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Military Cartography

EDITED BY MIRELA ALTIĆ

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3-foot ramsden theodolite from 1791 used during the principal Triangulation of Great Britain. Noe in the Science Museum, London.
Photo by User.geni, December 2008. CC-BY-SA GDFL

Defending Europe: Habsburg Military Cartography of the Croatian Borderland

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Abstract. In this paper we analyze the development of Habsburg military mapping in the area of the Croatian borderland as well as in neighboring Bosnia in the period of the Ottoman-Habsburg Wars from the mid-16th to the late 18th century. We demonstrate how military maps were created, who compiled them, which data collection strategies were applied apart from the survey, what was the subject of mapping, what types of maps were produced and how, given their status of secrecy, they influenced the development of military cartography in general.

Keywords. Military Cartography, Ottoman-Habsburg Wars, Habsburg Monarchy, Topographers, Military Engineers, Cartographic Education

Introduction

Today we cannot imagine a military operation in the absence of maps or geoinformation system. Yet, in the previous centuries maps were a relatively rare high-value commodity that was difficult to obtain. Consequently, armies fought campaigns with few maps and little geographical knowledge, or even with no maps at all. This would begin to change during the Early Modern Period when, under the pressure of protracted wars and new war techniques, the (artillery) relationship between warfare and cartography became very close. Long war campaigns encouraged the use of maps and also served as a catalyst for their improvement. Numerous innovations in mapping and cartographic production appeared as a result of military needs. However, among numerous maps used in the warfare since the 16th century it is hard to draw a clear line between military and non-military ones. To define military cartography of the Early Modern Era we have to consider both, their production and their use. In that regard, according to John Hale, an essential distinction should be made

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between the cartographic aspect of attack and those of defense. Both attack and defense cartography was drawn on printed early sixteenth century maps such as town views, commemorative prints of sieges and battlefields. Yet, none of that material was produced as an aid to military planning. Only after the distinction between attack and defense arose, the distinctive genre of military cartography can also be recognized with more certainty.[1] The military cartography of defense drawn on a rich surviving body of maps and plans concerned with fortification schemes evolved in the 16th century and was able to take advantage of regional maps produced for other purposes. On the other hand, attack cartography led to the conduction of reconnaissance activities of a wider area, which enabled the advancement of regional military mapping and flourished only since the mid-17th century.[2]

Another fundamental issue to understand the relationship between military affairs and cartography is to acknowledge that secrecy played a role in this relationship. Many technical advances in mapping were driven by military requirements, but the need for secrecy meant that knowledge of those technical advances was restricted to a small group of people. The secrecy policy had two major consequences: innovations of military cartography were slowly applied in other branches of cartography, while geographical knowledge recorded by military maps was inaccessible to the general public or to cartographers outside military circles.[3] Moreover, cartographic campaigns for collecting data in the field (simple reconnaissance or more extensive survey activities) were often secret and taken under cover.

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1 In the early war chronicles, there are more references to the employment of local guides than to the use of maps. John Hale, « Warfare and Cartography, ca. 1450 to ca. 1640 », in David Woodward (ed.), *The History of Cartography, Volume 3: Cartography in the European Renaissance, Part 1*, The University of Chicago Press, Chicago, 2007, p. 724.

2 There is no consent among map historians what makes a military map or since when military cartography has made a distinctive genre. E.g. Hodson considers the establishment of the General Quartermaster's Staff in 1758 as a beginning of Habsburg military cartography. Yolande Hodson, « Military Cartography and Topographic Surveying in Austrian Monarchy »,, in Matthew H. Edney and Mary Sponberg Pedley (eds.), *The History of Cartography, vol. IV, Cartography in the European Enlightenment*, The University of Chicago Press, Chicago 2019, p. 967.

3 Peter Collier, « Warfare and Cartography », in Mark Monmonier (ed.), *The History of Cartography Volume Six: Cartography in the Twentieth Century,* University of Chicago Press, Chicago, 2015, p. 721.

Habsburg cartography is one of European cartographies that in great extent grew out on military needs during the Habsburg-Ottoman Wars. Its development and characteristics clearly maintain the spirit of the time and the circumstances under which the military cartography of the Early Modern Era developed. Military mapping advanced most strongly in the areas of greatest geostrategic importance, along the borderlands with the Ottoman Empire (on both the Habsburg and Ottoman sides). Borderlands thus became a major zone of military cartographic activities, spurring development of military mapping and turning the Military Frontier into the largest outdoor education center for surveying and mapping.

Organization of New Defense System: Borderlands as Cartographic Laboratory

The Ottoman occupation of Bosnia (1463) and the final invasion of Hungary after the Battle of Mohács (1526) marked the turning point in the Habsburg-Ottoman Wars. The Ottoman conquest of a significant part of Southeast and Central Europe (Greece, Albania, Bulgaria, Walachia, Moldova, Serbia, Bosnia, large parts of Hungary, Croatia, and Dalmatia) alerted the Habsburg authorities to introduce a new defense strategy against the Ottoman Empire. Instead of brief military incursions toward enemy lines, applied by invaded countries themselves, they decided to establish permanent fortified stations accompanied by heavily armed military troops along the entire borderline with the Ottoman Empire. Thus, a wide belt of Habsburg territory along the Ottoman border was placed under military administration and served as a shield against further Ottoman incursions. It is known as the Military Frontier or Military Border (*Miltärgrenze*).[4] After its

4 The Military Frontier was not established by a single act but was created gradually. In Croatia, its formal beginnings can be traced back to 1527, when Ferdinand of Habsburg was elected Croatian king, after which the organization and financing of defense against the Ottomans gradually passed into the jurisdiction of the Habsburg military authorities. The first significant provisions on the organization of the Military Frontier in Croatia and Hungary were made in 1553. A stronger organization of defense and overall territory under the jurisdiction of the Habsburg military begins only after the Congress of Inner Austrian Lands in Bruck an der Mur in 1578, when defending strategy and territorial organization for all borderlands were defined. For more on the establishment and organization of Military Frontier see, Karl Kaser, *Freier Bauer und Soldat: die Militarisierung der agrarischen Gesellschaft und der kroatisch-slawonischen Militärgrenze (1535–1881),* Böhlau Verlag, Vienna, 1997; Gunther Erich Rothenberg, *The Austrian Military Border in Croatia, 1522–1747*. University of Illinois Press, Urbana, 1960 and Dragutin Pavličević (ed.),

establishment in the mid-16th century when it was limited to Croatia and Hungary, in the 17th century, its coverage was significantly extended, stretching from the Adriatic Sea in the west to Transylvania in the east, and including parts of present-day Slovenia, Croatia, Bosnia and Herzegovina, Serbia, Romania, and Hungary.[5] The Military Border consisted of several borderlands (Croatian, Slavonian, and Hungarian, i.e. Banat and Transylvania), and was further divided on generalates and captaincies (later, regiments).

The Military Frontier was placed under direct control of the Habsburg military authorities in Vienna, the *Hofkriegsrat* (a forerunner of the Ministry of Defense), which kept the main role in all military affairs until 1848. Founded in 1566, the Aulic War Council, consisted five generals and senior civil servants who oversaw the entire Habsburg military system in war and peace, deciding on fortress construction, army equipment, salary issues, and purchase of supplies, as well as on the planning and implementation of wars.[6] It also handled the civil and military administration of the borderlands. Thanks to joint coordination and funding until the late 16th century, there were already around 22,000 soldiers stationed along the Hungarian and Croatian Military Frontiers (compared to only 7,000 before 1526). These numbers are impressive even in the European context.[7] Although the Military Frontier underwent numerous reorganizations (including territorial ones), until its final dissolution in 1881 the centralized military administration would remain its constant. Decisions on military actions as well as all accompanying activities concerning the organization of life in the borderlands would be made exclusively by the Aulic War Council located in Graz and Vienna (after 1709), respectively.

Vojna krajina: Povijesni pregled – historiografija – rasprave [Military Border: Historical Review, Historiography, Studies], Sveučilišna Naklada Liber, Zagreb, 1984.

5 In the 1560s the Military Border consisted of several borderlands (Captain Generalcies): Croatian, Slavonian, Kanizsa, Györ, the Captain Generalcy of Mining Towns (along the Garam River), and Upper Hungarian, or Kassa Captain Generalcy. Géza Pállfy, « The Habsburg Defense System in Hungary Against the Ottomans in the Sixteenth Century: A Catalyst of Military Development in Central Europe », in Brian Davies (ed.), *Warfare in Eastern Europe, 1500–1800*, Brill, Leiden, 2012, p. 44.

6 For more on the Aulic War Council see, Oskar Regele, *Der österreichische Hofskriegsrat, 1556–1848,* Verlag der Österreichischen Staatsdruckerei, Vienna, 1949.

7 Pállfy, 2012, p. 52.

The establishment of the Military Frontier did not only contribute to the advance in government affairs and military administration, but it also gave a substantial boost to the military cartography. With the expansion of the Ottoman Empire in the early sixteenth century, the countries of East and Central Europe became a great European battlefield. Owing to the military strategic importance that East-Central Europe gained with the invasion of the Ottomans, countries that otherwise had not attracted much attention of the cartographers suddenly found themselves in the focus of their interest. From the mid-sixteenth century, the maps of countries such as Croatia, Slavonia, Dalmatia, or Bosnia, which had previously been represented only on small-scale general maps, became the subject of detail military mapping. Units of trained topographers (regularly from the ranks of military officers) soon began to operate along the borderlands, working continuously in the field and producing maps for the needs of generalates or individual captaincies. Numerous lower-ranking soldiers also took part in field work, thus learning the art of surveying and mapping directly in the field. Thus, the frontiers became a large cartographic laboratory where not only mapping was conducted, but also practical education on military cartography took place that eventually grew into schools of formal education. Military maps of the borderlands produced by the army forces since the late 16th century onward represent the first regional maps of these areas based on the principles of modern surveying and cartography.

From Military Engineers to Military Topographers: Early Cartographic Campaigns Ordered by the Aulic War Council

The implementation of the new defense strategy, organized through a system of military frontier fortresses, turned the borderlands into a huge construction site. Old feudal fortresses (burgs) needed to be rebuilt to meet the demands of the warfare. Burgs were not adapted to long-term wars, especially to the threat of a new weapon – the siege cannon. The biggest disadvantage of the old burgs was their location. Built in naturally protected positions, they corresponded to the organization of feudal administration, but not to the monitoring of enemy movements, as well as to easy and fast supply. Another disadvantage was their small surface, which often could not accommodate a sufficient number of soldiers. Finally, the essential difference between the old burgs and a renaissance military fort was in the defensive strength of the fortification system itself. Feudal burgs

relied on the height of their walls, while Renaissance fortifications on a system of lowland fortifications, moats, and bastion systems that together formed a complex defense system.[8] The increase in fortress building for the newly established defense system brought about the establishment of a new military architectural organization. During the 1550s and 1560s the Aulic War Council engaged dozens of architects, mostly Italians, who were contracted by Habsburg military authorities.[9] Their activities were supervised by a Superintendent of Construction (*Bausuperintendant*) of each Generalcy. After 1569 their activities were coordinated by the Vienna-based Fortress Construction Commissioner.

The appearance of a significant number of military engineers and architects who worked on military border fortifications played a key role in the development of Habsburg military cartography. Their knowledge of mathematics, geometry, and technical drawing proved to be key skills needed for surveying and mapping.[10] In the absence of other technically educated staff, they soon turned into military topographers.[11] In fact, as fortifications were to form an organized system of military defense of the entire Monarchy, it was concluded that, in addition to fortifications, the surrounding terrain connecting the fortifications needed to be mapped as well. The mapping of fortifications carried out by engineers for the purpose of their reconstruction or extension thus gradually grew into a cartographic campaign, which resulted in the first military maps of the region.

The first such campaign was conducted already in the 1560s. Its main actors were Natale and Nicolò Angielini, architects of Milanese origin who were

8 Milan Kruhek, *Krajiške utvrde Hrvatskog Kraljevstva* [Military Frontier's Fortifications of the Croatian Kingdom], Institut za suvremenu povijest, Zagreb, 1995, pp. 13–18.

9 At that time, Italy was the leader in almost all arts and sciences. Italian cities, experiencing the devastating effectiveness of French artillery from 1494 onward, required engineers for constructing and fortifying the cities. Italian military engineers were recognized as building authorities throughout Europe where they were often invited as experts. E.g. Italian engineers were employed by Henry VIII in the 1540s. Marcus Merriman, « Italian Military Engineers in Britain in the 1540s », in Sarah Tyacke (ed.), *English map-making 1500–1650*, British Library, London, 1983, pp. 57–67.

10 The first more elaborated manuals for military engineering and drawing appeared already in the 15th century. See Mariano Taccola, *M. De rebus militaribus (De machinis, 1449),* National Library of France, Codex Parisinus Latinus 7239.

11 The same phenomenon can be noticed in other countries like Italy, France, Spain, and England. For the French case see, David Buisseret, *Ingénieurs et fortifications avant Vauban: L'organisation d'un service royal aux XVIe –XVIIe siècles,* Éd. du CTHS, Paris, 2002.

contracted by the Aulic War Council as *Baumeisters*.[12] In the period between 1560 and 1567, the two masters, possibly accompanied by Natale's son Paolo, visited more than 50 fortresses along the Croatian and Hungarian borderlands and produced dozens of fortification plans and a few maps. The series of fortification plans made by the Angielini brothers until 1566 were the oldest such series showing the condition and structure of fortifications along the entire Habsburg borderlands in Croatia and Hungary.[13] For many forts and fortified cities, these are also their oldest cartographic representations (e.g. for Zagreb). The forts were mapped in their floor plan or in the bird's-eye perspective. Plans drawn at a large scale usually show the current layout of the fort and the proposed modernization (in a different color or by a different type of line). Although the Angielinis' fortification plans have a strong artistic touch atypical for military cartography (special attention was paid to aesthetics and colors), the plans have distinct engineering-military features: they focus on the display of fortifications and terrain topography, while elements of inner (civilian) cities are completely omitted.

Their three maps, those of Hungary, Croatia, and Upper Hungary have distinctive military features as well (Fig. 1).[14] The maps that were based on the reconnaissance of the terrain conducted between 1563 and 1566 brought significant advance, comparing the existing maps of the region.[15] Their focus on the elements of terrain configuration (passability!) and vegetation (visibility!) clearly

12 From the Angielini family came as many as three engineers who were also involved in military construction and mapping – brothers Natale and Nicolò and Paolo, Natale's son, who were all involved in military affairs of the Habsburg Monarchy. Among them, Nicolò was the most recognized and best paid. Ferdinand Opll, Helke Krause and Christoph Sonnlechner, *Wien als Festungsstadt im 16. Jahrhundert. Zum kartografischen Werk der Mailänder Familie Angielini,* Böchlau, Vienna, 2017, pp. 21–38.

13 All his manuscript work is contained in a single bound volume dated 1566. One copy of the Angielinis' volume is kept in the Austrian National Library (Cod. 8609), another in the Archives of Baden-Württenberg (Hfk, Bd/XV), while two copies are kept in the Archives of Saxony in Dresden (Sch. XXVI F. 96, N. 6 and XXVI F. 96, N. 11).

14 Maps of Croatia and Slavonia and a map of Upper Hungary were drawn at a scale of 1:500,000, while a map of entire Hungary was compiled at a small scale, serving as an overall map of the region.

15 In addition to their own observations, they relied on existing maps of Hungary by a Hungarian civil mapmaker Lazarus (*Tabula Hungariae*, 1528), by map of Wolfgang Lazius, a court counsellor of Ferdinand I, (*Regni Hungariae*, 1556), and those by Augustin Hirschvogel, a cartographer in the service of Ferdinand I (map of the borderland from ca. 1539, and *Zu Herr der Römischen zu Hungaren*, 1565) which all served them as a starting point in their work.

differs from all existing general maps, reflecting their military purpose. Particular progress was made in the presentation of reliefs, where the still dominant method of stylized moles was abandoned in favor of a so-called cavalier perspective.[16]

Their effort in showing afforestation was also significant. By varying the size and shape of the tree-shaped symbol, they were able to evoke different densities and heights of vegetation. In addition, they marked communications (alert system) along the border, affiliation of each fortification to the Habsburg or Ottoman side, and the exact extent of Ottoman conquest. Since the map also shows a part of the Ottoman territory with an indication of whether there was a military crew in their fortress or they were abandoned, it is clear that the data were collected not only by observation but also by intelligence work.[17] The maps are accompanied by scale, which enabled the calculation of distances, but with no graticule of latitude and longitude. Although clearly compiled to meet the requirements of warfare, the maps are characterized by high aesthetics, which would suggest that one of the brothers might have had some kind of artistic education. The two traditions, those of the land surveyor and the artist evidently overlapped here.[18]

16 The cavalier perspective shows the objects as they would be seen from this high point. The representation was initially used for the presentations of military fortifications. In French, the 'cavalier' is an artificial hill behind the walls that allows to see the enemy above the walls.

17 Abandoned fortifications on the Ottoman territory are marked without a crescent and those with a Ottoman military crew are presented with a crescent.

18 That was often the case in the 15th-century visuality represented in the works of Leonardo da Vinci and Albrecht Dürer.

Fig. 1 A detail of a map of Croatia and Slavonia compiled by the Angielini brothers about 1566. It shows a part of the Croatian Military Border (green) and a part of Slavonia under Ottoman control (reddish). An innovative method of displaying relief and vegetation was applied. Note the alert system marked along the border (a thin dashed line at the edge of Habsburg territory that connects the border posts).
(Austrian National Library, Cod. 8609, fol. 2)

Military Topographers of the Seventeenth Century: The Beginnings of the Professionalization of Mapmaking

The epochal success of the brothers Angielinis' cartographic campaign, which provided the Habsburg army with much-needed geographical information about the border area, was not soon repeated.[19] Frequent Ottoman incursions followed by a new Habsburg-Ottoman War (1593–1606), which largely took place in Croatia, hampered the possibility of field mapping of the Croatian borderland for a long time.[20] At that time, the territorial extent of Ottoman conquests in SE Europe reached its peak and the territory of Croatia and Hungary were reduced to a narrow belt known as remnants of remnants (*reliquiae reliquiarum*).

Despite the undeniable quality of brothers Angielini's work, which provided the army with information on the position of the fortifications and the possibilities of the army's movement along the border, the lack of larger-scale maps was still a major issue. This is evidenced by an initiative of Ferdinand II, Archduke of Austria, who was charged with the command of the defense of Croatia and Hungary. In the lack of other options, he ordered Ivan Klobučarić, a prior of the Augustinian monastery in Fürstenfeld, otherwise known for his drawing skills, to perform a topographic mapping of the inner Austrian countries for strategic purposes.[21] Between 1601 and 1606, Klobučarić conducted a reconnaissance and

19 The stalemate occurred primarily in Croatia. In Upper Hungary some cartographic activities continued. Sometime after 1580, Giovanni Jacopo Gasparini, an Italian military architect in charge of the modernization of forts of Upper Hungary, produced a map of Hungarian borderlands, while about 1600, Ferenc Batthány produced a defense map of the region between the Mura and the Rába rivers. Zsolt Török, « Renaissance Cartography in East-Central Europe, ca. 1450–1650 », in David Woodward (ed.), *The History of Cartography, Volume 3: Cartography in the European Renaissance, Part 1*, The University of Chicago Press, Chicago, 2007, pp. 1847–1848.

20 The long-lasting Habsburg-Ottoman conflict, also known as the Long War or the Thirteen Years' War, was concluded with the Peace Treaty of Žitva (Zsitvatorok) in 1606, with meager territorial gains for the two main empires. The treaty confirmed the Ottomans' inability to penetrate further into Habsburg territories. It also demonstrated that Transylvania was beyond Habsburg power. Though Emperor Rudolf had failed in his war objectives, he nonetheless won some prestige thanks to this resistance to the Ottomans, by presenting the war as a victory. The treaty stabilized the conditions on the Habsburg-Ottoman frontier.

21 Ivan Klobučarić (ca. 1150–1606), a Croatian Augustinian priest and painter. After receiving his education in Rome, he served as a prior to the Augustinian monastery in Rijeka. At the time he was engaged in mapping, he was a prior of the Augustinian monastery in Fürstenfeld (Styria). Fritz Popelka, *Die Landesaufnahme Innerösterreichs von Johannes*

drafted about a hundred sketches that were to be used to compile a topographic map. His rough sketches, drawn only with the help of a compass and a drawing table, testify to the hands of a talented painter (his presentations of forts and bird's-eye views of towns were exquisite) without any military or engineering education (Fig. 2). Unfortunately, due to Klobučarić's sudden death in 1606, the map was never compiled.[22] Klobučarić's engagement in military mapping testifies to the absence of military personnel trained in surveying and mapmaking. The professionalization of military mapping can to some extent be noticed only since the 1630s. Although, even then, most cartographic campaigns were still undertaken by engineers in charge of the maintaining of fortifications, they now regularly came from the ranks of officers in permanent military service.[23] The position of the engineer as a professional in charge of military mapping would be maintained until the late 17th/early 18th century when the terms topographer and field engineer became more frequently used.[24]

The first major campaign to map the military frontier in the 17th century was undertaken by the colonel Giovanni de Galliano Pieroni (1586–1654), a military engineer specialized in the construction of fortifications.[25] He spent a lot of time working for General Albrecht of Wallenstein in Vienna and Prague. After successful work on a set of fortifications in Prague he was engaged by the Aulic War

Clobucciarich 1601–1605, Verlag Url. Mossers Buchhandlung, Graz, 1924, pp. 1–20.

22 Klobučarić's numerous sketches are still preserved in the Steiermärkisches Landesarchiv, Graz Sammlung Clobucciarich.

23 The status and military rank of engineers involved in early mapping is sometimes hard to reconstruct. Most of them were appointed to the Aulic War Council and officially contracted into the service. In doing so, they were given a military degree, in most cases the Hauptmann, and sometimes the rank of Lieutenant Colonel, even a General. Joseph Paldus, « Johann Christoph Müller. Ein Beitrag zur Geschichte vaterländischer Kartographie », *Mitteilungen des k.u.k. Kriegsarchivs* 5 (1907), p. 15.

24 In 1694, the French Academy of Sciences defined the term engineer as one who invents, sketches, and conducts the works and instruments for the attack and defense of fortifications. Ken Alder, *Engineering the Revolution: Arms and Enlightenment in France, 1763–1815,* Princeton University Press, Princeton, NY, 1997, pp. 56–57.

25 Giovanni de Galliano Pieroni (1586–1654), a Florentine architect, mathematician and astronomer specialized in fortifications, author of *Trattato delle fortificazioni moderne*. His father was an architect at the court of the Medicis. Giovanni Pieroni studied law, earning a doctorate in law in Pisa. He is also known for his cooperation with Galileo Galilei and Johannes Kepler. Guido Carrai, « Giovanni Pieroni: un informatore medico al seguito del générale Wallenstein », *Esamizdat,* II (2004), pp. 175–180.

Council to conduct a survey of Croatian borderland and its fortresses. Between 1636 and 1639 he made the inspection of Croatian forts, writing an extensive report accompanied by numerous fortification plans and proposals for their extensions.[26] Beside the standard ground-plan of a fortification, Pieroni introduced the use of panoramic bird's-eye views of forts, which, in addition to the physical appearance of the fort, also evoked the overall ambience of the place.[27] This type of military plan drew on two interacting genres: the town view and the landscape panorama, which provided a panoramic background to a military post.

A relatively long period of truce between the Thirteen Years' War (1593–1606) and the Great Turkish War (1663–1699) enabled the development of more extensive cartographic campaigns that would bring further advances to military cartography. In this regard, a significant step toward regional military mapping was made by Martin Stier (1630–1669).[28] His maps clearly show how much military mapmaking developed since the Angelinis' time. As a trained officer in the rank of captain, he first served in the infantry, and about 1654 transferred to the construction section. In 1657 Stier was appointed chief engineer (*Oberingenier*) and assigned by the Aulic War Council with the task of military inspection of the forts in Carniola and Styria and of the Hungarian and Croatian borderlands. Stier spent the period from 1657 to 1660 in a field trip, conducting the inspection of forts, mapping them and proposing plans of modernization for each of them.[29] In contrast to his predecessors, he also conducted an extensive survey of the bor-

26 State Archive of Slovenia, Manuscript Collection, Cod. 1073. For Pieroni's published reports and fortification plans see, Helena Seražin, *Poročila in risbe utrdb arhitekta Giovannija Pieronija,* Arhiv Republike Slovenije, Ljubljana, 2008.

27 This genre grew out from the tradition of the late 16th-century commemorative siege maps that were usually compiled in the bird's-eye view perspective.

28 Surprisingly little information is known about Martin Stier. Just a few records in letters to the War Council and his last will from 1669 provide only elementary information. Because of the contribution to the modernization of the fortresses, his career is usually compared to famous Sébastien Le Prestre de Vauban (1633–1707). But unlike the latter, Stier never gained his fame and status. One of the reasons is certainly his early death (he died at 39).

29 His extensive report comprises 147 folio sheets and more than 40 plan and maps. One copy is kept in the Austrian National Library (Cod. 8609), and other in the War Archive in Vienna, Map Collection, Gi.a.220. For Stier's report and reproduction of his maps see, Ljudevit Krmpotić, *Izvještaji o utvrđivanju granica Hrvatskog Kraljevstva od 16. do 18. stoljeća* [Reports on the Fortification of the Borders of the Croatian Kingdom from the 16th to the 18th Century], Nakladni zavod Hrvatski zapisnik, 1997, Hannover – Karlobag – Čakovec, pp. 1–172.

Figure 2 A newly erected fort of Karlovac, a site of the Croatian borderland and its vicinity on a sketch by Ivan Klobučarić (ca. 1605). The lines between the fortifications and the radial lines from the hills testify to the use of a compass in the reconnaissance of the terrain. (Steiermärkisches Landesarchiv, Graz Sammlung Clobucciarich, Blatt 82a).

derlands, based on which he compiled several manuscript maps at a relatively large scale: a map of the Hungarian borderland,[30] a map of the Varaždin and Petrinja borderland,[31] a map of the Croatian borderland,[32] and a detailed map of the central part of the Karlovac Generalate (Fig. 3).[33] These maps are considered the first mid- to large-scale military maps of the Croatian borderland. Drawn at a scale (yet, still without a grid), they provided a detailed insight into the topography of the terrain and the spatial layout of all military installation such as forts, watchtowers (*chardaks*), safe river crossings, and abandoned military posts. As the then method of warfare included extensive use of natural land barriers, especially rivers, swamps, and mountains, the terrain and the objects are mostly given in the cavalier perspective, which gives a three-dimensional insight into the theater of war. Stier's maps were designated as military secrets and were never published. Yet, the comprehensive topographic material compiled by Stier was not entirely without echo outside military circles as well. In 1664 he compiled an overview map of Hungary, which, unlike his military maps was published in Vienna at a reduced scale of 1:1,000,000.[34]

30 Mappa über die Steierische Frontier Plätze gegen der Türkischen Poste Canischa. Austrian National Library, Cod. 8608, fol. 4

31 Mappa über die Windische, Petrinianische und Banatische Granitzen. Austrian National Library, Cod. 8609, fol. 32

32 Mappa über die Croatische und Meer Gränitzen sammst den Cameralischen Stätten. Austrian National Library, Cod. 8608, fol. 62.

33 Karlovac was the site of the Generalate and the most important military fort in Croatia that was built as a planned city in 1579. Abriss der Festung Carlstadt sammt den vorliegenden Wachten und Passen. Austrian National Library, Cod. 8608, fol. 74.

34 Vermehrte und Verbesserte Landkarten des Königreichs Ungarn und denen andern angräntzenden Königreichen… Copperplate in 12 sheets. Croatian State Archives, Map Collection, D.XIV.3.

Fig. 3 A detail of Martin Stier's large-scale map of the central part of the Karlovac Generalate compiled in 1657. The scope of the map is the fortified town of Karlovac (built in 1579) and the defense strategy of its immediate surroundings (note the watchtowers and river crossings!). Karlovac was one of the most important strongholds of the Croatian border. (Austrian National Library, Cod. 8608, fol. 74)

Under the Cannon Fire: Mapping the Great Turkish War (1683-1699)

While most of the early military maps of Habsburg borderlands appeared in the truce, the next Habsburg-Ottoman War would urge the practice of extensive mapping in the wartime. The circumstances of the war would introduce many changes not only in the way of mapping but also in the organization of cartographic works. Until then, the mapping was mostly conducted periodically through campaigns ordered by the Aulic War Council. However, the Great Turkish War (1683–1699) that was fought in conjunction with the Ottoman-Venetian War had an extremely large frontline that stretched from Poland to Dalmatia, so the strict centralized organization of mapping was not effective, leading to a much larger initiative of generals in the field. Aware of the military implications of mapmaking in the warfare, Raimund Montecuccoli, the president of the Aulic War Council, issued a set of instructions in 1673 that were intended for all engineers in the imperial services, clarifying their role as experts in military mapping.[35]

War offensives and incursions into the Ottoman-held territory were now used to reconnoitre the terrain and map even behind enemy lines. After the Ottomans retreated from Vienna (1683), the Habsburgs pressed forward, rapidly taking Hungary (1686–1697), north Serbia (1689), Slavonia, and most of Croatia (1687–1691). During military operations or immediately after the ceasefire, military topographers would come to the field to map the newly taken or temporarily occupied terrain. Thus, in the 1690s, a large number of operational and marching route maps appeared, as well as siege plans drawn by military topographers operating within military units.[36] At the same time, the first mid-scale regional military maps of borderland zones were created for the purpose of strategic planning.[37]

35 As part of military engineers' work on the maintenance of fortifications, they had to prepare drawings and architectural plans. During wartime operations, the military engineers deployed with the imperial troops had to draw maps showing the encampment of troops, marching routes, and especially the territory of newly acquired lands. These maps incorporated all the settlements, rivers, streams, mills, forests, mountains, swamps, lakes, and other significant geographical features. The engineers sent one copy of each map to the Aulic War Council and another copy to the commanding general. The drawings could not be shared with anyone else. Heinrich Blasek and Franz Rieger, *Beiträge zur Geschichte der K. u. K. Genie-Waffe*, vol. 1, L.W. Seidel, Vienna, 1898, pp. 8–9, 217–218, 221–222.

36 Cf. some examples: Lagers der Truppen des Kurfürsten Max Emanuel von Bayern vom 22. Juni bis 4. September 1687…(H.III.c.98-4), Generalkarte der Kriegs Operationen der Kayserl. Armee in Jahr 1688 (H.III.c.99), Operationskarte in südostlichen Theils von Ungarn in 1697, (H.III.c.101-1).

37 Carte von dem Theile Croatiens welcher durch die Sava, Kulpa, Unna und Zermania Flüs-

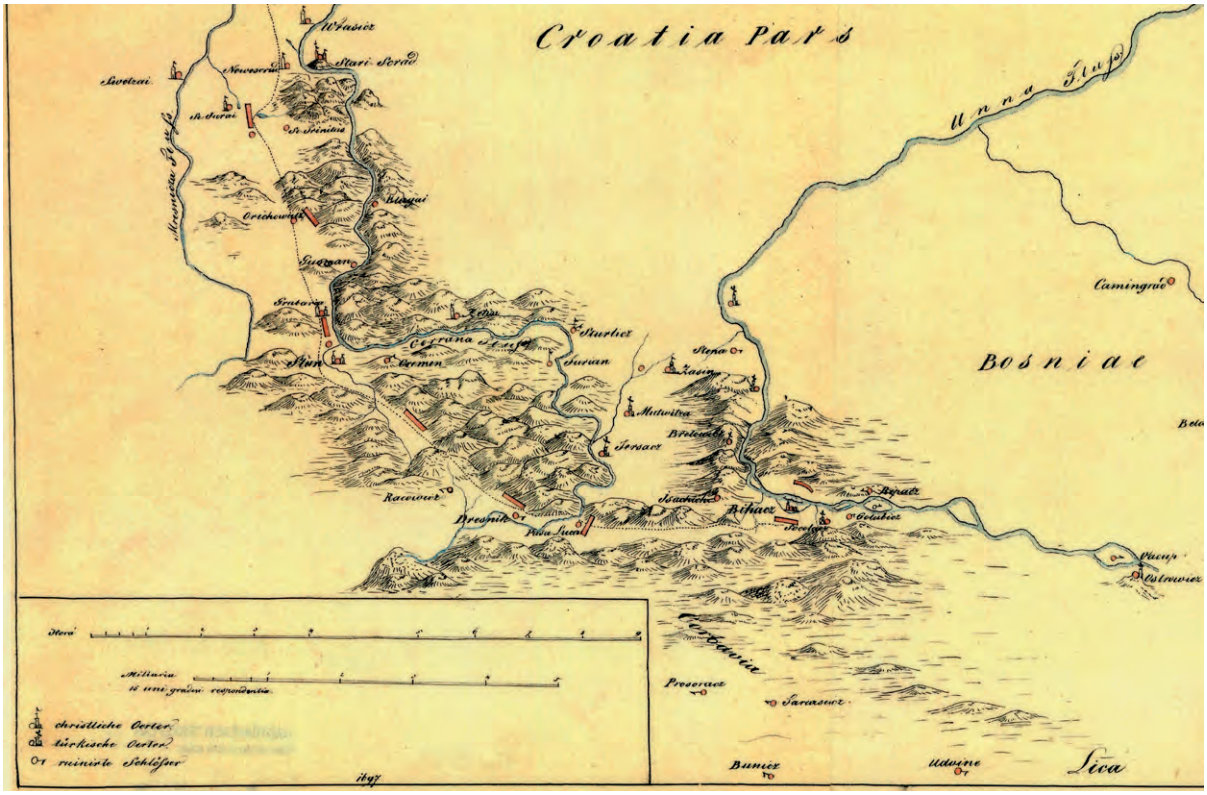

Fig. 4 An operation map (*Operationskarte*), which shows the movement of Habsburg troops from Karlovac (Croatia) to Bihać (Bosnia) in 1697 at a scale of 1: 240,000. Notice the advanced presentation of the hills. (Museum of Military History, Budapest, H.III.c.292)

Maps compiled during the Great Turkish War were used in the field, but they also often served to illustrate battlefield reports and thus had a dual role: to record geographical information required for military control of the newly ceased territory and, no less important, to demonstrate their victory over the Ottomans (sketches of siege plans and operational maps were often honorably given to generals). These maps were partially based on an instrumental survey, but were compiled at a relatively large scale (Fig. 4).[38] Beside their improved mathematical

se und dem Adriatischen Meere eingeschlossen ist, und worauf die befestigten Städte und Schlösser, dann die Pässe angegeben sind (von 1690–1700) /Johann Friedrich Hollstein. [S.l., 1690]. Manuscript in color; 58 6 x 43.1 cm. G.I.a-102, Plan 34.

38 E.g. [Operationskarte von Karlstadt bis Bihacs]. Scale ca. 1:240,000. [Sl.l.], 1697. Manuscript in color; 40 × 26 cm. Museum of Military History, Budapest, Map Collection, H.III.c.292, or Partes Croatiae circiter spatio 5 horarum ab Unna a nemine post expugnatam anno 1688 Costaniczam inhabitatae/ desseinié Joseph de Leonyt. Scale 1:223,000.

base, they are characterized by an advanced presentation of the terrain: hills given in the cavalier perspective are now supplemented with vertical lines of different densities (slopes!), thus representing a transition toward the method of hatching. However, several facts reveal that military mapping was still in its early stage: there is no elaboration of army-specific symbols (symbolization applied on military maps is still very similar to those for civilian use), mapmaking was limited to only a few map types (operation maps, march route maps, siege maps), while non-standardized symbols are still widely used (cf. pictorial representation of the forest barrier on a 1688 map) (Fig. 5).

During the Great Turkish War, the military and cartographic campaigns of the Habsburg army for the first time extended to Bosnia. During two offensives in 1697, one under the command of General Carl Auersperg on Bihać and the other under the command of Eugene of Savoy on Sarajevo, Habsburg topographers conducted the first military mapping of Bosnia and its key fortifications.[39] In terms of cartography, Eugen of Savoy's offensive was particularly successful. He was accompanied by a number of military topographers who, in only a few weeks, in difficult war conditions, drew numerous topographical sketches and siege plans of the forts, which were later used for the compilation of a military map of Bosnia, the first of that kind for this region.[40] Compiled at a scale of

[S.l., 1688]. Manuscript in color; 75.5 x 49 cm. National Library Budapest, TK 530.

39 For the plans made during the siege of Bihać, cf. For the War Archive in Vienna, Map Collection, H.III.c146 to H.III.c.148.

40 Very often the maps and plans made during the campaign of 1697 are mistakenly attributed to the surveying work of François Nicolas Sparr de Benstorf. Namely, Benstorf was born only in 1696 and could not attend the campaign of Eugene of Savoy. The confusion arose because Sparr de Benstorf, who later became a prominent military officer and engineer in the Habsburg army, around 1740 multiplied the

Fig. 5 A detail of the military map of Croatian borderland along the river Una that was drafted in 1688, immediately after the suppression of the Ottomans. The defense of the border with Bosnia (Turkey) relied on natural barriers, and thus a dense forest belt is marked along the border line (*Waldverhacke*). (National Library, Budapest, TK 530)

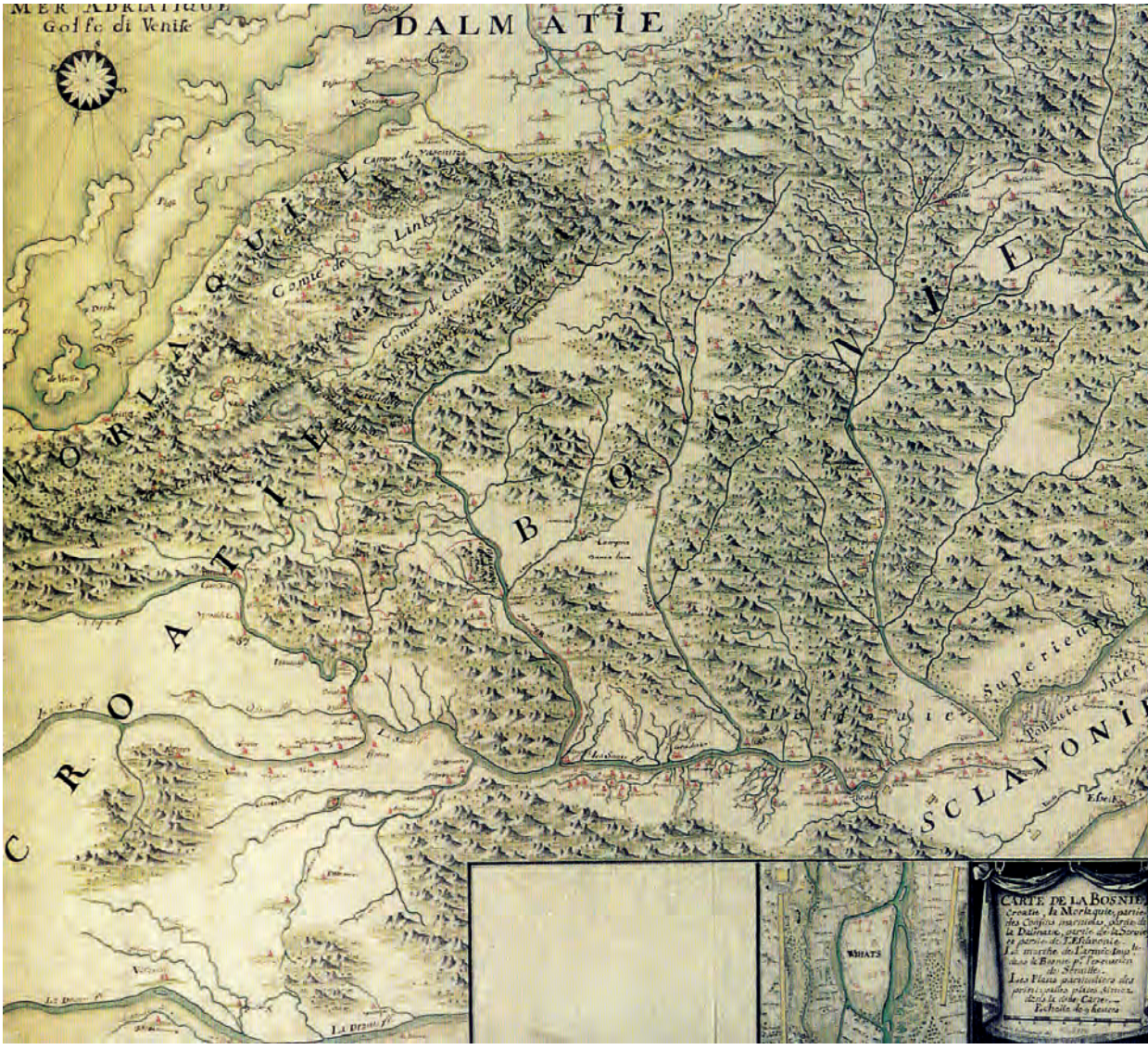

Fig. 6 The first Habsburg military map of Bosnia based on the reconnaissance made during Eugen of Savoy's offensive in 1697. The map is reversed in the way that it can be read accurately only by reading it in a mirror. (War Archive, Vienna, B-IX-a-934)

cartographic material created in 1697. Sparr de Benstorf is best known as the author of a series of siege plans from 1739. Erich Hillbrand and Friederike Hillbrand, « Ein Lothringer zeichnet die niederösterreichische Donauregion Ein Beitrag zum Leben und Werk François Nicolas Sparrs », *Jahrbuch für Landeskunde von Niederösterreich*, 59 (1993), p. 94.

1:440,000, the map shows only the general configuration of the terrain, the position of the forts and the marching route of Savoy's troops (Fig. 6).[41] This map was designated as highly confidential and was never printed. The fear of a possibility that the enemy could get hold of such a valuable cartographic document spurred the cartographer to draft the map in such a way that it could only be accurately read with the help of a mirror.

Turning Point of 1699: Interference of Military and State Cartography

The Great Turkish War in which the Ottoman Empire was heavily defeated by the Holy League was concluded with the Karlowitz Peace Treaty in 1699. Its conclusion marked the formal end of Ottoman control over a large portion of Central Europe as well as their first major territorial losses after centuries of expansion.[42] The Peace Treaty of Karlowitz was in many ways the beginning of a new era not only in the military history, but also in the history of cartography, announcing a new paradigm in military mapping. Since then military cartographers would be directly involved in numerous state affairs.

At the down of the 18th century there was an increasing number of affairs, which required military mapping, and which were not directly related to warfare, but had a high strategic value. One of the most

41 Carte de la Bosnie, Croatie, la Morlaquie, partie des Confins maritimes, parte de la Dalmatie, partie de la Servie et partie de L'Esclavonie. Scale 1:440,000.-1697. Manuscript in color; 61 x 93.5 cm. War Archive Vienna, Map Collection, B-IX-a-934.

42 The Ottomans were forced to surrender much of Hungary (including Transylvania), Croatia, and Slavonia, but kept the Banat of Temesvár and Moldavia. Venice regained the Morea (the Greek Peloponnese) and large parts of Dalmatia, while Poland retook Podolia.

important such affairs was the demarcation of the new Habsburg-Ottoman border established by the Peace Treaty of Karlowitz. The mapping of the borders was managed by the War Council, which assigned the job to Count Luigi Ferdinando Marsigli, then the adviser of the Habsburg army with the rank of colonel (*Obrist*).[43] Accompanied by a number of staff of officers and engineers, including the 26-year-old officer Johann Christoph Müller,[44] they conducted a survey and produced the first large-scale maps of the borderland. Supervised by Marsigli, Müller, who was appointed chief field engineer (*Feld-ingenieur*), produced an overview map at a scale of 1:500,000, which represented the position of the whole boundary as well as detailed sheets at a scale of 1:37,500, 24 sheets for the Habsburg-Ottoman boundary in Croatia and Slavonia and another 15 sheets for a portion of the boundary in Hungary, altogether 39 detailed sheets.[45] Although compiled for the purpose of demarcation, all sheets were clearly drawn in military style, with relief and vegetation given in the cavalier perspective, with watchtowers and the position of cavalry and infantry troops marked according to military conventions (Fig. 7). No less important, each sheet was accompanied by a graticule of longitude and latitude.

43 Count Ferdinando Luigi Marsigli (1658–1730) was born into a noble family in Bologna. He did not receive formal education. Instead, he preferred to gain empirical knowledge. Thus, after taking numerous lessons and courses in mathematics, astronomy, biology, and medicine, he started to travel extensively. Already at an early age he became a very keen map collector with strong interest in surveying and mapping techniques. His good social skills enabled him to join a Venetian diplomatic delegation sent to Constantinople in 1679. During the Siege of Vienna in 1683 he was captured by the Ottomans and kept in prison for almost a year. After being released in 1684, until the end of the war, Marsigli was engaged as a military adviser of the Habsburg army. For more about Marsigli's work see, John Stoye, *Marsigli's Europe, 1680–1730: The Life and Times of Luigi Ferdinando Marsigli, Soldier and Virtuoso,* Yale University Press, New Haven, 1994.

44 Johann Christoph Müller (1673–1721), one of the most prominent Habsburg military cartographers and surveyors of the late seventeenth and early eighteenth centuries. Already in 1696 he came into contact with Marsigli at whose initiative he was hired as the chief cartographer of the Peace Treaty of Karlowitz. In addition to a series of large-scale demarcation maps, he also produced a general map of Hungary (Hungariae Regi invictissimo mappam hanc Regni Hungariae, 1709), a map of Moravia (Tabula generalis Marchionatus Moraviae, 1720), and a map of Bohemia (Mappa geographica Regni Bohemiae, 1722). Paldus, 1907, pp. 11–13, 53, 73.

45 Mappa Geographico-Limitanea in qua Imperiorum Caesarei et Ottomanici Confinia in almae pacis Carlovitzensis Congressu decreta. Johann Christian Müller, 1699. Scale 1:500,000. Manuscript in color; 111 x 51 cm. The detailed manuscript sheets (68 x 51 cm) have a common numeration, 1–39; each sheet, however, has its own title. War Archives in Vienna, Map Collection, B.IX.c.634.

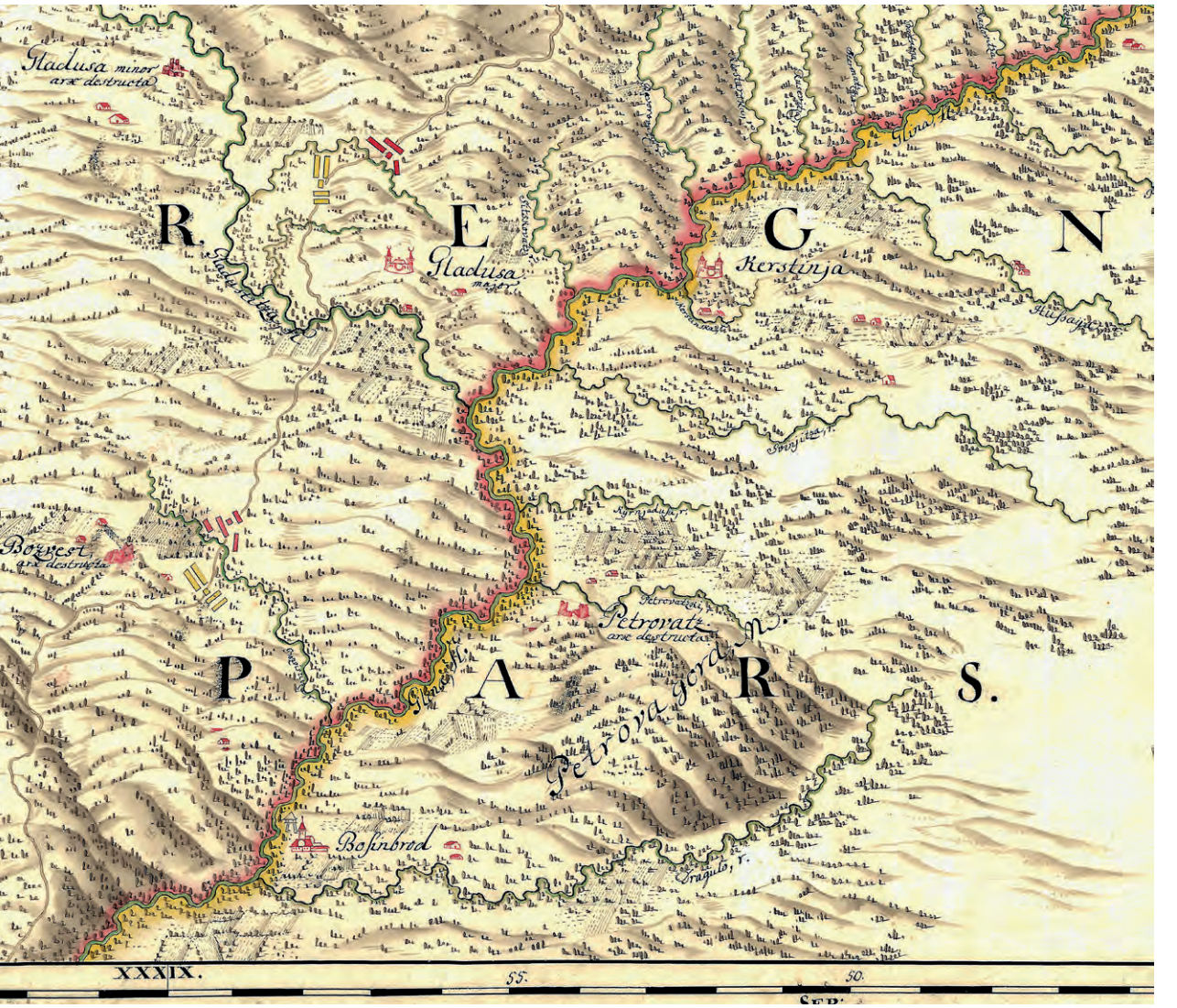

Fig. 7 A detail of the demarcation map of the Habsburg-Ottoman borderline in Croatia, compiled by Johann Christoph Müller in 1699 under the supervision of Count Marsigli. (War Archive, Vienna, B.IX.c.634, sheet XVII)

Under the agreement, the boundary was mapped from both sides up to a distance of two hours' walk. That fact made it possible to actually turn the demarcation of the boundary line into the surveying of the wider borderland, which allowed Habsburg cartographers to gain legal entrance to the Ottoman territory

and thus map their military frontier zone.[46] Mapping was done with the help of available measuring instruments, among which the compass was the most useful one. Only horizontal angles were measured with no high-altitude elevations. Distances were obtained by intersecting horizontal angles or by measuring time. The extensive project of boundary mapping was, without any doubt, the teamwork of a group of surveyors and cartographers, but the maps were almost without exception signed by Müller and Marsigli. Because of that fact, many participants in this mapping campaign remained anonymous.

The great success of the cartographic campaign of 1699 and numerous maps that appeared represent a significant step in the development of both military and commercial cartographies. The Karlowitz Peace Treaty of 1699 and the suppression of the Ottomans from Central Europe was a great sensation throughout Europe. Although detailed demarcation maps were maintained in the manuscript as a confidential government and military document, some geographical knowledge acquired by military staff would appear on a printed commercial map for the very first time. Since 1699, some of the first-hand knowledge on the borderland, at a reduced scale and content, would be available for the general public, informing them on the theater of war and the position of the Habsburg-Ottoman border.[47]

The engagement of military topographers in the conduction of the demarcation proved to be very effective. Since then military cartographers were regularly involved in the demarcation mapping of the Habsburg-Ottoman border (1718, 1739, 1791), confirming the close link between state and military cartographies. The connection between military and state cartography would strengthen over time, and the army would soon make use of not only the topographic but also of the cadastral survey of the entire Monarchy.

46 During the demarcation of the boundary, for the first time, legal Habsburg maps of countries under Ottoman rule, such as Bosnia, Moldova, Serbia, Bulgaria, and Romania, appeared as well. They were also produced by Marsigli and Müller.

47 As early as 1701, a map by Christoph Weigl was published in Nuremberg with an accurate representation of the Ottoman border of 1699 and accompanied by plans of all key border fortifications. See, Mappa der zu Carlovitz geschlossenen und hernach durch zwey gevollmaehtigte Commissarios vollzogenen Kaiserlich Tuerkischen Graentz Scheidung: so in dem Frueh Jahr 1699 angefangen und nach Verfliesung 26 Monaten vollendet worden. Copperplate in color; 37 x 30 cm.

Diversification of Military Mapmaking – From Warfare to Economic Sustainability

Due to the further Habsburg-Ottoman Wars (1716–1718, 1737–1739) that would take place along the Croatian borderland, for some time Habsburg military cartography would stay focused on mapping the fortifications and on the production of medium-scale operational and route maps, and plans for the fortifications. Although the cartographic campaigns after the Peace Treaty of Passarowitz (1718) and the Peace Treaty of Belgrade (1739) would no longer be as extensive as those of 1699, a new series of maps depicting the border and key fortifications made by Habsburg military topographers and field engineers emerged after each of the armistices.

The Ottoman-Habsburg wars of the first half of the 18th century further confirmed the importance of the acquired advantage in the field of cartography.[48] This fact prompted the Austrian military authorities to realize how useful it would be to have reliable maps available for the entire borderland, or even for the whole the Monarchy, and not just for a narrow strip of land along the border. Military reasons began to be joined with economic ones, such as better control of resources like forests and agricultural land. Thus, from the 18th century military maps were understood not only as a tool of warfare but also as an instrument for the implementation of a much needed tax reform and achieving of greater economic self-sustainability of the borderlands, whose financing from the central treasury became increasingly difficult. The implementation of the reforms that would take place during the 18th century would largely depend on the training of new personnel, so greater attention began to be paid to military education, including that in the field of cartography.

In the 1720s the number of staff trained in surveying and mapping began to grow significantly. The increase in officers with training in mapmaking was particularly spurred by the establishment of the Imperial and Royal Technical Military Academy (*K.u.k. Technische Militärakademie),* a military training facility

48 In contrast to Habsburgs, the Ottoman army did not use maps in the warfare. Due to the secrecy policy (maps could always get into the hands of the enemy), they preferred using local people to guide them through the unknown terrain. For more on the Ottoman policy of mapping see, Altić, « Nineteenth-Century Ottoman Topographic Mapping of the Balkans », *The Cartographic Journal* 55/4 (2018), pp. 326–340.

founded in 1717 for the officers of the Habsburg Monarchy. It was established on the initiative of Eugen of Savoy who, recognizing the shortage of military engineers in the Habsburg army, urged Emperor Charles VI to set up corresponding training facilities.[49] Only in the period between 1718 and 1743, some 300 students attended the academy. Another important impetus to the development of military cartography occurred in 1747, when Maria Theresa ordered the formation of the imperial Genie Corps (Corps of Engineers) with the primary task of surveying and mapping for military purposes. By centralizing military engineers under a common leadership, the Aulic Council could allocate officers more effectively all over the Empire. The Genie Corps consisted of four brigades, each in charge of a certain part of the Empire: German (for German hereditary lands), Hungarian (for Hungary, Croatia, Slavonia, Banat, Transylvania), Italian (for Italian lands), and the one of the Low-Countries (for Austrian Netherlands).[50]

Yet, it seems that a larger number of military engineers involved in surveying and mapping along the borderlands were trained more in the field than in schools. During the 18th century, special topographic departments were established in the headquarters of the Generalates, as well as in some regiments whose task was to conduct local surveys and mapping. Eventually, some of those departments grew into outdoor schools for mapping. This is especially the case for Karlovac, which became an important educational center for officers stationed locally. Their activity would be especially intensified at the time of the juridical and territorial reorganization of the Military Frontier (1737–1746), when the old captaincies were replaced by regiments that, in addition to military, also received significant economic responsibilities. In order to carry out the reorganization, precise maps were much needed. Already in 1746, under the leadership of Lieutenant Johann Andreas Schillinger, a Royal Military Engineer of the Hungarian Brigade of the Genie Corps, begins a detailed topographic survey of all former captaincies of the Karlovac Generalate. In only three years time, assisted by numerous officers of the Karlovac Generalate trained in field mapping, Schillinger successfully con-

49 Gunther Erich Rothemberg, « Some Observations on the Evolution of Technical and Scientific Education in the Austrian Army during the Eighteenth Century », in Monte D. Wright and Lawrence J. Paszek (eds.), *Science, Technology, and Warfare: the Proceedings of the Third Military History Symposium*, *United States Air Force Academy, 8–9 May 1969*, U.S.G.P.O, Washington, DC, 1971, p. 77.

50 Madalina Veres, *Constructing Imperial Spaces: Habsburg Cartography in the Age of Enlightenment*. PhD diss., University of Pittsburgh, 2015, 49–50.

Fig. 8 A section of a topographic map of the former Karlovac Captaincy drafted in 1748 by Johann Andreas Schillinger at a scale of 1:43,200 (explanation key enlarged by author). Compiled almost thirty years before the first military survey, it represents one of the pioneering works of the Genie Corps accompanied by local staff. (War Archives, Vienna, B.IX.a.859-02)

ducted the survey and produced maps of each captaincy at a scale of 1:43,200 (Fig. 8).[51] Upon the survey of the captaincies, he summarized his results into a topographic map of the whole Karlovac Generalate at a scale of 1:100,000 (Fig. 9).[52]

51 War Archives in Vienna, Map Collection, B.IX.a.851, B.IX.a.853, B.IX.a.854, B.IX.a.856, B.IX.a.857, B.IX.a.859.

52 E.g. Mappa Geographica von dem Carlstädter Generalat, welches die Meer-Gränitz, bis an die Licca und Carbavia… von Schilinger aufgenohmen worden. Scale: 1:100,000. [S.l., 1748]. Manuscript in two sheets, 87 x 64 cm each. War Archive, Vienna, Map Collection, B.IX.a.783.

Schillinger's large-scale maps of the captaincies, as well as the map of the Karlovac Generalate, show a great progress of Habsburg military cartography. These detailed topographic maps are based on an instrumental survey by triangulation and astronomical observations. The maps show settlements at the level of individual households, all watchtowers (*chardaks*), sanitary check points (*contumanze*), mills, stores (magazines), churches, and the complete traffic network (roads are categorized). The presentation of the physical-geographical features of the terrain also experienced a significant progress. Not only relief is now marked by a new method of hatching, but land use of terrain is elaborated in detail as well. Thus, forested parts are clearly distinguished from those that are cultivated, as are individual areas under meadows, pastures, vineyards, and orchards. In addition, the maps of captaincies were regularly accompanied by auxiliary plans of forts and cities. Although undoubtedly produced as maps intended for strategic planning and management of the Generalate, their highly aestheticized visual identity confirms that they were also prepared for the central military authorities in Vienna. Most of them are equipped with decorative cartouches with strong symbols of Habsburg imperial power. Yet, none of these maps was accompanied by a grid of latitude and longitude.

Fig. 9 A section of Andreas Schillinger's military map of the Karlovac Generalate compiled in 1748 at a scale of 1:100,000. Physical geography is presented in the same style as would be applied on Josephinian topographic maps (War Archives, Vienna, BIX.a.783-02)

Schillinger's maps represent the pinnacle of Habsburg military cartography of the mid-18th century. Compiled more than thirty years before the first military survey of the Habsburg Monarchy, his maps testify to the strong advancement of military cartography enabled by the synergy between royal officers sent by central authorities and local staff stationed in the Generalates. No doubt, the participation of local officers alongside Schillinger meant for them additional training and experience that would allow them to continue cartographic work on their own for the needs of individual regiments. Locally organized mapping activities particularly contributed to the diversification of military mapmaking in the borderland. Using Schillinger's maps as a basis, local officers continued to produce maps, compiling a series of thematic large-scale maps mainly focused on border control and the economic valorization of land. Thus, a series of maps of sanitary cordons,[53] maps of pastures,[54] as well as maps of forests of individual regiments were created,[55] all of which compiled before the first military survey that would start there in 1774.

First Military Survey under General Quartermaster's Staff and Secret Mapping of Bosnia

The changes that started with the reorganization of the Military Frontier were only the beginning of Maria Theresa's extensive reforms (1747–1780) that would completely change the legislative framework of the Monarchy. To strengthen the military and bureaucratic efficiency of the Empire, she introduced radical centralization and extensive legislative changes, which also included financial reforms that deeply affected the serfdom and taxation system (taxation of the nobility and

53 Ideal Plan der Liccaner Granitz von Lopmardenichka Polliana bis an das Triplex confinium mit dem Turcico und die Venetianische Granitz von Triplex confinium bis Varzca…/ aufgenommen und gezeichnet Fahnrich Gary. Scale 1:180,000. [S.l.: ca. 1769]. Manuscript in color; 50 x 34 cm. Croatian State Archives, Map Collection, B.I.19.

54 E.g. Mappa geometrica des jenigen Terains Travarinae genannt auf welchen denen Venezianer gegen Bezahlung die Waide vor das Viech zugelassen wird…/ A. Waldschütz.- Scale 1:360,000. [S.l.]: 1753. Manuscript in color; 83 x 54 cm. Croatian State Archives, Map Collection, B.I.15.

55 E.g. Mappa deren K.K. an der See in litorali Austriaco liegenden Waldungen des löbl. Liccaner Gränz Regiment welche auf Allerhöchste Befehle Annis 1764 accourat und Geometrisch aufgenommen und nach der Wahren Laage der Gegend entworffen worden/ Dienzel, Penco, Pierker. Scale 1:43,200. [S.l.]: 1764. Manuscript in color; 160 x 260 cm. Croatian State Archives, Map Collection, B.III.3.

clergy was instituted for the first time). The reforms would have a particularly strong impact on the military, its funding and internal organization. In general, the Habsburg Monarchy during Maria Theresa and Joseph II went through a process of militarization, in which the fiscal and the economic systems more effectively supported war and defense. Although the funding of the army was still the responsibility of the central government, more and more insistence is placed on greater self-sustainability of the region, on the development of more sufficient agrarian production and crafts in the cities. Those changes would have a deep impact on military mapping, encouraging thematic cartography and production of maps focused on the economy of the Military Frontier.

During the Seven Years' War (1756–1763), another institution took an important role in the production of military maps. The General Quartermaster's Staff, until then organized only as a wartime body assigned with the tasks of logistics in military campaigns, relied heavily on maps and plans. Due to its immense utility for the defense of the Monarchy, by the end of the Seven Years' War, the General Quartermaster's Staff had become a permanent military mapping institution of the Monarchy with Field Marshal Franz Moritz von Lacy (1725–1801) as a chief of staff. Much like the Corps of Engineers, the General Quartermaster was subordinated to the Aulic War Council.[56] They employed elite mapmakers recently graduated from the Academy of Engineering in Vienna, which enabled a full professionalization of military mapmaking. The transformation of the General Quartermaster's Staff into the mapmaking engine of the Monarchy soon resulted in a great increase of staff officers trained in survey and mapping. In 1757, only a small group of officers had the training in mapping, but by 1766, more than half of the senior officers and 40% of the subalterns received some training in mapmaking. By 1786, 100% of the staff officers had the ability to contribute to the mapping operation.[57] At the same time, the transformation of the General Quartermaster's Staff into the imperial mapping institution allowed members of the corps of engineers to focus more on rebuilding the fortresses.[58]

56 Hubert Zeinar, *Geschichte des österreichischen Generalstabes,* Böchlau, Vienna, 2006, p. 113.

57 Veres, 2015, p. 55.

58 The relationships between the General Quartermaster's Staff and the imperial Corps of Engineers is not clear. Some authors state that the Corps of Engineers were subordinated to the General Quartermaster's Staff.

A series of Austrian military defeats, in the War of the Polish Succession (1733–1738), the Habsburg-Ottoman War (1737–1739), the War of Austrian Succession (1740–1748), including both the Silesian and the Seven Years' War (1756–63) led to the decision on a topographic and cadastral survey of the entire Monarchy, which would finally provide the army with detailed and completely reliable maps. The poor outcome of these wars was namely attributed to the lack of geographical knowledge and the lack of reliable maps. Thus, the new military survey of the empire was meant to provide maps specifically designated for the military's requirements. The First Military Survey of the Habsburg Empire (*Josephinische Landesaufnahme*), together with the cadastral survey (*Ökonomische Landesaufnahme),* were carried out between 1763 and 1787 and were based on the experiences of the 1756–1789 topographical surveys of France, led by Cassini de Thury. Thus, the first military survey did not result only in topographic sheets at a scale 1:28,800 (1 Zoll = 400 Klafters), but also in cadastral maps at a scale of 1:3,600.

For strategic reasons the surveying activities started in the borderlands and only after that moved to the inlands. The survey of the Croatian Military Frontier started in 1774 with the mapping of its central part (*Bannal Grenze*),[59] then extending westward to the Karlovac Generalate, which was surveyed between 1775 and 1777,[60] followed by the Varaždin Generalate (central Croatia),[61] and the Slavonian Generalate (eastern Croatia),[62] surveyed between 1781 and 1782. Simultaneously, a cadastral survey was conducted based on which the first land registers were established, enabling detailed insight into the ownership and land use of the properties. Only two copies of each map were made. Maps compiled by the first military survey were considered strictly confidential and kept as mil-

59 Militär-Charte der Banalgrenze samt denen inclarierten Privatherrschaften, aufgenommen unter der Direktion des Oberwach. von Brady vom Grossen Generalstab. Scale 1:28,000. Manuscript map in 25 sheets. War Archive, Vienna, Map Collection sign. B.IX.a.771.

60 Originalaufnahme der Karlstädter Generalats oder Grenze, bestehend aus dem Liccaner, Oguliner, Otočaner und Szluiner Grenz-Infanterie-Regiments, bearbeitet unter der Direktion des Major, später Oberleutenant Jeney in den Jahren 1775–1777. Manuscript map in 64 sheets. War Archive in Vienna, Map Collection, B-IX-a-786.

61 Militär-Mappa des Warasdiner Generalats. Aufgenommen unter Direktion des Obersleutenant Jeney in den Jahren 1781–1782. Scale 1:28,000. Manuscript map in 26 sheets. War Archive, Vienna, Map Collection, B.IX.a.799.

62 Militär-Mappa des Sclavonischen Generalats, verfasst in Esseg 1782. Scale 1:28,000. Manuscript map in 61 sheets. War Archive, Vienna, Map Collection, B.IX.a.878.

itary secret until 1864. The officers from the General Quartermaster's Staff who directed the survey were assisted by numerous officers stationed in the Military Frontier who spoke the local language and knew the terrain well.

Although the maps of the first military survey of the Habsburg Monarchy did not achieve the excellence of their French role model, those maps provided the army with the first standardized large-scale military maps for the whole Monarchy. The survey was not based on a unique geodetic basis of trigonometric points (each country developed its own triangulation network), but it still enabled a significant mathematical accuracy of maps, which was particularly important for an artillery of improved mobility and specifications that saw the increased use (though maps were not accompanied by a coordinate system nor by height points).[63]

They provided detailed presentation of the terrain configuration presented by hatching, a concise categorization of roads, so important for estimating the movement of the army, an accurate view of the hydrographic network with indicated flood ranges, bridges and possible river crossings, insight into vegetation density and land use, as well as an accurate view of settlement structure (including their capacity in housing the army). Each sheet was accompanied by a military description of the terrain (*Militär Beschreibung*), which contained information important for the movement of military troops and the conducting of operations. All of that finally enabled effective and timely planning of military operations. No less important, maps by the first military survey were used as a base for the production of other military zone maps like those of the regiments and companies as well as thematic maps required locally. That especially refers to the time of the last Habsburg-Ottoman War (1788–1791) when particularly large quantity of thematic military maps appeared (Fig. 10).[64] Those maps were regularly produced by officers stationed and trained locally.

63 Maps were particularly important for the use of artillery, not at the tactical level (because of the problems of mapping height), but, instead, at the operational one, as maps provided indications of where artillery could be transported. Jeremy Black, « A Revolution in Military Cartography?: Europe 1650–1815 », *The Journal of Military History,* 73/1 (2009), pp. 51–52.

64 E.g. Plan der Szluiner Regiments Cordons Strecke welche der Obristlieutenant Baron Bajalich de Bajahacz von Erklaerung des Krieges bis Ende Februari 1789 unbeschaedigter in Vertheitigungs Stand hielt. Scale 1:73,000. 1798. Manuscript in color; 36 x 31.5 cm. National Library Budapest, TK 220.

Fig. 10 A map of the eastern part of the Karlovac Generalate (Slunj Regiment) drafted in 1789 during the Habsburg-Ottoman War (1788–1791). Based on the first military survey it was compiled to show the position of local troops. Scale 1:73,000. (National Library Budapest, TK 220)

The established network of surveyors and draftsmen in the field encouraged the Habsburg military authorities to, after surveying the Monarchy, expand the cartographic work to areas under Ottoman rule, most of all to neighboring Bosnia from where most of the attacks came from. The plan for secret reconnaissance was personally prepared by Field Marshal Lacy. According to his instructions, it was necessary to collect extensive information on geography, economy, culture, politics, and ethnography of the region. Data were to be collected by field observation and by intelligence. In 1777, the General Staff accepted Lacy's proposal and authorized Lieutenant Colonel Mihály Janos Jeney to conduct a field campaign in Bosnia.[65] Jeney was one of the officers who played a leading role in the first military survey of the Monarchy and had a wealth of knowledge and experience.[66] Disguised as merchants, as early as 1778, Jeney and his staff entered Bosnia near Jasenovac, continued along the Una valley to Bihać, and penetrated all the way to Sarajevo, visiting Banja Luka on their way back. During the trip, Jeney and his officers collected abundant intelligence material and made several topographic sketches based on which they compiled several maps.[67]

Marshal Lacy was satisfied with Jeney's initial campaign, so in 1783 he entrusted a further survey of Bosnia to Colonel Zechenter. He travelled to Karlovac, where he was assigned two officers, Major von Held and Captain Schmidt, as well as several other lower officers as support staff. During 1783, they surveyed almost the whole of Bosnia at a scale of 1:115,200.[68] Mapping was done secretly and quickly, while information was collected from informants and monks, mostly

65 Instruktion für der Obstlt. Jeney, entworfen von Feldmarchal Graf von Lacy (1777). War Archive, Vienna, Map Collection, K.VII.m.3.

66 Mihály Janos Jeney (1723/4-1797), a military engineer and cartographer who worked for the General Quartermaster's Staff. He served at least three powerful states, France (1758–1763), Prussia (in the 1760s) and the Habsburg Monarchy. He was born in a Protestant noble family. He participated in the 1737–1739 Habsburg-Ottoman War and in the War of the Austrian Succession (1740–1748). In 1759, Jeney published a tactic manual for conducting irregular operations, Mihály Janos Jeney, *Le Partisan Ou L'art De Faire La Petite-guerre Avec Succès Selon Le Génie De Nos Jours,* H. Constapel, Hague, 1759. After serving for a few years in the Prussian army in the 1760s, he returned to Vienna in 1768, just in time to take a prominent place in the first military survey. He directed the first military survey of inner Austria, Croatia, and Slavonia, as well as Transylvania. Veres, 2015, pp. 94–95.

67 Most of his material is considered lost. Two 1780 maps are preserved in the National Library of Austria, Map Collection, FKB Q.6.4 KAR MAG and AA-XXIV-(2)-369.

68 War Archive, Vienna, Map Collection, K.VII.m.6 – K.VII.m. 14.

the Franciscans. The reconnaissance was not conducted instrumentally but visually (*a la vue*) and the distances were estimated with regard to walking hours. A partial triangulation was carried out only in northern Bosnia, where Captain Maković managed to mark 31 trigonometric points and connect them with the neighboring network established in Croatia.[69] The accompanying military descriptions also resembled those of the first military survey. Special attention was paid to data important for the movement of the army, potential shelters, such as caves and lonely houses, water sources, river crossings, etc. At the same time, a significant progress was made in the surveying of Bosnian towns, especially those of strategic importance. Lieutenant Lidescron drew up a plan of Sarajevo at a scale of 1:7,200, as well as those of Tuzla, Srebrenica, and Višegrad at a scale of 1:5, 300,[70] while the petty officers Golubović and Matuč drew up plans of Travnik and Stolac at a scale of 1:14,400.[71]

Over time, the survey of Bosnia was increasingly left to local officers stationed on the Croatian Military Frontier, so in 1785, further mapping was carried out by the ensign Boxich from the Brod Regiment. He managed to compile no less than 16 topographic sheets at a scale of 1:115,200, as well as plans of several fortifications. The survey was performed by visual observation and a compass.[72] Finally, the last Habsburg-Ottoman War (1788–1791) would provide the officers with an opportunity for a more extensive instrumental survey of entire Bosnia, and, by 1789, the General Quartermaster's Staff collected enough topographic material to compile a complete map of Bosnia at a scale of 1:115,200. Compiled in 12 sheets, this map is in the full sense a continuation of the military map of Croatia, only at a four times reduced scale.[73] The sheets were compiled according

69 Plan von denen jenigen Gebirgen und fixierten Puncten in Königreich Bosnien und türkisch-Croatien, über den Sau Strom welche von der diesseitigen Gemeinden längst der löblichen Gradiskaner und Broder Regimenten. Nummer haben können aufgenommen und figuriert werden. Anno 1783, aufgenommen und gezeichnet durch I. von Makovich, Hptm. Von General Stabb. War Archive, Vienna, Map Collection B.IX.a.945.

70 War Archive, Vienna, Map Collection G.I.h.621-10; G.I.g.727-10, G.I.h.648-10.

71 War Archive, Vienna, Map Collection G.I.h.654-10 and G.I.h.693-10.

72 War Archive, Vienna, Map Collection K.VII.m.20.

73 Militärische Karte jener Bezirke in türkisch-Croatien, welche durch die den 26. August 1788 erfolgte Einnahme der Festung Dinica und der am 3. October 1788 beschehenen Eroberung der Festung Novi durch das k.k. croatische Truppen-Corps in Besitz genommen. War Archive, Vienna, Map Collection B.IX.a.959.

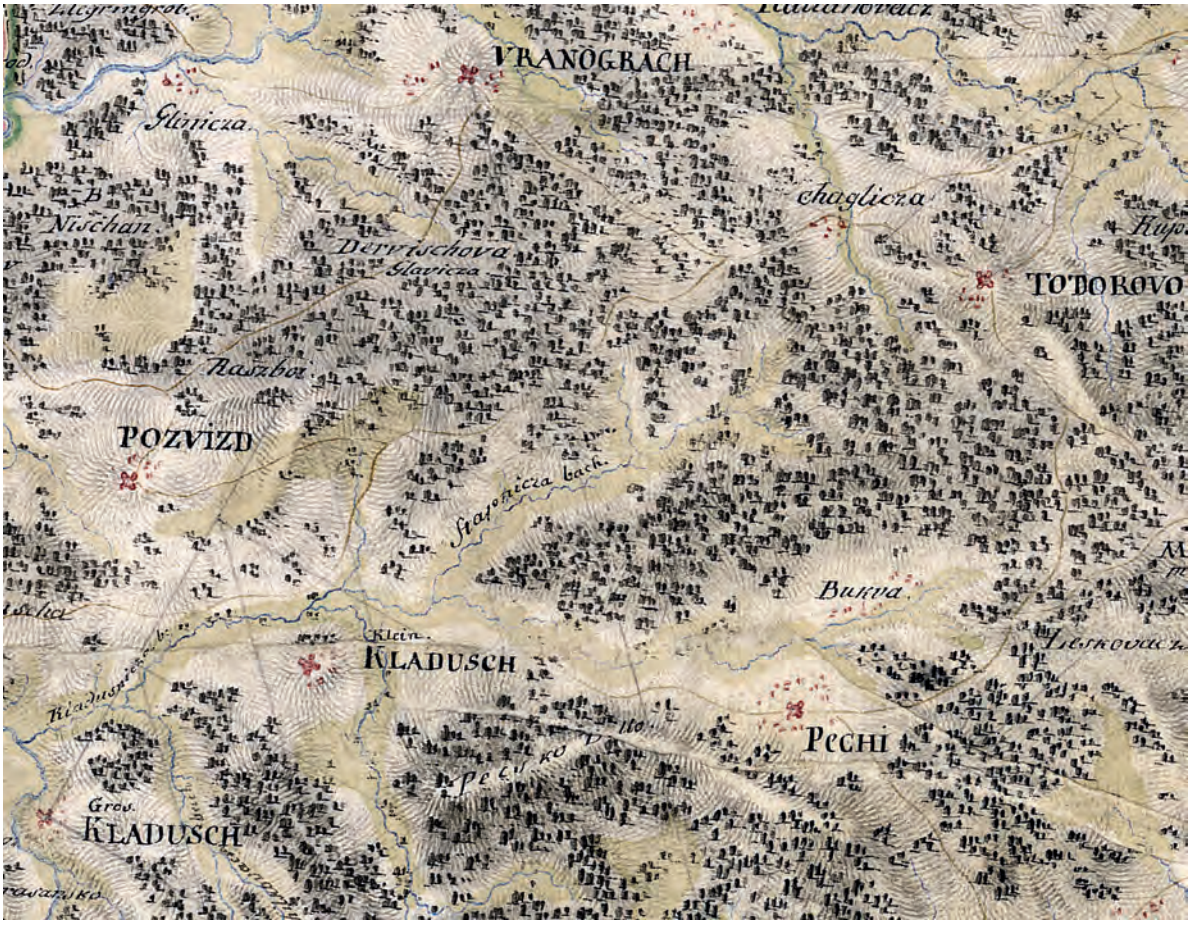

Fig. 11 SW Bosnia on a topographic map compiled based on a secret mapping campaign in 1784. This is a copy from 1794 with new borders established after the Treaty of Sistova. Note the trigonometric network in the back that was drawn in pencil. (War Archive, Vienna, B.IX.c.932)

to the same cartographic key and drawn in the same style as the maps of the first military survey, yet with less accuracy. In 1794, another copy of the same map was compiled that showed the newly established border upon the Peace Treaty of Sistova (1791) that ended the war (Fig.11).[74]

74 Situations-Karte der Kais. Königlich. und Türkish-Croatien Graenze ...welche aus der Veranlassung eines Höchlöblich Kaiser. König. Hofkriegsrath in Jahre 1794 oeconomich augenohmen auch die im grösseren Masstab eingedructe Festungen aus einem Bereisungs

By conducting a secret mapping of Bosnia by the end of the 18th century, the Habsburg military authorities acquired considerable geographic knowledge that was required for the maneuvering of the troops and military planning of the operation in Bosnia. Although directed by the staff of the General Quartermaster, the undercover mapping campaign would not had been possible without a number of officers stationed and trained in the centers of the Croatian Military Frontier who played an important role in the surveying and mapping of the Ottoman territories of interest to the Habsburgs. Ironically, just when they drew up reliable military maps, there were no more wars with the Ottomans. The Habsburgs gained Bosnia without a war by a decision of the Berlin Congress of 1878.

Concluding Remarks

The Habsburg military cartography of the Early Modern Period, developed under the circumstances of the Habsburg-Ottoman Wars, underwent significant changes that were reflected in advance of the quality and quantity of maps, the diversification of map types, as well as in the training of mapmakers and the organization of cartographic work in the field. Despite significant changes that marked the development of Habsburg military cartography from the 16th to the end of the 18th century, its constant was its subordination to the Aulic War Council, which controlled the organization and financing of mapping as well as the education of officers.

The beginning of organized Habsburg military mapping in the area of the Military Border coincides with the period of the Military Revolution, which is usually dated to 1560–1660.[75] In the period of the 16th and the first half of the 17th century, military maps differed from civilian maps mainly in their purpose,

Ideal-Karten unter Direction des Major Boxich… War Archive, Vienna, Map Collection, B.IX.c.932.

75 The term of Military Revolution as defined by Michael Roberts and Geoffrey Parker saw lots of criticism. There is no consent what makes the Military Revolution and how the military change should be periodized. In contrast to Roberts and Parker, Jeremy Black sees the truly revolutionary changes in European military affairs occurring only during the decades after 1660. Moreover, Black suggests that it was the development of the State that allowed the growth in size of the armies, not the other way around. Yet, most of the scholars agree that changes that took places in the 17th century were made possible by innovations in the organization of the army and techniques of the warfare that occurred in the 16th century.

while their content and symbolization largely coincided. However, even in the early period of military cartography, maps intended for military needs contain more data (including confidential ones) and are generally based on recent field observations (as opposed to civilian maps where this is an exception).

A more significant profiling of military cartography begins with the professionalization of mapmaking. As long as maps were made by architects and engineers under contract, the line between military and general cartography was very elusive. From the mid-17th century, when cartographic works were taken over by military topographers and field-engineers from the ranks of military officers in permanent service (in contrast to contracted military engineers in charge of fortifications), military maps receive more distinctive features. Yet, due to the lack of trained staff, their production is still limited to siege plans (*Belagerungs Plan*), war theatre maps (*Schauplatz Karte*), operation (*Operationen Karte*), position (*Positionskarte*) and dislocation maps (*Dislokation Karte, Marschroute Karte*).

The full professionalization of Habsburg military cartography began in the early 18th century when the central authorities established the Royal Technical Military Academy for the purpose of educating officers. Technical and military education of officers particularly encouraged map culture whose growth was part of the intellectual shift in which information, rather than received wisdom, had greater prevalence in military planning. Technical education and scientific methods entailed not only the concern of generals with artillery and sieges, but also the use of scientific knowledge at the operational level, with the need to plan foraging and marches requiring an understanding of agronomy, surveying, celestial navigation, botany, and forestry.[76]

No less important, these processes were accompanied by the development of local educational centers, especially in the headquarters of the generalates and regiments of the Military Border, which became an important generator of officers, including those with training in survey and cartography. Due to the increasing needs for large-scale zone maps, the Military Frontier soon became a large cartographic laboratory where mapmaking was trained and practiced in the field.

76 Erik A. Lund, *War for the Every Day: Generals, Knowledge, and Warfare in Early Modern Europe, 1680-1740,* Connecticut, Westport, 1999 and Erik A. Lund, « The Generation of 1683: The Scientific Revolution and Generalship in the Habsburg Army 1687–1723 », in Brian Davies (ed.), *Warfare in Eastern Europe, 1580–1800*, Brill, Leiden, 2012, pp. 200–211.

It is also a time when international conventions in military cartography in regard of topography and symbolization become more distinctive, emphasizing normative, rather than simply functional mapping.[77]

The relationship between war and cartography can thus be traced to developing consciousness about planning, with warfare providing instances of using information for both policy prescription, in the shape of planning, and policy discussion. Military technology and practice were thus influenced by a larger economy of knowledge, which expanded considerably, helped by the diffusion of information through the culture of print. Locational skills were important to the staff-planning that was at an increased premium, for example with the Austrian army during the Turkish War in 1737–1739.

Another important impetus appeared in 1747 with the establishment of the imperial Genie Corps and with the permanence of the General Quartermaster's Staff (1758), which together become the main engine for the production of all maps needed for military operations. Their activities lead to a significant increase in the quantity and quality of maps as to their standardization with more distinctive symbolization. Also, due to the centralization of the state and a strong connection between the financial and the military issues of the Monarchy in the time of Maria Theresa and Joseph II, the military cartography of the late 18th century had a significant impact on financial and tax reforms throughout the empire. Thus, in addition to standard operational and zone maps intended for warfare, an important quantity of maps that appeared within military cartography refers to military topographic maps (the first military survey), cadastral plans (the first economic survey), as well as to increasingly diverse thematic maps related to the issues of economic sustainability of the countries, especially their borderlands (forest maps, pasture maps, sanitary cordon maps, etc.). This kind of militarization of cartography was not a process limited to the Habsburg Monarchy, but was a direct result of a rising interest in maps as planning tools among military officers at a global scale.

77 Black, 2009, pp. 49–50.

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