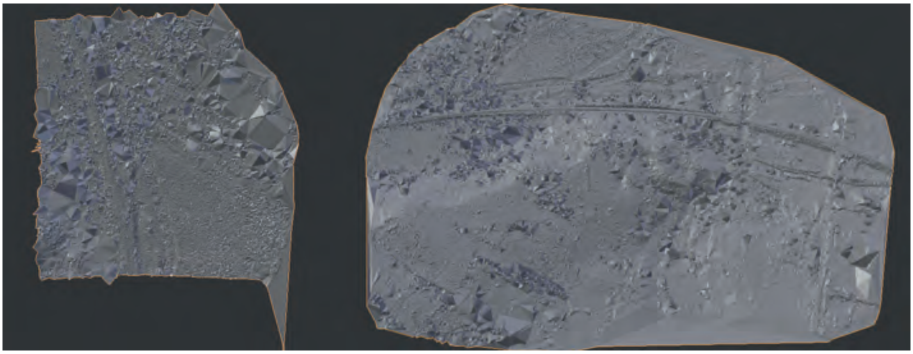

Figure 25.
A piece of the LIDAR image and the model of the whole surface after merging
Source: picture made by the authors

For optimisation, the height value of each vertex parallel to the vertical reference plane had to be taken as a basis and mapped in a 2D matrix, which was a traditional image file in our case. This was rendered possible by the fact that displaying a colour pixel generally requires 3 + 1 channels (RGB[92] and alpha[93] channels), and by their use, we get $256,^4$ that is, 4,294,967,296 different possible height values in the case of 32-bit colour depth. The elevation map made with this procedure is shown in *Figure 26.*

Figure 26.
The finished 2D height map
Source: picture made by the authors

92 RGB corresponds to Red, Green and Blue. The computer mixes the displayed colours from these three colours. Each colour is represented by 8 bits, so the value they take on range between 0 and 255. This is called a 24-bit colour depth.

93 The alpha channel has the same parameters as RGB channels, that is, they also use an 8-bit colour map. This is an additional byte that defines the transparency of an RGB colour. Together they make an RGBA colour, which corresponds to a 32-bit colour depth.

However, because – in addition to the actual terrain – all artificial and natural landscape features are present in the dataset collected by laser remote sensing, they also appear on the height map. In order to eliminate the effects of these, the discrete "clouds" on the map had to be removed before re-mapping, for which we chose the simplest solution, namely image editing. In the Krita software, having selected the individual clouds, we rebuilt their colour using values corresponding to the pixels in their immediate vicinity. The software was able to do this automatically, and we just had to make sure that only those white areas are selected that do not belong to the earth's surface.

After correcting the height map, the surface needed to be created in the engine, next it had to be calibrated and levelled, then the various elevations had to be coloured, finally the riverbed had to be deepened. Since the Unity 3D engine is able to create an elevation surface from a height map, we could simply rely on its capacities. By exporting the height map in RAW[94] format and then importing it into Unity 3D, we achieved the terrain *(Figure 27)*.

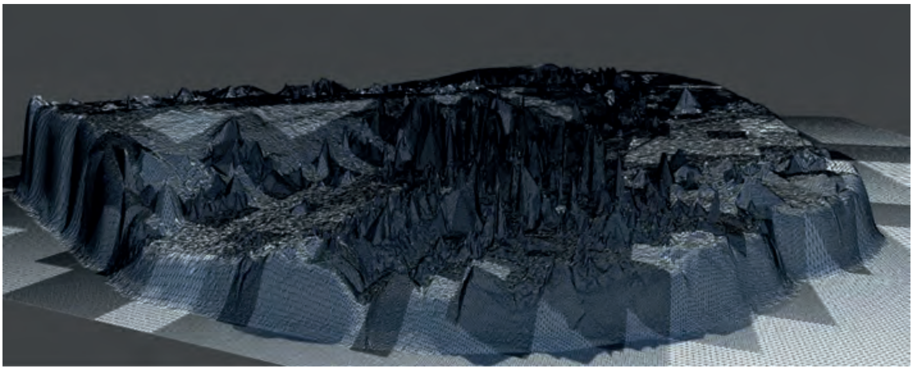

Figure 27.
The relief of the ground surface obtained by generating
Source: picture made by the authors

Unity 3D manages the terrain surfaces in a special way optimising their technical visualisation. It adjusts the vertices to be displayed and the resulting planes in a balanced way. Therefore, it creates only as many vertices as absolutely required by the complexity of the elevation. In other words, in the case of more complex geometries, the grid is denser, while in the case of simpler ones, it is looser.

Over the centuries, the riverbed of the Mura has significantly changed its course. To represent it correctly, the raster image of the model shown in *Figure 24* was superimposed on the designed terrain surface and the various transformations were performed until the two fit nearly perfectly. In this way, not only the river but also the lake next to the castle was replaced by its originally supposed position. Subsequently, we used the terrain deepening tool of Unity 3D to "dig" the riverbed along the outline of the raster, that is, we set the coordinates of the relevant vertices parallel to the vertical plane to zero, as a result

[94] Raw file format comprising only bits.

of which they appeared on the horizontal reference plane. Although not every element of the raster fit exactly on the surface, the LIDAR image could be used to draw the course of the river based on the detectable traces of the former riverbed *(Figure 28).*

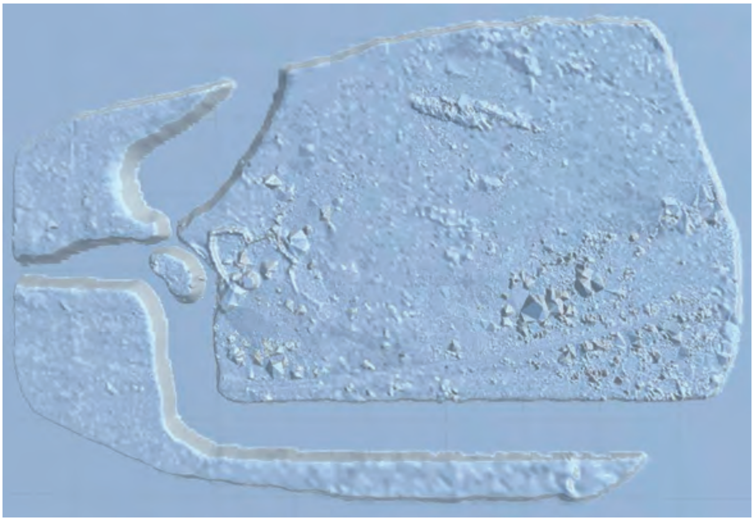

Figure 28.
The relief with the deepened riverbed
Source: picture made by the authors

After the generation, the surface still contained unwanted elements caused by trees and other features recorded during the LIDAR survey (which appear as spikes in the image above) so it was necessary to clean the model. This could be achieved by levelling the surface using the terrain levelling tool of Unity 3D designed specifically for this purpose. The end result is shown in *Figure 29.*

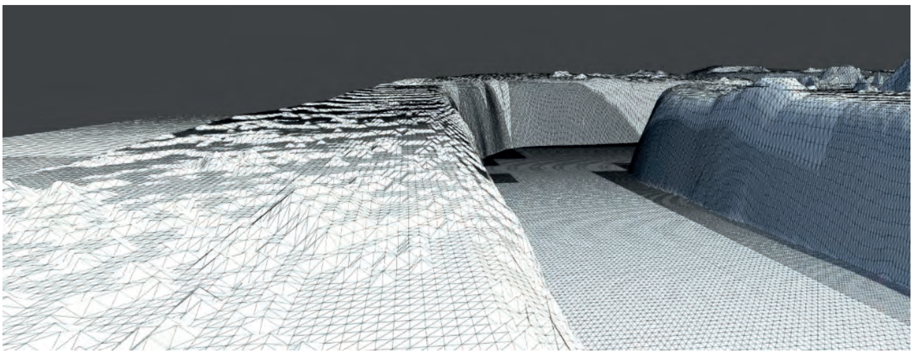

Figure 29.
The relief after levelling
Source: picture made by the authors

Creating features

The creation of the optimum surface gives the possibility for positioning contemporary features and technical establishments, which is why the following stage was the creation of moats, roads, siege trenches and firing positions. The raster image used for designing the river and lake beds served as a reference for this.

The method described above was used to draw the ditch around the barracks. No direct information, no authentic measuring result was available about the depth of the ditch, so we took into account the proportions of sketches shown in *Figure 30.* It can be clearly seen on the image that the depth of the ditch should be the same as the height of the walls around the barracks.

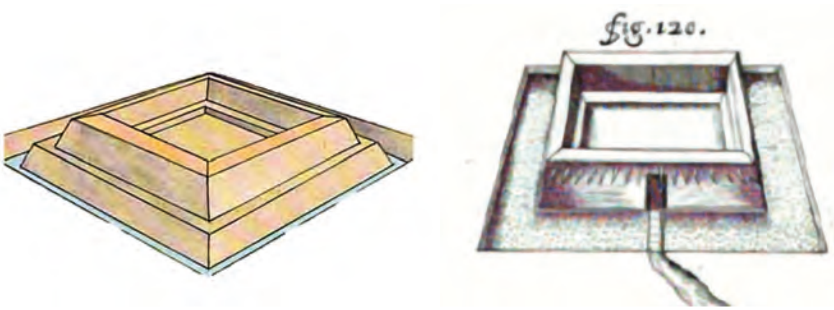

Figure 30.
The possible variations of the barracks
Source: compiled by the authors

Although not included in the sketch, the original structure was presumably also protected by a rampart, so we raised an embankment around the ditch. In its planning, we relied on the proportions of the scale-model. Both the sketches and the scale-model show a bridge leading to the gate of the barracks. This had to be taken into account when designing the embankment and its place had to be left open. The model and the end result projected on the model are shown in *Figure 31.*

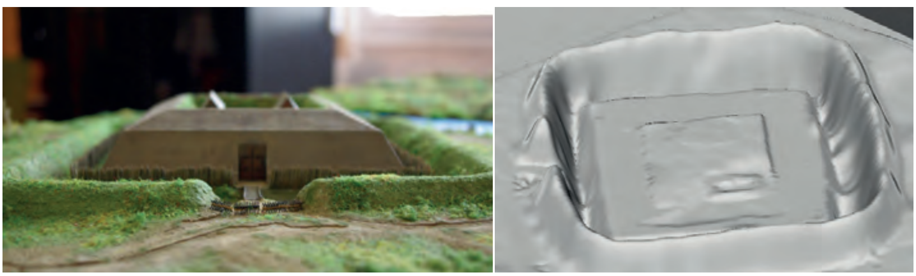

Figure 31.
The building of the barracks in the form of a scale-model (left), as well as its position and defence system in the digital model (right)
Source: pictures made by the authors

The scale-model was also used as a starting point for planning the roads and Ottoman siege trenches. *Figure 32* shows their position and orientation. In order to display these irregular geometries on the relief model, we had to make a template from the image above and project it on the surface. The line of the roads was not deepened. We only levelled its surface so that the model of the road fit properly on the surface and there would be no protrusions and bumps in the model.

During the planning of the siege trenches, their depth was defined relative to the average height of people,[95] while their width had to exceed the average shoulder width of people.[96] These values were used to set the relief deepening tool. Subsequently, the necessary deepening and levelling operations were carried out.

Figure 32.
A detail of the image used as a template
Source: picture made by the authors

The former template was also used to locate the three firing stations, and after the deepening phase, we raised an embankment around them, except for the mortar battery. In addition to the scale-model, sketches were also of great help for us in designing the equipment of the individual stations, which can be seen in *Figure 33,* along with their models.

95 www.averageheight.co/average-male-height-by-country (Accessed: 19 April 2019.)
96 http://antropologia.elte.hu/_vllszlessg1.html (Accessed: 19 April 2019.)

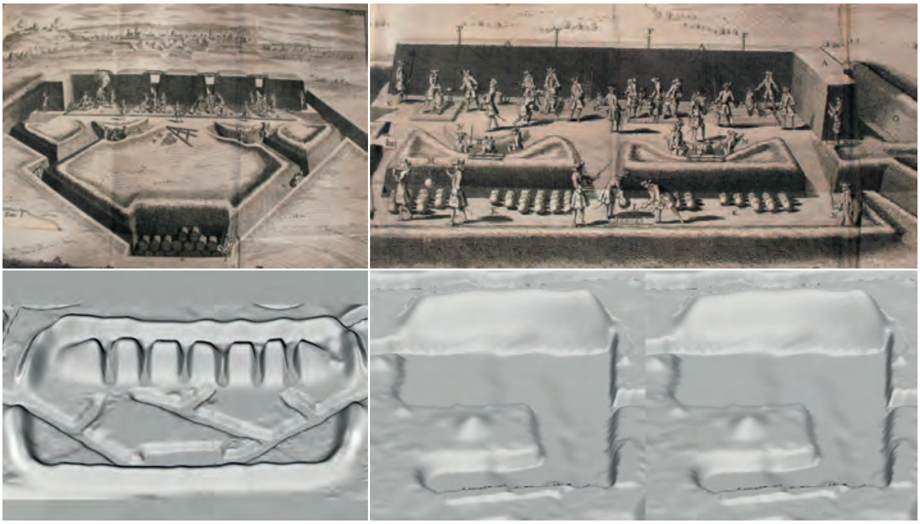

Figure 33.

Cannon (left) and mortar battery (right) stations and their models

Source: compiled by the authors based on *Saint-Remy* 1697

The design of the surface was completed with the creation of the structures above. As a next step, we moved on to modelling the various features of the terrain such as the fortress itself, the barracks, the cannons, the road, the fence, the barrier, guard towers, bridges and buildings.

The modelling of the barracks is illustrated in *Figure 30.* Its size was planned in a way that it would fit in the area delimited by the ditch created previously. For texturing, a mud-earth pattern was used. We projected it on the surface, and the gaps at the joining parts were subsequently refined.

The top view and cross-sectional sketches shown in *Figure 34* were used to create the floor plan of the fortress and to lift it out of the 2D plane. The advanced defensive work was created as a separate model. At first, the advanced defensive work was open from the side of the fortress, but after learning about the new research results we closed it from there, too.

The texture of the advanced defensive work and the fortress is the same as the one we used for the barracks. We faced the same problems when placing the fortification on the surface as in the case of the barracks. Furthermore, it turned out that the relief sloped too steeply towards the river, so the gap caused by the height difference between the base of the fortress and the surface had to be rectified subsequently by fill-up. The completed models are shown in *Figure 35.*

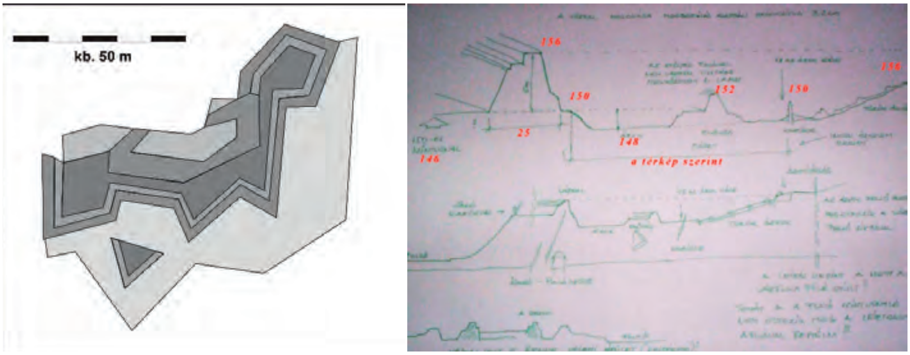

Figure 34.

The sketches of the plan of the fortress and its vertical section

Source: compiled by the authors

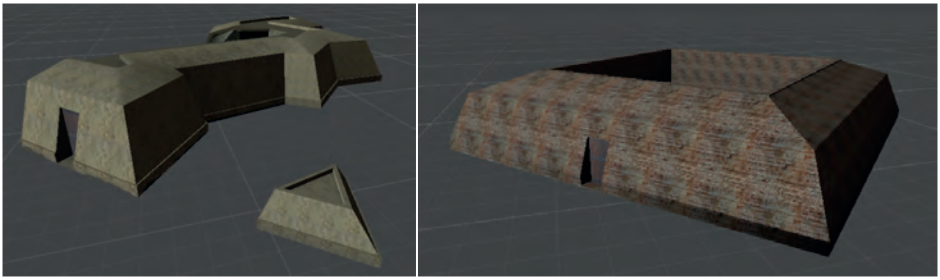

Figure 35.

The models of the fortress (left) and the barracks (right)

Source: picture made by the authors

Unity 3D is capable of generating a road along a line. As we have previously planned the tracks of the roads on the surface, it did not take much time to draw them. Although the software created the individual routes, it was more difficult to match them. In case of intersecting roads – so that their line could be drawn correctly later – one road had to be positioned invisibly higher than the other, as if one path overlapped the other. This was needed to avoid errors in 3D modelling. It also caused a problem with the LIDAR images because video cards are unable to correctly display planes that are in the same place and position. The problem could have been solved more precisely by adding new vertices to the model along the line of intersection and then using logical trimming along the vertices. However, this would have been cumbersome, mainly because the 3D engine used does not support such operations, so the model of the road would have had to be exported, next modified in Blender, and finally re-imported. Another disadvantage of this solution would have been that, in case of need, it would be difficult to modify it later.

When designing the road barrier and roadside watchtowers, we modelled features that could be seen on the scale-model, as no other information was available to us. During the implementation, it was enough to model a single segment of the palisade and multiply it as many times along the raster as necessary to create a continuous technical barrier across the road. In terms of its geometry, the watchtower is a very simple rectangular prism shaped structure, where a wooden plank leads up to the watchtower. The tower is covered with a pyramidal roof resting on four pillars. The watchtower closer to the lake is a stand-alone structure, while the one by the fortress is a bit more complex as it also functions as a crossing point. It consists of two watchtowers, which are connected by a footbridge, under which there is a gate. Both towers can be created from a rectangle and they receive their final form after being textured.

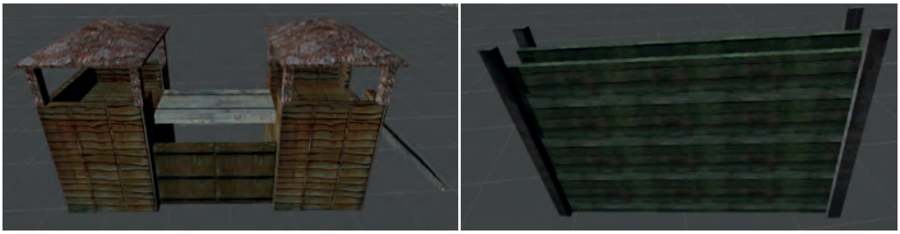

Figure 36.

The models of the crossing point (left) and a segment of the palisade (right)

Source: picture made by the authors

The scale-model also has four bridges and a dam. Two of the bridges span the Mura River, one crosses the dam and another one crosses the trench around the barracks. One of the bridges over the Mura River is a stable stationary engineering structure (i.e. a crossing supported by pillars), and the other one is a temporary pontoon bridge constructed of boats. In practice, the modelling of the permanent bridge meant modelling a multiplied segment. The segment consists of several support pillars joined with a cross bar. We laid beams on the crossbars, and "fixed" the wood boards on those. In practice, this process involved placing rectangles of different sizes on top of each other. The segments were placed side by side along the raster across the Mura River. In case of a pontoon bridge, the methodology was the same, except that the pillars were replaced by boats, which were modelled in advance. With the bridge spanning the ditch of the barracks and the dam, the pillars of the first modelled bridge were replaced with two U-profiles. In case of the dam, we used cylindrical bodies to imitate the logs and applied bark texture to them. The model representing the dam made of logs and the bridge can be seen in *Figure 37.*

Buildings have been digitally designed after the constructions seen in the scale-model. Two of the three taller buildings were placed in the courtyard of the fortress, and the third, which served as a powder magazine, was placed closer to the barracks, on the other side of the Mura River, along the road. The two smaller, one-storey buildings, on the other hand, were positioned in the "funnel" of the linear palisade leading to the river. Because, according to the current state of research, the existence of the buildings shown in the courtyard of the barracks on the scale-model is not proven, they have not been included in the 3D view. In terms of the building material, these were loam houses, so the texture for the models was chosen accordingly. The proportions of the scale-model were taken into account for sizing.

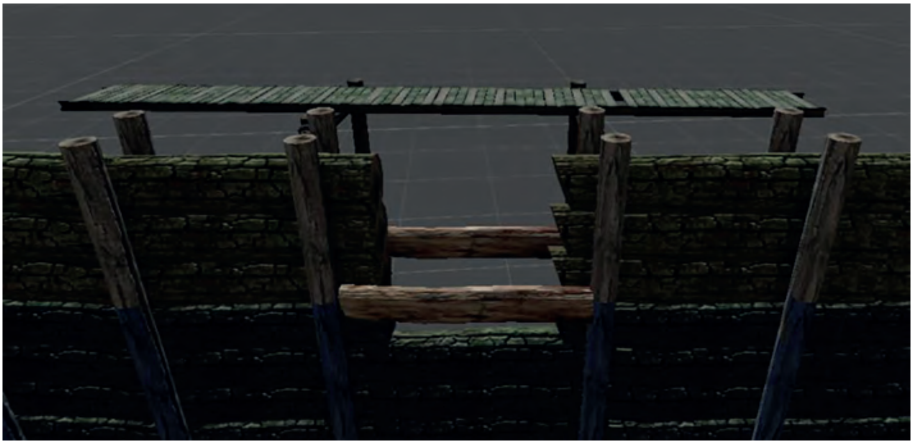

Figure 37.
The model of the dam and the bridge by that
Source: picture made by the authors

For the modelling of the cannon and the mortar, the illustration on the left side of *Figure 38* was taken as a baseline. Since the exact dimensions were not available to us, the illustration was used as a template, and the linear silhouettes of the components of cannons were added to this template in the modelling software. It was then embossed and finished with various solid-state operations. Having put the pieces together, we received the complete model.

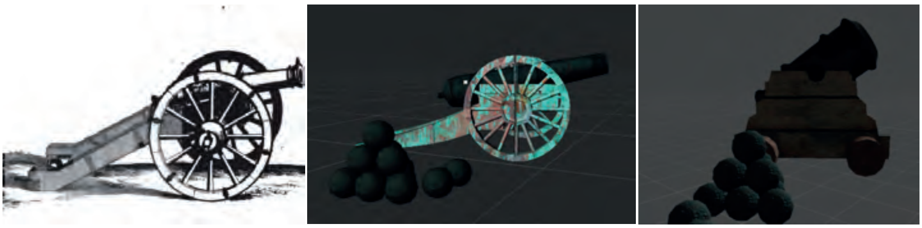

Figure 38.
Representation of a contemporary cannon (left),
as well as the models of the cannon (in the middle) and the mortar (right)
Source: Saint-Remy 1697 and picture made by the authors

After the installation of the models, only the landscape features (i.e. trees, the undergrowth, the lake and the river) were missing from the visual appearance of the view *(Figure 39).* For covering the ground surface with vegetation, we could use the built-in surface modifying tool of Unity 3D. The engine contains predefined tree types that can be customised with minor modifications. With the help of these, we finally designed two types of coniferous trees and five types of deciduous trees. "Grassing" was also carried out with the technique above. We designed general grass and a grass tuft version. The foliage was drawn on the surface with a brush, as a result of which at the specified locations between the pre-set limit values trees and lawn appeared at random intervals. The forest around the fortress was previously cut down, so we planted there individually modelled tree stumps.

The water surface was substituted by a simple plane during modelling, because the life-like representation of the water surface – waves, mirroring and reflection – would have demanded high computing capacity from the hardware resources. The plane was scaled in a way that it would cover the entire surface of the lake and then it was raised to the height of the shoreline. The water effects shown in the model were created with shaders[97] built in the graphics engine.

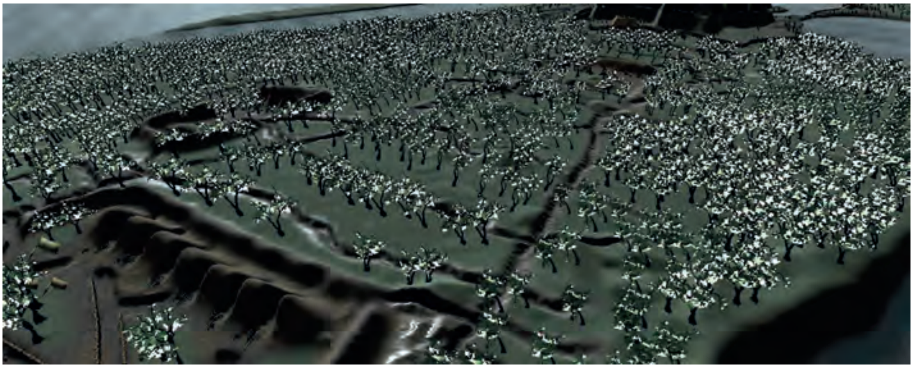

Figure 39.
The visual appearance of the complete model from one perspective
Source: picture made by the authors

We also needed to apply a light source to visualise the view, because without it, we would have only received a dark model. The engine has the potential to imitate global light source, that is, the Sun. For this, we added a so-called directional light to the scene, and applied the sun shader made by Unity 3D developers. The inclination of the light source determines the intensity of the sun. Currently it is 30 degrees, which corresponds to six o'clock in the morning. Although this is adjustable, it is the low angle of the sunlight at sunrise and at sunset that highlights the contours of the fortress and the siege structures the best.

So that we could make a tour within the model, between the locations, we had to plan a kind of "gameplay", which included the ability of rotating the camera, and the possibility of moving and bumping the camera against the landscape features. In order to navigate through space, we needed a point to be moved during control. The actual position of this point also gives the coordinates of the camera, so the camera had to be adjusted to the point when being moved. Unity 3D also allows us to set the focal length, view angle, and even the image quality of the camera. Additionally, there are posterior effects, such as blurring, macro and

[97] This is a sub-programme (algorithm) that modifies the points and/or texture, and colour of a 3D graphic model. Simultaneously to or after drawing, it modifies the drawing mechanism, thus affecting the visual appearance of the final result. It is usually used to visualise complex effects (water, shadow, sun, fire, smoke, fog, etc.). The sub-programme is usually (but not necessarily) interpreted and executed directly by the processor of the video card after its translation to a machine code.

HDR. By default, the drawn image – or more specifically, the focus of the camera – should point in the direction of the cursor. Since, in this case, the focal length is given, it is only necessary to determine the vector connecting the moved point and the focal point of the camera, which can be easily calculated from the starting position and the movement of the cursor. As we want to avoid moving in the global coordinate system – because in that case the image of the camera would not necessarily reflect the expected direction of motion – we need to design the motion of the point in relation to a local coordinate system. This means that the motion is not directed along the XYZ axes, but it is always in relation to the image we see. In other words, the objective is that motion would not be absolute but always relative to the image seen on the camera. For this, we need to use the vector directed to the former focus point; this will be the local X axis, while the normal vector perpendicular to it will be the Y axis, and the product of the two will be the Z axis. In this way, the absolute position of the moved point can be calculated.

All of our models in space are just the combination of planar surfaces bordered by points. Textures can be applied to the planes with different methods, such as stretching and mapping, which gives the colour of the model. Nevertheless, there are no restrictions for crossing these planes. In order to stop movement in space at the boundary of a certain model, a buffer zone must be set around it. This can be the model itself, but in order to avoid complexity, it is worth assigning a relatively simple buffer zone model to a complex model. Because in our case, the majority of the models have a low number of polygons, most of the models in the view are, at the same time, buffer zones. It was only the boundaries of the view where we placed separate planes specifically designed for this purpose so as to set limits to the accessible space.

Like all other software, Unity 3D has a setup interface that allows the user to set the graphics complexity, resolution and keyboard layout of the game before the scene starts.

From our virtual model, we are able to build software that can be executed on numerous processor architectures, devices and platforms. On the other hand, because the code is optimised for Intel architecture processors, the 3D view can only run on desktops and laptops using this resource. However, with minor modifications and at the cost of graphical compromises, it is possible to create a version that can run on ARM architecture, on mobile operating systems. The model itself, the accessible 3D view of Zrínyi-Újvár can be flexibly expanded, and offers users an experience rich in detail. New findings from ongoing archaeological and battlefield investigations can be integrated at any time in the future. Furthermore, the software can be used to investigate different scenarios, questions like "what would have happened if…?" and "what would it be like if…?". All these may provide significant help in the future work of our research team.

Summary

In the beginning, the results of archaeological investigations were recorded mainly in written form and in sketches of drawing, which is a still existing practice today. Afterwards, these were supplemented with analogue, celluloid film-based black and white, and then colour photographs and films, which considerably extended the possibilities of archiving our historical heritage and made data collection during fieldwork easier, but were not yet able to record the properties of finds discovered during excavations in an authentic and comprehensive way. Objects found in our environment have a 3-dimensional expansion in physical space, which cannot be reproduced by 2-dimensional photography without loss of information, even in digital form. In order to bring our material heritage recorded in a digital form closer to real human perception, we need to assign all their properties to a single spatial feature during visualisation.

In this chapter, we presented the archaeological applications of 3D technological innovations and the methods of applying them in different work processes through the example of Zrínyi-Újvár. We reviewed the possibilities of creating, processing and using 3D models. We have demonstrated through practical examples how modern visualisation tools can be combined with different archaeological and battlefield exploration methods. Although the conditions for the application of GIS in archaeological excavations are fully available today, their integration is still limited or have not been undertaken at all in domestic circumstances. Until recent years, the visual archiving of the individual archaeological finds has been limited to taking digital photos of them.

In the course of our research, we investigated the modern methods of archaeological find recording, and the potentials offered by virtual reality (VR), augmented reality (AR) and mixed reality (MR), as well as additive production technology, which can be used to display research results in a spectacular way. During archaeological excavations – as with the forensic investigation of a crime scene – the physical parameters of finds and the circumstances of their discovery must be fully recorded. This is especially important because the changing environmental conditions can greatly worsen the condition of finds after they are found. With MR technology, this information can be recorded within a short period of time and can be used at any time later without loss of information. With 3D printing, missing or damaged elements and details can be fit into place after reproduction, which may help verify various assumptions. Additionally, we are able to make tangible replicas in this way, even for their intended use, with the purposes of illustration or education.

It is also worth mentioning the usability of 3D printing in teaching the visually impaired and in museum education, since, in the case of limited or no vision, touch becomes one of the most important and effective tools for gathering information besides hearing. Thanks to the terrain tables and replicas that can be produced relatively quickly and cost-effectively, the people concerned can have access to many important pieces of information, even through direct experience. Previously, they had no possibility for this, since in most of the cases they could only rely on their imagination in an educational session.

At the same time, in general, the 3D visualisation of research results in the field of archaeology, military archaeology and battlefield investigation improves the process of learning and understanding to a great extent. Consequently, it may not only contribute to the scientific development of professional community but also directly enhance the quality of information available for the interested public. For today's rising generations of information society, solutions based on this – audio-visual or interactive e-learning educational materials, dissemination based on augmented or virtual reality technology – represent significant added values and effectively help them in the fields of their studies and general development through experiential learning.

In addition to general history teaching, this technology can play an increasingly important role in supporting specialised training. Its various methods and technical solutions may significantly increase the quality of practical sessions in archaeologist-technician or restorer-technician training. The leaning and integrating of the work processes of field surveys and excavations can certainly be achieved only through actual pursuit and continuous practice. Nevertheless, their preparation, as well as the transfer and processing of the required theoretical knowledge may become significantly more efficient. This method may save time and energy and thus increase the proportion of resources that can be spent on actual research.

At its current stage of development, technology still allows the design and use of models mainly by technical experts, but as a result of continuous progression, more and more sophisticated solutions and user-friendly IT supported tools are expected to come out. Due to these, the particular techniques will be accessible and usable to anyone. Even students will be able to take notes and prepare learning aids with VR/AR tools. Thus, by the analogy of the web 1.0 and 2.0, the current VR/AR users may turn into content producers in the future.

WRITTEN SOURCES ON ZRÍNYI-ÚJVÁR[1]

[1] The translator's note: the texts have been translated into English from the Hungarian translation of the sources originally written in Latin, Croatian and Turkish languages, which is indicated at the beginning of each document.

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Christian sources

1

Miklós Zrínyi to the Imperial War Council[1]
(Translated from Latin)

Légrád, 5 July 1661

Your Excellencies, Noble Counts!

There is complete silence on the Ottoman side and there is no news of any suspicious movement, so I cannot stop wondering from where Your Excellencies received news about the machinations of the Ottomans and the preparations of the commander in Buda directed against me and my fortress,[2] for which Your Excellencies counsel me against building this fortress. Engineer Wassenhoven[3] also tried to do it when he returned to me. I can see from this that Your Excellencies do not have accurate information about the state of the matter. So I respectfully request that you also consider my arguments more closely. If you do so, I am confident that you will not dissuade me from this work, but will instead most readily support me with advice and deeds.

It is not possible to describe the place itself and the suitability of its geographical position in a letter, Wassenhoven can better inform your Excellencies about it. In military terms, however, I can say that this place is the shield or bastion of the whole Muraköz, and even of the entire border region of Slavonia, from here to the south beyond the Drava. The one who holds this hill, has control over the Muraköz and the two rivers, the Mura and Drava, too. And if the Ottomans would have seized this hill (as they wanted to), neither Kapronca, nor any other fortress could have withheld them from the invasion of Slavonia. The truth is that, over the last sixty years, no one has observed this place, but the current pasha, who, accompanied by two thousand men, came here last May. He personally inspected everything with the greatest attention, and would have occupied it, if I had not prevented him from doing it in time. So that was the first reason why I could not delay any longer. If the plans of the pasha had not forced me to do so, I would, of course, have waited for a better occasion. Yet, even if he had not wanted to occupy this place, I would still have had to take it into possession, for the following reasons:

1. Since the flooding Drava had so badly damaged Légrád that many houses collapsed into it and the fortress itself was only twenty feet from the water, for half a year I could not be certain if

[1] Zrínyi Miklós válogatott levelei 1997 [Selected Letters by Miklós Zrínyi 1997]. 116–119. (For the original letter in Latin see The Complete Works of Miklós Zrínyi 1958. II. 540–544. Translated into Hungarian by *Csaba Csapodi*.)

[2] Against Zrínyi-Újvár.

[3] For Guislain Segers d'Ideghem von Wassenhoven, the Chief Military Engineer of Inner Austria see *Domokos* 2012.

the fortress itself would not also fall in the river. Where could I have gone then, where could I have translocated the fortress when absolutely no place was safe from the flood.

2. This site is so close to Légrád that cannonballs can be fired here from there. Moreover, since I have been in the Muraköz, over two hundred men have been abducted from here, because every single person heading for Légrád or Kotoriba can be seen from the hill, as if from a watchtower, and they can be captured with impunity.

3. There are nine outposts between Légrád and Kotoriba, which I have to maintain partly at my own expense and partly from royal pay. However, the money arrives so late and it is so little as if nothing came. So I cannot defend this line at my own expense any longer. The hill saves a lot of money for me because it substitutes six outposts, and although more soldiers will be needed here than at those six outposts, the soldiers are easier to support here because they are provided with vines, arable land and everything else they need. The area around Légrád, on the other hand, has been so devastated by the floods that many soldiers are considering leaving.

4. In the event of war or, at least, a kind of peace that has been so far, or if the Ottomans attack Komárom[4] (as they did a few years ago) or if they want to cause trouble in another part of the country, I cannot take help anywhere, even if only five hundred Ottomans occupy this hill. This is the case even if they do not build a fortress here. Now, however, if I set my feet here, the path of the Ottomans' retreat can be blocked at once, whether they want to go on raids to Styria or anywhere else; so by no means will they dare to attack.

5. If there was a war with the Ottomans, there would be no other secure place in the whole borderland to accommodate an army than this fortress, from where Kanizsa, Berzence, Segesd and Szigetvár could be attacked from safety. If only this place had been known when Kanizsa was besieged! Germany and Italy would not remember Kanizsa with such great sadness now.[5]

6. Once this fortress, as I hope, is successfully completed with a little help of His Imperial Majesty, I can promise Your Excellencies that Kanizsa will soon be in distress and thousands of Christians will be freed from the yoke of Turkish tyranny, and Styria will be able to enjoy peace and tranquillity without fear, even if Kanizsa remains on the hands of the Turks.

7. Once this fortress is rebuilt, it will not be easy to attack via Muraköz and Csáktornya.

The reasons above urge me to build the fortress and inspire every good Christian who protects the country and is a faithful servant to the emperor.

However, there are objections and apparent obstacles, so let us examine them:

1. It is said that the Ottomans will complain about the violation of peace because it is included in the terms of the peace that no more fortresses are to be built.

2. The undertaking is already obviously overdue, because the Ottomans are so much stronger than us that if they launch an attack on some pretext, we will not be able to withstand them at all.

3. Without the knowledge of His Majesty, I should not have commenced this work.

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4 Kiskomárom in Zala County.

5 Based on the Latin transcription, Zrínyi referred to the attempt to take back Kanizsa in 1601: "Utinam illo tempore, quo *Canisam Christiani obsederunt,* locus iste cognitus fuisse, Germania, Italia tam lugubrem memoriam Canisae hujusque non teneret." Zrínyi Miklós összes művei 1958 [The Complete Works of Miklós Zrínyi 1958]. II. 542. On this, see *Kelenik* 2012.

My answers to these are the following:

1. The Ottomans should not complain at all. Are they allowed to do what they rebuke us for? They have built three or four strongholds, and they are also prepared to reconstruct the fortress at Behigat, which was burnt down by the Hungarians last year. Furthermore, in Croatia, they built more fortresses than I did. Unlike them, I am not building this fortress on an Ottoman territory, but almost on my own property, ten steps from the Mura River, and in a distance of a cannon-shot from Légrád. After all, this place belonged to one of my great-grandfather's inner men, who fell in battle along with him during the siege of Szigetvár. It needs to be added that in a quarter of a mile from here, there was a small fortification called Bajacsa, which also had a garrison after the occupation of Kanizsa,[6] but it was afterwards abandoned due to the unsuitability of the place. It is easy to reason that this is the same place.

2. I deny that the Ottomans would be stronger than us. I deny that they were so arrogant that merely because of one such thing they would change all their plans, give up Transylvania, leave the Venetians, and come here with their entire army, just to avenge the construction of this fortress.

3. Certainly, I admit that I should have notified His Majesty of this before I started, but the pasha's plan prevented me from doing so. I wanted to inform His Majesty at a more convenient time. I am otherwise aware that all good subjects are obliged to undertake such unpleasant deeds that are advantageous for the country, and should not transfer them to their lord. I was also guided by trust and loyalty in my actions.

I will now return to the letter by Your Excellencies. You say this is why Buda's commander set out against me, but your Excellencies ought not to believe this under any circumstances. I am closer to this peril and pay more attention to my own troubles, but I have not heard anything about it so far. If, however, they come and I do not receive help from anyone, I will still readily stand in service of all Christendom to the last drop of my blood, as far as God allows and helps me to do so. And those who leave me alone in this useful endeavour out of vile fear, or even hinder me, will be summoned by me before God's judgment seat to face his terrible judgment. If the engineer is not allowed to work for me any further, I will send him back to Your Excellencies and continue the work as God instructs me. I let Your Excellencies decide which is better (because this work must be completed): to construct this fortress well or badly? The fortress is already half-built and can no longer be left unfinished, because the Ottomans would be able to complete it in a fortnight, along the marked lines, and I would not be able to demolish, even if I wanted to, because the work is so advanced. Instead, I expect the grace and goodwill of Your Excellencies in returning the engineer, who can stay here with me in safety until His Majesty orders otherwise. I wish a happy long life to your Excellencies.

Written at Légrád, on 5 July 1661.

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6 The palisade fortification at Bajcsavár was built in 1578 at the expense of the Styrian Estates. In the sixteenth century, it belonged to the Vend Generalate, and was abandoned by the Christians only after the 1609 fall of Kanizsa. For this, see *Leopold Toifl:* Bajcsavár története stájer levéltári források alapján [The History of Bajcsavár Based on Styrian Archival Sources]. In Weitschawar / Bajcsa-vár 2002. 39–401. See also *Kelenik* 2012.

2

Miklós Zrínyi to the Judges and Senators of the Town of Varasd[7]
(Translated from Latin)

Zrínyi-Újvár, 25 July 1661

Noble, Generosus, Excellent and Circumspect Lords, my most respected Friends and Neighbours, I send my regards and offer my most ready services to you.

I have no doubt that Your Excellencies are fully aware how useful the work is that I have not only started, but have for the most part completed, and in which I was proud to enjoy the benevolence of my friends and neighbours. In the same way, I believe that Your Excellencies bear the same goodwill towards me as my other neighbours, and seek to promote the good of the country with no less enthusiasm. Therefore, guided by this trust, I kindly ask Your Excellencies to send to me your serfs for a week's work, which I wish to recommend to Your Excellencies through my *familiaris* and secretary, Gábor Jurevics. I do hope I will not be disappointed in the good neighbourhood that I have always had with Your Excellencies, and you will support the work that is also highly useful for all Christendom. For my part I will also earnestly strive for good neighbourliness at every single opportunity. I wish you a long life.

Written at Zrínyi-Újvár, on 25 July 1661.

Your Excellencies' well-wishing friend and neighbour

Comes Nicolaus a Zrin

[7] Zrínyi Miklós válogatott levelei 1997 [Selected Letters by Miklós Zrínyi 1997]. 120. (For the original letter written in Latin see *Csapodi* 1962. 743. Translated into Hungarian by *Csaba Csapodi*.)

3

Miklós Zrínyi to János Gersei Pethő[8]
(*Translated from Croatian*)
Zrínyi-Újvár, 8 August 1661

My Respectable and Illustrious Lord, my most respected Friend

Since all my neighbours in the region have helped me out with day labourers in this good work that is useful for all Christendom, I also request Your Excellency to send some craftsmen to help for a few weeks, and that they also bring axes. To Your Excellency, My Noble Count, I am sending György Peharnik, who will orally inform Your Excellency in more detail. In reliquo,[9] may God preserve Your Excellency in good health!

Written in our fortress Zrin, on 8 August 1661.

A most ready servant to Your Respectable and Illustrious Lordship

C Nic a Zrin

8 Zrínyi Miklós válogatott levelei 1997 [Selected Letters by Miklós Zrínyi 1997]. 121. (For the original letter written in Croatian see *László–Lebár* 1984. 722–723. Translated into Hungarian by *Hermina László* and *Mária Lebár.*)

9 In the future.

4

Miklós Zrínyi to the Graz Council of War[10]
(Translated from Latin)

Csáktornya, 26 March 1662

Excellent and Noble Counts, my most respected Friends and Neighbours

In these highly perilous times, I, my new fortress[11] – built to defend both my island[12] and the entire neighbourhood, – and the island itself are threatened with complete destruction wrought by the sworn enemy of all Christendom. I receive different news about the preparations of their campaign almost every day. In the current state of affairs, lest I seem to do nothing about the preparations, which are certainly directed against me, I must take action, as far as my strength and talent allow. However, I must admit that I am utterly inadequate to bear such a burden on my own, so I have no other choice but to seek help and turn to my friends and neighbours, who are threatened by the same peril and doom. In this perilous and common distress, the first of my friends and neighbours are the Noble Orders and Estates of the Principality of Styria. What I wrote to them will be disclosed to Your Illustrious Lordships in more detail from the attached copy of my letter.[13] The enemy seeks my complete destruction. If Your Illustrious Lordships do not take steps with me to avert the peril, then I will perish with my men, and Your Illustrious Lordships will shortly follow me. If in this great misery and menacing doom I can truly count on the help of the Orders and Estates, I will also do everything relative to my own capabilities, even by shedding my blood and risking my life, so that all my neighbours could honestly and confidently testify to my loyalty for the posterity. If, however, I fail to receive the necessary help demanded by defence, I must limit my actions, withdraw myself from this great danger, and mind my own safety. That is why I wanted to kindly approach Your Illustrious Lordships, and request Your Lordships most humbly to support the decision of the Noble Orders and Estates, and discuss the matter of help in this great, common misery and menacing doom in order to defend me together with themselves from the imminent danger, as I will defend them – with your consent – as much as it is possible. If you are willing to help me, you will do something very dear to God, commended and welcomed by the whole of Christendom, and especially by our most excellent lord, His Imperial and Royal Majesty, useful to yourselves and your descendants, while for me, who keeps watching and fighting for their safe survival, it will be a great comfort. I entrusted my true and confidential friends, respectable and magnificent Baron János Listi of Köpcsény, and generosus masters, István Vitnyédy of Muzsaj and Miklós Guzics of Turan,[14] handing over this

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10 Zrínyi Miklós válogatott levelei 1997 [Selected Letters by Miklós Zrínyi 1997]. 125–126. (For the original letter written in Latin see *Csapodi* 1962. 747–748. Translated into Hungarian by *Csaba Csapodi*.)

11 Zrínyi-Újvár.

12 Muraköz.

13 I.e. from the copy of his letter written to the Styrian Estates on the same day. (See Zrínyi Miklós válogatott levelei 1997 [Selected Letters by Miklós Zrínyi 1997]. 122–124.)

14 István Vitnyédy was attorney in Sopron, a well-known figure in contemporary politics, one of Zrínyi's "noble servants". János Liszti (III) was in close relationship with the Zrínyi family, he was a confidant of the ban, and about one hundred volumes from his library were transferred to the Zrínyi Library in Csáktornya. Miklós Guzics is the confidant of Zrínyi, the Captain of the fortress in Szredicskó belonging to the ban's border fortress system. He was also present at the hunt on 18 November 1664, which ended with Zrínyi's death.

piece of writing, to explain these matters in more detail orally. I ask Your Illustrious Lordships to give unconditional credence to the meaning and validity of their words. I expect Your Illustrious Lordships' written response through them, so that I could keep myself to that. I wish you a long life and fortunate governance.

Written in the fortress of Csáktornya, on 26 March 1662.

Your Illustrious Lordship's most ready servant, friend and neighbour.

5

The Last Will and Testament of Miklós Zrínyi[15]

– Detail –
(*Translated from Latin*)

Csáktornya, 6 April 1662

[…] Finally and at last: We built Zrínyi-Újvár and our stronghold from its foundations in a desolate place, with a lot of labour and our own sweat, effort and at enormous costs. This site is so important that without it our Island of Muraköz cannot remain safe. So, if that fortress and stronghold can be preserved as it is and be further improved in accordance with our intentions so that it can be defended even more securely, we will inseparably annex it to our Muraköz property. We can freely decide about this, because we have obtained it in our own strength, and with our effort and sweat, and therefore we can leave this fortress and stronghold to our beloved wife and daughters. Our other estates that we have acquired ourselves, namely Tvadorc (Vas County), Safarszkovesz or Ráckanizsa, with its appurtenances, Hlapsina, with its appurtenances, Széchy Island, with its appurtenances (in Zala and Vas Counties) – unless we decide otherwise about the whole or a part of these estates, which we reserve the right for – may be left by us to whom we wish. Still, for a more appropriate management of these estates and the preservation of our position in the Muraköz, we attach them to Csáktornya, the centre of our estates and that of the Muraköz Island, so that they would be possessed with the same right as we acquired them […]

15 Zrínyi Miklós válogatott levelei 1997 [Selected Letters by Miklós Zrínyi 1997]. 188. (For the original letter written in Latin see Zrínyi Miklós összes művei 1958 [The Complete Works of Miklós Zrínyi 1958]. II. 610–611. Translated into Hungarian by *Csaba Csapodi*.)

6

Miklós Zrínyi to Leopold I[16]
(Translated from Latin)
Military camp under Zrínyi-Újvár, 27 June 1664

Although I always receive Your Majesty's letters with the utmost respect, it has never given me greater comfort than the last piece of gracious writing, which gave me sincere hope that Count Montecuccoli will bring Your Majesty's powerful help in our current need and will boldly attack and repel the enemy. However, while I trust and rejoice over my most reasonable hope, and look forward to beginning our military operations with some notable actions, I realise too late that here nothing mattered less than trying to do anything meaningful concerning the enemy and – as in the past years – the only objective has been to preserve and protect the army. In this way, My Most Excellent Lord, not only the honour of Your Majesty's armies will be lost, but also one stronghold after the other, and they will certainly be followed by the provinces and countries. Therefore, many things force me to uncover our affairs sincerely before Your Majesty, and I am also compelled to do so by my commitment to Your Majesty's service and my fidelity. I am ascertained that Your Majesty's armies can never be glorious or victorious if they fight like this all the time. I am writing briefly to Your Majesty to send information about the current affairs, which is fully supported by the experience of previous years. After the Grand Vizier attacked my new fortress with all his might, I successfully defended it with Your Majesty's small army that was available here, and I would also defend it now. If the defence of the fortress and the Mura had been my only responsibilities, I would never have wished for the arrival of either Count Montecuccoli or his army: two or three regiments of Your Majesty's army would have been sufficient to facilitate the task. Nevertheless, I certainly hoped that at least we would not be expelled completely from here; moreover, as the rest of Your Majesty's army expanded, I kept asking Count Montecuccoli day and night to speed up his travel. He himself eventually arrived earlier than the army, yet everything necessary was there in due time. We already have so many Hungarian and German troops that we could clash with the enemy not only out of necessity but also with good chances. We have about twenty thousand Hungarian and Croatian, as well as the same number of German soldiers. Although with this army we cannot surpass the power of the enemy, we are equal to that. Nevertheless, the intention to venture anything against the enemy was and still is so far from this force that we have not undertaken even the smallest sortie from the fortress. The enemy was so emboldened by these that, keeping the Christian army in sight, they approached the rampart of the fortress through their attacks. If we do not provide support within a few days, they will undoubtedly occupy the fortress before the eyes of this whole army. I see no other reason why our army is doing nothing than what the generals claim, that is, we have to wait for the entire army and the auxiliary forces of the Duke of Baden[17] so that we could clash with the enemy with full might. However convincing these arguments may seem, they pose a grave danger, for we have information that the Ottoman army, even though with small troops, is growing day by day, and it is also certain that two more pashas are going to arrive within two weeks. Our army, on the other hand, is not only

[16] Zrínyi Miklós válogatott levelei 1997 [Selected Letters by Miklós Zrínyi 1997]. 159–162. (For the original letter written in Latin see *Csapodi* 1962. 754–756. Translated into Hungarian by *Csaba Csapodi*.)

[17] Margrave Leopold Wilhelm of Baden-Baden (1626–1671), the Commander-in-Chief of the German imperial auxiliary unit.

losing its prestige by doing nothing, but it is also diminishing at an unprecedented rate due to diseases, and it is completely wrecked by the shortage of food, as well. In addition, the Hungarian and Croatian soldiers, who have never received any pay, cannot stay here for more than eight days because they have only brought bread with them; and whatever I had, I have already distributed among them. Verily I say, My Most Excellent Lord, the number and willingness of the soldiers is decreasing every hour, while the enemy is increasing to the same extent and even more. I do not plan to put everything to the decision of a general attack, either. Instead, I have trust in sorties from the fortress and raids on the camp from another direction: with these, even if the enemy cannot be completely bewildered, we could keep them away and – what is most important – preserve the fortress intact until the rest of the armies arrive. However, I was not able to persuade the generals concerning any of these, and accordingly, no action has ever been taken. With the few Hungarian soldiers who were with me at the beginning, I launched two successful attacks: on both occasions a few hundred Ottoman soldiers fell, and once we seized the pasha's flag, as well. Tomorrow, I am sending my brother[18] to try to do something with the Hungarians, the Croats, and the few hundred Germans, whom I had a hard time obtaining. Your Majesty, however, needs to be aware, and please do not judge from the empty and dubious claims of my rivals: as we could infer from the accounts of all the fugitives, the enemy has somewhat over thirty thousand soldiers. Even the higher ranking prisoners of war themselves – who are fully aware of the Ottoman affairs – are forced to admit this. Even if all this can be questioned, at least a copy of the record that Your Majesty's ambassador sent me yesterday through one of my most loyal men supports what I say. And here nothing is worth anything. More credit is given to the senseless babble of a fugitive who says that the army consist of a hundred thousand soldiers than to my most well-founded statements. This also makes the soldiers lose their courage and they rightly complain to Your Majesty that we do not attempt to do anything good. My Most Excellent Lord! I beg you most humbly to take into consideration what I have to tolerate from the undisciplined men of our army, as well. The cruelty of no enemy, not even the mad rage of the Tartars, can be compared to what this unfortunate island is forced to tolerate now, which I have defended against so many enemies for forty years with no little sweat and blood of mine. The destruction did not leave any church untouched. No living soul has remained in the villages; all the crops have been cut unripe, so they cannot even be used to feed the horses of the army. I keep silent about the murders and other atrocities so as not to offend Your Majesty. But still: I am compelled not to do anything about these, with no hope of remedy from the generals. What is more, to tell the truth to Your Majesty, all these deeds most clearly testify to the malice of Count Montecuccoli against me.[19] God is my witness that all this would affect me only as much as the slightest smoke and it would not bother me if I knew or hoped that Your Majesty would benefit from it, but it is a long way from reality. I must admit that no other malicious deed has ever put me under greater pressure. I beg Your Majesty to consider if I still have any means to protect myself or even to stay alive after all this? Yet, may God be praised for all that I can endure. I wish Your Majesty fortune and good luck.

Written in the military camp of Zrínyi-Újvár, on 27 June 1664.

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18 Péter Zrínyi (1621–1671).

19 The events that happened under Zrínyi-Újvár renewed the old disagreement between the two soldiers. For more details see *Nagy–Hausner* 2011. The motifs of the memoir addressed to Leopold, distributed in print all over Europe a few weeks later, begin to take shape in this letter.

7

Miklós Zrínyi to the Graz Council of War[20]
(Translated from Latin)

Csáktornya, 30 June 1664

I am writing to your Excellencies with great pain in my soul that this morning before the eyes of our larger army, my new fortress[21] – completely intact, without being undermined or destroyed by cannons – has been seized and occupied by the Ottomans merely with swords, which is an utterly unheard of thing, not recorded by any historian before. So this is the long-awaited and hoped-for help! Count Montecuccoli never allowed us to draw a sword to defend this fortress. This urged me to run to His Majesty with this post, but today the Hungarian noble lords pleaded me again to return, and so did Lord Montecuccoli. While I am waiting here and considering my return, I receive the sad news that the fortress had been occupied. I ask Your Excellencies to take action immediately and demonstrate to His Majesty that any huge army in the world would lose several fortresses and countries if they kept fighting like this. From here, I will return to the camp, which is reportedly rather perplexed. I will defend the Mura crossing (even if I have to fight alone), and I will not back down till the last drop of my blood, because this is the time and place for all the citizens of the country to die. I do not write anything more about the future; I let everything to be taken care of. May God bless Your Excellencies with good fortune.

Csáktornya, 30 June 1664.

Lord Wassenhoven will inform Your Excellencies in more detail orally. I cannot write any more due to my pain. There is already news of the siege of Sárvár, but this is not certain.

[20] Zrínyi Miklós válogatott levelei 1997 [Selected Letters by Miklós Zrínyi 1997]. 162. (For the original letter written in Latin see Zrínyi Miklós összes művei 1958 [The Complete Works of Miklós Zrínyi 1958]. II. 583–584. Translated into Hungarian by *Csaba Csapodi*.)

[21] Zrínyi-Újvár.

8

The memoirs of Miklós Zrínyi to Leopold I[22]
(Translated from Latin)

Vienna, 17 July 1664

I was just about to set off when I received a letter from Your Most Excellent Majesty written this month, on 3 July. According to this, Your Majesty was informed that I had left the camp and went to Csáktornya, and then graciously ordered and instructed me to join Your Majesty's camp, as the relief troops were to be united under the command of the Margrave of Baden,[23] and the military operations were to begin only now, and my presence would make the Hungarian soldiers wait more persistently and enthusiastically in the camp. Having read Your Majesty's letter, I decided I would definitely stay now. However, after careful consideration of the reasons above, I realised that the situation envisioned by Your Majesty had completely changed, and all our war plans had been turned upside down.

The Grand Vizier was definitely about to destroy the fortress after its occupation. Thus, on the seventh day of this month, he set fire to the buildings in the fortress and detonated some of them with mines. According to the unanimous statements of the fugitives and prisoners of war, he himself was considering retreating to Kanizsa within two days. Upon hearing this news, Count Montecuccoli (although he had previously promised me to take our chance with united forces), changed the previous war plan without contacting or notifying me. He summoned the Margrave of Baden to the border of Styria, and sent the French somewhat further away so that there would be no contact between the armies for the time being. What is more, when I informed Count Montecuccoli himself of my departure, he told me that he would also set off as soon as he learnt about the Grand Vizier's leave, and would follow him, even if taking a longer route. That is how and why our hoped-for military enterprise was abandoned and came to nothing.

As far as the Hungarian and Croatian armies are concerned, they gathered with enthusiasm and in quite a good number. When, however, they found that there was no serious intention for fight, nor any opportunity to gain glory, they consumed the little food they had brought with them, and went home. It was only Count Batthyány[24] that remained there until my departure. I supplied his soldiers with bread at my own expense, as far as I could. Nevertheless, because the Grand Vizier was approaching his estates and those places were in obvious danger, he was forced to leave, as well. So now there is no Hungarian and Croatian army in the camp other than that of Count Nádasdy.[25] Nevertheless, he stated that he was not subordinate to me but to Count Montecuccoli and would do nothing on my instructions. Having considered the aforementioned once again, I found no reason that would have necessitated my presence in the camp in the slightest degree. After all, neither schemes nor plans were made (unless individually, of which I had no knowledge). If I had stayed there without any rank, honour, or honesty, alone, only with 20–30 of my men (because there could be no more of them than that, as I shall relate it below), I would have only subjected myself to the laughter of my

[22] Zrínyi Miklós válogatott levelei 1997 [Selected Letters by Miklós Zrínyi 1997]. 213–222. (For the original letter written in Latin see Zrínyi Miklós összes művei 1958 [The Complete Works of Miklós Zrínyi 1958]. II. 585–597. Translated into Hungarian by *Csaba Csapodi*.)

[23] Margrave Leopold Wilhelm of Baden-Baden (1626–1671), the Commander-in-Chief of the German imperial auxiliary unit.

[24] Kristóf Batthyány.

[25] Ferenc Nádasdy.

enemies. Well, I do not believe that Your Majesty would wish this service from me and that it would be Your Majesty's gracious will.

And the reasons that force me to come before Your Majesty are certainly such that I had to flee here, to the royal throne, unless I wanted the whole country and Your Majesty's provinces to perish with me. Yet, as I have not yet been able to inform Your Majesty why the siege of Kanizsa has stopped due to my engagements and the ever-renewing obstacles, I humbly plead with Your Majesty to listen to my most faithful account.

I am well aware, My Excellent Lord, that affairs concluding with an unfortunate outcome can never be painted with such a delicate brush that it would not seem as if the apologiser was at fault. Nevertheless, I am not afraid of this, but I am only too happy to have the opportunity to honestly inform Your Majesty of the course of the events. By no means do I want to refer to ill fortune, like those who apologise for their mistakes because it is obvious that the occupation of this place have always been prevented by insignificant incidents. Greater zeal, willingness to fight, better organisation of the things needed, and more rational decisions could easily have led to a more fortunate turn of the events, and according to some, even to good luck.

Above all, however, I must honestly inform Your Majesty of what I not only surmise but (on the basis of the most obvious inferences) I dare positively say that with the exception of General Pucher, a general from Bavaria – who has always shown great zeal in this siege and in all other military operations – I did not experience any good intention or goodwill on the part of the senior officers or generals during this siege. The others all openly grumbled about joining battle too early, little or no pay, sustenance, fodder, and other, less significant reasons, although I solved all of these beyond my humble means. This was also overtly promulgated before the soldiers. Opinions secretly circulated by senior leaders, as well as the dangers of siege, to which they had long become unaccustomed, alienated soldiers from the idea of siege. Preparations were carried out like before some kind of loathed drag hunt. Some work was seemingly done, but a whole world separated it from enthusiasm and will, and consequently, from eager readiness for action. Count Hohenlohe[26] quite clearly expressed his aversion to this noble enterprise; not only with his words, but also with his delay and unwilling arrival. I will not repeat his words here, for his deeds throughout the siege speak loudly enough. Yet none of the generals dared outright refuse to take part in the siege.

When we successfully finished the winter campaign and occupied Babócsa, Berzence and Segesd, set fire to the Eszék Bridge, destroyed the countryside all around, and it seemed that the time had come for the siege of Kanizsa and terminate the sixty-three year old occupation of the Styrian borderland, I felt it was my obligation to make a humble suggestion for that. I will briefly summarise everything.

First, I wanted to hear the closer views of the privy councillors and members of the War Council, so I wrote to them. Through Wassenhoven, I communicated to them the results of the entire campaign, and at the same time that this was a good opportunity to take Kanizsa. I asked them – if they agreed with me – to communicate their views directly to Your Majesty and to shortly prepare the necessary steps. Kanizsa had to be besieged before Easter, because otherwise there was a danger that the Grand Vizier (who would undoubtedly try by all possible means to come to the aid of the fortress that the fate of the whole countryside depended on) would drive us out of there. Whether they liked this good opportunity, no one knows better than Your Majesty. They strongly and enthusiastically urged

26 Count Wolfgang Julius Hohenlohe (1622–1699), commander of the auxiliary units of the Rhenish Alliance.

the siege and promised me all the armament if Your Majesty pleases to send the thirteen thousand infantry soldiers whom I had requested for the enterprise. Eventually, on 18 March, Your Majesty made a resolution and ordered that this military enterprise should be started as soon as possible, which would be of great use not only for these provinces but also to the whole of Christendom. In addition, the military equipment prepared – while Wassenhoven was waiting for Your Majesty's gracious decision in Regensburg for twenty-four days – was to be transported here as quickly as possible.

Seeing this, Your Majesty's court and privy councillors sent Wassenhoven, who had returned from Regensburg, to me and insisted that I set a day for the siege. I need to admit, it seemed that a great deal of time had already been wasted, but when I could clearly see Your Majesty's gracious will from this letter and the zeal of the Styrians, I set the siege for 8 April. When Your Majesty graciously approved this, and the Styrians also agreed, promising that there would be no lack of the necessary things, I immediately communicated this to the Hungarians as well, and implored them to appear in as large numbers as possible on the set day. However, when I sent the same message to the Germans in Styria, some replied that they could not be there before 12 April, while others said that they could not come at all.

The War Council tried in every way to persuade them to set out, but they could achieve nothing. In the meantime, the set days passed, the Hungarians gathered together, but then they returned home very dispirited. This is how the most suitable occasion for battle passed, and I already believed that nothing would come out of the matter, and I would not have regretted it, because it was obvious that, with such a small army, it was impossible to besiege Kanizsa and defend ourselves against the relief army – which was certain to arrive as we wasted so much time. I humbly reported this to Your Majesty, and also informed the court councillors in detail, when Count Strozzi, Your Majesty's Lieutenant General, finally arrived, accompanied by Colonel Holst (as an artillery commander), some other artillery officers and two engineers. I could see that all this was arranged in a way that if I had objected, it would have appeared that the siege did not take place only because of me. Since there was still no report about the enemy's gathering, I agreed to inspect Kanizsa with Strozzi, Holst and Wassenhoven.

So on 19 April, we approached Kanizsa with the gathered army. We found that the swamps were not as large as we believed them to be. Finally, considering there on the spot what needed to be considered, we did not find it hopeless to seize the fortress unless we were prevented from this by the enemy's rescue army. This possibility could never be ruled out.

In the meantime, Count Hohenlohe also returned and we decided to meet in Graz, but, so as not to lose even more time, it seemed more advisable to change the plan and hold the war council on 21 April. For this, the Styrians delegated Baron Johann Christian Galler, who, considering everything during the council, offered and promised everything necessary on behalf of his principals that Wassenhoven and Holst wanted. Thus, by joint decision, we set 28 April as the day of the siege so that the army would no longer be stationed at the quarters, and we would not miss the entire opportunity. Hohenlohe received the matter rather unenthusiastically. He said we ought to wait until the grass grew again. But when we came together in my new fortress on 27 April, we found that the armament had not yet arrived despite that it had been promised.

In the meantime, however, the troops were rallying. Due to lack of the armament mentioned above we would have gladly cancelled the siege, yet preparations seemed to have reached a point where we could no longer stop without damage to the honour of Your Majesty's arms. This was the case all the more because Johann Senkmeier, Victualling Commissioner to the Court Chamber, claimed that everything had happened according to the promise given and the supplies would arrive the following day.

On 28 April, we surrounded Kanizsa according to the plans and expelled the enemy from the suburbs with the first storm. Soon afterwards, we marked out the place of the communication trenches and batteries. However, while we were waiting for the artillery unit and other necessary things for nine days, the menacing danger opened the enemy's eyes, who were initially so perplexed that they did not even know what to do. It was only on the third day that they began to surround the place with earthen embankments; they had failed to do so before.

The second reason why we could not take Kanizsa was not only that we had wasted so many days – which were very valuable in view of the enemy's rescue army – but that we had even contributed to the fortification of the unprepared town with our negligence. Additionally, another trouble was added to this, namely that we wanted to give an important role to the artillery unit in the siege and decided not to deploy them until all the cannons and mortars were in a position to put the fortress to flames with a single concentrated fire, and fuel the fire with grenades and incendiary bombs so much that it would be impossible to extinguish it. This fire would undoubtedly have damaged Kanizsa to such an extent that it could not have withstood the attack for long. However, some bombs were fired from Count Hohenlohe's camp, where there was a mortar – we did not have any. Seeing this, the enemy soon realised our intent and quickly demolished the rooftops, so that the bombs would have no effect (but they were worth of nothing anyway because they either exploded in the air or did not ignite in time).

The third and main reason we could not take Kanizsa was that even if the grenades had been better, we could hardly have achieved anything with them – as it was shown by experience when we received proper grenades on 2 May – because whenever we set Kanizsa on fire, the enemy could easily extinguish the small flames by removing flammable materials. It was also a great problem that, despite our expectations and to the surprise of us all, our cannons were so burnt and damaged after a few shots that when we needed to fire them, they could hardly be used. This inhibited our activities for a while, and gave the enemy the courage and opportunity to set fire to these approach trenches to our great detriment on 21 May (as they also tried it on 6 and 8 May, when the Hungarians were making the trenches, but they were unsuccessful then).

The fourth reason was that the promised thirteen thousand infantry soldiers did not arrive. Initially, Strozzi had one thousand five hundred soldiers, Spick had one thousand two hundred men (because the others remained in Radkersburg and Ferslangfeld), Spaar had one thousand two hundred, and the League had four thousand soldiers. That made altogether seven thousand nine hundred soldiers. Although there were also nine hundred Bavarians and finally one thousand seven hundred soldiers served under Colonel Munfort, there were still only ten thousand five hundred men in total. As a result, there were not enough men available for the numerous guard duties and other tasks, and so we had to do without a lot of things, which – if we had had an army of thirteen thousand five hundred soldiers from the beginning – would have eased the siege.

There are many other matters that have considerably hindered us, but it would be insipid to Your Majesty to read a detailed account of everything and would only cause distress. Therefore, because what has happened cannot be undone, I resolved to explain very briefly at least the four major reasons why we were not able to seize Kanizsa, so that Your Majesty would see that we failed not for lack of opportunity, but for lack of armament requested and promised, as well as the necessary goodwill. But even so, Kanizsa got into such a state that – as we later learnt it from the prisoners – if we had stayed there for another five or six days, the Ottomans would have been forced to give it up. For the bastion, which could have prevented us from crossing the moat, was demolished on the last days with the new cannons to such an extent that neither cannons nor people could be kept in it any longer.

It is clear from this, even if we ignore everything else, how much damage was caused by postponing the siege from 8 to 28 April, and we lingered idly for nine more days. Everything goes wrong for the unlucky, and one mistake creates another. When the news first spread of the approach of the Grand Vizier, the members of the council manfully decided to die on our embankments than give up the work we had begun, and we only humbly pleaded with Your Majesty to send us help. But as the Vizier got closer, we modified our plans and left so hurriedly that I will never be able to think about it without pain. I resisted, withstood, and protested, but in vain. Hohenlohe urged, and Strozzi demanded that we leave the site. When I asked about the reasons, they replied that the enemy had sixty thousand soldiers, and we had so few that we would not be able to defend our embankments. But how did they know that the enemy was so huge in numbers? Wassenhoven twice clearly denied this, but to no avail; the reason was maybe that they at last had the opportunity to leave. Nevertheless, that was not true, because the enemy had less than twenty thousand men back then. If Hohenlohe had joined us as I asked him, we could have easily defended the line. However, he did not even want to hear about it and demanded that we go over to him, leaving our camp behind.

I was powerless to keep them here as I intended to, so I had to run with them, whether I wanted to or not. Moreover, I also failed to achieve that we, sending our luggage forward, retreat in an orderly fashion. Confusion caused total disorganisation, and lots of things were lost. Yet, these were not the only erroneous actions. When it came to where the camp should be set up, I definitely recommended that we station the infantry on the hill, in front of my fortress. This way we could still have kept Kanizsa occupied to some extent, we could have secured Zrínyi-Újvár and the Mura, and we would have had the opportunity of wreaking havoc on the enemy every day. However, no one listened to me. We crossed the Mura and camped in a low-lying, waterlogged area and let the enemy have the hill.

The Grand Vizier noticed this, and he followed us on the fourth day. He set up his camp on the hill not far from the fortress. Then again, I suggested Hohenlohe and Strozzi that this was a good opportunity to attack the enemy. I proposed that we should attack at night when they were tired and there was still disorder in their camp. We had nothing to fear, as we could easily retreat any time. However, they did not even want to hear about it, as if I had proposed them the greatest nonsense. Consequently, the enemy found enough courage to cross the Mura with two hundred men and entrench themselves on the island. However, we did away with them. If I had not seen it with my own eyes, I might not believe anyone else that in broad daylight, maybe around eleven o'clock, five hundred Ottomans came over and started to entrench themselves a gunshot away. Furthermore, they constructed a defensive line across the hill on the same day. I demanded again that we oust them at night, but to no avail.

So the enemy came closer day by day, and the more I asked to disturb them, the less anything happened, because all things were postponed until the arrival of Count Montecuccoli. We waited very impatiently, but I had to face Scylla when I wanted to avoid Charybdis. Because after his arrival, he immediately took actions in a way that I could easily understand his intentions. He removed the commander from his office and made himself the defender of Muraköz and the fortress.

I could have resisted, but hoping that after the arrival of Lieutenant General Spork, we would try to do something valiant against the enemy – as he promised in the council – I decided to remain silent. After his arrival, however, Spork did not mean to do any such thing; instead, he insisted that we should wait for the Margrave of Baden. Meanwhile, I could not achieve the slightest thing in defence of the fortress. What is more, when one night I wanted to send two thousand Hungarians to the fortress, the commander appointed by Montecuccoli replied that I may as well send them, but he would not let them in unless he received a written order to that effect. When I was informed about this, I already knew what his plans were, so I gave up again.

The enemy kept approaching every day, while our soldiers were raiding the Muraköz. They broke into churches and raped women, but none of them wanted to fight a battle. They did not even want to defend themselves, but rather died without fighting back. What an unheard-of thing! Fifty Ottomans, armed merely with swords, managed to expel three hundred and fifty Germans out of the moat and ramparts, and killed many of them. There was only one man who fired his rifle, but none drew a sword. Montecuccoli seemed angry, and he even said he would impose an exemplary punishment, but that, too, remained a mere threat.

But why should I bother Your Majesty with more details of these shameful things? In the end, fifty Ottomans ousted all our men out of the moat and rampart. They not only killed many Germans by climbing over the walls of the fortress, but they also bewildered them so much that they all immediately left their posts and fled in a disorganised manner towards the bridge. The Ottomans entered the fortress through a small gate left open by the soldiers running scared from the rampart, and ruthlessly butchered everyone who was still in the fortress.

May Your Most Gracious Majesty judge if Count Montecuccoli had a genuine intention of defending the fortress when, without my knowledge, he prepared everything by undermining the ramparts and bastions in a way that he could detonate the fortress at the first sign of an enemy attack? (As a matter of fact, the bastions were blown up before anyone tried to climb on them.) The day before the fortress was taken, the commander – evidently by the instruction of Count Montecuccoli – also ordered that my one hundred soldiers who were in the fortress should leave, because – he claimed – there were enough Germans. Moreover, when on the last night Count Batthyány asked him to let his two hundred soldiers enter the fortress, his request was rejected. Perhaps they feared that they would have defended the fortress longer than it was considered desirable. Last year, as few as one hundred and twenty Germans and one hundred and fifty Hungarians defended the fortress against three completely unexpected and most violent sieges, causing great losses to the enemy. And now one thousand nine hundred soldiers and an enormous army have disgracefully lost the fortress.

It was a great help, indeed! My fortress was taken from me, Muraköz was destroyed, and the serfs were driven away or slain. These are enormous losses for me. However, they do not hurt me nearly as much as the fact that my soldiers, who throughout so many years defended not only Muraköz but also Your Majesty's province, Styria, were expelled from their homes and forced to flee with their wives and children, not to mention the disgrace that was brought upon Your Majesty's arms in this way.

These are the reasons, My Most Excellent Lord, which compelled me to rush to Your Majesty and find out what I can do now? My estates are ravaged, my serfs are scattered, and I am deprived of my soldiers in the devastated and uninhabited Muraköz lying open to the enemy. For forty years, I have defended this region against the enormous power of the Ottomans with lots of sweat and blood shed by me and my men, and now my ruination has come from where I was supposed to receive help, in which I placed all my trust and hope. And my greatest pain of all is that I could neither serve Your Majesty nor benefit Christendom, and now with merely one sword on my side I await Your Majesty's orders.

Written in Vienna, on 17 July 1664.

A humble and loyal servant to Your Most Gracious Majesty

Comes Nicolaus a Zrinyo

9

Pál Esterházy: Mars Hungaricus[27]

– Detail –
(Translated from Latin)

Chapter Thirty

Seeing our soldiers running, the Grand Vizier happily entered the fortress of Kanizsa, and comforted the besieged. Not long after reorganising the fortress guards, he decided in his fit of anger to attack Zrínyi with the pagan army, because it was he that inflicted damages on them. He wasted no time and approached Zrínyi-Újvár with his camp on the third day. Zrínyi fought back, and after some minor clashes causing severe damages to the Ottomans, he returned to his fortress. Zrínyi urged Hollach[28] and Strozzi[29] to place their camp between the enemy and the fortress, but without success.

The Grand Vizier started considering the siege the following day, when he saw that our men crossed the Mura River and set up their camp in a low-lying, waterlogged place, voluntarily relinquishing the hill adjacent to – or rather in the immediate vicinity of – the fortress to the enemy. He seized the opportunity, and occupied the unprotected hill and camped there exultantly,[30] because from there Zrínyi-Újvár could be occupied without much effort, whereas for us, it was very difficult to receive help because of the nearby river that had to be crossed for getting into the fortress.

Zrínyi-Újvár, once called the fortress of fools, was used by the Zrínyi family, who transferred this place to one of their meritorious servitors as an act of benevolence. Over time, however, when Sziget, Babócsa and soon Kanizsa fell, this place became completely destroyed. It was unusable and stood in ruins[31] until it was finally rebuilt in its current form by the magnificent Count Miklós Zrínyi, Ban of Croatia, Slavonia and Dalmatia, with the intention of placing the Ottomans in Kanizsa under pressure, especially because he could clearly see the suitability of this place for causing damage to the enemy by sorties made from there (for it was neighboured by Kanizsa to the north, Segesd and Berzence to the east). It was his wish to call this fortress Zrínyi-Újvár, after his own name, in order to distinguish it from their other fortress found in Croatia, which was occupied by the Ottomans. So from a small castle it turned into some kind of fortress. It was located in the close vicinity of the hill, from which it is separated by a deep ditch. To the north, there was a lake made with arduous work, while to the south and west (that is, in the direction of the island), it was surrounded by the Mura River. As it was erected on a relatively high elevation, it could be approached with difficulty by those coming from the direction of the island. There are no rocks or cliffs here, as the whole area is sandy, and therefore, although it was built as a fortress with tremendous effort, it cannot be called a fortified

27 *Esterházy* 1989. 159–167. (For the original Latin text see *Esterházy* 251–257. Translated into Hungarian by *Emma Iványi*.)

28 Count Wolfgang Julius Hohenlohe (1622–1699), commander of the auxiliary units of the Rhenish Alliance.

29 Pietro Strozzi, an Italian Lieutenant General. He met his death under Zrínyi-Újvár in 1664.

30 Esterházy here cites the Memoir of Zrínyi almost word by word. Cf. Zrínyi Miklós válogatott levelei 1997 [Selected Letters by Miklós Zrínyi 1997]. 219–220.

31 We slightly modified the Hungarian translation by Emma Iványi as suggested by József Kelenik. See *Kelenik* 2012.

place, mainly because the hills rise so high above it that it could have been quite conveniently attacked with cannons from several places. But let that be enough about Zrínyi-Újvár.[32]

So the Grand Vizier, having occupied the hills, gave the order to build an embankment for cannons opposite the eastern bastion. On the third day, they shot their cannons from there, but they did little harm to us. On the same day, the Janissaries began to dig their way towards the fortress, and also made a trench across. Seeing this, Zrínyi turned to Hollach and Strozzi again and made a suggestion on how to attack the enemy. He proposed to cause turbulence in the camp with an unexpected attack, and argued that there was no need to be afraid, because even if the enemy got the upper hand, they could easily access the fortress nearby. He suggested that they should not wait until the enemy approached, but rather torment them incessantly with various sorties and cause them as much damage as possible every day. However, his speech fell on deaf ears.

So when the enemy observed that our men did nothing, they became so self-assured that two hundred Janissaries crossed the Mura River, and in their audacity they did not even shy away from entrenching themselves on the island, and would have finished what they started if, under compulsion, the Christians had not deployed all their forces against the enemy.[33]

With his imperial musketeers, Strozzi was the first to launch a strike on the Ottomans digging in the ground quite busily. When auxiliary troops arrived, he himself fell onto the enemy, he slew a lot of them and put the others to flight. But in the end, while he was dauntlessly pursuing the barbarians, he fell gloriously defending Christendom leaving his immortal memory to posterity. He was hit by two bullets shot by the Janissaries – one on his thigh and the other on his forehead. Our men were so exacerbated by the tragic fate of their commander that they spared no one of the enemy; all of them were cut down and slain.

This, then, was the end of Count Strozzi, a most noble leader, who was a much too reckless and at the same time valiant soldier. It is odd that he almost never supported Count Zrínyi's proposals, which I myself perceived on many occasions in astonishment.[34]

After the Janissaries were thus expelled from the island, the enemy, seeing their soldiers die, did not attempt to cross the river any more. Zrínyi, on the other hand, did not stop from taking a toll on the Ottomans by means of daily sallies with Croats and Hungarians. He cut off many of them or carried them into captivity.

In the meantime, His Excellency Count Raimondo Montecuccoli, Imperial Field Marshal, arrived. His presence brought some comfort to Zrínyi and Hollach, because they could hardly wait for him to join them. After sorting out the matter of the fortress, he set up his camp at Légrád.[35]

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32 The "other fortress" found in Croatia and occupied by the Ottomans was Zrin. It was the ancient home of the Zrínyi family located near the River Una flowing into the Sava, to the south-west of Kosztojnica (today Hrvatska Kostajnica in Croatia), which was already held by the Ottomans at that time.

33 The same again by Zrínyi: "Then again, I suggested to Hohenlohe and Strozzi that this was a good opportunity to attack the enemy. I proposed that we should attack at night when they were tired and there was still disorder in his camp. We had nothing to fear, as we could easily retreat any time. However, they did not even want to hear about it… Thus, the enemy found enough courage to cross the Mura with two hundred men and entrench themselves on the island." Zrínyi Miklós válogatott levelei 1997 [Selected Letters by Miklós Zrínyi 1997]. 220.

34 Archbishop György Lippay also blamed Strozzi for the failure of the siege of Kanizsa in his letter written to Wesselényi on 16 June 1664. He acknowledged, on the other hand, that he had fallen fighting against the Ottomans under Zrínyi-Újvár. (OL E 199 Kamarai lt. Wesselényi lt. 4. cs. Missiles.)

35 Montecuccoli arrived under Zrínyi-Újvár on 15 June. Here again, Esterházy adopts the method of Zrínyi's anti-Montecuccoli pamphlet: first he exalts Montecuccoli, and then he exposes him in the narrative with

He was followed by His Excellency Lieutenant General Spork and his army of five thousand cavalry soldiers, who also encamped there, as well as Baron Spaar and His Serene Highness, Duke Sulzbach,[36] who were also Imperial Field Marshals and arrived with large numbers of infantry soldiers and artillerymen. They were followed by His Illustrious Highness, Count Ferenc Nádasdy and Pál Esterházy at the head of five thousand Hungarians, as well as many other counts and barons.

Our army was already so large that, even if it could not surpass the strength of the enemy, it was apparently equal to them, all the more so because His Excellency, Count Péter Zrínyi came to help from Croatia accompanied by other distinguished Croatian lords and an army of approximately ten thousand men. Furthermore, we also expected the powerful imperial army, led by the His Serene Highness, Duke and Margrave of Baden, as well as the army of His Majesty, King of France, led by Their Excellencies Field Marshal Count Polcin and Deputy Field Marshal Count La Folliada, consisting of six thousand most excellent soldiers. They were followed by His Serene Highness, Duke of Württemberg and his three thousand soldiers.[37] From them, one could expect a certain victory.

In the meantime, the enemy got closer to the fortress day by day and besieged it with their cannons incessantly.

For us, the bridge built over the Mura to the fortress was very beneficial, because new soldiers could be sent to the fortress every day to replace the exhausted ones. When the enemy realised this, they established a gun emplacement opposite the bridge, and by towing cannons to that place, they caused enormous damage to the ships, which were destroyed little by little. They also erected two other embankments, and shot at the walls of the fortress with their cannons day and night. Our men, on the other hand, resisted valiantly and did no little harm to the barbarians on a daily basis, so much so that we expected that the siege would cease sooner or later, as our forces had increased considerably.

Chapter Thirty-One

While these things happened at Zrínyi-Újvár on both sides, Zrínyi decided to carry out some kind of notable raid on the Ottomans with the Hungarians and Croats. After sending out his scouts, he found that this could be implemented without difficulty. Accordingly, he collected two thousand men and visited Count Montecuccoli. Disclosing his intention to the Imperial Field Marshal, he asked for some German auxiliary troops. He argued that he may not only be able to drive the enemy away from the mines, but also take the batteries of cannon themselves. Even if he would not be able to acquire the cannons of the enemy, he could make them unusable.

They held a discussion about this, while our men encountered a serious calamity. Some of Zrínyi's chief officers sallied out of the fortress and fell on the enemy. Zrínyi's most successful soldier, an excellent valiant man was the first to attack the enemy, and after causing great destruction among the Janissaries, he fell gloriously, hit by a bullet. His body was brought back to the fortress by his

hard facts. It should be noted here that Zrínyi and Esterházy were not the only ones who had low opinions about Montecuccoli. Their views were shared by György Lippay, who said that the good opportunity "will be washed out of our hands by Lord Montecuccoli". (In the letter cited above: OL E 199 Kamarai lt. Wesselényi lt. 4. cs. Missiles.)

36 Prince Philip Sulzbach, Prince Elector, Lieutenant General.

37 The Duke of Baden: Leopold of Baden. La Follida: Count D'Aubusson François Feuillade (1618–1697). In 1664, he was the lieutenant to Coligny in the French army sent to Hungary. The Prince of Württemberg sent Duke Eberhard Ulrich with the army. By 20 June, everyone had arrived except for Leopold of Baden, Spar and Coligny, and there were as many as thirty thousand soldiers. *Széchy* V. 1902. 104; *Perjés* 1965. 368.

companions. The unfortunate death of this most valiant chief officer (who had done much without Zrínyi, but Zrínyi had already done less without him) filled the entire Pannonian army with great pain and wrought tears from their eyes; indeed, many, even from other nations, mourned him as if he had been one of them.

He was called Farkas Kis, a Turk by birth. He fled from the Ottomans and took up Christianity. He stayed in Kiskomárom for a while, and caused lots of trouble to the enemy. Zrínyi noticed his brave deeds and wished for his service. He accepted Zrínyi's invitation and became such a faithful and valiant servant to him that he stood out high among his comrades in the school of Zrínyi, and therefore he was always the dearest man of his lord. Under Zrínyi, he caused several hundreds of thousands of Florins worth of damage to the enemy, which made the whole country admire his military virtues. His body was later taken from the fortress to Légrád and buried there.

Finishing the discussions, it was decided that although raiding was the right thing to do, but it was not feasible, as the enemy established a lot of firing positions, and from those they could shower a hail of bullets on our men, as if they were forts. So Zrínyi's plan came to nothing due to the contradictions of others.[38]

Meanwhile, the approaching enemy worked tirelessly to dig ditches for the mines, and getting closer to the moat, they finally made mines, and our men worked tirelessly to make the countermines.

When, on a certain evening, the enemy fired all their cannons and small firearms at the fortress every day, we detonated the countermine. Then behold! the mass of earth flying high due to the fire lit in the deep killed many of the enemy. As a matter of fact, I myself watched it from the fortress as we sent several of our enemies to the next world. The power of the explosion blew them up together with their hoes and other tools.[39] The sight was, of course, welcome to us, especially when we heard the wailing and shouting of the enemy from the bastions. Having accomplished this, we tirelessly dug ditches needed for our mines and caused a lot of harm to the enemy every day. Zrínyi started to urge the Imperial Field Marshals again to disturb the enemy, to which they had finally contributed. In accordance with collective will, his brother, Count Péter Zrínyi, marched with three thousand German and six thousand Hungarian and Croatian soldiers towards Berzence to attack the enemy camp from behind. At the same time, a sortie was to be made from the fortress against the enemy's mine ditches and batteries of cannons. And all this could have been achieved if the enemy had not learnt about our plan – due to the treason of a deserting musketeer – that was about to be put into action. As soon as they got to know this, they were watching vigilantly in both directions, and thwarted this whole good opportunity. As a result, Count Péter Zrínyi was forced to return to camp without accomplishing anything, and the attack came to nothing.

At the same time, a part of the enemy's army was sent towards the River Rába to plunder. Passing by Batthyány's border fortress district,[40] they burnt many villages to ashes, cut down lots of serfs or took them captive, and some nobles also fell into the hands of the enemy. A few days later, they returned to their camp with plenty of loot. The Grand Vizier welcomed them joyfully, for on that day, in addition to the customary noise of trumpets and whistles and the drum beats, they also signalled their rejoicing with more frequent cannon shots than usual, which we heard on the walls of

[38] Zrínyi refers to this plan in his report to Leopold I. The letter written by Pál Esterházy on 15 June also contains information about the death of Farkas Kis, *Esterházy* 1989. 325.

[39] Cf. the letter written by Pál Esterházy on 24 June 1664, *Esterházy* 1989. 326.

[40] The border fortress district facing Kanizsa, the Captain General of which was Kristóf Batthyány at that time.

the fortress. As we later learnt from those men who escaped over to us, the reason for this was the same thing we suspected.

Chapter Thirty-Two

The seventh week had come, and the barbarians were still unable to seize Zrínyi-Újvár, even though many of them had fallen from them, and therefore they had little or no hope of taking the fortress. However, they did not get discouraged. What is more, they were engaged in digging trenches day and night. They were trying to break through the walls with their cannons, while our men resisted persistently. Suddenly, we do not know for what unfortunate reason, a fire broke out accidentally on the biggest bastion of the fortress where the grenades and other firearms were stored. The unexpected explosion tore the men and cannons into pieces and threw them high into the air with a huge rumble, bringing great misfortune on us. The pain of Zrínyi, the commander of the fortress, was exacerbated by the death of his most valiant soldier, András Horváth,[41] who perished from the same fire while taking care of the cannons and causing considerable damage to the enemy. After Farkas Kis, this was Zrínyi's favourite man for his expertise in military science and considerable experience.

When all this happened, everything turned worse eventually, and the hope of defending the fortress gradually turned into despair. I remember that after this misfortune, Zrínyi, this big-hearted hero, often cast his tear-filled eyes on his fortress as something that would soon be lost; especially after seeing the advancement of the enemy day by day and the alienation of our men from him. Moreover, even the Christian army started to plunder his estates, loot the churches, rape and kill his miserable people.[42] I remember how often he complained to me about these things in private, with tears in his eyes, while referring to the fortress no longer as his own, but as the fortress of the enemy. This noble soul born to battle could not suppress his grief too long. So as not to see the disgraceful end of his fortress, he left the camp for Csáktornya, which was also his own fortress, after saying farewell to me and a few more men.[43]

Surely I could not watch without compassion the great misfortune of this Mars of Pannonia, without whom, the Pannonians could expect nothing but peril, like the sheep when their shepherd is lost.

I went to the fortress that day, and indeed, the cannons had already started to be removed from the bastions and the fortress and were transported together with other military equipment to the island. Additionally, gunpowder was poured at the feet of the bastions in order to detonate the fortress. From these, as if I could only see it in a mirror, I could easily understand what these men were up to.[44] On the following day, the Hungarians and the Croats held a discussion among themselves and they unanimously agreed that Miklós Zrínyi should be called back from Csáktornya, because even his

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41 András Horváth was in Ottoman captivity in Kanizsa for a while in 1654, but escaped and took part in the winter campaign. In early 1664, he remained in the Fortress of Babócsa as a member of the guard. Cf. *Hunyady* 1980. 77, 80.

42 Zrínyi also writes about this in his memoir on 17 July.

43 After the meeting on 26 June, seeing that he could not achieve anything, Zrínyi decided to go to Vienna to make a complaint. On 27 June, still in the camp under Zrínyi-Újvár, he wrote a letter of complaint about Montecuccoli to Leopold I. Two days later, on 29 June, he travelled to Csáktornya. See the letter by Pál Esterházy, dated 31 June, *Esterházy* 1989. 327. Cf. *Klaniczay* 1964. 768.

44 See the letter by Pál Esterházy dated 24 June, *Esterházy* 1989. 326. The bastions were undermined in advance so that they could be blown up after the fortress was evacuated. One day before the occupation, the German commander of the fortress even sent away Zrínyi's one hundred men.

mere presence would be more beneficial for the case than the workings of others. By collective will, I was dispatched with the letter and arrived there before next dawn. The sorrowful Zrínyi was still in bed, and I comforted him as much as I could in the midst of frequent sighs. I gave him the letter that His Excellency Field Marshal Count Montecuccoli, Their Illustrious Highnesses Count Ferenc Nádasdy and Count Péter Zrínyi, as well as other counts and magnates wrote to him.[45] Finally, after a two-hour conversation, having put forward a lot of arguments, I managed to persuade him to come back to the camp, it was not easy though. When I returned to the camp with the same letter rejoicing, and passed by Zrínyi-Újvár, alas, I saw the tragic turn of the situation. I witnessed what no Christian should have seen. The Ottomans, when they cleverly found out that there were not any cannons in the fortress and that according to all signs our men had lost hope, left their approach trenches and launched a general attack on the fortress. Around seven o'clock in the morning, the assault began with loud battle cries. First, about fifty Ottomans rushed to the advance bastion, and since no Hungarian army had been allowed to enter the fortress for five days, more than three hundred of our men were driven away merely with swords, many Christians were butchered and the advance bastion mentioned above was taken.[46] They did not stop there, but expelled our soldiers out of the moat and from the counter breast-work called "falsa bracha",[47] and drove them purposefully to higher-lying parts. Eventually, in the course of a second assault, they could enter the fortress through the small gate that was left open by our men fleeing fearfully. The Ottomans started to slay them, and they became so confused that they could not think about defence any more. All of them left their weapons and posts behind in disorder and fled to the bridge in horror, while some officers tried to hold them back, in vain. When they got there, many of them fell into the river as the bridge collapsed in the middle. In the meantime, the Ottomans occupied the fortress to the eternal disgrace of Christianity.

I watched this tragedy with tearful eyes. I saw that hundreds of Christians drowned in the water miserably and witnessed that the triumphant Ottomans walked around the walls of the fortress and penetrated the houses without fear. Finally, I saw that the enemy hang their flags on the fortress walls with great arrogance. What caused me even greater pain was that I had persuaded Zrínyi to return and he had to see these terrible things.

This is how Zrínyi-Újvár was taken.

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45 Montecuccoli was uncomfortably affected by Zrínyi's leave and possible complaint, so he even wrote to Vienna to make him stay, *Klaniczay* 1964. 768. According to all signs, Zrínyi liked Esterházy perhaps the most among the Hungarian nobles. That is why he was sent on this difficult mission. See also Pál Esterházy's Memoirs, *Esterházy* 1989 on page 309, and his letter dated 30 June 1664, *Esterházy* 1989. 327.

46 Esterházy cites again Zrínyi describing the seizure of the fortress on 30 June.

47 "Falsa bracha": a firing position constructed in the moat on the side of the fortress, from where the moat could be kept under fire. (Explanation by Géza Perjés.)

10

Raimondo Montecuccoli: Relazione della campagna dell'Armata Cesarea nell'Anno MDCLXIV[48]
(Translated from Italian)

[**4r**] When Field Marshal[49] Count Montecuccoli received the order written by His Imperial Majesty himself on 4 June 1664, ordering him to leave Vienna immediately and travel with the letter to Graz and Zrínyi's island[50] to take over the command of the army, two opposing feelings came over him. On the one hand, the blind obedience to the command, on the other hand, the military aspects, knowing the weakness of the army, were in conflict. The pain and suffering of riding to Pécs in winter [51] [*and*] the unsuccessful siege of Kanizsa, in which many of the old, experienced soldiers perished, [*furthermore*] the frequent adversities and illnesses made the army weary and fearful. The constant fight, which did not leave even a breath of time for the soldiers, [**4v**] ruined their clothing, [*as well as*] completely broke their souls and consumed their strength. All this decreased the number of experienced soldiers to a minimum. Additionally, the new recruits could be hardly used for anything worthwhile as in any situation they were more of a trouble being completely inexperienced. They were not even trained how to carry their weapons, let alone use them. The Ottomans, on the other hand, were well-rested, proud and victorious, as they managed to take Berzence and Babócsa[52] without any resistance, they supported Kanizsa, and there were many of them.

In addition to the fact that [*the plan for*] the campaign had already been turned upside down – as most of the campaign season had already passed and the site of the battle had been shifted to difficult and disadvantageous terrain, where the warehouses had not been prepared either (they had been set up along the Danube) – the transportation [*of reinforcements*] was not possible either, and the join of the imperial army could only be achieved late and with great difficulty.

In Montecuccoli, the tendency to obey prevailed, [**5r**] so he only sent an apology to the Emperor[53] in advance saying that if anything [*ill-fated*] happened, it would not be his fault. Furthermore, he most humbly protested [*against the assumption*] that he wanted to spare his effort, care, fatigue, blood, life in the service of His Majesty. Nevertheless, he strongly hoped that imperial justice would not want to accuse him in the future, or to oblige him to consider those matters that were based on the ideas and intricate actions of others, or resulted from causes unconnected to him [Montecuccoli].

On the 8th, he left Vienna with the letter and stopped for a short time in Graz to discuss with the officials[54] there about the things necessary for the war. He arrived in camp marked with an 'A' on 15 June.

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48 *Relazione della campagna dell'armata cesarea nell'anno MDCLXIV.* Unpublished to this day. Place of preservation: ÖStA KA AFA 1664/13/29. fol. 1–42. (Translated from Italian into Hungarian by Mónika F. Molnár and Levente Nagy, with notes and comments by György Domokos.)

49 *Marescial di Campo,* that is, Feldmarschall in German, which was, of course, different from the rank of the modern military hierarchy. It indicated the commander-in-chief of the army.

50 That is, to the Muraköz.

51 That is, Zrínyi's winter campaign.

52 These were seized from the Ottomans by allied forces during the winter campaign mentioned above.

53 It is evident that Montecuccoli here refers to the events of campaign that took place in that year.

54 That is, the officials of the Inner Austrian War Council.

By that time, Zrínyi's fortress had already been attacked and besieged by the enemy. The imperial army, for the reasons mentioned above, was exhausted, tired, reluctant, and above all, it was short of officers, [**5v**] because most of them were wounded.

The fortress and the Mura crossing had to be defended. (The left side where the enemy camped was hilly, dominating [*i.e. over the neighbourhood*], and covered with a forest. Furthermore, the bend of the river was also favourable to them. The opposite bank was flat, low-lying, and defenceless.) Over several miles, men could not even take shifts in the trenches because their numbers had decreased so much, and because there were less than 2,500 infantry and 500 cavalry soldiers in service of the allied forces. At the discussion held on 17 [*June*], Count Zrínyi said that men in the Hungarian border fortresses were in complete uncertainty – because they had not received their payment for years – and therefore they could not be counted on at all. The defence of the fortress and the border required f10 [**6r**] quintals[55] of lead, so there was often a shortage of ammunition and victuals. This stronghold was not built on the model of fortifications (neither its geographical location, nor the structure itself, nor the area allowed that), but to defend – together with a redoute[56] – the bridgehead that ensured the passage over the Mura towards Kanizsa, and to cover the troops that went on raids in peacetime. It was therefore a worthless place: with no moat, no contrascarpa,[57] no forma,[58] no wings,[59] and no earth[60] inside. It was completely open towards the water: and it was indeed very likely to fall at any hour of the attack. It was also dominated [*i.e. by the adjacent heights*], and it was also unsuitable for sorties on account of the steep slope and the hills opposite. [*It was*] confined, where only a few people could fit without confusion and hindering one another. Consequently, it was not worth defending it.

[**6v**] The enemy attacked [*the fortress*] with united forces, but the Christians could only help with minor troops, as they could cross exclusively[61] over the bridge, which was constantly watched by the enemy and kept under fire. Thus, he [*i.e. Montecuccoli*] would not have even started to defend if he had not taken into account what others said, namely that he did not want to help the fortress, but to demolish it with countermines[62] and to level it to the ground as soon as possible, to burn it down and to blow it up, even before they came to the end. The military considerations did not justify that the life of even one soldier should be put at risk. Military practice had already shown that such small fortlets, which were built on the side of a river where the enemy's army camped and to where only small reinforcements could be sent under the enemy's nose, were normally given up. Baron D'Avancour repeatedly advised us to do so, [**7r**] committing himself to build a better one in eight days after the enemy's army left. In spite or because of the reasons above, or to gain time to gather Christian forces

55 A contemporary quintal was approximately 50 kg.

56 *Ridotto di campagna,* a redoute, was a simple rectangular camp rampart, possibly surrounded by a ditch and/or a row of stakes. Glossarium Artis 1979. 90.

57 *Contrascarpa,* the outer side of the moat; in contemporary terminology it sometimes also included the covered road, the castle plane and the shooting bench behind the breastwork. Glossarium Artis 1979. 135.

58 It is not quite clear what Montecuccoli meant by this word. The word *forma* was primarily used for the casting mould of cannons. Gran dizionario teorico-militare. Italia, 1847. 325. Here it perhaps refers to the irregular floor plan of the fortress and the makeshift (?) structure of its walls.

59 *Fianchi,* a bastion wing, two sides of the bastion perpendicular to the curtain wall.

60 A literal translation, but presumably the word "earth" here refers to the earthwork of the fortress walls, which, in Montecuccoli's opinion, was not thick enough.

61 The original term used here was *difilare,* which means "going straight". Here, however, it apparently indicated that one could cross only over the bridge.

62 The Italian word used there was indeed *contramina,* which at first glance seems meaningless. It is very likely though that Montecuccoli meant here the countermines prepared in advance for the case of an enemy attack.

coming from different places, and to keep the enemy busy so that they could not start another action elsewhere, and to make them lose there [*under the fortress*] as many people and horses as possible, a [*military*] council was held on the 17th, where the following issues were discussed:

1. How could the stronghold be defended from being occupied?

2. If the stronghold no longer be held, how can the bridge be demolished and the Mura defended?

The following decisions were made:

1. From the very first day, it seemed impossible to prevent the loss of the stronghold, still

2. it has to be defended by all human means possible, including well shafts,[63] countermines, mine chambers,[64] traverse dykes,[65] entrenchments,[66] palisades,[67] caponieres,[68] [**7v**] buried bombs, hand and large grenades, counter-batteries, and the like;

3. to change and replace soldiers every day so that they could bear great fatigue and constant vigilance better;

4. to replace Count Jacopo Leslie, Lieutenant Colonel to Spick,[69] who had been the commander of the fortress from the beginnings, with Tasso, Lieutenant Colonel to Strozzi, despite the allies' reluctance to do so.

On 18 June, the Croats and dragoons arrived at the camp.

On 19 June, the German cavalry and Hungarian soldiers led by Nádasdy and Batthyány arrived.

On 20 June, [*the*] defence of the Mura was [*re*]organised.[70] A stretch of the river was assigned to each unit, and they had to defend them with trenches and guards, namely

1. the area from the confluence of the Mura and the Drava to the fortress [**8r**] belonged to the imperial army;

2. the area from the fortress to Kotoriba belonged to the League;

3. above Kotoriba, there was Count Zrínyi, as well as the Hajdús of Nádasdy and Batthyány.

Furthermore, they gave an order for a major attack to be launched on the morning of the 22nd, as follows:

1. 2,200 German infantry soldiers and 500 Hajdús led by a commander;[71]

2. one of two 600-strong units[72] should launch an assault, and the other should stay in reserve;

3. the men should stand at the foot of the hill one hour before sunrise;

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63 The *pozzo* was a vertically dug well-like pit to detect the mines of the enemy. Gran dizionario teorico-militare 1847. 535.

64 The word *fornello* literally means "cavity". In military terminology, it was used to indicate the chamber dug at the end of the mine corridor, where gunpowder was kept. Gran dizionario teorico-militare 1847. 326.

65 A dyke constructed perpendicular to the direction of the attack. Glossarium Artis 1979. 163–164.

66 The *tagliata* was "a separate embankment consisting of simple trenches with or without breastworks. It was used to protect the gorge of bastions, narrow passages and roads". Gran dizionario teorico-militare 1847. 707.

67 A palisade made out of tree trunks, but in a general sense, could mean any kind of military structure that impeded the movement of the enemy.

68 It was originally a covered emplacement made at the bottom of the dry ditch. Glossarium Artis 1979. 129–132.

69 The rank "lieutenant colonel" is, of course, a modern concept. It is used here for the lack of a better one. The tenente colonello was the deputy commander of the regiment at this time.

70 Evidently, the banks of the Mura River had already been protected.

71 The General di Battaglia was the commander of the detachment allotted for attack.

72 Although the original term *battaglie* also indicates "battalion", which in this period referred to an unspecified number of military units dedicated to a specific task, the meanings "team" and "grouping" were also common. As it cannot be decided clearly which sense of the word was used here, we took the more general meaning.

4. the weapons should include many half-pikes, guns, *Kurzgewehr,*[73] bundles of brushwood, hatchets, and hand grenades.

On the 21st, the infantry arrived.

On the 22nd, men stood prepared in the fortress already at night to leave one hour before sunrise, as agreed. However, it was raining all night, [**8v**] the ground and the steep, sloping part of the hill turned so soggy that it was extremely slippery and unusable, which prevented the action from being carried out.

The men had to retreat, and they were ordered [*by Montecuccoli*] to carry out the attack on the following morning.

On the 23rd, however, it [*i.e. the action*] was thwarted again by a soldier, who had escaped from the fortress to the enemy on the previous night. He betrayed and disclosed the enterprise. He [*i.e. Montecuccoli*] could see that the enemy had strengthened the guard of the nearest trenches; they had twelve more ensigns[74] than usual, and so did their cavalry. With God's help, this misfortune [*i.e. the failure of the action*] was perhaps the lesser evil for us, because when he [*i.e. Montecuccoli*] took into account how cramped the place where our men were supposed to climb on the hillside as well as the quality of the enemy's closed and densely spaced trenches with the entire, united Janissary corps in them, he was doubtful about the success of the action.

[**9r**] On the 26th, a discussion was held again to decide whether something could still be done against the enemy, and we agreed unanimously that

1. it would be a very risky undertaking to attack the enemy in their own positions, frontally, where the slope, the forest, the bend of the Mura were advantageous to them, all the more so because we had to cross the river, and pass through the hillside, the forest and the dykes, before their eyes;

2. all in all, however, the other solution did not seem less dangerous and risky either: to flank [*the Ottoman camp*], and [*for this*] to cross the Drava twice, first near the Ottoman camp, and second at a lower-lying place, where the two rivers meet towards Ternia.[75] Then everyone would have to find their own place again [*i.e. to deploy*]. In the meantime, the defensive lines along the Mura would be left with either no or few guards in them.

[**9v**] 3. At every moment it seemed that the enemy was trying to attack us and cross. So if it seemed to be a good idea to clash with them, why not let them come? Why not receive them where we are in a more advantageous position instead of approaching them?

4. So we had to wait for the imperial troops coming with the Margrave of Baden and make the right decision then.

At midday on the 27th, the enemy launched an attack against the ravelin,[76] yet – with heavy casualties on both sides – we managed to repel it. During this, the fatigued enemy made a final attempt to seize the fortress and to take their cannons and equipment on the other side of the Mura, but in

73 There is no Hungarian equivalent to this. It was a short, stabbing weapon used rather as a badge of power by junior officers.

74 The term *insegne* also means "flag", but in this case it could refer to anything that was used as a unit badge in the Ottoman army, e.g. horsetail bunchuk standards. The reinforcement apparently refers to the troops serving under the flags.

75 Dernia.

76 Montecuccoli used the term *mezza luna del forte* here, which literally means "crescent". In the official and technical use of the term, it indicated a wedge-shaped defensive work placed in front of the tops of bastions. However, due to its shape, the ravelin was sometimes also called in this way. Elsewhere, Montecuccoli used this latter term. Glossarium Artis 1979. 85.

both cases they encountered considerable resistance, until on the 28th, Lieutenant Colonel Tasso, who was the commander [*of the fortress*], wrote [*a letter*] asking to consider [**10r**] the condition of the fortress, which was now indefensible, the men were afraid and the palisades – which served as protection – had been burnt by the enemy.

On the 29th, the enemy advanced so far under the fortress that the fired cannonballs could no longer reach them (and large bombs were thrown into the enemy's trenches, causing severe losses to them). The deteriorating situation came to an end, as the enemy with their entire force left their trenches and evaded, approaching from the side where the [*fortress*] line was open and did not run to the river. At that time all the chief officers – D'Avancourt, Tasso, Rumling, Buttler and Rossi – wrote letters, because they decided to call back from the trenches[77] the guards attacked from all sides, so that the expected repression of these forces would not cause even more confusion and fear among the rest of the soldiers. Similarly, [*they decided that*] the cannons should be moved back, and it happened accordingly.

[**10v**] Early in the morning on the 30th, the enemy set off a mine at the top of the ravelin of the fortress,[78] just when Generals Montecuccoli and Sparr were standing on the bastion and inspected the fortress. Then they [*i.e. the enemy*] took their position on the ruins of it [*i.e. the ravelin*], and likewise they took their position on both sides, where the wings had already been destroyed, and covered themselves with bundles of sticks and hives filled with earth.[79] The generals – seeing that there was no defence left but a simple breastwork[80] with a small ditch and a palisade – ordered Tasso to set the wooden structures and the shacks on fire in time, to recall the soldiers, to set off the mines that had already been filled, to demolish the place, to withdraw the guard beyond the bridge, and then to demolish it as well when he finds that this rampart[81] can no longer be defended. The commander considered that he would be able to hold [**11r**] it until the following day. Yet, as soon as the generals had left and arrived at the camp, the enemy started to assault the above-mentioned rampart[82] so fiercely that the defenders were confused and – with no time left to destroy either the fortress or the bridge – they fled to the other side of the river in complete turmoil, losing many officers and approximately eight hundred men. The [*Christian*] army retreated there either crossing the bridge – that collapsed due to the excessive weight – or swimming. The enemy did not want to let them [*i.e. the running soldiers*] succeed in crossing the Mura in that turmoil. However, the defence that had been positioned there earlier with good foresight stood their ground so valiantly that after two hours of fierce fight, the enemy, prevented in their intentions, was forced to retreat because they could not achieve their goal, even though they lost a great many soldiers.

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[77] Apparently, these were trenches dug by themselves or the ditches in the ravelin, or possibly the *fausse braye* mentioned by Esterházy.

[78] See *Domokos* 2012.

[79] The term *rondaccia* originally meant a certain kind of round shield. However, by definition, here it referred to round cannon hives filled with earth.

[80] Montecuccoli used the term *tagliata* here, which equally meant an obstruction built out of tree trunks and covered trench.

[81] The term *riparo* – that is, rempart in French – originally indicated the whole length of the fortress walls, but it could also refer to the wide, flat top of bastions and curtain walls behind the parapets. Glossarium Artis 1979. 167–171.

[82] *Rintrinciamento* could refer to a simple rampart, but also a defensive work built behind the shattered wall to prevent the enemy from breaking into the fortress. Glossarium Artis 1979. 146–147.

[**11v**] However, the enemy made repeated attempts and renewed his efforts, using those advantages that their own side offered to them: the dominating heights, the large amount of wood, and the protrusions formed by the river bend. In contrast, the positions of the Christian army were lower [*lying*], and its area was uncovered and open, completely exposed to the enemy fire. With extra effort, deep trenches had to be made there, which joined the camp and the ditches along the river. However, redoutes could not be constructed, as was customary, for the opposite height greatly hindered this. Instead, dig deep pits[83] and wide ditches had to be dug into the ground in which three people could fit side by side. Finally the enemy, seeing that they could not break [*i.e. the resistance of the Christian army*],

[**12r**] on 7 July, detonated the mines, burnt them down, and razed the fortress to the ground. From this, it is clear how weak they considered this fortress to be, because they did not want to keep it or use it.

On the 8th, the Ottomans pretended that they left, but they did not leave. Perhaps they waited for us to march away and leave the Mura crossings unguarded, and then they would quickly return and seize them.

83 The word *caldaie* literally means "cauldron". Here, it was apparently used for the pits where soldiers could find shelter from gunfire.

Ottoman sources

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Nihádí: Táríh-i Nihádí[84]
(Translated from Turkish)

Afterwards, they went to the Fortress of Kanizsa. The Fortress of Győr was somewhat further away, on the opposite side. "Now, it would be the best if we could see the enemy for certain." Thus, contrary to the peace with Zrínyioglu, they marched to the newly built Újvár to besiege it. In order to look at it closely, the following day they set out and camped at a place that was located an hour and a half's distance from Újvár. His Most High Excellency the Grand Vizier and his valiant armed light cavalry soldiers rode out to inspect the site of the trenches, so they camped at that place for two days. Because the original destination was the Fortress of Győr, and the matter of Újvár came up later, the siege engines were not there. Therefore, Yentür Hassan Pasha (the Beylerbey of Kanizsa) was given an order and Mustafa Pasha (the Beylerbey of Rumelia) was dispatched as a messenger to bring five cannons from the above-mentioned fortress. He went there accordingly. On the 11th day of that month,[85] they settled in the mountains opposite the fortress, inaccessible to the cannons, as a river called the Mura flowed behind the fortress. On the other side, the water of the Drava swirled. The two rivers met there, and on the other side of the aforementioned river that flowed under the walls of the fortress, the cursed Zrínyioglu – in addition to establishing camps at two places by the river – had trenches dug. Here and there, he had outposts built on the trenches and placed cannons in them. This is how he got prepared. His Most High Excellency the Grand Vizier claimed and determined the following: "If one could easily cross the Mura River, it would also be easy to seize the fortress." Consequently, he had no intention of taking the fortress. On the 12th night of that month,[86] ten battalions of the Janissaries of the Sublime Porte and the mercenaries of the Grand Vizier entrenched themselves on the left side of the fortress, along the water, from the confluence of the Mura and the Drava to the vicinity of the fortress, and prepared for battle against the infidels. The Grand Vizier had a bastion built on a hill – from which the trenches could be seen – and positioned there 120 *zarbuzans*[87] and Shahi *kolunburnas*[88] of the imperial camp. As stated above, the infidels were on the other side of the water, whereas the soldiers bearing the sign of victory entrenched themselves on the inner side ready to fight. With the aim of crossing the said river, they made rafts, and tied bags made of the skins of butchered sheep to the bottom of the rafts so that they would not sink. The Muslim soldiers went over these. They used three rafts like this to cross the said river. While one hundred of the Grand Vizier's

84 *Özkasap* 2004. 53–55.

85 11 Zilqad 1074 = 6 June 1664.

86 12 Zilqad 1074 = 7 June 1664.

87 The *zarbuzan* – also known as *zarbzen* or *darbzen* – was the Ottomans' most popular type of field gun. Within them, the ones with the largest capacity – which could fire balls of approximately 2.5 kg – were called Shahi ('the Emperor's) zarbuzan. *Ágoston* 2005. 83.

88 The *kolunburna* was a type of Ottoman light field gun. *Ágoston* 2005. 81.

deli cavalrymen, one hundred volunteers and one hundred Janissaries were trying to get to the other bank of the river [with the aforementioned rafts], and even more of them wanted to cross, one raft was carried away by the water and another one sank. Because of the condition of the rafts, it proved to be difficult to send help across the river. The despicable infidels immediately attacked the three hundred faithful Muslim warriors who got on the other side, and they started to battle. As the infidels gradually overcame, one hundred faithful Muslim warriors were martyred, and some of them became martyrs in the water. Therefore, it was not possible to occupy the said river. Subsequently, the Pasha of Kanizsa brought seven *balyemez* cannons. On the 15th day of that month,[89] they settled in the mountains near the above-mentioned fortress, and the valiant soldiers of the thirty-nine Janissary *odas*[90] of the High Porte entered the approach trenches, and the other victorious soldiers also entrenched themselves. They started shooting at the aforementioned fortress from two sides. On one wing, there was Ismail Pasha (the Governor of Bosnia) with [the armies of the Provinces] Sivas and Karaman and the Timar Sipahis with three siege cannons. On the other wing, there was Mustafa (the Beylerbey of Rumelia) along with the army of his province and four thundering cannons. They started the siege shooting [at the fortress]. When the accursed Zrínyioglu erected the fortress, behind that, he had a bridge built across the water, which led to the fortress. Before the occupation of the bridge, healthy soldiers and armament arrived in the fortress every day, so it did not weaken but held out strongly. On the night of the 16th day of the same month,[91] the evil infidels came out of the fortress and launched an assault with the aim of attacking the trenches. A half-an-hour battle ensued, but by the grace of God, the counter-attack of the warriors of the Faith made them run. Over one hundred heads and ten captured infidels were taken before the Grand Vizier, who showed great grace for this.

The Birth of Sultan Mustafa Han

On the 19th day,[92] [news came] from the Sultan's palace that on the 8th day of the month of Zilqad,[93] on Tuesday, the majestic child of the World-Defender Padishah, the prince named Sultan Mustafa Han was born. There was great rejoicing in the camp. Istanbul was floodlit for seven days and seven nights. Afterwards, a mine was dug under the walls of the aforementioned fortress, and when all the necessary things were prepared, the said mine was exploded, and a part of the bastion blew up together with the infidels in it. Every warrior who was on that side shouted *Tekbir*[94] and launched an attack: ignoring the cannons and muskets of the evil infidels, they stormed the fortress with naked swords like spiders. By the grace of God, on the 21st day,[95] their standards were planted on the bastions. Its seizure and occupation were carried out easily. Out of the 4,300 infidels, 1,300 were killed and 200 were captured. Thanks to Allah the Almighty, this new conquest was easy for the victorious army.

89 15 Zilqad 1074 = 10 June 1664.

90 It was a military unit of the Janissaries, roughly equivalent to a squad.

91 16 Zilqad 1074 = 11 June 1664.

92 It is uncertain which 19th day the author referred to here. It is perhaps the 19th day of the month of Zilqad (14 June). Evliya Çelebi also recorded a similar date (18 Zilqad).

93 3 June 1664. It was a Tuesday, indeed.

94 Tekbir is the abbreviation of the phrase Allahu Akbar ('Allah is greater [than everything]').

95 It is uncertain how the author calculated the days. In any case, these are not so much likely to be the days of the month as those of the siege. Since, according to him, the actual siege began on 15 Zilqad, the 21st day of the siege was 6 Zilhijje, which, based on the Christian calendar, was 30 June 1664.

Mustafa, the Pasha of Damascus, known as Kibleli, became a martyr during the siege. When the news of the conquest reached the Sultan's palace, the sea was lit for three nights. After this new fortress was taken, it was completely demolished. Nothing was left of the building. It took three hours to march from there to Kanizsa. They camped there, and the following day they set up their camp at the Fortress of Komárom.

2

Erzurumlu Osman Dede: The Gems of History[96]
(Translated from Turkish)

After Babócsa, they camped at Berzence and then at the Bridge of Pogány,[97] which is at two hours' distance from Kanizsa. The same day, when they arrived at that place, the infidels besieging Kanizsa heard about the arrival of the famous Serdar and ran away leaving the trenches behind. Moreover, as some men panicked, they left two cannons, a store of grenades *(kumbarahane),* and lots of ammunition behind them, and went to Újvár, three hours away from Kanizsa. They even crossed the water of the Mura and set up their camp on the other side. When the news of their encampment was heard by the Grand Vizier, he went to the Fortress of Kanizsa with a few soldiers, covered the shoulders of Yentür Hassan Pasha with two fur kaftans, and presented him with a jewelled *khanjar* and five bags of *akçe.* He gave ornate robes to the eminent [persons] in the fortress and rewarded them. Furthermore, he ordered that ten bags of akçe should be distributed among the wounded. Because it was certain that the cursed infidels would gather to some extent and make efforts, and if they [i.e. the Muslims] had not gone there within a few days, they would have caused damage to the fortress [of Kanizsa]. So, as it could be expected, he [i.e. the Grand Vizier] crossed the Pogány Bridge and encamped near Újvár in order to attack the military camp of the infidels. A bridge was needed over the Mura River, so 300 men of the Janissaries were selected to occupy the other side of the river. Additionally, 300 of the Grand Vizier's Sekbans were [selected as] raftsmen and some rafts were made. However, because they could not all cross at once, 50–60 Janissaries were sent over the river one night, who disembarked in a place farther from the camp of the infidels and entrenched themselves. Because the enemies of the True Faith were unaware of this, they could do nothing to prevent it. The Janissaries started shouting to one another from the two banks of the river: "What are you standing about there for? Come over quickly!" Their cries were heard by the enemy, who gathered together against the unfortunate ones, lit a fire, and in the sixth hour of the night, around sunrise, they drove sixty warriors of the Faith out of the trench. Nevertheless, along with Zrínyioglu, they feared that many men had crossed the river. Confused, they came to the site of the struggle, and gathered there in large numbers. Their group was shot at with cannons from the other side [by the Muslims] and many of the accursed ones died. This was later admitted by the captured soldiers. On the other bank of the river, every member of Muhammad's people who was in the camp witnessed what was happening to those who crossed the river, but the water did not allow them to cross, so there was no way to help. Only two men could swim back and were spared in this way. The others were martyred during the fights and struggles. Afterwards, the infidels made trenches along the other bank of the river, so there was no way to cross. Therefore, as the goal was to seize Újvár, they [i.e. the Muslims] entrenched themselves on the 15th day of the month of Zilqad.[98] Since there was water on both sides of the said stronghold and the walls were made of clay and [earth] fill, it was a very solid and strong fortress. At dawn, on the second day of the siege, the infidels launched an assault on the trenches. However, because the Muslim warriors were expecting them, they fought back and cut off many heads. They also wanted to attack the trenches on the third day, but they were put to flight. A valiant

96 *Boyraz* 2002. 24a–25b.
97 Possibly Pogányszentpéter.
98 15 Zilqad 1074 = 10 June 1664.

Janissary soldier even leapt inside the gate and was fighting in the fortress, when he became a martyr [there]. Every morning and evening, healthy soldiers were sent to the fortress from the [Christian] camp, so the warriors were indefatigable. As the trenches were violently attacked, the Sipahis, Silahdars and Pashas gathered behind the ditches in excessive numbers for defence. On the 18th day of the month of Zilqad,[99] the happy news of the birth of Prince Sultan Mustafa [came]. In addition, by order of the ruler, a fur kaftan and a jewelled khanjar were handed over by Musahib[100] Yusuf Agha. There was a joyful celebration in the trenches. The copy of the ruler's order is the following: […].[101] The aforementioned Agha was treated with due respect. Just as his permission letter for leave was being written, a cannonball hit and broke the pole of the Great Serdar's tent. He [i.e. the Agha] collected the said projectile and set out for the imperial palace.[102]

Until they [i.e. the Muslims] reached the moat, the infidels launched assaults on the trenches many times, detonated mines on fifteen occasions, but by the grace of Allah, the Most High, they were unable to cause harm to the men. There was also a large bastion in the middle of the moat of the fortress, which could take in 2,000 enemies. A mine was drilled under it. When it was blown up, the Muslim army launched an attack. They took the detonated part and stopped there. However, Allah gave strength to the Muslim army, and although there was no order or command for it, and there was no breach on the wall of the fortress, the gunsmiths and volunteers, followed by the Janissary battalions, climbed to the top the fortress. When the Great Serdar[103] received the news that the fortress had been assaulted, he said: "There is no breach. There is no suitable place for a siege. How are they attacking then?" He accused the man [bringing the news] of lying and scolded him in various ways. Then the captives and severed heads started to arrive continuously. When the Muslim warriors crawled and climbed on the bastions, standing on each other's shoulders, the Hungarian and Croatian soldiers crossed the bridge and cut off the other end of the bridge. The German soldiers lagging behind remained on the side of the fortress; five to ten of them clung to a board or a boat and threw themselves into the water in the hope of reaching the other bank of the river. The Muslim warriors attacked the accursed ones with muskets, arrows and spears, and slayed most of them. 1,100 heads were cut off in the fortress, and over 1,500 men perished in the water. Grand Vizier Kibleli Mustafa Pasha, the Governor of Damascus, was wounded during the siege and died four days later. The valiant Erzurumlu Kul Abbas, one of the Inner Aghas of the Great Serdar, was the very first to get into the fortress. When they returned to the Sultan's court, and Our Blessed Padishah heard this, he stuck a plume on his helmet and gave the left side of the Agha-Command of Erzurum under his control. Since it was better to demolish the said fortress than keep it, they levelled it to the ground. The guns and armament withdrawn [from the fortress] were ordered to be taken to Kanizsa along with the seven cannons brought from Kanizsa for the siege. During the siege, many Tartar soldiers were dispatched to destroy the country of Battyányioglu. They raided one to two hundred settlements, and returned with a large number of captives.

99 18 Zilqad 1074 = 13 June 1664.

100 The Musahib was the Sultan's companion.

101 The author quotes the Sultan's letter at length here. As it bears no relevance to the events, we have omitted its translation.

102 That is, the Sultan's Saray.

103 The Serdar was a person charged with leading a military campaign. Here, of course, the text refers to the Grand Vizier, Köprülüzade Fazil Ahmed Pasha.

3

Evliya Çelebi: Book of Travels[104]
(Translated from Turkish)

Kedzskivár, or the description of the siege of the strong and great Újvár

It is named Kedzskivár in the language of Croatian Magyars.[105] In Hungarian, *kale* is called *vár*. Kedzskivár means —- —-,[106] but in the language of the Rums[107] it is called Yenikale, since it was built by Zerin-oglu in the year 1071,[108] and because it was not long ago, it is referred to as Yenikale ['New Fortress']. When Sihrab Mehmed Pasha was the Wali of Kanizsa, and Kanizsa was burnt down,[109] he [i.e. Zerin-oglu] built this fortress with the aim of taking Kanizsa, on the inner side of the Mura River, on the land of our Kanizsa, at a distance of three hours from Kanizsa, in spite of the peace treaty. Although Sihrab Mehmed Pasha repeatedly ordered him "Demolish this fortress!", he never pulled it down, but made it an even more formidable fortress with strong fortifications and solid walls, and stationed twenty thousand selected soldiers in it, who looted and destroyed the Islamic Province. Eventually, with the aid of this fortress, they attacked the Fortress of Kanizsa in the year 1074,[110] but forty days and forty nights later the Grand Vizier freed the Fortress of Kanizsa from the hands of the infidels. The heathens ran away and went to this Újvár ['New Fortress']. Chasing the infernal heathens, the Grand Vizier arrived at this fortress. The reason for its siege was the following: this fortress was erected despite the peace treaty, which is why it was besieged.

The shape of Újvár and its details

The new fortress was built of timber, similarly to Kanizsa [located] on a forested and wooded promontory, by the Mura River. As a matter of fact, it seemed [as if] the cursed infidels had built the walls of Iskender.[111] It was a fifty-foot wide and fifty-cubit high double palisade filled [with earth]. Some of the trees of the fortress – being trees planted there [locally] – were huge leafy, rooted trees growing out of the walls of the fortress, which would not rot for a long time. The place between the rooted oak and acorn trees was filled with earth and the wall of the fortress was made of them. On the side of the mainland, seven large bastions were erected – similarly to the walls of Iskender – and in each of them, forty to fifty balyemez cannons as well as several kolunburnas and Shahi cannons have been positioned. As the bank of the Mura River is theirs, the fortress has no wall on the waterfront.

104 *Evliyâ* 2002. 319–322, 326–328.

105 Evliya often uses such terms (e.g. Saxon Magyars, Szekler Magyars, Tót Magyars). In this case, the word "Magyar" does not refer to ethnicity, but belonging to the State of Hungary. In other words, the word "Magyar" was used in the sense "Hungarus" by him.

106 Evliya left the place of some pieces of information blank in the text. We indicated these with the sign —-.

107 Rum refers to Rome and in the figurative sense of the word to the Eastern Roman Empire, Byzantium. As a result of a further change of the meaning, it also indicates the inhabitants of the former empire – including the Ottomans.

108 6 September 1660 – 26 August 1661.

109 Kanizsa burnt down in the summer of 1660.

110 5 August 1663 – 24 July 1664.

111 Iskender is the name of Alexander the Great in the Muslim legends. His stronghold erected against Gog and Magog is used as an analogy in the Ottoman literary language to express the strength of a fortress.

Instead, they built a large bridge over it [using] fifty boats, and thousands of infidels arrive from the other side of the river – from their fortress [called] Légrádzsik, from the Fortress of Csáktornya, and from the Province of Mekomorya.[112] Through that bridge, they go to the aid of the fortress. They also transport there supplies from everywhere.

Each bastion has been furnished with balyemez cannons like the quills of a hedgehog, and its covered passages *(kemíngáh)* are laid out. It is such a contiguous fortress that no breach with the size of a speck of dust can be seen anywhere: it is a new, iron-like fortress. Its moat is full of water from the Drava River [sic!], to such an extent, that even a galley *(kadirga)* would fit on it.

When Köprülüzade Fazil Ahmed Pasha beheld the condition of this strong fortress, he immediately asked his seasoned men, who were experienced in sieges: "From which side of this fortress is it possible to get into the siege trench easily?" He looked at and observed the fortress from a distance, and examined its surroundings and sides at his wish and will, and inspected the location of the trenches. Subsequently, as the incontrovertible law "Consult with them about things!"[113] demanded, he held a public council with all the people of the *odjaks* and the seasoned veterans. However, in the past years, during the siege of Újvár, the eyes of every soldier were full of fear, so they said: "Let's not besiege Yenikale this year, but loot and destroy the province of the infidels!" The Grand Vizier replied to this: "What shall we do with this fortress then? When the infidels erected this stronghold on the land of our fortress in Kanizsa, their aim was to seize the Fortress of Kanizsa from us with the help of their fortress sooner or later. What is your answer to that? What kind of opinion and counsel can you give me?" The elders all replied: "Your Most High Excellency the Vizier! Since last year, our army has provided help at many places, three times during the winter, and has been weakened by the campaigns. In this blessed year, let us loot and raid here by the Mura River, and on the opposite side, in the Provinces of Mekemorya,[114] Islovin,[115] —- and Duduska[116] in Croatia and Hungary, razing their houses to the ground, and skewering up their animals! Let the Muslim warriors be packed with plunder, let us go as far as Németújvár, the Vienna Castle, the Prague Castle, destroying the towns, and punishing the ignoble infidels! Let us set out with confidence in Allah! If we burn and destroy the walls of houses, the market towns *(kasaba),* the villages, the settlements, the fortresses, the lands, the […] in the realms of the infidels, then the evil infidels with no repute will be smitten with complete victory, strength and triumph, and the enemies of the [True] Faith, the infidel Germans and the Croats, will suffer ill fate." With this opinion, the speech ended in the council, and they agreed on this solution. However, the Vizier, who had the right to make the decision, said: "Oh, aghas! You have given good advice, but while you are raiding the people and the realm of the infidels, this fortress here [will be like] a thorn in our side. While this base of the infernal heathens stands facing Kanizsa, wherever we go, the infidels will come out of this fortress. They will destroy and raid our people and our province, and it is quite certain that they will block the roads, as well. Apart from our towns and fortresses, will there be any place that they will not scorch, which they will cause no harm to, loot and destroy?" As he said this, all the warriors of the Faith in Kanizsa replied in Bosnian: "Have mercy on us, Your Most High Excellency […?] the Vizier! Either seize this fortress and raze it to the ground, or kill us all together with our children!" When they were complaining

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112 Muraköz.

113 Quran 3:159.

114 The Ottoman name for the Muraköz.

115 Slavonia.

116 The Ottoman name for Carinthia, which comes from the misspelling of the Slavic Koroska.

like this, Köprülüzade, who was as courageous as Asaph, said: "In the name of Allah! That [should] be the purpose of the war of the Faith! Rolling up the bottom of our garments, if that is the will of Allah, we will take this fortress blessed with the miracle of Muhammad Mustafa. We will demolish the fortress with mines according to the guidance of the warriors of Kanizsa. Afterwards, following the blessed advice of the elders, we will loot and destruct the region of the Rába, the surroundings of Németújvár – to the fortresses of Tata, Pápa, Veszprém, Szentmárton[117] and Győr. We will make all the infidels wail, and then we will proceed to Buda! Let us see what image the mirror of fate shows!" When he recited this [latter] line of poetry, it was said all around: "This is clever speech, My Sultan!"[118]

Kazandjizade Suleiman Agha and Hadjizade Efendi said the Fatiha.[119] After the prayer and praise, on the —- day of the —- month of 1074, the Janissary Agha of the Sublime Porte, Salih Pasha, the Kul Kethüda,[120] the artillery, the gunsmiths, as well as the *timar*-holders and *ziamet*-holders, were instructed to enter the siege trenches. The entire army of the Faith entered the siege trenches in broad daylight. At this time, however, the infidels from inside the fortress – whose eyes were bloodshot from drinking wine shamelessly – started to shoot cannonballs and musket bullets, and launch bombs at the Muslim army so heavily that every cannonball hit a tree, and every piece of wood hit a man on the head. In that moment, the three hundred warriors in the trench drank out the cup of martyrdom, and became drunk with the bliss of creation.[121] Our balyemez cannons, on the other hand, were pounding on the infuriated chest of the fortress from seven directions. However, they could not breach a hole even of the size of a poppy seed. All our bullets fell among the trees of the fortress and disappeared there.

Finally, the Illustrious Grand Vizier summoned a few hundred warriors of the Faith from Kanizsa walking on the path of Allah, as well as the persons called Kurundji-oglu, Yunak Ali, Müfti-zade, and Vaizzade, and said: "This Újvár is in your border region, so you are aware of all the secrets of its situation. You have more knowledge and information than any of our soldiers from what direction to shoot at the fortress and attack the bastion, where to dig mines and siege trenches, and from where and to where the soil can be carried. Take part in all things [of the siege] of this fortress!" Twenty of the warriors of the Faith from Kanizsa were presented with robes, and each of them was given 100 gold coins.

He sent the warriors from Kanizsa to Janissary Agha Salih Pasha, where they were his guests. On that day, he commanded and confirmed to the seven viziers and to all the leading men: "Do nothing against the opinion and plan of these men from Kanizsa!" When he issued this order, all the viziers and their deputies said: "We hear it and will obey!" Afterwards, they joined their units to carry out their duties. It must be admitted that the said persons, named Kursundjizade, Yunak Ali, and Pirbe Fazlí, were cunning, deadly poison-like, impetuous, valiant, fearless men, who gained experience and name in battles. They were men born to men, as well as selected and eminent warriors. Based on their plan, the siege of Újvár was launched from seven directions. The fight began, which grew fiercer every day.

117 Today Pannonhalma.

118 The 'Sultan' is a title of honour in the Turkish language, which was not restricted to the sovereign ruler.

119 The Fatiha is the first chapter (Sura) of the Quran, which was also recited as a prayer.

120 Kul Kethüda: the Janissary Agha's deputy commander.

121 That is, he returned to Allah.

First of all, Kibleli [Mustafa] Pasha and [the army of] the Province of Anatolia fired at the fortress from the north. Salih Pasha, the Agha of the Janissaries, attacked with forty-six odas of Janissaries from the direction of the Grand Vizier's division. From the right wing, Kara Mustafa Pasha attacked with the Vilayet of Rumelia. Gürji Mehmed Pasha attacked with the Vilayet of Aleppo. Ismail Pasha attacked with the Vilayet of Buda. Briefly speaking, the fortress was fired from seven sides, from seventy siege trenches according to this order, and the infidels could not rest for a blink of an eye, either day or night. However, the wall of the fortress could be breached nowhere. On the eleventh day, when they reached the edge of the moat, Kibleli Pasha became a martyr and went to the Merciful [God]. His body —- was buried. The Province of Damascus was donated to —- Pasha. On that day, three hundred more valiant men were martyred.

When our bombs dropped inside the fortress, the enemy always perished like ants, but the south side of the fortress was adjacent to the bank of the Drava River, and through that river, over the bridge mentioned above, healthy troops kept coming to help by replacing those who fell. They all fought in the turmoil of battle, the supplies also arrived incessantly. Yet, by the mercy of Allah – may His name be praised! – Kursundjiogli of Kanizsa had a bright idea and plan. The barriers on the edge of the moat and the giant trees in the wall of the fortress were smashed in a line with the cannonballs on one side. As a result, the earth filling in the wall of the fortress became more and more visible. Previously, if a cannonball impacted the fortress frontally, it did no harm to it.

In short, with the blows of the siege cannons, the fortress cracked here and there, the moat was taken, and now they also had access to the fortress itself. Nevertheless, the infidels showered hand grenades on the Muslim warriors as if curst rain had been falling. That day, the infidels rushed out because they wanted to occupy the trenches, but by the grace of Allah – may His name be praised! – 300 heads and 307 prisoners were taken from the heathens.

Afterwards, they made every effort to seize the fortress. Penetrating the tunnel *(kubur)* found in the ditches, the Muslim warriors and auxiliary peoples accessed the foundations of the fortress like ants. Some of them cut down the posts with axes, while the others pulled out what was cut [by the former]. There were also many warriors who removed the staves of the palisade or the bark of trees, and after spreading naphtha and tar over the trees, they set them on fire. The incomprehensibly speaking, filthy and ungodly Croats in the fortress exerted enormous power wholeheartedly. They aroused each other's souls a thousand times over, shed a thousand bloods for every tree of the fortress, and sacrificed a thousand souls.

The fortress was still new, and because all its parts were strongly built, they had strength in their hearts. Help came from the other side over the bridge day and night, so they seemed as if they had not been besieged. They fought and battled without fear and dread. Large guns and cannons firing grapeshot were positioned over the bastion of the gate. Various vile objects were placed on the bastions to restrain those who were approaching. Inside, ditches were dug around the bastions to the depth of three men, and inside them, there were beams lined with spears and iron hooks. With various deception and viciousness, they created barriers and fiery wheels, and made thousands of different magic weapons and flame-throwers, and prepared [fire] spitting mines.

One day, by the will of God, ten valiant men from the Muslim warriors gathered and said: "If Allah wills, the opportunity and victory is ours!" As they were waiting for the siege of the fortress, an accursed enemy fired a balyemez cannon over the gate of the fortress, and each of the ten heroes above was hit by the cannonball, which ripped off the left leg of each of them, either at the ankle or at the shank. Six of them became martyrs and five became warriors of the Faith and blessed.

It was destined that these ten men – having a common fate – would be wounded by a single cannon shot at the same time. What a curious and strange thing it is! It is certain that one cannonball can injure as many as one thousand or two thousand people, penetrating through them all. The miracle and [God's] commandment, however, was that it wounded each of these ten men on the left leg. "Allah does what He wills." [122]

In addition to them, thousands were wounded or martyred. However, no one got scared. They did not give up the fight. No officer felt sympathy; they did not spare human bodies. The Muslim warriors were all like a stone or a piece of wood, equal to the ground like trodden sand. The wounded died in the nook of suffering, being hungry, thirsty and bitter.

[…][123]

In these days, Yusuf Agha, the treasurer of the emperor arrived from the blessed palace with the happy news that in the month of Zilqad of the year 1074,[124] the pure child, Prince Mustafa, the son of Sultan Mehmed III, was born.

In the Muslim camp, the cannons and muskets were fired for joy, and the celebration lasted for three days. But what can we do? Poor me, I lived under the fortress – because the fortress was not seized and conquered – and was as restless as if I had been in prison, and I was wondering where to go. By the will of God, the Grand Vizier presented a robe to the son of the Tartar Khan. He sent out 20,000 Tartar warriors and 500 musketeers of the border fortress region to destroy and scorch the land of the heathens. Poor me, I followed the said warriors to the Provinces of Dodoska, Mekomorya and Islovin. […][125]

Poor me, a man full of defects, I stayed by the Grand Vizier, and I told him a few times what lands we had passed through in this war of Faith, what provinces we had destroyed and scorched, how many strong fortresses we had seen, how many captives we had taken and how much booty we had seized. I presented our adventures and story to the Grand Vizier in detail. The seizure of Újvár, however, was not easy.

Since the Muslim army under the fortress had not been heartened by us, Újvár remained untaken for such a long time. However, when we returned from the war of Faith [i.e. the raid in Croatia], we saw that every wound of every warrior of the Faith was being wailed over and commiserated upon, those who had lost a hand or a limb were being honourably retired, promotions, ziamet-holders and timar-holders were being donated, therefore the Muslim warriors heartened each other for battle.

On the same day that the hand of the Grand Vizier's inner *muezzin* called Ahmed Çelebi was hit by a cannonball and the Grand Vizier sent him to retirement donating him a ziamet, he entrusted poor me with accompanying Ahmed Çelebi to Kanizsa. We immediately set out and arrived in Kanizsa in three hours and stayed at the palace of Yentür Hassan Pasha, the Wali of Kanizsa, where the surgeons began applying remedies to Ahmed Çelebi's hand. Three days later, poor me, I returned under Újvár again. On the —- day —- of the month —- he became a martyr, and his position of was donated to —-.

In brief, there were more and more cracks on each side of the fortress day by day. Yet, the posts were dug into the ground in a row and the earth filling was strengthened in a Khorasan[126] [style?] with

[122] Quran 14:27.

[123] In the following, Evliya tells some stories about martyrdom.

[124] 27 May – 24 June 1664.

[125] In the following Evliya gives a long description about a raid in Croatia. The story is not based on real facts. Our traveller used the description of the 1532 campaign for his story. Cf. *Sudár* 2012. 106–111.

[126] Khorasan: a region in Central Asia.

lime, which swallowed up thousands of human-head-sized balls fired from balyemez cannons night and day as if it had been honey,[127] so they did less harm to it than the scratch of a nail.

Eventually, Defterdar Ahmed Pasha stole the earth filling from some of the cracked walls, and thus demolished them. The accursed errant infidels, however, immediately filled those places with earth. They created various obstructions and pig traps inside the walls of the fortress. Mines were detonated on the Muslim troops at two places, but, thank God, they did no harm to the soldiers because they exploded backwards. Behind them, they immediately set up phalanxes, and the infidels walked about in a carefree manner without fear and trembling.

Eventually, spears with hooked ends were handed out to each warrior from the arsenal. They used the hooks for dragging the infidels off the bastions and other places into the moat, and there they cut off their heads with gleaming, fiery swords. They were engaged in various great combats from morning to night.

May endless praise and infinite laudation be given to the King of the Empire [i.e. Allah] for the enemy having no dexterity to blast mines, no skill to shoot bombs, as well as no idea and resourcefulness to destroy the siege trenches and launch attacks at night. It must be admitted though that the cursed infidels are outstanding in guarding the fortress, disciplining the soldiers, encouraging them in battle, and fighting flesh against flesh.

Finally, in this way —- a royal struggle ensued at night, to which no fight at the Fortress of Azak,[128] in the Province of the Cossacks, in Hanja,[129] in Várad, or in the Fortress of Újvár was comparable. The manifold fights and struggles that took place at this fortress cannot be described and told.

In the end, with the help of Allah – may His name be praised! – on the —- day of the —- month of 1074, although there was no order of attack, a pious and skilful physician from the people [of Muhammad], Kazandjizadeh Suleiman Agha and the *suhta hajizadeh* of the Grand Vizier held a council with the Muslim warriors and the army of believers in one God. They were reminded of the efforts for Muhammad: “We are sitting and perishing under this fortress like useless old women!” Then the warriors of the Faith shouted: “Allah, Allah!” all around, and the mountains echoed with the sound of the words of Muhammad.

All the hiding saints, the souls of the prophets and saints, the pole of the poles,[130] the pillars of the empire, the nobles, the leaders of communities, the inspectors, the dervishes and the entire Muslim army helped, and the whole army launched a siege at the fortress.

It was destined that the walls of the fortress were breached at several places, which were suitable for an attack. However, in addition to the hundreds of thousands of Satans on the walls, there were also deep ditches. Additionally, there were traps and devilish things in the holes of the walls that were invisible to the eye and incomprehensible to the mind, so not even birds could fly over the walls of the fortress. Yet, the volunteers attacked the fortress like ants and wasps, shouting “Allah, Allah!” and pulling up themselves with hooks and clinging to one another, they climbed into the fortress. The infidels were not left even as much time as a blink of an eye, so by the grace of Allah – may His name be praised! – the standards of the Prophet were planted on the gates, walls and bastions of

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127 It is a pun with the name of the *balyemez* (‘not eating honey’) cannon and the word *bal* (‘honey’).

128 Azov.

129 Hania in Crete.

130 The pole *(kutb)* in Muslim thinking is the person who most purely represents the True Faith in a given era. Here, it symbolises divine help to the Ottoman army.

the fortress. At that moment, poor me, – thank God! – with a sword in my hand, I sang the *ezan* of Muhammad, encouraging all the warriors of the Faith. They also cried out the words of Muhammad, and, slashing the infidels with their swords, they pushed into the fortress. They kept chasing and slaying the infidels, and were slashing them until they reached the bank of the Mura River.

When the infidels realised this serious situation, they became frightened and desperate and all of them rushed towards the bridge over the Mura River.trying to get to the other bank. The Muslim warriors of the Faith – turning into Muhammad's butcher knife – followed the infidels to the bridge with bloody hands and arms, naked swords and heated breasts, slaying the heathens. The enemy on the other side of the Mura River could see that in the footsteps of the beaten infidels, the Ottoman troops were approaching like a flooding sea, chasing the infidels. "Hey! Help! Our province is going to be lost!" – they said, and on the other bank, the heathens fell upon the bridgehead with axes, and cut off the bridge. Our warriors returned in the blink of an eye.

By the power of Allah, the infidels were trapped on the torn bridge, and the bridge was drifted on the great river back, towards the fortress. The infidels started jumping into the water, but some said: "Zanja Türk!"[131] and came to the fortress, begged for mercy, and became prisoners of war. It was an extraordinary sight as if it had provided the heathens with an example of the Last Judgment. The heathens did so much harm to their own army that even if the people of the whole world had been their enemies, they would not have been able to do the same.

A description of the ill fate of the infidels in Újvár

When the bridge was cut off by the infidels on the other bank, all the heathens on it submerged in the water together with their weapons. Black caps were floating on the surface of the Mura River, as if a sea of men had been flowing there. The evil infidels who had escaped the killing all went to the fair of souls. They threw themselves into the water where some submerged and others fled swimming. On the inner side, our frontier warriors jumped into the Mura River with their swords in their mouths. They reached hundreds of infidels in the water, whom they killed. Thousands of others were dragged ashore by their hair and were enslaved. Some infidels managed to swim to the other bank, but our warriors fired thousands of bullets at the inner side with long-barrelled *Dálján*[132] guns using one wick. They fired so many musket balls at the infidels who were fleeing in the water that the Mura River was showered with bullets as if water had been boiled in a cauldron, and the infidels hit by the bullets sank into the river. Their corpses were drifted along with their caps.

Briefly speaking, none of the infidels who fell into the water could escape. Their souls went to hell. Thousands of enemies were carried down by the water, but the wind-speed enemy-hunting Tartars galloped down along the riverbank, made their horses jump into the water and dragged roughly seven thousand infidels out of the water by their hair and took them captive. All the cannons of Újvár were turned towards the Mura River, and the infidels crammed on the bank of the river and standing about in amazement, were fired at with the 170 balyemez cannons of the fortress. They opened streets among the infidels and made an order. The gunshots made a *kellepache*[133] of thousands of them. Nothing but a butchery remained after them.

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131 It is today an unintelligible word of Hungarian – or possibly South Slavic – origin.

132 *Dálján* is the misspelling of the word Tálián ('Italian').

133 Kellepache is a popular dish in the Near East, which is made of the heads and shanks of sheep.

For some unknown reason, the leaders who remained in the fortress failed to praise the God and render proper thanks for occupying the fortress and drowning thousands of infidels in the river: "Hurrah, the infidels drowned! Hurrah, they got killed! Lo! They ran away, for they were standing about with their mouths open at the time of work." That is how they laughed and yelled. They made arrogant statements to the enemy ignoring that this victory and conquest came from the Most High God, and believed that it was due to their good decisions and plans. Eventually – thank God! – the fortress was seized, but 3,700 of the warriors drank from the chalice of martyrdom, joined the bliss of the congregation existing from the beginning,[134] and earned the high eternity and infinite life. May the grace of Allah be upon them all!

Over two thousands of our warriors were wounded and left without attaining their goal. Seeing this, thousands of warriors fled. Yet, more than five thousand enemies who were captured in the water or at other places became chained prisoners. Only God, the Most High knows the number of those who were captured from the people living in the surroundings by the Tartars or the soldiers of the borderland. I heard some prisoners say that "since the day of —- 17,000 Christians died in the siege of the fortress. 9,000 were taken captive, but it is unknown how many people met their deaths in the water" – they gave such a blissful answer. "Seven of our captains fell in this fortress, one of whom was a relative of Zerin-oglu, a man named Mizde, well-known for his bravery. The other was the son of Hersek Ban.[135] He died as well. If that valiant soldier had not died, you would not see the signs [of victory] on this fortress!" – claimed another captive count.

In short, the fortress has been seized. However, because it was a new construction, there was no market and bazaar or other communal building, only a useful little church, some rather long soldiers' houses similar to camel barns, and a gate to Kanizsa. There is no trace of a wall by the Mura River. On the opposite side of the fortress – accessible by lead – is the land of the infidels, the fortresses of Légrád and Csáktornya and the Province of Mekemorya. The circumference of the earth-filled palisade of the occupied Újvár is 3,700 steps long around. Furthermore, to make the curst fortress even stronger, there is a water well in the middle of it. At the top of the shingled canopy over the well, there is an eye-catching finial made of gold. Previously, in wintertime, the infidels scorched the fortresses of Babócsa, Berzence and Pécs, and this finial was the ornament of the *Türbe* of Sultan Suleiman found in the vicinity of our stronghold in Szigetvár, at a distance of a cannon shot from it. However, it was taken off from the *Türbe* of Sultan Suleiman and put on this well. After the victory, the Grand Vizier had this sign removed from the well and sent it back to the *Türbe* of Sultan Suleiman, near Szigetvár. He seconded the Beylerbeys of Mohács, Pécs and Szigetvár for repairing and renewing the noble *Türbe* and the stronghold, and they went there accordingly.

Afterwards, they gathered to discuss the matter of Újvár in the presence of the Grand Vizier. The seasoned men who wanted the best for the empire said: "Fortunate Vizier! This fortress is the pride of the enemy. It causes lots of harm to the Ottomans and will be of no use. What enormous fortune of the Muslims and how much income of the Sultan was lost because of this fortress! In addition to causing so much distress, how much time was wasted on it, and how many Muslim warriors became pointlessly martyred on account of it! Besides the great affliction and [waste of] time, it does not belong to any establishment of the religion and does not bring benefit for it to be protected under all circumstances. If we posted a sufficient number of Muslim warriors in it, where would their pay and takings come from? It would require half of the garrison of an Iskender-like fortress, such as Kanizsa,

[134] That is, he passed away.

[135] Hersek Ban: Evliya normally refers to Christian nobles with the words 'Prince' and 'Ban'.

to be drawn out and moved here. Let us suppose that we garrison them here and turn this fortress into a key element of the border defence system. Then the enemy would easily take Kanizsa – in the absence of guards –, and then they would occupy it as well. You would imprison so many servants of Allah in this fortress and leave. If you made this fortress the seat of the Pasha of Kanizsa, you would also make a mistake. Because if the heathens build another fortress on the other side of the Mura River, not only men, but even ducks or hens will be unable to move in it." All the respectable leaders believed so, and the Grand Vizier replied: "Then what shall we do?" The Aghas of the Odjaks and all the veterans of Kanizsa said: "Long live the Padishah! Even though we had [sacrificed] so much wealth and such a great army came here, we took revenge on the infidels a hundred thousand times over. So be it! We have suffered hard for the Faith, but let it not remain so. Fortunate Vizier, let us take the armament of this fortress at once and send it to Kanizsa together with the other necessary things! Let us demolish the churches and barracks in it, and then blow up the fortress with mines in many places! Then let us march with all the warriors of the Faith for a campaign of your noble intention!" That is what they said, and they agreed on the same advice and opinion. The entire armament and 170 cannons were sent to Kanizsa, and Újvár – including all the bastions and walls – was exploded with seven large mines in seven places. Some of its points were left as they were, but because it burdened the hearts of those in Kanizsa, the remaining buildings of the fortress were also destroyed with bombs.

The essence of these words is that the pay and money spent on this fortress was in vain. This battle of the Faith did not produce honey and wax, so the honeybee returned to its hive. So many servants of Allah died, and although many eloquent historians of Rum wrote various chronograms[136] on the seizure of this fortress, they ate sugar. —- —-

Then the Grand Vizier went with all the Muslim soldiers to the Fortress of Kanizsa in two days.

[136] This is a kind of text, a poem or a snap. The sum of the numerical value of its letters gives the date of an event.

4

Behdjeti: The History of the Köprülü Family[137]
(Translated from Turkish)

The enemies of the Faith prevent the building of a bridge over the Mura

On hearing the sound of the drums of the Muslim army, the contemptible camp of the enemies of the True Faith gave up the siege of Kanizsa, and fled to Újvár that was two hours away from the aforementioned fortress. Having crossed the waters of the Mura, they settled down erecting their wretched tents on the other side of the said river. When the Grand Vizier was informed of this, he held a council, and decided to assail them. However, there was no place on that river suitable for fording, so it was essential to build a bridge for the victorious Muslim army to cross over. Therefore, three hundred Janissaries and three hundred of the men of the Grand Vizier's Sekbans[138] were chosen to cross to the other side. At first, from the Janissaries, about 50–60 warriors of the Faith crossed the river with the rafts constructed, and they began to dig communication trenches with great forces. The rest of the seconded soldiers were crossing the river with rafts in groups when the vile enemy learnt about this situation, and at five o'clock in the morning they fell on the 50–60 warriors of the Faith engaged in digging trenches, to defeat them. The curst enemy attacked the unfortunate ones like bees, and knowing that no help would come from beyond the river, they got to work. Since they [i.e. the Muslims] had no hope of getting away, they fought heroically until dawn, and then they all became martyrs. Yet, two of the miserable ones could get back to the side by swimming across the water. Before the Grand Vizier, they reported in detail what had happened, and told the good news that a considerable number of infidels were killed in this fight. Subsequently, the accursed ones dug trenches on the other bank of the said river so that the victorious army in the imperial camp could not cross the river. This rendered it impossible for the Muslim army to cross the river. As they were prevented in their plan, they [i.e. the Muslims] decided to besiege Újvár with great effort and violence. On the 15th day of Zilqad[139] [month], they started to entrench themselves. At the time of the morning prayer, on the second or third day, the infidels launched an assault with the aim of destroying [the trenches], but the Janissary warriors fought back. In addition to the slashes of swords, the despicable infidels had to face such a heavy and devastating gunfire that they were not able to resist and turned back with great losses and misfortune. They ran away having been defeated and helpless.

The mission of Musahib Yusuf Agha to the Grand Vizier

From the imperial court, a marten pelt and a jewelled khanjar [was brought] to the Grand Vizier by the Musahib Agha. Additionally, a noble and dignified letter arrived, announcing the good news that His Highness, the revered Prince Mustafa Khan was born from the blessed tribe, and the fact that, in terms of the fight for the Faith and war, considerable efforts and striving were expected of the warriors of the

137 *Gökçek* 2006. 164–167. *Rasid* 1865. 71–75.

138 The Sekbans were the private mercenaries of Muslim leaders.

139 15 Zilqad 1074 = 10 June 1664.

Faith. In the tent of the [Grand Vizier similar to the] Asaph[140] wearing a fortunate girdle, a Divan was convened according to the customs, and all present were informed about the illustrious and eloquent words of the blessed letter. The agha above stayed and rested in the imperial camp for one day. After he became ascertained about the efforts of the Muslim warriors of the Faith in the approach trenches of the besieged Újvár, he received twenty bags of akçe from [the Vizier similar to] the Asaph. Just as a certificate and a writing was made for him saying that he was currently with the Muslim army besieging Újvár, the pole of the Grand Vizier's tent was hit by cannonballs fired from the fortress. These [balls] were then sent to the ruler with the agha mentioned above.

The seizure and occupation of Újvár from the approach trenches, and the destruction of the said fortress

When it became clear and evident that the infernal heathens fighting in the besieged Újvár had no strength to withstand the storms of the Muslim army, new soldiers were sent to the fortress from the defeated camp on the other bank of the Mura and were thus strengthened. That is the reason why the approach trenches reached the edge of the moat in only twenty-three days,[141] at the cost of great difficulty. During this time, the accursed ones made two attempts to demolish the trenches and tried to dig mines in the direction of the trenches on fifteen occasions.

Nevertheless, as the Muslim warriors [showed] perseverance and strength in the field of resistance, they returned without success and with great losses. After the approach trenches reached the edge of the moat, the mine dug and prepared by the Muslim warriors under the bastion found between the moat and the fortress was ignited. The moment it exploded – as His Most High Excellency the Grand Vizier was informed – the Muslim warriors could no longer restrain themselves and launched an assault. The criers among the soldiers gave the order for the attack, and the Muslim soldiers stormed the fortress like lions sacrificing themselves for the Faith on the soul-taking battlefield. Arriving at the moment [of unification with Allah],[142] they climbed up to the bastion of the fortress wall, and with the helping hand of God they set foot there and won victory. When the infidels heard the noise of the Muslim siege, they began to flee towards their defeated camp on the other side of the Mura. The accursed ones in the camp – fearing that they [i.e. the running soldiers] would be followed by the Muslim warriors – demolished the bridge. The miserable infidels trapped on the inner side of the river entered the House of Hell over the bridge of swords descending on them. As they [i.e. the Muslims] realised that the said fortress could not be protected in any way from the guile and opposition of the enemies of the Faith, it was found reasonable to demolish it, so they destroyed and razed it to the ground with mines.

The Governor of Silistra is commissioned to take the cannons from Eszék

When they left Eszék and the sense of urgency to help the Fortress of Kanizsa became apparent, the siege cannons found in the imperial camp were left behind in the Fortress of Eszék. When it became necessary to march against Újvár and start a siege, they brought seven Shahi cannons from Kanizsa.

140 In the Muslim mythology, Asaph is the name of the biblical Solomon (Suleiman) the Wise. In Ottoman literary texts, it is a constant attribute of wise leaders.

141 Rasid gives account of twenty days.

142 In other words, the hour of death has come.

After the fortress was taken, it was decided to take those cannons back to the Fortress of Kanizsa, and then to the Fortress of Janova.[143] In order to quickly transport the twenty huge siege cannons left in Eszék to the imperial camp, commands were given to Vizier Hüseyin Pasha (the Governor of Silistra) and Vizier Mustafa (the Governor of Maras) that they had to carry out urgently.

The imperial camp heads for the Fortress of Komárom.[144]
The seizure and occupation of the fortress

After this, the Grand Vizier and all the leaders of the army discussed in which direction it would be best to proceed within the country of the enemy. It was determined that they had the time and means to seize and occupy the Fortress of Komárom found near the Fortress of Kanizsa. Accordingly, they set out from Újvár on the 18th day of the blessed month of Zilhijje.[145] On the following day, they put up the tents of the army outside the said Komárom Fortress.

143 Janova is the Turkish equivalent of the name Jenő. Here it is an erratum used instead of Janik, that is, Győr. (Rasid mentions Janik.)
144 Kiskomárom.
145 18 Zilhijje 1074 = 12 July 1664.

5

Silahdar Mehmed: Silahdar Tarihi[146]

(Translated from Turkish)

The siege of Újvár

When the Grand Vizier returned to his tent, he summoned the leaders of the army, and the matter was discussed.[147] They opposed the [siege of the] fortresses of Győr and Óvár, and said: "First of all, the proximity of the enemy must be considered!" They agreed to lay siege to the aforementioned fortress – which was newly built by the accursed Zrínyiogli despite the bond of peace and was called Zrínyivár among the Christians, but became generally known as Újvár – and with the help of Allah (may His name be praised!), they would seize and occupy it, and then they would all proceed to demolish the camp of the infidels. That is how they considered it to be appropriate. Afterwards, they said the Fatiha. On the 10th day of the said month, on Thursday,[148] they marched with all the Muslim soldiers under Kanizsa crossing the Bridge of Bogan.[149] On the following day, which was Friday, an hour and a half walk away from Újvár, an order was given to set up a camp at a suitable location. The Grand Vizier left with the unladen light cavalry division of Silahdars and inspected the communication trenches around the fortress. After he arrived, they camped there for two more days. As the main targets were originally the fortresses of Győr and Óvár, the siege armament, the ammunition and the heavy balyemez cannons were all left behind at the Bridge of Eszék. [Now] for the siege of the fortress, Yansur Hassan Pasha, the Beylerbey of Kanizsa, was given an order. In accordance with the high order sent to him, he gave out seven cannons from the fortress. Kara Mustafa Pasha, the Beylerbey of Rumelia, was appointed and dispatched to collect them. On the 12th of that month, on Thursday,[150] [the Muslim army] left the place above, and encamped opposite Újvár, in a wooded area that could [not] be accessed by cannonballs. Their aim was to cross to the [Christian] camp found on the opposite side.

However, behind the aforementioned fortress a large river called the Mura flowed, and on the other side the waters of the Drava swirled. The two rivers met and flowed under the walls of the fortress. On the other side, on the bank of the aforementioned river, the accursed Zrínyioglu set up the camp of the defeated in two places. Here and there, at some places suitable for crossing, he had trenches and outposts established, and positioned many guns and stand-by musketeers everywhere. This is how he got prepared and moved into position. His Most High Excellency the Great Serdar – may God uplift him and make him great! – immediately said the following: "If one could easily cross the Mura River, it would be easy to seize the fortress mentioned above." He disregarded the fortress. He did not even care about it. Instead, he was engaged in crossing to the other side. The following day, at Sunday night, he gave orders, and ten battalions [of soldiers] were selected from the Janissaries of the Sublime Porte and his own mercenaries *(levend)* armed with muskets.

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146 *Silahdâr* 1928. 338–345.

147 It is a reference to the siege of Kanizsa mentioned in the previous chapter.

148 10 Zilqad 1074 = 5 June 1664. It was a Thursday, indeed.

149 The Bridge of Bogan was perhaps at Pogányszentpéter.

150 12 Zilqad 1074 = 7 June 1664. In reality, it was a Monday. (It was apparently a clerical error, since the following day is said to be a Sunday by the author.)

They entrenched themselves next to the water, on the left side of the fortress, from the confluence of the Mura and the Drava to the place near the fortress, to fight against the infidels. On the hill, from where the trenches could be overseen, he had bastions erected. On these, he placed and arranged 120 kolunburnas and Shahi zarbuzans of the imperial camp. The [two enemy] parties began to fight each other with guns and muskets. There was an opinion that they should cross the said river. However, there was no ford anywhere. Therefore, patience was needed. In order to occupy the other side – after the payment of service and promotions – 300 Janissaries and 300 of the Grand Vizier's Sekbans were enlisted as rafter volunteers with the promise of admitting them in the unit of the Sipahis. In order to take them over, rafts were started to be built. Three rafts were made shortly. In order to prevent them from sinking, inflated bags made of the skins of butchered sheep were tied to the bottom of the rafts. Nevertheless, not all the volunteers mentioned above could cross the river at the same time. On Monday[151] night, the 14th of that month, the rafts were put on the water. At first, twenty-five men boarded two rafts, and pulling the oars, they crossed to the side of the enemy. Having landed on the other side, they were digging a communication trench for one hour. The communication trenches of the infidels were an hour away from them, so they did not even know about these events. Then the rest of the Janissaries and Sekbans also started to cross, but one of the rafts sank and another one was carried away by the water. When the [third] raft became uncontrollable and its state became precarious, someone shouted on the other side: "What are you standing there for? Come over to the other side!" The infernal heathens heard these voices and realised what was happening. They attacked the unfortunate ones and opened fire on them. The Muslims faced the attack and charge of the infidels, and they started to fight one another. The warriors of the Faith were just a drop in the ocean, and with [no] help from the other side, they stood with their backs at each other. The infidels, on the other hand, kept receiving help from behind, and so they grew stronger. The sound of battle cries [was heard] all around, and the rumble of muskets and cannons filled the air. It was impossible to cross the water, and there was no help. Those fifty valiant warriors fought from the sixth hour of the night until sunrise. There were only two men who could swim back to the other side and escaped. The others were martyred while fighting bravely. Those who were in the imperial camp watched them, amazed and shaking their heads. Because Zrínyioglu believed that the whole Muslim army had crossed the water, he himself led his army against the warriors of the Faith mentioned above. The cannonballs fired at them from the other side mercilessly killed many of the accursed ones. On the following day, the multitude of their hideous filth seemed to be greater than the amount of gravel. Subsequently, the infidels started to dig communication trenches along the other bank, so crossing the water and occupying the said river would have been too difficult an order to obey. Therefore, they [i.e. the Muslims] gave up this idea and strove to take the fortress. Yansur Hassan Pasha, the Beylerbey of Kanizsa, was commissioned to take seven balyemez cannons to the imperial camp. On the 15th of that month, on Tuesday,[152] the camp was translocated, and they encamped on the wooded hills opposite Újvár. By the Serdar's order, a sea of Muslim soldiers mounted their horses running as fast as the wind, and at midday, they distributed shovels from the arsenal among the infantry soldiers for digging. Opposite the army of infidels, on one wing, the Great Serdar positioned four balyemez cannons along with four battalions of his Sekban infantry. Furthermore, Kara Mustafa Pasha, the Beylerbey of Rumelia, set up his own mercenaries and the provincial army, an army of Anatolian Zaims and timar-holders, while the Janissary agha together with the *kul kethüda* brought 20 odas of Janissaries.

[151] 14 Zilqad 1074 = 9 June 1664. It was a Monday, indeed.
[152] 15 Zilqad 1074 = 10 June 1664. It was a Tuesday, indeed.

On the other wing, with three balyemez cannons, there was Vizier Bosnian Ishmail Pasha, the Beylerbey of Bosnia, with his own excellent mercenaries and his provincial army, the Zaims and Timariots of the province of Sivas. Additionally, twenty odas of Janissaries led by the Zagharjibashi and Samsondjibashi entrenched themselves. Therefore, they besieged the fortress from two sides. They opened fire with the cannons and muskets at once, and started to shoot at the fortress heavily. Its gates and walls were demolished, and the fortress was levelled to the ground. During the first attack, only about ten warriors of the Faith were wounded. At the Serdar's command, the division of the Silahdars joined the ranks with its units, like the wings and feathers of the Simurgh or Anka bird,[153] – their flags and spearheads were gleaming like lightning – and along with the Rumelian Ghazis, the warriors of the Faith bearing the sign of victory and serving in the approach trenches, they stood at the front line for defence against the sea of assault. The aforementioned fortress was strong and solid. On its two sides, the water of the Mura [flowed], and on one side, there was dry land. Its moat was deep and wide, and its walls were made of wattle and daub. Inside, it was full of infidels, and besides a large bastion suitable for 2,000 warriors, it also had a bridge that joined the fortress with the other bank of the Mura River flowing behind. Because the said bridge could not be taken, it was easy to send rested soldiers, weapons, ammunitions and other necessary things from the camp of the accursed ones found on the other side of the river every day, so they fought fiercely. The next night, at half past seven on Wednesday,[154] a group of cursed infidels dashed out of the fortress and struck the trenches of the Muslims. It was their rebellious intent and futile desire to cause harm. The Muslim soldiers, however, were prepared. They jumped on their horses and launched an attack along with the infantry. They assailed and fell upon the enemies of the Faith, and hardly had one hour and a half passed, when the accursed ones turned their faces back, and started to run beaten and scattered, and were slashed until they reached the gates of the fortress. At dawn, more than one hundred heads and ten prisoners were brought in front of the Vizier by the Rumelian Ghazis, and generous rewards were distributed [among them]. At sunrise on the following day, which was Thursday,[155] some infidels came out again to attack the trenches. However, when they attacked, the Muslim Ghazis were also alert, and when they confronted them, [the attackers] turned back, and took their [next] breath in the fortress. Moreover, a valiant Janissary made his way to the gates of the fortress slaying many infidels with his sword, and then he became a martyr. On the 19th day of that month, on Saturday,[156] which was the 5th day of the siege, Musahib Yusuf Agha arrived with a letter from the Sultan, and announced the joyful news that Prince Sultan Mustafa, the blessed child of His Majesty the Ghazi Padishah, similar to a royal pearl, was born in the blissful palace. They lined up to welcome him, and he stayed in the Asaph's[157] tent. [The soldiers] fired cannons and muskets making loud noise, which was followed by merrymaking and celebration. The leaders of the army were summoned to the tent, and the letter was opened and read out in their presence. […][158]

The aforementioned agha was presented with 10,000 *kuruş* worth of pelts and an equipped horse, and was treated with due respect. He prepared to return and the *telhis*[159] was just being written, when

[153] The Simurgh, also known as Anka, is a wonderful bird in the Persian mythology whose shadow or feather brings good luck.
[154] That is, on 11 June.
[155] On 12 June.
[156] 19 Zilqad 1074 = 14 June 1664. (It was really Saturday.)
[157] Worthy of Asaph, that is, belonging to the Grand Vizier.
[158] Silahdar Mehmed quotes the letter – we omit it here.
[159] The Grand Vizier's document submitted to the Sultan.

the post of the Grand Vizier's tent was hit and smashed by one of the cannonballs fired from the besieged fortress. In order to show the said missile to the Padishah as well, he [i.e. the envoy] collected it and set off for the imperial court. In the imperial camp, the Muslim army was short of victuals for a while, but somewhat later, travel supplies arrived on wagons from the neighbourhood, which were heavily loaded. Mahmud Pasha (the Sanjakbey of Nicopolis), Ibrahim Pasha (the Sanjakbey of Avlona), Buhurli Begogli Mehmed Pasha (the Sanjakbey of Ohrid), as well as the Albanian Sekban musketeers and infantry enlisted at the expense of the treasury arrived and entered the imperial camp. In the meantime, an order was issued, and under the guidance of a master, rafts were built, like before. For example, they were raised on six wheels. They were tied together from three pieces (?), and appropriate rings were made of steel for the places where they were tied together. To the bows of the galleys, similar ornaments (?) and two items called … on top of which two Shahi zarbuzan cannons were placed, and five or six pieces of walls (two *zira*[160] long each) were nailed with iron nails. When it was hit from the inside, it moved forward and slammed to the other side. Then they were properly connected through their rings, and next to them, they prepared a ramp similar to a table, made of two fathom long boards.[161] In this way, at a blessed time, it was put on the said river: it was like a crocodile. At dawn on the 3rd day of the month of Zilhijje, on Friday,[162] the master that made the raft, a warrior of the Faith called Zahid, opened fire on a bastion found in front of the said fortress using all of the naphtha oil. When some of the warriors of the Faith bearing the sign of victory launched an attack on that bastion, many infidels confronted them with the desire of fight and repulse. However, the swords of the Muslim warriors showed the fire of the bastions in their eyes only as smoke. Several infidels fell victim to their swords. Forty-five severed heads and three prisoners of war were taken to the tent of the Grand Vizier. The other enemies of the Faith who were killed in the bastions were beheaded. From behind the infidels, one thousand firearms showed their craft, and it was impossible to resist them. Therefore, the Muslim warriors returned to their trenches and gathered strength for the battle again. They changed their place, and until their approach trenches reached the edge of the moat, they [i.e. the infidels] attacked the trenches quite a few times and dug mines against the trenches on fifteen occasions. However, by the grace of Allah – may His name be praised! – no one was harmed.

The capture of Újvár

A mine was dug under the wall of the said bastion with the help of a shelter (?), and after gunpowder was put in it, it was blown up on the 21st day of the siege, four hours before sunrise on Monday,[163] on the 6th of the said month. One part [of the bastion] seemed to rise into the air, and a large hole was breached in it. As the Grand Vizier was on the alert in one of the approach trenches, he commanded the volunteers of the Janissaries serving in the trenches and other Muslim warriors bearing the sign of victory to shout the Muhammadan cry of war, and ignoring the cannons and muskets of the infidels, they launched an attack with naked swords. When they reached the bastion, they assaulted the communication trenches[164] of the enemies of the Faith and occupied the exploded

160 An Ottoman measure of length, ca. 76 cm.

161 The description of the strange siege engine is not clear. The story also does not reveal what it was actually used for.

162 3 Zilhijje 1074 = 27 June 1664. It was a Friday, indeed.

163 6 Zilhijje 1074 = 30 June 1664. It was a Monday, indeed.

164 Here, he certainly refers to the defensive work (fausse braye) of the Christian army outside the walls of the fortress. Pál Esterházy also mentions them.

place. As God strengthened the army of Islam, from there, they went on to attack the fortress without the order of the Grand Vizier, thinking that "the occasion is the manifestation of the command". However, because there was no suitable breach to storm the fortress, they stood on each other's shoulders and crawled up the fortress like spiders. From the top of the fortress, the musketeers and volunteers, followed by the battalions of the Janissaries, attacked inward and broke in. With the help and mercy of Allah, it took a little more than one hour to cut off 2,600 heads and to take 80 captives from the despicable defenders (a total of 4,300 infidels) of the curst Zrínyiogli. The despised army was defeated in this way, and it became possible to seize and occupy the aforementioned fortress. Having taken it in the name of the ruler, they planted horse-tail standards on some of the walls, and sang the *ezan*. When the warriors of the Faith, crawling and climbing, got onto the bastions, the Hungarian and Croatian soldiers crossed the bridge connected to the fortress and cut the other end of the bridge. The German soldiers remained on the side of the fortress, and in order to save their unclean souls, they climbed on a board or a boat in groups of five or ten, and tried to cross the river. The Muslim warriors captured the accursed ones with arrows, spears and lead, and killed most of them. Some of them left the multitude. Each and every one of the more than two thousand accursed ones who were on the bridge fell in the said river. Some of them were drifted ashore. On the other side, opposite their camp, they were put to death by the swords [of the Muslims] before the eyes [of their comrades], disregarding the cannons and muskets fired by the enemy. During the siege, as the illustrious Serdar was watching and inspecting the bastion, some Ghazis [came up to him] with [severed] heads in their hands and said: "Good news! We attacked the fortress and took it!" He [i.e. the Grand Vizier], however, did not believe them and said: "There is no breach suitable for a siege. How would they attack? It is impossible!" However, as he was standing there, the warriors of the Faith arrived one after the other with captives and severed heads, and the trenches were filled with the heads of the enemy. The Grand Vizier said a prayer and gave thanks to God, the Creator at that place: In his joy and happy mood, he commanded that anyone who had a head or a captive should go to the [Grand Vizier's] tent, and the Muslim army should be properly accommodated in the fortress, and then the soldiers should receive their reward. At the time of these events, the enemies of the Faith believing in other gods were thinking in their defeated camp on the other side of the water as follows: "It is possible that now the Muslim army is crossing the Mura River somewhere and falls upon us. We must get prepared!" In their wild fear, they all jumped on their horses, and in their great shock they started to run around like foolish hens. They were shooting their cannons and muskets from their communication trenches by the river, making some warriors martyrs.

Now that, with the help of Allah – may His name be praised! – the siege clearly ended with this decisive defeat, a Divan was convened in the Asaph's tent. The leaders of the army were given robes, and [the soldiers] who brought the prisoners and heads received rewards and promotions. The heads of the prisoners were cut off. Expensive drugs were placed on the wounds of the warriors, and those who were no longer capable of fighting went into retirement. The number of the wounded soldiers and martyrs was exactly 500. A detailed list of mercenaries made by the scribe of the treasury comprised that 10,000 *kuruş bahsis* had been distributed.

After discussing [the issue], the leaders of the army agreed that the fortress above was not useful to the Sublime Porte in any way, and its defence would be difficult to organise. Therefore, at the command of the illustrious Serdar, one eleven-*okka*[165] kolunburna and six Shahi zarbuzan cannons,

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[165] *Okka* was an Ottoman measure of mass, 1.281 kg. In case of cannons, it referred to the weight of the fired balls.

as well as three bombers were towed out of the fortress together with ammunitions belonging to them. Along with the seven balyemez cannons previously brought from the Fortress of Kanizsa, they were sent to Kanizsa. Afterwards, some parts [of the fortress] were set on fire, and other parts were blown up with mines and levelled to the ground. Nothing was left of the building. The report of the victory telling the great news was written and sent to the imperial court.

During the siege, Vizier Kibleli Mustafa Pasha, the Beylerbey of Damascus, was injured and died four days later. His post along with the rank of the vizier was donated to Janissary Agha Bosnavi Salih. The post of the Janissary agha was given to Mustafa Agha, the *kul kethüda* [deputy of the Janissary agha], whereas the post of the *kul kethüda* was given to Arnavud Uzun Ibrahim Agha, who was the *zagarjibashi*. The first to get into the fortress – even before the permit was given – was an *iczoglan* [i.e. page] of the Great Serdar, whose name was Erzurumlu Kul Abbas. Later, when they arrived in Istanbul, his glorious deed was also reported to the Padishah, and his head was adorned with a plume at the imperial court, and to strengthen him, he was given the left side of the Agha-Command of Erzurum.

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List of Abbreviations

AFA	Alte Feldakten
App. H.	Apponyi Hungarica (OSZK)
App. M.	Apponyi Metszetgyűjtemény [Apponyi Collection of Copperplate Engravings] (OSZK)
Bd.	Band
fol.	folio
HKA HFU RN	Hofkammerarschiv, Hoffinanz Ungarn, Rote Nummer
HHStA	Haus-, Hof- und Staatsarchiv
HKR	Hofkriegsrat
HM HIM	Honvédelmi Minisztérium Hadtörténeti Intézet és Múzeum [Ministry of Defence, Institute and Museum of Military History]
IÖHKR	Innerösterreichischer Hofkriegsrat
IÖHKR Prot	Protokollen des Innerösterreichischer Hofkriegsrates
KA	Kriegsarchiv
LaA	Landschaftliches Archiv
MNL OL	Magyar Nemzeti Levéltár Országos Levéltára [National Archives of Hungary, Hungarian National Archives]
MNM TKCs	Magyar Nemzeti Múzeum Történelmi Képcsarnok [Hungarian National Museum, Historical Art Gallery]
OSZK	Országos Széchenyi Könyvtár [National Széchényi Library]
ÖStA	Österreichisches Staatsarchiv
Prot. Exp.	Protocollum Expedit
Prot.	Protocollum Registratur
Reg.	Registratur
StLA	Steiermärkisches Landesarchiv, Graz

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The Fortress of Zrínyi-Újvár was built by Miklós Zrínyi, poet and military leader, near the confluence of the Drava and the Mura, on the left bank of the Mura, opposite Kanizsa in 1661. It played an important role in international anti-Ottoman schemes and served as a casus belli for the outbreak of the great Ottoman–Habsburg War of 1663–1664. During the war, after a more than three-week long siege, the Ottoman forces seized the fortress on 30 June 1664. Subsequently, they razed it to the ground. The stronghold, which had existed for merely three years, disappeared from the face of the earth for good.

The history of the location, role, building and destruction of Zrínyi-Újvár came back to the forefront of international interest with the launch of cross-border, interdisciplinary research programs in the mid-1990s, which focused on the historical research of this special border region flanked by the Mura and Drava. Connected to these, researchers at the Faculty of Military Science and Officer Training at the National University of Public Service and its predecessor have been conducting systematic battlefield investigations at the site since 2005. The extensive, multi-perspective investigations "have enlisted" a number of new procedures and technologies. Our volume presents these methods and the diverse research results obtained with their help.

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