

THE DISCOVERY OF THE DANUBE

INTRODUCTORY THOUGHTS AND ACKNOWLEDGEMENTS

I was the first to shed light on this distant and secret world hidden in barbarian obscurity – stated Luigi Ferdinando Marsigli proudly in the foreword to the *Danubius Pannonico-Mysicus* (1726). He was referring to Hungary. This was the same Hungary that was the battleground for the battles between Christian Europe and the Islamic East from the 14th century until the end of the 17th century. And while engaged in this deadly struggle, people perished and the villages and the towns that survived the torments of campaigns in the shelter of the castles became poverty-stricken. The waters and meadows went wild and, through neglect, became swampy. In this state, they often served in the defence of towns and castles. When the Turkish forces were ultimately expelled, Hungary, in the heart of Europe, awaited an explorer who would re-discover the ethnographic, geographic and natural conditions prevailing there. This explorer arrived in 1683 in the person of Marsigli when the Turkish army advanced for the last time during the siege of Vienna.

Marsigli (1658 – 1730) was born and educated to become a mature scientist, diplomat and soldier in an exciting century of flourishing science. This was a world which saw the genesis of the modern history of our continent: it combined the theocentric ideas of the medieval world, the Renaissance with its revival of the classical past and values and the age of Newton, delighting in the ecstasy of new scientific theories. He had close links with the Catholic Church, yet he studied, drew and collected pagan Roman relics with zeal and sought an explanation for every phenomenon in the world surrounding him with the rational thirst of an enlightened man. He was never lost in details but aimed at understanding the broader connections between phenomena. He thought structurally. He produced valuable studies in the branches of science where his education and knowledge were only sufficient to achieve an impression of the essence of the problem. In such cases, with unerring instinct, he lost no time in turning to specialists who could help him. He knew, for instance, little about mineralogy and mines, yet he enriched science with details that should not be neglected in any study on the history of mining. The same is true for cartography. Wherever he happened to be, he made notes, sketches, drafts of the scenery. He measured altitude above sea level with a barometer, and determined the location of places with a portable quadrant. He was the first western cartographer who followed the meanders of the Danube with a compass and had Johann Christoph Müller, the talented drawer of his maps from Nürnberg, check the results. If problems occurred during the observations, he asked for help from his parental friend Gian Domenico Cassini, or the Frenchman Jean Dominique Cassini, living in Bologna or Georg Christoph Eimmart in Nürnberg. And when he researched the history of the peoples of the Carpathian Basin and the natural and economic conditions of the region and found his knowledge lacking, he relied on the collaboration and specific studies of scholars living in the Hungarian Kingdom. Furthermore, his intuitive intellect permitted him to become the founder of several branches of science such as oceanography, alkaloid chemistry, hydrography, limes-research and meteorology.

The broad sweep of his interests was characteristic of how sensitive his brain was to problems: the secrets of the abyss of the earth and the sea, the mysteries of cartography and astronomy, the surviving remnants of ancient cultures, the structure of animal organisms – he dissected them, - the composition of waters, the connection between swamps and rivers, the healing properties of thermal springs, the genesis of rocks, the genealogy of famous families in the Balkans – among them the Zrínyis and families who became Moslem, – and scientific collaboration between European academies, which he first suggested in his speech at the

meeting of the Royal Society. This list is far from being complete. The mission of the *Istituto delle Scienze* (1714) - Scientific Academy – that Marsigli established revealed his intellectual openness: BONONIENSE SCIENTIARUM ET ARTIUM INSTITUTUM AD PUBLICUM TOTIUS ORBIS USUM, which is expressed in the foundation deed as follows: *The university is open to any student from this or any other state irrespective of descent and nationality.*¹ The Academies of Paris, London and Montpellier acknowledged his scientific activity by electing him to be one of their members.

The presentation of the whole richness of his life and *oeuvre* is beyond the scope of the present work. I will confined my endeavour to the events I found significant with regard to the Danube monograph, which is the focus of the present study. This aspect was respected concerning his biography as well. And since science has hardly ever dealt with the mysteries of the origin of the book and the adventurous fate of the text and the figures in it, this book purposes to fill in this gap, primarily with facts gleaned from archives.

I would like to express my gratitude to the following institutions and people: The Hungarian Museum of Environment Protection and Water Affairs, the Office of the National Scientific Research Fund, the National Technical Development Committee and the Ministry of Education for their support, to Lajos Bartha, Anita McConnell, Marta Cavazza, Franco Farinelli, Professor Zoltán Kádár and John Soye, who helped me with their articles and in personal discussions. In addition, I owe thanks to the scientists who evaluated my grant project and to the helpful assistants at the Marsigli Archives in Bologna, especially Gertrude Rapalli, *Maruska*, a great admirer of Marsigli, who offered me a home and her help during my studies there.

I. ON THE ROAD TO THE DANUBIUS

BONONIA DOCET – BOLOGNA TEACHES

Bologna, Marsigli's native town, the *mater studiorum*, was, and perhaps always has been, one of Italy's richest towns. Its favourable geographic setting largely contributed to its wealth: the town was founded on the banks of the Reno, at the meeting point of ancient trade routes running from north to south and from east to west. The Asinelli and the Garisenda families demonstrated their power and richness in the Middle Ages by the construction of huge towers, which became the focal points in the town's appearance and the symbols of the settlement. In the shadow of these symbols of power, a spiritual tower, the first *universitas*² in the world, the Archiginnasio³ was established to the admiration of the whole of Europe.

This was the town where Marsigli was born, the son of a count, on July 20, 1658. His father Carlo Marsigli and his mother Margarita Ercolani paid great attention to his intellectual education. The talented Marsigli studied first in his native town, then in Padua and finally in Rome. Officially, he was not a university student but pursued his studies privately.⁴ His connections with the scientific circles of Bologna – in addition to the academic legacy that he inherited from his birthplace - played a significant role in his intellectual development. Many private scientific academies were established in Bologna in the years of 1659 and on, and were soon replaced by others. Scientific men,

¹ *Instrumentum donationis.*

² It was founded in 1087. Its effect on culture and the development of consciousness could be felt over the whole of Europe. Following its example, universities were founded one after the other in Europe: 1170 Oxford, 1200 Paris, 1222 Padua, 1257 Sorbonne, 1233 Montpellier and Orleans, 1303 Rome, 1321 Florence, 1343 Pisa, 1347 Prague, 1357 Sienna, 1364 Vienna, 1388 Köln, 1409 Leipzig.

³ Several Hungarians studied within its walls.

⁴ John Soye: Marsigli's Europe. New Haven and London 1994. 8.

students of Science and those who were interested in science in general gathered around talented organizers. That's how the Accademia della Traccia, the Accademia del Davia, the Accademia dell'Archiginnasio and the Accademia degli Inquieti got established. Marsigli's favourite tutors are among the members of the last three Academies!⁵ He was to maintain personal contact with his highly esteemed professors to the end. They sent their didactic letters after him even into the fields of battle. This was a real correspondence course. Marsigli turned to them with great confidence when confronted with scientific problems and they gave the best of their knowledge in their replies.⁶ The former student was primarily interested in the natural sciences. His unrelenting love of learning was to help him become a renowned scientist. However, he not only found the cultivation of science important. Marsigli made a special point of encouraging the propagation and teaching of science. The observatory in Bologna and the university library, of which he was very proud, were established as the result of his initiatives. In 1709, he proposed that physics and chemistry should be introduced into the curriculum of the University of Bologna, emphasising the close connection between the two sciences.⁷ He urged the teaching of law, physics, botany, mathematics, secular history and eastern languages besides traditional religious subjects.⁸

A STUDY TRIP THAT ENDED IN A MILITARY CAREER

In 1677 his mother died and he began his wanderings in the world at the age of 19. He had earlier been to Venice and Padua with his father.⁹ This time, however, he left without him. First, he went to Rome to Cardinal Alfonso Ercolani his uncle. Then he proceeded to Naples, in the company of others as protection against highwaymen, to see the world. Walking on the slopes of Mount Vesuvius, the volcano that belched forth secrets from the depths of the earth, the hot sulphuric steams and gases captivated his fantasy. He recalled these memories 20-25 years later when he found sulphuric springs during his journeys in north Hungary and Transylvania. He observed similar phenomena in upper northern Hungary as well. *It is not only the Kingdom of Naples who can boast of such miraculous issues of nature, he wrote in his Danubius, the same can also be found in Hungary and Transylvania.*¹⁰ In Naples, he met an English trader, from whom he learned about the ruthless competition between western countries for markets and about Istanbul, one of the centres of Mediterranean commerce.¹¹ Homeward bound, he visited Magliabecchi the famous librarian in Florence. From there he went to Pisa, then to Livorno where he met Count R. Montecuccoli's son, whose father played a well-known role in Hungarian history.¹²

On July 22, 1679, he was given the chance to visit the capital of Turkey as a member

⁵ Accademia delle Scienze dello Istituto di Bologna... Bologna, 1881; Marta Cavazza: Settecento inquieto... Il Mulino, 1990; Marta Cavazza: La „Casa di Salomone” realizzata? (I materiali dell' Istituto delle Scienze. Accademia delle Scienze, 1979.

⁶ These tutors included G. Lancisi from Rome and L. Trionfetti, M. Malpighi, Montanari, and Borelli from Bologna in the field of botany. Cassini also came from Bologna, and he respected him as his paternal friend. Geminiari, mathematician and astronomer for the University of Rome, was his instructor in 1677 and taught him about cartography and locating places through astronomic observation.

⁷ Without a perfect knowledge of chemistry, he said in his proposal, nobody can become a perfect experimenting physicist. Without a perfect knowledge of chemistry, he said in his proposal, nobody can become a perfect experimental physicist. Yet, these are the sciences, which can most dynamically increase increase our knowledge of nature. So, if the university of Bologna wishes to keep pace with the universities of Europe, he emphasized, these two sciences cannot be omitted from the list of taught subjects.

⁸ Archivio di Stato. Assunteria di studio. Diversorum B. 10 n. 100. Tomo 10. Parallelo tra le Universita di Bologna e le oltramontane 1709.

⁹ Autobiographia di Luigi Ferdinando Marsili, ed. Emilio Lovarini (Bologna, 1930).

¹⁰ Danubius Pannonico-Mysicus Vol. I. Pars III.

¹¹ Autobiographia : p. 4. and Allgemeiner Discurs über den Traffico, 1699. Vien ÖStA HRK Akten 1701 BLG Júli/42, 10. Relation.

¹² Montecuccoli, Raimund (1609-1680). He was a military leader and author of military studies.

of a Venetian delegation. He carried instruments in his luggage designed to make natural scientific observations including: a thermometer, a hydrostatic balance (to measure the specific gravity differences between water samples) and a microscope (to study plants and seeds). In Constantinople he learned Turkish from an interpreter called Abraham Gabai, made the acquaintance of Turkish scribes and scholars and started to collect Turkish manuscripts and maps.¹³ He studied the sea currents in the Bosphorus,¹⁴ and the specifics of Turkish governmental and military mechanisms. During an excursion to Bursa, he was amazed by the monuments and the architectural masterpieces that reflected the power of ancient Sultans. He came to the conclusion that the Ottoman empire was on the decline. He obtained an extremely important piece of information that was to determine his fate as well - the Sultan was preparing another campaign against Hungary.

A year later, the members of the delegation left for home on a ship. On the 22nd of August, 1680 Marsigli and two of his companions started out on the long road on horseback to see more of the world. They followed the same road across the Balkans that the Turkish army used when they marched against Hungary (Istanbul – Edirne – Plovdiv – Sofia – Nis – Belgrade). He planned to follow the Danube to Buda and further on to Vienna. The plague epidemic, however, forced him to make a detour: having left Belgrade, they turned towards Sarajevo, first along the Sava and then the Drina river, the boundary river between Bosnia and Serbia. After crossing the Dinaric Alps, they arrived at the harbour of Spalato (Split).¹⁵ On his way he took notes, marking the remains of Roman roads and architectural monuments as well as the specific ethnic, political and economic conditions existing at that time in the Balkans. His sensitivity to the problems of the region developed during this journey. He enriched his knowledge about the past of the people and the economic and geographical settings of this region from maps and books during the war and the subsequent frontier demarcation. No one else in the Austrian military and political elite would have been as familiar with this region as he was. He and later also Emperor Leopold I, profited from this knowledge on the occasion of the establishment of the borders following the conclusion of the peace treaty at Karlóca (1699), and when he wrote his study on commercial possibilities in the Balkans and Turkey.¹⁶ The knowledge he had accumulated at that time served as the basis for his book, *Monarchia Hungarica...* The manuscript of this book has survived¹⁷ as have the maps it contained.¹⁸

By the end of the journey to Constantinople and his adventures there, it had become clear to him that he was not destined to lead the peaceful life of a public officer, which would normally have awaited him as a count's son. He determined to improve his knowledge of military science and go into the army. He studied mathematics and astronomy, first in Bologna¹⁹ and then in Padua as well as anatomy and practical medicine²⁰.

In 1682, the 24 year-old Marsigli travelled to Vienna through Switzerland and Germany and joined Leopold I's army. He began his service in the cavalry troop of General

¹³ John Stoye: Marsigli's Europe. New Haven and London 1994. 18.

¹⁴ His first publication concerned the Bosphorus: Osservazioni intorno al Bosforo Tracio. Roma, 1681. It was re-edited: Bollettino di pesca, di piscicoltura e di idrobiologia, Ano XI (5) 1935, 734-758. His interest in the marine world never ceased. M. Longhena: L. F. Marsili e le sue osservazioni sul mare Adriatico. Bologna, 1926; Histoire phisique de la mer (It was re-edited and translated into English by Anita McConnell, Bologna, 1999).

¹⁵ He boarded a ship in Spalato.

¹⁶ See note 11.

¹⁷ BUB (Biblioteca Universitaria, Bologna) Mss di Marsigli, Vol. 28. *Monarchia* refers to the Kingdom of Hungary. This how Marsigli consequently would refer to Hungary.

¹⁸ He commissioned J.C. Müller to draw the maps of the Balkan states between 1702 and 1703– Bulgaria, Serbia, Bosnia, Herzegovina, Croatia and Slavonia. They can be found attached to the front of the manuscript volume.

¹⁹ from Geminiano Montanari

²⁰ from Pighi and Malpighi

Enea Caprara in Hungary.

HUNGARY, 1683

Geographical and natural setting

The *Danube* was the *salus Imperii*, guardian of the empire for the Romans who ruled strongly in the Carpathian Basin from the AD 1st - 4th centuries. The *limes*, reinforced by military watchtowers and garrisons, was developed along its banks, and the province of Pannonia, through which important military and commercial roads ran, flourished behind its shield. They built the first permanent bridge on the Lower Danube and the public road carved into the rocks of the Kazan straights, achievements that Marsigli inspected with admiration. The memory of their presence in Pannonia has been preserved in the remains of aqueducts, the foundations of military forts, dams at the mouths' of valleys, paved roads, tombstones, inscription fragments carved into stone, relief and statue remains, which Marsigli also encountered, and which he looked for, collected and described with great zeal in the second volume of his Danube monograph.

The Danube, however, often became a *gateway for destruction*. It offered passageway to hostile armies from the direction of Vienna as well as from the Balkans. Emperor Henry III's fleet reached the heart of the country without hindrance (1052) and the Danube was the umbilical cord for the Turkish army attacking from the south. The battle of Mohács, which sealed the fate of the country in 1526, was also fought by the Danube, with the victorious conquerors following the river up to Buda. The Danube also played an important role 150 years later during the liberation campaign (1683-1699), in which Marsigli also took part. Marsigli, as a military engineer, was often charged with the task of building bridges over the river and its swamps. It was possible to transport provisions nearly exclusively on the river. The terrestrial roads of Hungary along the rivers and in the Hungarian Plain were not secure. It is enough to glance at the map of Hungary prior to river regulation to see that the armies had to march on damaged roads through territories regularly devastated by floods. *When a ship sinks, you are still able to swim in the water. But here there are tussocks that pull you down, the water is full of sedge and bulrush, and you will be lost together with your horse ...*, wrote a Saxon mercenary about the roads through the Hungarian Plain when he marched with the army toward Szeged and Zenta at the heels of the Turks after the reoccupation of Buda. He continued: *It is September, it is raining, wild shrubs, waterlogged meadows and water full of bulrushes flank the road. For days and days nothing but water and water. And of course you can die of thirst just like shipwrecked people. Because drinking water means death. The water smells bad and, naturally, there are no wells anywhere. Because there are no villages. And if you find a well, you can be sure that one or two corpses are rotting in it... The baggage was brought after us on eight-oxen carts, but they were trapped in the mud.*²¹ So, until the middle of the 19th century, boats were the main means of transportation. Salt and timber from Transylvania, wheat from the Backa were usually transported to Buda and Vienna on boats pulled by people. The herds of the plains and floodplains of the Hungarian Plain were brought on the hoof to markets in Buda, Vienna, Nürnberg or even Venice.

Political atmosphere in a country torn in three

A tense and complex social-political atmosphere confronted Marsigli in Hungary. He must have been disappointed, thinking that the Hungarians who had suffered 150 years of Turkish oppression would receive him, a

²¹ Rüdiger Hitzkopf szász zsoldoskatona magakáromlása. (The self-slander of Saxon mercenaries) Balázs Lengyel: A török Magyarországon (The Turks in Hungary), Móra Ferenc Könyvkiadó, Budapest, 1971. 149.

volunteer in the service of the Austrian emperor, as a liberator. The Hapsburg presence, however, was not wanted in Hungary anymore than that of the Turks. The country, as it was said at that time, struggled *between two pagans*. Marsigli certainly felt the tension the moment he arrived in the country, the tension that finally burst out in the war of liberation led by Prince Ferenc Rákóczi II soon after the Turkish war (1703-1711).

The embers of resistance had long been glowing beneath the cinders. About ten years before Marsigli arrived in Hungary, his own patron Leopold I had Nádasdy, Zrinyi and Frangepán, Hungarian aristocrats who had rebelled against him, beheaded (1669) and suspended the Hungarian constitution. The emperor planned the division of Hungary, its annexation to the hereditary provinces and changed the composition of the population by resettlement. Many people hid and fled to Transylvania in fear of this reign of terror. The poor *kuruts*, who had gone into hiding, gathered under the banners of Thököly, a Transylvanian prince. In 1683, they advanced up to Bratislava towards Vienna as allies of the Turks (!).

The hopes of liberation from the Hapsburg rule, however, dissipated when the united Christian troops smashed the High Vizier Kara Mustafa's army of a hundred and fifty thousand warriors below Vienna (1683).

After this victory, many people thought that the Turks could soon be forced out of Hungary. The country, already with a long history of suffering, became a battlefield for 16 more years. Entire counties emptied of people. Resettlement following the war and the settlements that still bear Slovakian, German and Serbian names attest to the mass devastation of the Hungarian population.²² An act decreeing that the country where the military campaigns took place had to cater for the army, deepened the privations of the people. In the name of this act, soldiers felt justified in their looting and pillage. It was the marching mercenary troops that caused the depopulation of the region along the Danube between Vienna and Buda. A German mercenary drew a shocking picture of the country in the autumn of 1686: *"Mercenaries, Tartarians, Turks, the Kuruts and German taxmen have been turning this wretched country inside out, year by year, for gold, silver or any kind of goods, so that it is easier to find a needle in a haystack here than gold. Easier, because there is no gold... This is not a country but a cemetery, a place of beasts of the night. And Hungarians are not people. I myself saw a peasant, who preferred to be burnt to death rather than give up his little wheat from the pit. We found the pit when we wanted to bury him, lest there would be any trouble. Is this a human being? And woe to you, if you go astray from your troop or if you are found alone. You will be felled by a hoe or a spade, or your feet will be cut by a sickle."*²³

IN A SOLDIER'S GREATCOAT

The slave

Marsigli's military career abounded in dramatic turns right from the beginning. He started his true military activity as a junior officer in Kristóf Batthyány's unit in Győr under Hungarian officers. Their task was to strengthen the castle of Győr and the line of the Rába river against the approaching Turkish army. Marsigli inspected the defence system of Győr, suggested modifications and made sketches, which first came into Caprara's hands and then into the possession of Lajos of Baden, the commander-in-chief. His suggestions were favourably received by the commander. Next, he was ordered to inspect the Rába, Rábca and Hanság region and propose how to defend it. He surveyed the territory and drafted maps of the swamps or waterlogged areas and the dry formations. By the time Lajos of Baden arrived in Győr to discuss the defence of the territory supervised by Pál Esterházy, he had finished his maps and took part in the conference which dealt with

²² *Poor Hungarian people, / When will you recover, / You've been broken like a pot* – complains a hiding *kurut* in his poem (Detail from a Rákóczi-song from after the failure of Rákóczi's war of liberation in 1711).

²³ See note 21

questions of defence.²⁴

The advance units of the Turkish army comprising 150,000 soldiers, reached the Rába in the summer of 1683. On the night of June 2, Marsigli was sent out on a reconnaissance mission at the head of a small company. The Turks discovered and encircled them. He fled across the swamps and nearly died. It was the first time that the swamps, which he often encountered and struggled with later as a military surveyor, revealed their deadly power to him. “*While you are looking for the right path, you find yourself entrapped by water and you can get out only at the risk of your life*” – he wrote later in his book.²⁵ The officer, wounded by arrows, was captured by the Turks, but “by Allah’s inspiration” they granted him his life. *Frederico* – he passed himself off as the servant of a Dutch tradesman – was deprived of his clothes and was clad in shabby, louse-ridden rags. The Turks tried to stop his wounds from bleeding with heated stones and salt. As he had lost strength, he was tied up and put on a lead horse, then he was sold in the camp to Pasha Ahmed of Temesvár for 17 thalers. He arrived below Vienna with the Turkish army as a *slave*. Later, in one of his drawings, he depicted the scene as they crossed a river, probably the Rába: the mounted soldiers on their horses, and those who could not swim on makeshift rafts made from bundles of sticks. It is shocking to see the mass of slaves tied with ropes awaiting the crossing. Marsigli indicated his place among them. In his new role, he had to clean the public café tents and he learned the art of Turkish coffee making and the custom of coffee drinking. Later, he wrote a book about it²⁶, which largely contributed to the acceptance of coffee in Europe. During this period, he made the acquaintance of two Bosnian tradesmen, who were not opposed to the slave-trade and who later played an important role in his fate. Thanks to his journey to Constantinople in 1680, he could make himself understood, something that proved especially useful when he was sentenced to death after an unsuccessful escape attempt. One day he was taken to carry wood together with some other slaves. It was also an occasion to have a glimpse of life in a Turkish camp. He saw many 15-16 year old slaves as well. At night, he freed himself from his chains and tried to run away through the sleeping Turks. They noticed him and took him to his master who had him flogged, chained and gave orders to execute him the next day. In the morning, the two Bosnians heard what had happened, hastened to the pasha and bought him for 24 thalers with the intention of selling him to the owner of a *serai* in Bosnia for 100 Venetian gold coins. Marsigli told them that he would be worth 200 thalers to them if he could send a letter to the Venetian envoy. The Bosnians accepted his suggestion, but further difficulties yet awaited him. He fled with the Turkish army from below the walls of Vienna barefoot, bound to the stirrups of the horse of his new masters. When he could no longer walk, he was thrown on a lead horse. They arrived beneath Pannonhalma hungry and thirsty, fleeing the Christian army, where his masters stole grapes. Here a courier reported to Kara Mustafa that the pursuers had reached the Rába. The high vizier ordered the slaughter of the slaves so that they would not hamper his flight. However, hopes of a high ransom rescued Marsigli’s life once again. At Esztergom, the fleeing Turkish army calmed down and their small group dropped back from the troops, partly because Marsigli could not keep up with them. He was exhausted when they arrived in Buda. After a short stay they travelled on towards Bosnia. The planned slave-trade failed in Sarajevo, so his masters took him to their smoky hut three days’ walk from there on the Rama river, which was already occupied by their two brothers, their wives and children. He awaited a better fate in chains, pestered by lice. His kidneys stopped functioning. A Franciscan monk visited him and took care of his physical and spiritual needs. When he recovered, he was

²⁴ BUB Mss di Marsigli, Vol. 50, 27 (La difesa che disposi sul fiume Raab l'anno 1683 contro l'invasione de' Tartari); Vol. 53, c. 109-129 (Mia spedizione per la difesa del fiume Rab 1683); Vol. 53. 145-204 (Progetto originale per fortificare il fiume Rab, e qui sono annessi in ultimo gli ordini datami e lettere ricevute e da me scritte originalmente sopra l'istessa materia).

²⁵ Danubius Pannonico-Mysicus Vol. I. Pars I.

²⁶ Bevanda Asiatica...Vienna, 1685.

forced to pen another letter, in which his owners demanded 300 pieces of Venetian gold as well as goods equivalent to 100 pieces of gold for him. Marsigli addressed his letter to his friends in Venice and Bologna. A favourable answer arrived and the castle of Dovaria was specified for the scene of the exchange. The Turkish castellan, however, threatened them with arrest. So they fled back to their hut. One day, a Turk arrived in worn clothing with another suggestion of how to carry out the exchange, and this time it ended in success. After the bargain was struck, they embraced Marsigli and organised a farewell dinner for him.²⁷ He was given a horse, and left the house at night in the company of the Turk who had acted as an intermediary. They reached safety after a two nights' ride to the house of a gentleman called Marco Bassi. From here, he was led to the Franciscan monastery, where he could finally take a bath and put on fresh clothes. He spent the Easter holidays in Split in the beach house of Antonio Mozato, a tradesman, whose friendship he had won on the way to Constantinople in 1679. Here, he boarded a ship, which sailed into the harbour of Venice four days later.²⁸

During the journey, Marsigli the slave had become *goods* of an increasingly precious kind, and not only to his masters. He gathered important data about the internal problems and military plans of the Turkish camp and, while they paused beneath Buda, he used the sap of a plant to make a sketch of the Turkish defensive system, which was used three years later in the successful siege of Buda. At Eszék, he also used the sap of a plant to mark down militarily important details. Further along in the Balkans, he studied the road, transport and trading conditions in Bosnia, which were included in his study on commerce in 1699.

Marsigli's chains are exhibited in the Museo Archeologico in Bologna.²⁹

The military engineer

After his liberation he spent three weeks in Venice and then went on to Ferrara. From there he travelled to Loreto, Florence and finally home to Bologna. On learning that an assassination was planned against him,³⁰ he left the town in haste and travelled to Linz through Innsbruck, where he was received by Emperor Leopold himself. Then, he once again entered the army, and was ordered to join Count Stahremberg's army, who met him with the exclamation: *Here is the man who has barely won back his freedom and is already ready to fight!* And in fact, Marsigli put all his heart into the fight as a true soldier. He made plans, siege plans, during the campaigns or analysed events. He was interested even in those battles that he had not seen. At the time when Esztergom was recaptured (autumn of 1683), he was being carried as a slave toward Eszék, yet during the first winter pause after his liberation following the unsuccessful siege of Buda, he translated a Turkish report about the events that occurred below Vienna, at Párkány and at Esztergom in 1683. I emphasise the latter since it sheds light on an episode that has been considered a mystery up to the present. Tens of

²⁷ In 1699, Marsigli found his former slave-owners during the demarcation of the frontier. They appeared before him impoverished and broken.

²⁸ For more details see: Gróf László: Marsigli gróf élete (The life of Count Marsigli) I. Cartographica Hungarica no. 2, October, 1992.

²⁹ The inscription under the chain goes: Quas conspicis catenas / Aloisius Ferdinandus Marsilius / Dux exercitus caes. Adversus, turcas, / Bello sauciatus captus / Binis ferme annis in servitute conpeditus / Libertate recuperata / Magnae Virgini Dei Parenti Designatae / In sacrario instituti huiusce a se conditi donavit / Illoque diruto heic asservandas curavimus – which means: , Luigi Ferdinando Marsigli, officer of the imperial army fighting against the Turks, wore the chains you can see here during the nearly two years he was held as a slave after being wounded in the war and captured. Having regained his liberty, he donated them to the shrine dedicated to God's mother, the Virgin Mary, which he had founded. And when the shrine was demolished we took care that these chains should be preserved here.

³⁰ He was sitting at the barber's when a monk came to him with the news that somebody had "given the order to kill Marsigli for 100 double thalers". Gróf László: Marsigli gróf élete (The life of Count Marsigli) II. Cartographica Hungarica no. 3. May, 1993.

thousands of Turks drowned in the Danube when they fled the Párkány battle to the castle of Esztergom across a pontoon bridge, which broke in the middle. Hungarian historiography has held that it was hit by one of Sobieski's canons. The Turkish source translated by Marsigli reported, however, that the Turks themselves had destroyed it. The correct decision would have been, said the Turkish reporter, if after the first successful attack *they had retreated to Esztergom across the bridge and had burned up the planks of Párkány. Instead, the bridge on the Danube was cut into two on the mistaken order of Pasha Kara Muhamed.*³¹

At that time, and until 1686, the Turks ruled Buda. The significance of the recaptured town of Esztergom increased. In the spring of 1685, Marsigli was sent into the castle of Esztergom to inspect the defences of the castle and to carry out the necessary fortification work. The Austrian military leaders were afraid that the Turks sitting in Buda would lay siege to Esztergom while the allied troops were advancing against Érsekújvár, according to plan, which later proved to be true. So Marsigli, as a military engineer, inspected Esztergom and took steps to make up for the deficiencies. He had walls constructed to protect the soldiers from the cannons of the enemy, ramparts raised to provide shelter, settle artillery, and even insisted on building a baker's oven and improving provisions, because, as he described in his report, *a great misery ruled in this place.* He ordered the castellan to construct latrines, because *unimaginable dirt and ill smells gather on the slopes of the castle hill.*³²

While the allied troops gathered at Párkány on the other side of the Danube to recapture Érsekújvár, in his mission as a military engineer, he inspected the nearby castle of Visegrád and then crossed the river at Esztergom and joined the troops that surrounded Érsekújvár. As expected, the Turks advanced from Buda against Esztergom as soon as word of the siege came to them. Sobiesky,³³ leaving just enough forces behind to maintain the blockade, crossed the Danube at Komárom and hastened to the aid of Esztergom against the Turkish threat. Coronelli³⁴ recorded the daily events of the battle and the movements of the troops on a map.³⁵

Marsigli directed the construction of bridges at fords and the building of ramparts during sieges. He had a cannon stand built from sand bags on the bank of the Nitra river, and then, preparing for the siege, gathered 1500 people to raise a bulwark in three nights. During the attack, he was among the first to break into the castle when a stone flake hit his face. Losing consciousness, he fell into the moat. He was nursed back to health, first in Vienna and then in Sopron. It was probably during this period that he met Samuel Rohfrey who became one of his informants on Hungarian history.³⁶ During his recuperation he had sufficient time to deal with the plans for his next major task, the occupation of the Buda castle. In the spring, he was able to present a thoroughly worked out siege plan to Karl von Lotharingen. He joined the army that moved through Komárom, Esztergom, Visegrád and Szentendre to retake Buda. Marsigli, who assiduously drew maps and took notes on his journeys, observed at Vác that the Danube did not flow in the direction indicated on earlier maps but took a definite turn from the north to the south.³⁷

During the siege of Buda, he directed the

³¹ BUB Mss di Marsigli Vol. 57. Manuscritti diversi. Vol. VII. 38. Relazione dell'assedio di Vienna, fedelmente dall'idioma Turco tradotta in Italiano dal Conte Marsigli, pp. 407-446.

³² BUB Mss di Marsigli Vol. 53. Manuscritti diversi. Vol. III. letter no. 43.

³³ Jan Sobiesky, Polish king (1674-1696) gloriously defeated the Turks at Kochin in 1673 and at Lemberg in 1675. His reputation as a defeater of Turks was enhanced when he crushed Kara Mustafa's army below Vienna, then at Párkány in 1683 in alliance with Leopold I.

³⁴ Coronelli, Vincenzo Maria (1650 – 1718).

³⁵ "The movements and camps of the Imperial army from the start of the campaign of 1695 to the battle of Esztergom and the occupation of Érsekújvár, the place where the army concentrated and its route from there to the beginning of the siege of Érsekújvár can be see. The route was was interrupted in order to relieve Esztergom from under the Turkish siege."

³⁶ Scientist from Gyulafehérvár. See note 92.

³⁷ The Danube maps and drafts held in Bologna support this theory.

construction of mines. He was wounded once more with shrapnel mangling his left arm. After the victory, General Rabatta summoned him and thanked him for his useful services as engineer. Stimulated by scientific curiosity, Marsigli grasped the opportunity and asked permission to inspect the castle. He made sketches and notes and rescued valuable old books from the burning ruins. In a ground plan he indicated the locations of the more remarkable buildings in the castle, among others the renown baths of Buda, the drawings of which were published in the *Danubius*.

With this, Marsigli's adventures on the stretch of the Danube above Buda came to an end. What he told the Royal Society about himself in the introduction to the promotion of his Danube monograph: *miles sum*, I am a soldier, seems to have been true for this period of his life. Those who read it knew that Marsigli's self-characterisation was not complete. He was not a simple soldier but a *miles eruditus*, a learned soldier. In the last 15 to 16 years of the war, including the establishment of the borders, he proved absolutely worthy of this honourable tribute.

With the liberation of Buda, the theatre of war shifted to the southern part of the country and Transylvania. We shall give an even more sketchy account of Marsigli's military career and the events of war in this region.³⁸ He marched towards Eszék with Karl von Lotharingen's army in 1687. At Nagyharsány they met the Turkish army that had set out to recapture Buda. In the bloody battle, the Christian troops scattered the Turks and forced them into the swamps. This victory opened the road to Transylvania. Marsigli had a bridge built on the Danube at Baja, across Mohács island, and they proceeded toward Szeged. Nevertheless, they were not able to fight their way through the swamps, which were filled by the flood waters of the Tisza. They detoured northwards toward Szolnok, where they intended to cross over the bridge across the Tisza. Marsigli mentioned in his diary that this region was already inhabited and cultivated. His words imply that the land they had left behind was desolate and uninhabited. The campaign proved successful. The army retook Transylvania. Karl von Lotharingen had a coin minted with the inscription *Capta Transylvania*.³⁹ As the campaign ended they started back to Vienna. On the way they blockaded the castle of Eger and Marsigli attended the negotiations for its surrender. Pasha Rostan, the Turkish negotiator, desired that Marsigli be the hostage to insure their free withdrawal. His wish was accepted. The same situation was repeated a year later when Vidin was delivered (1688), which suggests that Marsigli's person was a guarantee for the Turks. In his free time, he studied Roman monuments along the Lower Danube. On one of his excursions he discovered Emperor Trajan's bridge. In his *Danubius*, he provides a detailed description of the piers, which could be seen in the low water, the inscriptions on the bank, and its structure reconstructed from the depiction of the bridge in Rome. He admired the cataracts of the Lower Danube and was awed by the mighty strength of the huge river flowing through the Kazan straits. *While I was gazing with delight at the straits of the Danube at Marecobila, which are estimated at 30-40 fathoms, and examined the steepness and solidity of the rocks on both banks, I was often filled with awe to see how the rocks forced the huge mass of the river into those narrow straits.*⁴⁰ He also examined the rocks that formed the bed of the river and learned about the fishes from the fishermen. He even made notes on the plants that grew along the river banks as he assiduously collected material for his *Danubius*.

The diplomat

In 1691, he travelled on a boat to Constantinople to negotiate peace, facing the

³⁸ The description of the following events of war and Marsigli's actions are discussed by László Gróf in his *Cartographica Hungarica* – no. 3, May, 1993: 25-29.

³⁹ The Capture of Transylvania

⁴⁰ DPM Vol- I. Pars III.

menacing whirlpools of the Lower Danube, including the renown reefs and whirlpools of the Iron Gates. The notes and sketches he took on the journey show us that the boats had to cross the dangerous cataracts in the middle of the river at high water and near the left bank at low water.⁴¹

The peace negotiations did not bring the expected results. The debilitating fight dragged on between the two armies. As if acted out of a script, each spring the Ottoman armies would march along the Danube towards Belgrade and the allied troops would advance southwards, also along the Danube. The Turks took the initiative so that the war mostly caused devastation in Hungarian lands. And the Turks always avoided decisive battles. When they were going to lose a battle, they abandoned the relatively easily replaceable war machinery and retreated, thus, preserving the lives of their soldiers to initiate new attacks the following spring. Finally in 1697, Eugene of Savoy⁴² caught the Turkish army, led personally by the Turkish sultan, unawares while they were crossing the Tisza and annihilated the troops that had already crossed over to the left bank of the river. It was such a great rout that from this point the Turkish military leaders became more inclined to make peace. On October 18, 1689 an agreement was signed concerning a cease-fire, and peace negotiations got underway at Karlócza on the 13th of November in the same year.

In the meantime, Marsigli had been promoted to the rank of general and charged with important diplomatic missions as the emperor's golden-keyed treasurer and confidant. He had visited the previously mentioned territories both as soldier and diplomat. They included the Danube region, the southern and southeastern parts of Hungary, Transylvania and the Balkans, the latter territory more than once. He used the involuntary winter breaks for reading, studying, the organisation of his notes and research. He made good use of his education and military achievements in his diplomatic missions as well. As an envoy of Vienna, he twice visited Constantinople and the sultan's camp while travelling on the Danube and on land. On his journeys he made notes and drafted maps: *At the time, when I studied the Danube ... I decided after the surrender of Belgrade in 1690 that I would make more observations so that they could help not only in compiling a hydrographic map of the Danube but also in drafting and drawing the map of the territories adjacent to the river. Thus, I pondered and devised how it could be done most easily. I obtained a graduated astronomical quadrant with a radius of 2 ½ feet (ca. 80 cm), made from brass.* However, he was not able to stop wherever he needed and wished. *Military service deprived me of everything that was needed for making precise observations,* he complained in his Danube monograph.

His commissions as a delegate were not free from excitement and he played with his life by taking notes and making sketches in Turkish controlled territories. The poor data and details in the XVI –XVIII Danube sections must be related to this fact. Typically for the atmosphere of those times, the high vizier had the corpses of beheaded Hungarian soldiers laid out in front of his tent at the site of the peace negotiations in Belgrade with the intention of intimidating him. From there he proceeded, together with the English envoy to Constantinople, through Szendrő, Vidin, Nikapol and Drinapol.

In this way, Marsigli accumulated political experience in his negotiations with the Turks. During the campaigns he became thoroughly acquainted with the water and land-based transport roads in the southern part of the country, roads that were not roads, the swamps and

⁴¹ DPM Vol. II. Tab. 7.

⁴² Eugene de Savoie-Carignan (Paris 1663 – Vienna 1736) was one of the greatest generals in modern history. In 1696, Leopold I appointed him supreme commander of the Hungarian army against the Turks. He won his greatest victory at Zenta, smashing the Turkish army while they were crossing the Tisza (September 11, 1697). The fruit of this victory was the peace treaty signed at Karlócza (January 26, 1699).

floods blocking travellers. It is unlikely that there was anybody in Hungary at that time who had such a broad view of the political, ethnic, military, transport and road systems of the region, and it was not by chance that he was given an important role in the peace negotiations at Karlócza that ended the war as well as in the demarcation of the borders after the ratification of the peace treaty.

FRONTIER DEMARCATION

Karlócza, 1699

The above-mentioned peace negotiations got underway at Karlócza on November 13, 1698. Representatives from Venice, England, the Netherlands and the Russian Empire were present as well as Leopold Schlick⁴³ on Leopold I's side with L. F. Marsigli as his secretary while the high chancellor and inner counsellor of the empire represented the Turkish Sultan. Hungary was not represented. By this omission, Emperor Leopold wanted to declare that he considered the country a province, a *quasi* colony, that he had conquered by force.

The negotiations progressed very slowly, although the delegates were anxious to leave for home. It was winter and Karlócza did not offer many comforts for the delegates. The situation was further aggravated by the fact that the negotiations were conducted in tents from ten to half past two in the afternoon. John Paget, a delegate from England, having had enough of being cold, established a final deadline for the ratification of the treaty,⁴⁴ which happened in due time, on January 26, 1699.⁴⁵ With this, *blessed peace* returned to Hungary for the next 25 years.

The ruling principle was *uti possidetis, ita possideatis* (that is: as you have possessed, you will possess), and both sides tried to interpret it to their own advantage.

The treaty also dealt with the trading interests of the two sides. The decrees can definitely be called trade friendly. They, namely, banned the building of any kind of fortification along the banks of the boundary rivers: the Maros, the Tisza, the Sava and the Unna, while it declared that the inhabitants of the two empires had equal rights to use the rivers. *And since ...the cargo-boats sailing from the upper territories either on the Maros to the Tisza or on the Tisza to the Danube are not to be held up either down stream or on their way back by any kind of barrage..., the principle of mutual friendship and goodwill also demands that the subjects of the Turkish Empire can also freely pass with their fishing ships and boats on these rivers.* As an added protection, the building of water mills was strictly limited so that the traffic of the imperial ships should not be disturbed. For the sake of sailing, it was prohibited to divert the water of the Maros either to drive a mill or for any other purpose. The same principle was also effectuated on the boundary stretch of the Sava (from the mouth of the Bossut river to the mouth of the Unna) and on the boundary stretch of the Unna (from the mouth to approximately Novi). Turks and Austrians were both interested in Balkan, especially Croatian, commerce. In article V of the treaty a remark was added about Brod: *this place is especially suitable for trading, a town can be built there with proper defences...* (Although the castle rebuilt and fortified by the imperial forces had to be demolished).

The peace treaty signed for 25 years on 26 January 1699 did not exactly define the location of the frontiers. Accurate lines were demarcated by a Turkish and an Austrian border commission. The work had to be started on 22 March 1699, so that the boundaries would *be clearly set up and staked out* as soon as possible according to the mutual decisions of the commissions *for the sake of the peace and*

⁴³ Schlick (Schlik), Leopold Adam Joseph (1663 –1727), lieutenant general and diplomat. By the time of the peace treaty of Karlócza he was the envoy of emperor Leopold.

⁴⁴ Ignác Acsády: Magyarország története I. Lipót és I. József alatt. (The History of Hungary under Leopold I and Josef I) Budapest, 1898.

⁴⁵ An agreement was reached with Venice, only later.

*security of the subjects.*⁴⁶

The head of the frontier commission

Marsigli was appointed head of the Austrian commission. He prepared for the negotiations with the Turkish delegate on the demarcation of the 850 km long stretch of frontier between the two empires that meandered from Transylvania to Croatia down to nearly the Adriatic Sea by obtaining maps and studying the present and past of the peoples living in the relevant territories. His quest included Dávid Rosnyai's History of Transylvania, which was translated from Turkish into Latin especially for him by an eminent scholar of old Hungarian literature as well as maps and diplomas about Croatia. When later, in his *Treatise*, he outlined the possibilities of establishing trading routes⁴⁷ or wrote about the history of the region in his *Danubius*, he drew not only on his many personal experiences in the Balkans, Turkey, Transylvania and Hungary but also on a profound historical knowledge of the region. All these were complemented by Marsigli the cartographer's brilliant notion of having military engineers survey and map supervised stretches of the boundaries. In this manner, he could defend himself against the malicious attacks and intrigues made against him every now and again by rivals in Vienna. At the same time, he could present a concrete document to the Austrian emperor and military leadership that would help them avoid future border skirmishes between the two empires. As soon as an agreement was reached on the exact position of a stretch of frontier, he marked it on a map. This was signed and sealed by the leaders of both parties. We know from one of Marsigli's letters that he sometimes had a copy of these maps made for the Turkish side as well.⁴⁸ Marsigli invited *Johann Christoph Müller*, a cartographer from Nürnberg, to Hungary in 1696 with the definite purpose to draw maps under his direction.⁴⁹ They drew maps of the frontier, not only when an agreement was reached on a stretch of border, but also when he wanted to visually depict the debated problems described in his reports. He sometimes indicated 3 or 4 boundary versions in these maps, from which the military council could gain a clear idea of the process of negotiations. The routes the two commissions followed along the border and where and in what arrangements they set up their tents was also mapped. Usually, the commissions on the two sides marched and camped in their own territories so as not to burden the subjects of their counterpart with their provisioning.

Where rivers unambiguously separated the two empires, their work was easy – disregarding the unsettled circumstances and the oppressive environment of swamps and waterlogged areas. There were no debates about islands either. They were not placed under the control of either empire, but allowed to remain *border zones*, which could be used by the subjects of both sides. And where there were no rivers to indicate the borders, the exact line of the boundary was marked by *ditches, stones, posts and other unmistakable signs*. In the mountains, trees were marked. A crescent and Arabic letters were incised in their bark on the Turkish side and while crosses were usually used on the Hungarian side. Marsigli made his

⁴⁶ The text of the peace treaty was published in István Katona: *Historia critica regnum Hungariae* (Buda, 1805. 106-125. p.)

⁴⁷ *Mappa Geographica facta in usum commerciorum...* Bécs, ÖStA KA HKR Akten 1701 BLG. Juli/42. Relation 10.

⁴⁸ BUB Mss di Marsigli Vol. 49. p. 10. („Mappa commissario Turcico communicata”)

⁴⁹ Johann Christoph Müller [1673, Wehr (outskirts of Nürnberg) – 1721, Vienna]. *He showed great attraction to science and art in his early childhood and received a solid education in Latin and the humanities*, J. G. Doppelmayer wrote about him in his book titled *Historische Nachricht von den Nürnbergischen Mathematicis und Künstlern...* (Nürnberg, 1730). For four years from 1692, he was a student of Georg Christoph Eimmart. He studied mathematics, theoretical and practical astronomy and the draftsmanship. From 1696 to 1703, he worked in Marsigli's service in the territory of the Hungarian Kingdom as cartographer, astronomer, draftsman and personal secretary. From 1704, he surveyed first Moravia then Bohemia as imperial cartographer. He prepared the *Large Hungary map*, which appeared in 1709 and which served as an example for western cartographers throughout the century. (Deák A. A.: *Johan Christoph Müller = Dunakanyar*, 1987/2).

cartographer Müller note the geographical position, shape and inscription of these border marks. He sent the maps of the mutually accepted frontiers to Vienna enclosed in his reports,⁵⁰ while he kept the original drafts of the maps.

MAPS – FORERUNNERS OF THE MAPS OF THE DANUBIUS

Negotiations often brought results only after a series of eastern type bargaining sessions in which several alternatives were discussed. This is clearly illustrated by the geographical map that shows the demarcated borderlines along the Corana [Korana] river down to Jesera. In this map, 4 separate borderlines are indicated in different colours. One line is the *accepted plan sent to the Imperial Court on July 3*, the second one is the proposal handed in by Marsigli after negotiations with the Turks, the third one is the already staked out frontier line, while the fourth is *the line proposed by the Turks based on Pasha Hassan's directives*.⁵¹ The final borderline shows that it was less favourable than the one proposed by Marsigli, but it turned out to be better than what Vienna would have been willing to accept.

Another map shows the character, political and military importance of Marsigli's work. This map shows what would have been the consequences of demolishing Novi in the region between the Una, the Kulpa and the Sava rivers,⁵² which was controlled by the emperor's army at the end of the war. In the sense of the peace treaty it would stay so. Marsigli, as the emperor's commissary, maintained his claim on the territory citing the principle of *possideatis, etc.* At the same time, he declared his claim over the whole territory that had been controlled by Old Novi until the last war. He listed the strategic alternatives in the negotiations in six points and indicated possible solutions in the map so that the consequences of the eventual decisions could be worked out in Vienna. The worst variation would be if New Novi had to be demolished without proviso being made to establish a fort of similar strength. In that case, he wrote, *we would give up secure contact between Castanovitz [Kostajnica], Petrina [Petrinja] and Sziszek [Sisak], and the entire area up to Glina would be exposed; furthermore, there would remain nothing apart from the castles of Castanovitz and Zerín [Új-Zrinyi] and the ruins of the old castle of Pedal to curb the unruly Wallachians.*

It was the first time in history that a map had played such a key role in diplomacy and tactics. Some of these maps were known: the famous frontier section map 39 drawn after the demarcation of the boundary (1702-1703) is held in the National Library of Vienna, while some of the maps prepared as annexes to the frontier reports are stored in the Military Archives of Vienna, separated from their original context. Many maps remained hidden in the storage spaces of the Military Archives together with Marsigli's reports. They were found only in 1998 through the generous co-operation of friends.

Since these maps, which *documented both the frontier and its history*, were the antecedents to the famous Danube and Carpathian Basin maps published in the Danube monograph and we had either fragmentary or incorrect information about them or even none at all, we shall describe them shortly.

⁵⁰ The drafts of the map sheets can be found in the Marsigli Archives at the University in Bologna, while the good copies are in the map collection of the Staatsarchiv in Vienna. Since the reports and the attached maps that were found due to a lucky coincidence in a hidden corner of the depository have not yet been analysed, we cannot provide their exact archival registry numbers here. (ÖStA KA HKR Akten, Box 76-77-78).

⁵¹ Vienna, ÖStA KA Kartensammlung, B IX c 829.-7, Geographical map showing the demarcated frontier line on the Corana river up to Jesera.

⁵² Vienna, ÖStA KA Kartensammlung, B IX c 829 – 6.

Frontier section map 39 (42)⁵³

However well known this map is as an outstanding achievement, not only because of its significance but also in its scope and aesthetic value, a few words must be said about it since even those who have studied the maps in detail bridged any gaps in information concerning its origin and fate with erroneous assumptions.⁵⁴

First, we should say the name, section map 39, is used following the term accepted in the technical literature. Müller always spoke about 41 sections. It is true that sheets 40 and 41 are not typical maps, they contain the locations of the 96 borderline marks indicated in the individual sections. Thus, the work consisted of a summary sheet (50 x 110 cm), 39 sections (mostly 50 x 66 cm) and 2 folio appendices.⁵⁵

When and for whom did Müller draw them? According to the technical literature, he made them on the order of Eugene of Savoy in 1706. At the same time, his letters written to Marsigli show that he himself drew them in 1703 in Nürnberg for Marsigli. We even learn such details that he received 5 florenas per section of the borderline maps, 12 florenas per section for the maps of the states of the Hungarian Kingdom, and only 6 florenas per Danube section despite the fact that *he prepared three frontier sections in the time it took him to draw one Danube section*. Marsigli paid the same price for the beautiful *Mappa Generalis* and *Mappa Potamographica* of the Danube monograph as for the Danube sections. It was not possible to overpay him, since Müller, just like Eimmart the copperplate engraver, constantly suffered from financial difficulties. *Time is consumed, debt increases*, he said quoting a proverb.⁵⁶ It also happened that Eimmart, the main partner, spent money on copperplates that had been sent to him for Müller, while Müller had a shortage of the parchments he needed for drawing the maps for the Danube monograph.

In his last letter, written on the 12th of May 1703,⁵⁷ Müller gave such a detailed report on the preparation of the map known in the technical literature as section map 39 that it almost seems as if he intended it for his curious descendants. *I have completed all the frontier sections, altogether 41 items, together with the summary map*⁵⁸. He also mentioned that although Marsigli had ordered the drawing of the special map of the borderline mounds, he had not yet prepared it, as he had not made the map of Bulgaria and Hungary in the stricter sense (*Hungaria vera*) either. He hoped, however, that he would be finished with them by the time Marsigli received his letter. We also learn that he was given 12 florenas for drawing the maps of the states of the Hungarian Kingdom.

It is here that we first hear that Müller's exceptional talent was noted in the imperial court in Vienna. A certain Mr Schirndorf visited him and invited him to Vienna on Eugene of Savoy's authority. Without Marsigli's assent, however, he did not want to accept the invitation although he was bored of being closed up in a room and incessantly drawing maps, and as a young man he wished for a more varied life. He tried to convince Marsigli in a letter that he would also benefit if he accepted the invitation to Vienna, because he could charge Pfeffer with the engraving of the Danube sections and he would be there to control this work.

⁵³ ÖStA KA Kartensammlung, B IX C 829-5, 36 x 63,7 cm

⁵⁴ Joseph Paldus: Johann Christoph Müller – Ein Beitrag zur Geschichte vaterländischer Kartographie. Mitteilungen des k. und k. Kriegsarchivs, Dritte Folge. V. Bd.

⁵⁵ The inscription on the map is: *Mappa geographico limitanea in qua imperiorum caesarei et ottomanici confinia in almae pacis carlovitzensis congressu descreta...exhibentur...* (Map along the geographical boundary showing the borderline fixed by the Karlócza peace...)

⁵⁶ BUB Mss di Marsigli Vol. 82. pp. 52-52. 6. January 1703, Latin

⁵⁷ BUB Mss di Marsigli Vol. 80. B. pp. 164-165. Latin

⁵⁸ Müller counted the two sheets with the locations of the border markers as separate sections. So he consequently spoke about section map 41.

Soon after Marsigli fell into disgrace, Müller arrived in Vienna.

The next time we read about frontier section map 39 (41) is 7 years later in documents from Bologna. By this time Müller's *patron*, as Marsigli was called in Nürnberg, had returned to Bologna and bequeathed his valuable property to his native town. Marsigli sent his testimony to the magistrates of the town on the 3rd of February 1710.⁵⁹ He asked the Senate to turn over the collection of maps that Müller had drawn on his initiative and from his money to the Austrian emperor after his death. He gave his reasons as well: first the collection contained very important information for the Christian world and, second, he wanted to demonstrate to the Austrian emperor that he was not angry with him for being disgraced.

His letter containing his testimony was read out in the Senate on the 11th of August 1731, the year following his death. They immediately decided to prepare an accurate copy of the map before complying with Marsigli's wishes. There were several candidates for this work. We learn from a letter written to Manfredi Rondelli, the secretary of the university, that on the 14th of June, 1732 F. *Vandi* was chosen. Nevertheless, he was only to prepare the summary sheet.⁶⁰ The original one, that is, the summary sheet, the 39 sections and the two sheets with the locations of the 91 border markers were handed over to the Austrian envoy in Venice enclosed in a ornamental box.⁶¹ This is how the entire pioneering work of frontier maps came to the National Library of Vienna. As soon as it arrived, the Military Council had a copy made, which is preserved today in the Military Archives in Vienna.⁶²

Maps separated from the frontier reports.⁶³

More than a dozen frontier maps are kept in the Staatsarchiv in Vienna, and neither their authors nor when they were made have been exactly known until recently. The ones cited in the previous chapter also belong here. The open questions concerning the author, the dating and their purpose were answered by the drafts of Müller's maps. Namely Müller, who drew the maps, stuck a label on each draft with the number of the report the final version of the given map was to be attached to, the name of the courier who took it to the emperor and the day it was sent. The maps that illustrated and helped the interpretation of Marsigli's reports will be described in the following chapters. The translations of the sometimes lengthy Latin legends can be read in the footnotes.

1. Map of the Transylvanian frontier⁶⁴

Marsigli charged Visconti, his fellow-citizen, with the survey of the *Transylvanian mountains*, although he had to be pressed to accomplish it. From the material compiled by

⁵⁹ Archivio di Stato, Bologna, Assunteria di Istituto, Diversorum B. n. 7. fasc. 3.

⁶⁰ Archivio di Stato, Bologna; Assunteria di Istituto - Diversorum - B. 20 n. 8. fasc. 3. We can deduce from the letter that only the summary map was redrawn, not the 41 sections. And really, we have found a copy only of the summary map. It is evident from Marsigli's cited testimony that the map was made not in 1706, as it is accepted in the technical literature, but in 1702-1703 and not on Eugene of Savoy's order but on Marsigli's. So the mystery how and why one of Chr. Müller's nicest map got in Vienna has been solved. Complying with Marsigli's last will, the Senate of the University of Bologna sent it in a box to the emperor's envoy in Venice in 1732. A list was made of the content of the box dated from 28. October 1732.

⁶¹ Archivio di Stato, Bologna, Assunteria di Istituto, Diversorum B. n. 8.

⁶² The original: Vienna, Nationalbibliothek, C. P. Min. 85; apart from the summary sheet a copy of which is kept in Bologna, the only copy is: Vienna, Kriegsarchiv, Kartenabt. B IX c. 634.

⁶³ See note 66.

⁶⁴ Vienna, ÖStA KA Kartensammlung. B IX. C 743. Measurements: 74 cm x 237 cm. Legends:

According to Müller's note in German on the draft kept in Bologna, the map was sent to Vienna attached to Relatio IV. Two copies were made of it, one taken by courier to Vienna on December 14, 1700, while the other one was sent to General Rabutin to Transylvania on the 23rd of December. Another note is an instruction: The Iron Gates must be drawn using a larger scale.. (Biblioteca Universitaria, Mss di Marsigli, Vol. 49: 40)

Visconti, Müller drew a *geographical map* of the territory, *which showed the boundary between Transylvania and the Temes Banat*. The map was later sent to Vienna together with Marsigli's report. He drew the borderline in red. Beside it, there is another red dotted line *running from the peak of the Cornu Ruski mountain [Ruska mountain range] across the peaks of the other mountains*, which indicates the boundary proposed by the Turks. They tried to interpret the basic principle of *uti possidetis ita possideatis*⁶⁵ to their own advantage. Marsigli, however, did not yield.

The map was intended to be an accurate document. It contained the *boundary markers* called "humka", which were constructed from earth and stone, the *spots* that were suitable for establishing military bases, *pathways* for pedestrian travellers, where it would be troublesome to pass on a horse, the possible place for a *new bridge* over the Maros river, and three *mounds* that were built after the temporary agreement, and which were to be established on the Prisbul, Branul and Murarul mountains. The map also indicated a *watchtower* on top of the hill next to the Bistra river, from where *one could see as far as Karánsebes when conditions were favourable*. It was also noted that an abandoned stream bed was found lying parallel to the left bank of the Maros.⁶⁶ Marsigli certified with his signature at the bottom of the page that *the borders are accurately depicted*.

2. From Szalánkemen to the mouth of the Una river⁶⁷

The map of the Transylvanian frontier stretch followed the boundary only until the mouth of the Maros river at the Tisza. From this point, the Tisza river marked the boundary until it flowed into the Danube. Although we did not find a map of this stretch among the borderline maps registered in Vienna, we did find one in Bologna.⁶⁸ The nearly three and a half meter long drawing indicated channels, sometimes called *bara* in Slavic or *ruptura* in Latin, streams, swamps and some settlements along the river marked by ordinary numbers from 1 to 96: *Krivi channel, Beke channel, Supin headland, Mathias bara, Tatalia ruptura, Tzuro-channel vel ruptura*⁶⁹. In this stretch, the width, depth and speed of the rivers were measured on the Tisza at the mouth of the Maros and below Szeged, on the Danube at Pétervárad and on the Kerka river, and at two places on the Sava river. He even had the gradient of the river measured at the cataracts on the Lower Danube.⁷⁰

When the commissions reached the mouth of the Tisza, they crossed the Danube and pitched camp at Szalánkemen. The natural setting offered easy passage toward Belgrade along the Danube, turning west only at the mouth of the Sava river. This was all very well, but Belgrade was a very important fort for the Turks, so the border had to be maintained at a safe distance from it. So they crossed Sirmia and reached the Sava river in the direction of Rumen and Metrovi. In the meantime, according to the official statement of Marsigli, 208 frontier mounds were constructed.⁷¹ They did not have to attend to raising mounds along the Sava river, since from here to the mouth of the Una river the Sava marked the border. Along this stretch, the presence of swamps, channels and streamlets meant a lot of extra work for the Austrian commission, which carefully surveyed this region as well. The drafts and notes found in the Marsigli Archives testify to the tenacious alacrity the engineers showed in their work even along unambiguous stretches of the frontier. Everything was noted with

⁶⁵ The status of the territory remained unchanged: as you have possessed, you will possess.

⁶⁶ BUB Mss di Marsigli Vol. 6.

⁶⁷ B IX C 831 *ibid.*; 480 mm x 2340 mm. The draft is in BUB Mss di Marsigli Vol. 49. p. 5. Müller's note: *Simonetti took it to Vienna enclosed to Relatio V. on June 12, 1699.*

⁶⁸ BUB Mss di Marsigli Vol. 38. p. 30. 59 x 340 cm.

⁶⁹ The name shows us in what sense Marsigli and Müller used the name channel. (The word "ruptura" means a rupture, a gap; *rupti aggeres* = ruptured dams, dikes.)

⁷⁰ BUB Mss di Marsigli Vol. 46. p. 14. We do not have any data indicating the time the measurements were taken.

⁷¹ BUB Mss di Marsigli Vol. 69. pp. 37–46.

topographical accuracy in the uninhabited swamps – *Lauter Wald und Morast* (pure forest and swamp), Müller remarked on one of his sketches.⁷² Five drawings about the river are kept in the Marsigli Archives in Bologna, made by the engineers during the demarcation of the frontier.⁷³ They surveyed the Roman remains at Szalánkemen, the width of the Danube (280 fathoms; 530 m), 30-40 channels and “*bara*” along the Sava. Three camps were pitched on the frontier stretch along the Sava river up to the mouth of the Una. The locations of the camps and the arrangement of the tents were indicated on the map.

3. The Una (Unna) as a boundary river⁷⁴

At the mouth of the Una river, the frontier commission left the Sava and proceeded south along the banks of the next boundary river. The Una was also carefully surveyed. It is typical of their circumspection that on the stretch of the river where it divided the two empires, the locations of 242 islands were marked, the shapes of the larger ones were drawn. Several maps were made of this area. Novi and its environs was strategically very important for both parties. Neither yielded to the other, so, suspending the unpromising discussions, a decision was postponed. In fact, agreement was never reached. This is why there is a *hiatus*, a gap in this frontier line on each borderline map. Marsigli had several maps made of the disputed area to show what consequences the various borderline versions would have had from the military, communication and political points of view.⁷⁵

4. Croatia west of the Una river

This frontier stretch produced the largest number of the maps. Partly because both parties obstinately clung to Novi, partly because the territory west of the Una river had acquired great strategic significance: its importance was increased by castles, the low number of passable roads, and the passes where the mountains could be crossed. We can find several maps among our *unknown acquaintances*⁷⁶: from the triple border (Austrian – Turkish – Venetian borders) to Sluin, from the Corana river to Jesera,⁷⁷ from the mouths of the Sava and Una rivers to the Popina mountain and from there to the territories ruled by Venice down to the Adriatic Sea,⁷⁸ the region of Jesenovitz and Dubitza,⁷⁹ the frontier map of Croatia with the accepted and still disputed frontier stretches and,⁸⁰ southern Hungary west of the Danube, where Marsigli suggested barriers that might hinder the advance of pestilence towards the heart of the empire.⁸¹

⁷² BUB Mss di Marsigli Vol. 49. p. 4.

⁷³ BUB Mss di Marsigli Vol. 38. p. 1, 3, 4, Vol. 39. 4, 16.

⁷⁴ The stretch of the Una river from Kastanovitz to the ruins of the monastery, that is, until the still disputed territory of Novi, was depicted on map B IX c. 829-1. Neither the author nor the date is indicated. Manuscript, coloured, inverse orientation. Measurements: 67 x 151.5 cm; 66 x 150 cm.

⁷⁵ B IX a 764 – 800 A *geographical map, which shows within a red frame the territory that had legally belonged to the emperor before the fixing of the borders on this side of the Danube and that had to be ceded to the Turks by virtue of the peace treaty*. Measurements: 43 cm x 36.5 cm.

IX c 829-3 *ibid.*; 47 cm x 70.5 cm. Inscription: A *geographical map, which depicts the stretch of the Una river flowing between the two empires*.

⁷⁶ I am thinking of the unregistered maps kept in the *Kriegarchiv* of the National Archives of Vienna.

⁷⁷ ÖStA KA B IX c 829-7 *ibid.*; 36 cm x 49.5 cm.

⁷⁸ ÖStA KA B IX c 829-2 *ibid.*; measurements: 42.5 cm x 61 cm.

⁷⁹ ÖStA KA B IX c 790 – 800 Vienna, ÖStA KA Kartensammlung, inverse orientation, measurements: 50.5 cm x 59 cm

⁸⁰ ÖStA KA B IX C 829-8 *ibid.*; measurements: 40 cm x 65 cm. The text is very short: *Legends: Higher wooden structures or towers with sentries*.

⁸¹ ÖStA KA B IX. c 829-5. A geographical map which depicts the measures to be taken by virtue of the peace treaty after the evacuation and demolition of the settlements along the frontier beyond the Danube with the purpose of stopping the spread of pestilence.

Hidden frontier maps⁸²

It was obvious that the maps called *unknown acquaintances* were made as attachments to certain documents. The notes made in pencil on the registry cards imply the same. What is more, the morphological and contextual traits uniformly indicate that most of these unnamed maps were drawn by Müller. Also, Müller's letters to Marsigli hinted at the fact that more frontier maps were drawn than the ones actually registered. They were certainly also sent to Vienna together with the frontier reports. Yet, we could not find them. Archivists wrote them off saying that they could have been discarded or been burned in past centuries.

Nevertheless, in the spring of 1998, the frontier reports were finally found through luck and a friendly gesture.⁸³ They were found hidden in a corner of the repository without numbers and inventory registration.

These sheets were probably less important for the military leaders, so they were left where they arrived, fastened to the documents with ribbons. Most of them were drawn by Müller, although he did not sign them. Several arguments can be raised to support the idea that these maps were Müller's work: the position and interrelation of the places determined by astronomical position are a constant in Müller's maps; the depictions of the boundary rivers and the course of the Danube are specific in his maps, since he corrected the characteristic bends with a compass. The cartographic marks and the stylistic traits are also helpful in demonstrating authorship.⁸⁴

1. The map of the Sirmium frontier stretch⁸⁵

This map shows the territory crossed by a red borderline between Illok on the Danube river and Belgrade and Morov on the Sava river. A drawing of a boundary mound can be seen in the upper left corner with a sapling in its center.

2. The map of Szalánkemen⁸⁶

This map depicts the few kilometres long stretch of the Danube around the fort and the mouth of the Tisza on the left side together with three *channels* forking out from one of the branches of the Danube, *through which boats sail out to Backa*.⁸⁷

⁸² Vienna ÖStA KA HKR documents, box 76, 77, 78.

⁸³ I complained about my fruitless research to Dr. István Czigány at the Institute of Military History, who at that time worked in the Kriegsarchiv as a member of a Hungarian delegation. He interrupted me and said: "Wait a bit, I think I saw them a few weeks ago when I was poking into some paper boxes." And they indeed were Marsigli's reports...

⁸⁴ Antal András Deák: Eine neu entdeckte Karte von Kroatien von Johann Christoph Müller. 8. Kartographiehistorisches Colloquium. Bern, 1996.

⁸⁵ Vienna, ÖStA KA HKR documents. Unregistered. Enclosed within Information III, which was sent to Vienna in May 1699. Its inscription was in Latin and its drawer did not sign it. Measurements: 34.5 x 60 cm

⁸⁶ Vienna, ÖStA KA HKR documents. Unregistered. Measurements: 30 x 41.5 cm. Title: *Copia Mappae, quae, una cum priori et sequente per Lieut. Kayser, Aulae est transmissa. Datum Dresnik, d.11. Sept. 1699. Lit. B ad Annex. E in Relat. X.* (Copy of the map that was sent by Captain Kayser to the imperial court together with the previous and the subsequent ones. Dresnik, September 11, 1699. To letter "B" of document "E" attached to report X.)

⁸⁷ In the maps, these headlands are called canales or channels. Marsigli himself tells us in chapter II on the marshes of the Danube in volume I of his Danubius book that by these channels he means natural headlands (plate 42).

3. Geographical map drawn for tradesmen⁸⁸

This is the earliest map from Hungary where the main export routes are indicated.

Following the ratification of the peace treaty, new possibilities opened up for Austro-Hungarian commerce. Leopold I, the German-Roman emperor and Hungarian king (1640-1705) wanted to make use of the favourable political and economic situation secured by the victory over the Turks, so he ordered Marsigli, with his intimate knowledge of Hungary, to draw up a proposal on the development of new commercial contacts and trading routes. He tried to fulfill this honourable task by carrying out a study in four parts entitled *Allgemeiner Discurs über den Traffico*.⁸⁹ Similarly to every report he sent to the emperor related to discussion of a complicated geographical problem, he illustrated his ideas on maps. His independent intellect is reflected in the fact that he placed the commercial centre in Baja, a small town on the Danube in southern Hungary, instead of in Vienna and Buda, the centres of the empire.

Baja was a main supply depot for the army's provisioning during the Turkish liberation wars. For Marsigli, it was not only the centre of the over land roads leading to Turkey, Poland and the ports of the Adriatic, gateways to the Mediterranean Sea, but also, to use his words, the *terminus a quo*, that is, a starting point for the river trade on the Maros, the Tisza, the Sava and, last but not least, the Danube rivers.

The map is *unique* in four respects:

- it was the first to outline possible trading routes and contacts points for Hungary;
- as far as we know, this is the earliest map of its kind in the world;⁹⁰
- it contains the earliest accurate and precisely dated Marsigli-Müller depiction of the Danube bend and the Hungarian stretch of the Danube;
- it is the first map that indicates flood dikes along the Hungarian stretch of the Danube.

4. The first postal map of Hungary⁹¹

This map was drawn up for the use of couriers and the postal service. In the spring of 1700, Marsigli, who was staying in the southern part of the country, was charged with carrying out another similarly important task. He was asked to submit a proposal to show how the recently liberated Slavonian and Croatian territories and Buda and Vienna, the two centres of the empire, could be connected by a postal service. Marsigli, before sending his proposition to Vienna, discussed the matter with postmasters in the southern part of the country. He had J. C. Müller illustrate his scheme on a map. This was how the first postal map of Hungary came into being. It depicted the western part of the country bordered by the Danube.

Maps kept in Bologna

Many sketches, drafts and finely detailed manuscript maps are preserved in Marsigli's

⁸⁸ Manuscript, coloured, 50 x 74 cm; 1699. (without date); ÖStA KA HRK Akten 1701 BLG Juli/42.

⁸⁹ A general treatise on commerce. Vienna; ÖStA KA HRK Akten 1701 BLG Juli/42. Attachment to Relation 10.

⁹⁰ The responses to my question addressed to the gathering at the 18th International Conference on the History of Cartography indicated that none of the participants had come across a commercial thematic map with such an early date.

⁹¹ A geographical map, which we made for the benefit of officers nominated by the Imperial Office of Postal Affairs to assist in drawing up the regulations concerning the establishment of post offices. ÖStA KA HRK. 1701. BLG Júlý – 42. Relatio 21.

bequest collection. They are of immeasurable significance for those who study the way these regions and waters were long ago.⁹² The drafts of the frontier maps sent to Vienna owe their importance to the fact that Müller systematically noted on each one when, by whom, and the document they were attached to when they were taken to Vienna. With their help it should prove possible to reunite the above-mentioned and described maps from Vienna with the documents they originally came with, since separately neither the maps nor documents can be fully interpreted. The documents from Vienna – ÖStA HKR:Akten, BLG 171; 76, 77, 78. cartons – are listed in the right column. For clarity's sake, I also included their origin. I listed the notes that are from the corresponding Bolognese Emporium in the right column. You can find Müller's note that he put on maps in foot-notes:

Wien, ÖStA KA Kartensammlung BIX a 764-800.	Lit. C. ad Relat. XX. Mappa XVIII. ⁹³
Wien, ÖStA KA Kartensammlung BIX a 790-800.	Lit. E. Relat. XVI. Mappa XVII. ⁹⁴
Wien, ÖStA KA Kartensammlung BIX C 829	Lit. E. ad Relat. V. Mappa II. ⁹⁵
Wien, ÖStA KA Kartensammlung BIX C 829-1;	Lit. H. ad Relat. XXVI. Mappa XXII. ⁹⁶
Wien, ÖStA KA Kartensammlung BIX C 829-2;	Lit. H. ad Relat. XXVI. Mappa XXII. ⁹⁷
Wien, ÖStA KA Kartensammlung BIX C 829-3;	Lit. E. ad Relat. V. Mappa II. ⁹⁸
Wien, ÖStA KA Kartensammlung BIX X 829-4;	Lit. K. ad Relat. IX. Mappa VII.
Wien, ÖStA KA Kartensammlung BIX C 829-5,	Lit. B. annex. Relat. XX. Mappa XVIII. ⁹⁹
Wien, ÖStA KA Kartensammlung BIX C 829-6	(without impurum-copy)
Wien, ÖStA KA Kartensammlung BIX C 829-7;	Lit. A. ad Relat. XIV. Mappa XII.
Wien, ÖStA KA Kartensammlung BIX C 829-8;	Lit. B. ad Relat. VI. Mappa III.tia ¹⁰⁰
Wien, ÖStA KA Kartensammlung BIX C 830;	Lit. A. ad Relat. X. ¹⁰¹
Wien, ÖStA KA Kartensammlung BIX C 831.	Lit. A. ad Relat. X. ¹⁰²
Wien, ÖStA KA Kartensammlung BIX C. 832	Lit. A. ad Relat. X. Mappa VIII. ¹⁰³
Wien, ÖStA KA Kartensammlung BIX C 834	Lit. B. ad annex. A. Relat. XVI. ¹⁰⁴

I bring your attention to the unsigned but carefully crafted Bolognese Maps:

⁹² I have been working on cataloging them.

⁹³ Copia Mappae, quae, una cum praecedente, per Staffetta, Aulae, est transmissa. Datum, Sisszek; d. 4. April. 1700 (Mappa XVIII.)

⁹⁴ ; Hujus Mappae Copia, per Staffetta, Aulae est transmissa. Datum Sisszek, d. 4. Febr. 1700

⁹⁵ Copia Mappae, quaem uni cum priori mappa, a Belgrad, usque ad Confluxum Unnae per Dn. Com. Simonetti Viennam missa est. Datum, Novi, Croatiae, d. 12. Junii. 1699.

⁹⁶ Copia Mappae, quae, per Dn Schmied, una cum sequente, et planta aggeris Brod, Aulae est transmissa. Datum, Jacovar; d. 20. Augusti; 1700.

⁹⁷ Copia Mappae, quae, per Dn Schmied, una cum sequente, et planta aggeris Brod, Aulae est transmissa. Datum, Jacovar; d. 20. Augusti; 1700.

⁹⁸ Copia Mappae, quaem uni cum priori mappa, a Belgrad, usque ad Confluxum Unnae per Dn. Com. Simonetti Viennam missa est. Datum, Novi, Croatiae, d. 12. Junii. 1699.

⁹⁹ Copia Mappae, quae, una cum sequenti, per Staffetta, Viennam missa est. Datum Sisszek, d. 4. April. 1700

¹⁰⁰ Copia Mappae, quae per Dn. Com. Rabatta, Viennam missa est. Datum, Sluin, d.22. Junii, 1699.

¹⁰¹ Una cum altera sequente Mappa, per Comitem Simonetti, Viennam missa est. Datum, Novi, Croatiae, d. 12. Junii 1699.

¹⁰² Una cum altera sequente Mappa, per Comitem Simonetti, Viennam missa est. Datum, Novi, Croatiae, d. 12. Junii 1699.

¹⁰³ Copia Mappae, quae, una, cum sequentibus duabus, per Lieut. Kayser, Aulae est transmissa. Datum, Dresnik; d. 11. September. 1699.

¹⁰⁴ Mappa XIV.; Copia Mappae, quae una cum priori, et sequentibus aliis, per Dn. Signiferum et Philippi, Aulae est transmissa. Datum, Bielovatz, d. 30. X.br. 1699.

1. Austrian-Turkish border map¹⁰⁵

The colored and richly illustrated map depicts the new, final borders that were officially signed by the leaders of the Border Committee in March 5 1701. The text is surrounded by symbolic figurines. The figurine in the middle sits above the Hungarian emblem surrounded by two putti with a sentence in Latin.¹⁰⁶ The putto on the left holds the half-length portrait of the Emperor Leopold while the one on the right holds the sign: *securitas imperii*.¹⁰⁷

The Legend attached to the map reveals the rich content of the map.

The black dots signify the border hillocks that were built from dirt and rocks; the lines of semi-colons denote the most important mountain passes. Dedicated symbols are reserved to show the inhabited places that were protected by walls all around; places that were fortified but ruined now; the fenced forts; cities without walls; villages, and other localities that were raised to the ground. They also noted the camps of those who were marking the borders. From the point of view of Cartography, there is a note that is more significant since it reveals that:

a) The drawer of the map noted the latitudinal and longitudinal measurements based on astronomical observations.

b) The paths of the bigger rivers, such as the path of Unna from Novi to Mitrovitz; the path of Tisza from its mouth to Szeged; Maros to Deva - with their natural turning. The drawer of the map used a compass by the surveying of the landscape. The more significant rivers and lakes were noted in green, the smaller ones in brown ink, the swamps were depicted in brownish green, and the mountains were done in blue-grey. The Earth Grid that was done with a pen is visible here and there. The distance was given in hours. The name of the cartographer is **missing**. Based on the style and the content as mentioned above, we can safely conclude that it was Muller who prepared the map.¹⁰⁸

2. The states of the Hungarian Kingdom¹⁰⁹

In the foreword of his never-edited work, Marsigli promised a description of the history of Hungary in a narrower sense (*Hungaria vera*) as well as of Bosnia, Serbia, Croatia, Slavonia, Hercegovina, Moldva, Wallachia, Transylvania, the Temes Banat and Bulgaria. Since his knowledge of the territory, the surveys carried out in the border zone and the maps based on the surveys and drawn by Müller provided a first rate opportunity, he inserted the maps of the relevant countries in front of the manuscript ready for printing. The ten finely coloured maps, each measuring 52 x 72 cm, - with the exception of Hungary's map, which had not yet been completed¹¹⁰ - awaited only an engraver in 1703. Marsigli, however, did not find ten maps sufficient. He thought that a summary sheet was also necessary to provide an overview of these countries and principalities, and thought it necessary to prepare a map of Hungary that would illustrate the conditions described by Bonfini.¹¹¹ He issued instructions for the cartographer on the front page of the manuscript volume saying that the map of Slavonia

¹⁰⁵ BUB Mssdi Marsigli, Rotolo 29.

¹⁰⁶ Qui fines regimus, securitatem prestamus.

¹⁰⁷ Assurance of the Empire

¹⁰⁸ The measurements of the sheets are: 70 cm x 155,5 cm; 75,2 cm x 163 cm.

¹⁰⁹ BUB Mss di Marsigli Vol. 28. The original title of the sheets prepared for printing is: "Monarchia Hungarica in sua regna principatus et ducatus divisa..." Monarchy here refers to the kingdom. The measurements of the sheets are 52 x 72 cm (inner measurements: 43 x 60 cm).

¹¹⁰ The map of Hungary is missing: Müller mentioned in one of his letters written to Marsigli in 1703 that he had half finished it (BUB Mss di Marsigli Vol. II. letter B. 63. p. 164. Nürnberg, May 12, 1703), still he probably drew the complete map of Hungary only in 1706 on the order of the Hungarian nobility. It was edited in 1709 and became a model for the cartographic depiction of the country in European cartography.

¹¹¹ Bonfini (Bonfinius) (born in Ancona around 1434 – died in Buda in 1503) was King Matthias's royal historiographer in Buda from 1486. He wrote the history of Hungary from the Huns to his time under the title *Rerum Hungaricarum Decades* (1495).

should be drawn up using the information he had acquired when the frontiers were being established, and based on the sketches concerning the Sava and Drava rivers. Finally, the genealogy of the Croatian families who were converted from Christianity to Islam should be added, even if the list was not complete. These notes suggest that although the manuscript seems to have been closed, the book was not really completed. Müller wrote about the circumstances of its development in his letters, now kept in Bologna¹¹². We shall speak about the role that Paulus Ritter from Croatia and an unknown maker of coats of arms played in the history of the book in the chapter dealing with the persons who assisted Marsigli.

3. The map of Croatia¹¹³

This richly coloured map lacks legends, is very important from a cartographic point of view. We do not know, however, who drew it, when it was drawn and for whom. According to the Italian entry in the Bologna catalogue, Marsigli made it for the Austrian emperor during the demarcation of the frontier. This statement is untrue concerning both the time of its preparation and its purpose.

First, the map could not be made prior to the demarcation and the ratification of the borders, since it depicts the final, accepted borderline along the Unna river with the characteristic gap above Novi.¹¹⁴

Second, had the map been made for the Austrian emperor it would not have remained in Marsigli's possession. It is more probable that the map was made for Marsigli himself. This seems to be supported by an legend on the map. The following remark can be read in Latin near *Ostrovitza* where three borders meet: *Domus natalitia familiae Zriniana; quam vero postmodum, cum arce Zerín, permutavit*, that is: *The famous Zrinyi family, who later moved to the castle of Új-Zrinyi, originated from here*. The manuscript bequest in Bologna reveals that Marsigli also studied the genealogy and history of the Zrinyi family who were famous fighters against the Turks.¹¹⁵

The map was apparently *drawn*, not by Marsigli, but by Müller. This supposition, based on certain, specific stylistic traits, is supported by its hydrographical characteristics and Müller's scale drawn using astronomically determined positions.

If we compare it with the map of Croatia in the volume concerning the states of the Hungarian Kingdom drawn by Müller,¹¹⁶ one where his authorship has already been demonstrated with documents,¹¹⁷ the map of Hungary published in 1709 and one of the frontier maps that can be found both in Vienna and Bologna,¹¹⁸ it becomes evident that Müller drew the map.¹¹⁹

In this regard, the legend on this last map provides the most important arguments for this map being Müller's work. *First*, Müller emphasised, *we ourselves determined the scale*

¹¹² BUB Mss di Marsigli Vol. 82. pp. 174-177. Joh. Chr. Müller; Nürnberg, April 17, 1703. Latin

¹¹³ BUB Mss di Marsigli Rotolo No. 23. Measurements: 104.5 cm x 92.5 cm (inner), 108 cm x 97 cm (outer)

¹¹⁴ The ultimate boundaries were ratified and ceremoniously announced on March 5, 1701.

¹¹⁵ BUB Mss di Marsigli Vol. 79. p. 191. Paulus Ritter. ZÁGRÁB, February 26, 1700. He was not yet able to send the genealogy of the Zrinyi family. He attached the treatise on the Bans of Slavonia as Marsigli requested.

¹¹⁶ BUB Mss di Marsigli Vol. 28. *Monarchia Hungarica in sua regna, principatus et ducatus divisa*

¹¹⁷ Deák Antal András: Die Nürnberger Hersteller der Ungarn- und Donau-Karten von L. F. Marsigli. In: W. Scharfe (Hrsg.): Gerhard Mercator und seine Zeit. 7. Kartographiehistorisches Colloquium Duisburg 1994. Vorträge und Berichte. Duisburg 1996. (= Duisburger Forschungen, Bd. 42) p. 211-216.

¹¹⁸ The Vienna version can be found in: Kriegsarchiv, Kartenabteilung B IX c 632.; the Bologna one in: BUB Mss di Marsigli Rotolo 29. On the Bologna version, neither the name nor the date is indicated, while Müller signed and dated the one which was sent to Vienna (1701). The measurements of the Bologna version are: 75x156 cm; the Vienna one can be seen on 75x50 cm, 75x55 cm and 75x51 cm sheets mounted on canvas. They have an inverse orientation. Scale: 1:450,000.

¹¹⁹ See Vol. 28.

indicated at the edge of the map after a few astronomical observations made during the work of the frontier commission; second, the course of larger rivers, such as the Unna river from Novi to its mouth, the Sava river from Zagreb to Mitrovitz [Mitrovica], the Tisza river from its mouth to Szeged and, the Maros river up to Déva were depicted along with their natural meanders from the data calculated by a compass.

The outlines of the rivers and the scale are identical on the four maps. This means that this nice map of Croatia, made to a scale, based on instrumental measurements and astronomical positions was made by Müller between 1701 and 1702¹²⁰ on the order of Marsigli.

Following Marsigli's and Müller's mapping activities along the borders, we witness exciting cartographic process and development. Before our very eyes, detailed surveys became the backbones for regional and partial national maps. The cartographic work done during the demarcation of the borders was important in regard to the Danube monograph as well. Müller, who drew the maps for the *Danubius*, grew to be a ripe and experienced cartographer during the years of the surveys. His and Marsigli's accurate surveys¹²¹ provided the basis for drawing the Danube river and the countries through which it flowed with an authenticity beyond their original function. These maps became the basis for other important maps such as the first commercial and postal maps of Hungary, and even the Danubian and Hungarian maps of the *Danubius Pannonico-Mysicus*, which were the models for the maps of Hungary made in Western Europe for nearly a century as well as the "large" map of Hungary depicting the Hungarian Kingdom and the Transylvanian Principality published in 1709, which exceeded all former maps in accuracy. Müller definitely hinted at the same in his legend saying that he had drawn the settlements, the mountains, the forests, the distances between the lakes and the boundaries of the provinces and countries with great care and ended his sentence with: *we borrowed all these faithfully and very accurately from extremely detailed manuscript maps*. Because of the Turkish occupation it had previously not been possible to produce similar maps.

Contemporaries also recognised the significance of Marsigli's and Müller's cartographic activities during the demarcation of the frontier. An oil painting is preserved in the Marsigli Museum in Bologna which commemorates the cartographic work which followed the peace treaty of Karlócza. The leader of the Turkish commission is sitting on the ground in front of his tent confusedly gazing at the map laid out in front of him, while self-confident Austrian imperial officers are standing by his sides. This is probably the first diplomatic scene in the world where a map is at the focus of a picture.

II. THE DANUBIUS ON THE WAY TO REALISATION

Marsigli proved to be a skilled organiser, not only on battlefields but also in the collection and organisation of the material for his Danube monograph and its preparation for printing. The material compressed in the book is more than the formulation of his own experiences, it is the summary of knowledge collected from the whole of Europe. Hungarian, Austrian, Italian, German, Swiss, English and Dutch scientists, artists and book handlers assisted him in his work.

HUNGARIAN SCIENTISTS IN MARSIGLI'S SERVICE

The darkest pages of Hungarian history were being written in the 16th - 17th centuries.

¹²⁰ As we have seen, he could not have drawn it earlier. If he had drawn it previously, it would have been discussed in the repeatedly quoted letters.

¹²¹ Wherever and whenever he could, Müller himself took part in the surveys. The courses and the bends in the rivers were checked by compasses and when they felt it necessary, the surveyors used their quadrant to determine their geographical position.

The Ottoman-Turkish army, pushing westwards, won an important victory over the army of the Hungarian aristocracy at Mohács in 1526 in which even the king perished. The central part of the country and Buda at its heart were ruled by the Turks for 150 years from 1541. The western parts of the country and Upper Northern Hungary remained under Austrian control, while the Transylvanian princes, who paid taxes to the Turks, had relatively independent control over their lands. In such circumstances, the flourishing cultural life of earlier times faded away. Only the few sons of less wealthy families who were sent to foreign universities by an ecclesiastic organisation or town received a higher education. Young Hungarian men from Transylvania even studied in Turkey.

Dávid Rosnyai¹²², an eminent scholar of old Hungarian literature who achieved fame with his name and work, also visited Istanbul in his youth. In 1701, he translated into Latin and sent to Marsigli, his history of Transylvania written in Turkish 36 years earlier. The book describes through 200 pages the history of the principality between 1525 and 1666.¹²³ We have found some of the documents which were associated with the manuscript.¹²⁴

Paulus Ritter, a scholar from Zagreb¹²⁵, also assisted Marsigli with historical data, genealogy, books and documents on Croatia and Slavonia and must have been an important influence. Once, on his return from visiting Marsigli who was serving in the southern part of the country, he wrote a letter in a 30 line verse addressed to his *patron*. He enclosed the requested coats of arms of the most eminent families of Croatia. He expressed his regrets in the letter that the coats-of-arms were so poorly painted, but he was not to be blamed since there were no qualified painters in Zagreb or in the whole country. At the beginning of the poem he highlights a picture of a bygone world: *Parted from you and departed from the castle, under Dersnik/ Me, the knight endowed with your blessed mercy/ Went to the bank of the river to ease my hunger/ And where a bridge spans the waves of the water/ My servants fried me fish and crayfish,/ Which they could catch in the water with their bare hands.*¹²⁶

In return for his services, he requested Marsigli to ask for 1000 thalers from the emperor for his book which was ready to be printed. Marsigli probably did his best, as he was

¹²² Dávid Rosnyai was the Turkish notary and interpreter of Mihály Apafi, the last Transylvanian prince. It was he who interpreted Ferenc Rákóczi II's Turkish letters (1641 Marosvásárhely – 1718 Fogaras). Hungarian historiography knows only his Hungarian historical studies (see: Sándor Szilágyi: *R., az utolsó török deák történeti maradványai*. Pest, 1867 [The historical traces of the last Turkish scribe]). The *Horologicum Turcicum*, his transcription of the Panchatantra, note no. 43, tells us that he lived in Constantinople at the age of 24 where he wrote the cited *Erdély története* [History of Transylvania] in Turkish.

¹²³ The introduction was written in a double circle, it can be translated as follows: The sorrowful events that took place in the east, in the west, in the south and in the north from the time of Emperor Ferdinand I and Bajezid Sultan and also from the days of László VI, Hungarian King, to the days of the victorious Emperor Leopold I and Sultan Mehemed IV, which Dávid Rosnai had written in Constantinople in Turkish with respect to the territory of Transylvania six years ago was translated into Latin for Christian people with no less care. It is now handed over with the greatest goodwill and obedience, to His Majesty's advisor, the captain of one of his famous troops, the most honourable leader of frontier demarcation, General Luigi Fernando Marsigli, his gracious patron and protector – in the year 1701 of our salvation. (We did not know of Dávid Rosnyai's work earlier. New data emerged about his life from these few quoted lines: he stayed in Constantinople in 1665 where he wrote the history of Transylvania between 1525-1665 in Turkish.) - BUB Mss di Marsigli BUB Vol. 103. pp. 390-490. F II. 3. 1701.

¹²⁴ BUB Vol. 103. pp 390-490. F II. 3. 1701.

¹²⁵ Vjekoslav Klaić: *Zivot i djela Pavla Rittera Vitezovica – 1652-1713*; U Zagrebu; Izdala Matica Hrvatska; Kartografski izvori za povijest Triplex Confinium; Cartographic sources for the history of the Triplex Confinium; Kartographische Quellen zur Geschichte des Triplex Confinium. Hrvatski drzavni arhiv Zavod za hrvatsku povijest Odsejka za povijest Filozofskog fakulteta u Zagrebu..

¹²⁶ BUB Mss di Marsigli Vol. 79. p. 40-41. P. Ritter to Marsigli. Zágráb, 9 October 1699.
Postquam a te redii, sub arce relicto,
Faustus amore tuo, et munere dives Eques;
Consedi fluminis primus pransurus ad amnem,
Qua firmo fluide ponte jugantur aquae,
Hic mihi pisciculos famuli, cancrosque paraunt,
Quos poterant nuda carpere in amne manu...

grateful to the bishopric of Zagreb as well which had helped him with historical data about the country. Marsigli made arrangements for several young men from Croatia to study theology in Bologna. The tone of this letter, however, implies that Marsigli forgot to return the books and the precious maps Ritter had given him. He was able to use them not only during the demarcation of the frontier but also in his earlier book entitled *The states of the Hungarian Kingdom*. The following topics are discussed in the manuscript which follows the maps:¹²⁷

The arrival of the Huns in Pannonia and the genealogy of Attila their king.

The second invasion of the Huns with the seven princes and King Stephen I's genealogy.

Genealogy of the kings of Bosnia. The genealogies of various Serbian kings and counts and of the despot Vuk Brankovich. The genealogy of the kings of Bulgaria followed by those from Transylvania and Wallachia.

The volume is ornamented with lovely, coloured coats-of-arms of the aristocracy. He even indicated with six different colours, *the blood* carried in the veins of the various rulers.

A scientist in Sopron called *Gruber*¹²⁸ sent Marsigli a study entitled *Status Daciae Antiquae* on July 24, 1702.¹²⁹ He promised in the letter to send him his report on the counties of Hungary although he was not yet ready with them. An unknown gentleman with the monogram *C. D.*, sent material from Sopron to Marsigli on the Pannonian, Dacian and Serbian legions. Concerning the history of Slavonia, he provided two book titles: *Historia Ecclesiasticae Ecclesiarum Slavonicarum*, Trajecti 1652 and *Helmoldi et Arnoldi: Cronica Slavonum...*, Lübeck, 1659.¹³⁰

Samuel *Rohfrey* (Samuel Rohfrey in Kreisbach) from Gyulafehérvár sent him descriptions of the minerals and the mining districts of Transylvania.¹³¹ He answered Marsigli's letter and request with the following statement: "*Transylvania is so rich in various ores that no European land can match it. Regrettably, however, there are very few people in Transylvania, who could exploit the treasures lying deep in the earth.*

The mountains hide metals in two regions. One, the mountains that begin at Gyulafehérvár and extend twelve miles over Körös-Bánya, is extremely rich in gold. The other one, from Kapnik toward Besztere in the land of the Seklers abounds in silver. In comparison with other gold mines in Hungary, gold mining is unbelievably easy here.

There are also ore and copper mines, but these latter no longer yeild much and have been abandoned. Antimony and cinnabar are also mined. And gold is washed from the rivers. The land is fabulous, not barren. There is little water in the mines except in those in the southern part of the region.

Yet, there is more salt in Transylvania than metal. Pure white salt, which is hard and heavy but dry, can be found in great abundance from Maramaros through Dés until the border of Wallachia and Moldva. It is often found exposed on the surface. There are many kinds of mineral waters, which can rival other European mineral waters in taste as well as in their healing powers."

Marsigli incorporated these pieces of information in his *Danubius*, similarly to a report by an *unknown person*, who wrote about the sulphuric springs in Transylvania. The topic appears in the *Danubius* in the following way: *In Transylvania, near the small county called Drik, close to the village of Accida, there are bitter springs and cold baths beside them..., and a deadly hole can be found in their vicinity.*¹³²

¹²⁷ BUB Vol. 103. pp 390-490. F II. 3. 1701.

¹²⁸ Perhaps Ádám Gruber, Lutheran minister in Sopron from 1692 to 1707. (Lajos Bartha).

¹²⁹ BUB Mss di Marsigli Vol. 82. Gruber; Sopron, 24. June, 1702. In Latin.

¹³⁰ BUB Mss di Marsigli Vol. 80. B. A letter by an unknown writer with the monogram C.D. Sopron, August 28, 1702.

¹³¹ BUB, Vol. 80. C. p. 70. Samuel Rohfrey; Gyulafehérvár (Alba Iulia), February 5, 1701. In Latin.

¹³² DPM, Vol. I. Pars III.

The letter from Ander Jacob *Schmidt*, a mining supervisor, also deals with mines. He sent a sketchy drawing of the mining establishments of Selmeč on a map following a survey on June 19, 1703 (with the names of 124 establishments).¹³³

The manuscript collection includes *Matthias Ethesius's* ink drawings of 4 shafts, all from 1688: the *Scemnitzer Berg Chart*, the drawing of the *Herrengrund* without a title, the depiction of the *Ratzengrunder Bergwerk* and the *Polnitzer Eisbergwerks inheimische Grube* from Selmečbánya.¹³⁴ The drawings are in colour and illustrated with figures holding lamps, adzes and wheelbarrows, as can be seen in the mine depictions published in the book.

INDIVIDUALS PROVIDING DATA FROM OUTSIDE THE TERRITORY OF THE HUNGARIAN MONARCHY¹³⁵

Italian scholars and artists

Marsigli's bequest contains letters from *G. D. Malpighi* (a member of the Royal Society) who introduced him to the basics of anatomy. He used this knowledge when he described and drew the dissection drawings and anatomy of eagles, the great sturgeon and the otter in the *Danubius* (Volume VI). He also asked his tutor's advice regarding the depictions of fish in his Danube monograph which was still in preparation. The tutor was very satisfied with them.¹³⁶ When he received Marsigli's report about the sensational discovery of Trajan's bridge on the Lower Danube,¹³⁷ he called his former pupil's attention to its depiction in Rome. The picture of this relief can be seen in the *Danubius* (Volume II).

From *Triofetti*, he learned botany. He listed the plants found growing along the course of the Danube in charts in Volume VI. Furthermore, many nicely coloured pictures are preserved in his bequest concerning the fruits growing in floodplains. Even fruit diseases are indicated in the drawings as well as succulent plants. *Guglielmini*, the author of a book about water, sent letters to Marsigli, who was serving and doing research in Hungary at that time, with instructions about the techniques used to measure the velocity of water.¹³⁸ In two of his letters he even drew the quadrant necessary for the measurements and explained the theory of behind its operation: ... *I applied a plumb line with a lead bob of about 6-7 pounds suspended from an AB cord depending on the speed of the river, although I think 10-12 pounds would be appropriate on the Danube. The AB cord should as strong, thin and light as possible. When the water is calm, the AB cord runs vertically into the depths, but when it flows, the cord will diverge to a certain extent in the direction of the flow, while it creates an AB angle varying in degree depending on the water speed, which can be read on an AEF quadrant.* Marsigli measured the velocity of the water on the Tisza, the Danube, the Drava and the Sava rivers. The resulting measurements can be found in volume VI of the Danube monograph together with the sites where the measurements were made. The drawing of Guglielmini's velocimeter quadrant was more than once used in the book as an ornamental drawing.

Cassini, the renowned astronomer, sent him instructions in long letters about the skills needed for calculating astronomical position.¹³⁹ In the Danube monograph he remembered his tutor with grateful words and called him his paternal friend and one who *loved him as his*

¹³³ BUB Mss di Marsigli Vol. 25.

¹³⁴ BUB Mss di Marsigli Vol. 11.

¹³⁵ This is how Marsigli calls the Hungarian Kingdom.

¹³⁶ ...le figure de i pesci con grandissima diligenza et arte

¹³⁷ BUB Mss di Marsigli Vol. 79. Letter no. 2, Rome, 4 April 1693; Vol. 79. Letter no. 1; Rome, 30 August 1693.

¹³⁸ BUB, Mss Marsigli, Vol. 79. pp. 46 - 47. Bologna, 30 August 1692 and Vol. 79. pp. 48-50.

¹³⁹ BUB Mss di Marsigli Vol. I. and Vol. II. *Eruditorum epistolae ad Marsilium.*

son.¹⁴⁰ About fifty letters from him were preserved in Marsigli's bequest. In one of them, for example, Cassini wrote that he had read out his theory on the movements of the moons of Jupiter to the Royal Academy and described his method of measuring larger distances based on astronomical position. *Terrestrial measurements*, he said, *however carefully they are made, aggregate measurement errors, and the distances measured on journeys overland or during sea voyages can conceal mistakes*. He emphasised the importance of longitude measurements. The geographical maps, which had been recently edited in Italy at that time, were much better than other, much more famous and widespread geographical maps because they contained fewer errors in longitude. However, a good telescope was needed for geographical position to observe the eclipses of the moons of Jupiter, and a precise watch with a second-hand. All the astronomers in the world who make similar observations should be furnished with similar instruments.¹⁴¹ After this letter Marsigli hastened to contact *Georg Christoph Eimmart*¹⁴² with a request that a portable instrument be prepared that would be suitable for measuring the distances between planets. By May 1696, Eimmart reported that he had already come up with the theoretical design for the sextant and made its drawing as well. He also negotiated with the technician who would make the instrument. It would cost about 60 thalers, which might seem expensive at first glance except that the sextant would take the technician two months to make. The letter also revealed that Marsigli had already measured geographical distances in Vienna and that he was asking for the opinion of the expert from Nürnberg.¹⁴³ Furthermore, he asked for a good telescope from Eimmart, one that was similar to Cassini's. Eimmart, however, declined his request. He thought that the instrument should be ordered in Italy, because the best lenses of the time were made there.

Francesco D. Maria, *Francia* from Bologna, was given the most important task of all the Italian masters concerning the preparation of the *Danubius Pannonico-Mysicus*.¹⁴⁴ Both Eimmart and Müller mention in their letters that the *Minerals* volume was engraved in Italy. They, however, did not tell the name of the engraver. We learned from Lelio Trionfetti that having seen the engravings, Müller expressed his great admiration for *Maria Franca's* art, although he did not know him.¹⁴⁵ Another document mentions that Marsigli paid 100 liras to *Franza* (sic!).¹⁴⁶ A three volume collection of engravings is kept in the Bibliotheca Univesitaria in Bologna, composed by *Francia* himself from his *oeuvre*.

Scattered in the free spaces of these volumes, *Francia* inserted some illustrations from the *Danubius*, verifying the evidence in the above argument.¹⁴⁷

Trionfetti, who seems to have been an intermediary between Marsigli and *Francia*, wrote in his letter of April 19, 1703 that Marsigli had also been very pleased with the prints

¹⁴⁰ Danubius Pannonico-Mysicus Vol. I. Pars II. Introduction.

¹⁴¹ BUB Mss di Marsigli. Domenico Cassini's letter to Marsigli Vol. 79. pp. 71-72. Bologna, 20 November 1695.

¹⁴² Georg Christoph Eimmart (1638-1705), a copperplate engraver, mathematician, astronomer and skilled precision instrument maker. He established a private observatory in Nürnberg, which he later donated to its citizens.

¹⁴³ BUB Mss di Marsigli. G. C. Eimmart's letter to Marsiglihoz, Nürnberg, 25 May 1696. (In Latin) Vol. 79, 78.

¹⁴⁴ *Francia* Francesco D. Maria (Bologna, October 17, 1657 –January 31, 1735) As a copperplate engraver he worked with G.M. Mitelivel and Lodovico Mattiolival. As an illustrator of books he drew many frontspieces. Bologna, Bibl. Univ. A.V.Tab. III. E.I.2. Vol. I-III. The individual engravings do not follow a strict chronological order, and his illustrations made for Marsigli's book are also distributed throughout the chapters. In volume I he drew Roman coins, initials and minerals.

¹⁴⁵ BUB Mss di Marsigli Vol. 82. p. 27. Lelio Trionfetti; Bologna, January 23, 1703, in Italian.

"Inviai a Vestra Ecc. in una mia fino delli 24. ottb. /comsegnava al S. Simiani/ una mostra del primo Intaglio de minerali fatto dal S. Francia e spettante al di Lei Tomo, quale Intaglio per esser il primo /non avendo esso - Francia - per l addietro mai intagliato cose simili/ non penso debba apparire il migliore fra gli altri che non faccendo come appunti questi altri, che qui annessi si trasmettono potra farne il confronto..."

¹⁴⁶ BUB Mss di Marsigli Vol. 82. p. 51. "Contos Netto Della distribuzione delle due milla lire ultimamente spedite per cambio da S. Exxellenza Al Franza a conto 100".

¹⁴⁷ *Francia* Intaglji. Vol. I-III. BUB Mss di Marsigli A.v. Tab. III. E. I.2.

he had received.¹⁴⁸

The manuscript was even modified just before publication. I found a list of Marsigli's expenses in the above-mentioned *Archivio di Stato*.¹⁴⁹ Among other things, *he paid an unnamed person for five frontispiece drawings, which were still missing and for six ornamental drawings and the initials of the all the volumes*. Signore Ghizzi from Rome, who drew the frontispiece of the volume on Roman antiquities, asked for a box of mortadella instead of money. He paid 35 florenas to Sig. Dottor *Margagni* for the anatomical drawings of great sturgeons in volume VI and to an unknown person for two other great sturgeon depictions.¹⁵⁰ In April 1725, a Sig. Dott. Ant. Matelocci was paid 12.10 florenas for certain drawings. The list of expenses also contained the price for wrapping the work that was to be transported from Bologna to Amsterdam through Verona (14 florenas) and the sum paid to copiers who worked six months on the book in Bologna (22 florenas).

The Nürnberg workshop

The Danube monograph mainly took its final form in Nürnberg in 1702-1703. Georg Christoph *Eimmart*, whom Marsigli probably had contacted when astronomical problems came up, co-ordinated the work. The renown astronomer and copperplate engraver's letters to Marsigli only suggest how their relationship started. Marsigli's attention may have been caught by Eimmart's observations concerning Jupiter and the Moon. We also know, as previously mentioned, that Marsigli would have liked to order a portable sextant. Eimmart agreed that he would design and have it prepared.¹⁵¹ He even undertook the construction of an instrument designed by Professor Sturm and executed by a mechanic that could produce vacuum.¹⁵² Both letters deal with the technique for determining longitudinal position. Eimmart found the observation of Jupiter to be the best method but accepted that the observation of the phases of the Moon was also useful. These planets, together with their drawings, were given particular attention in his book.¹⁵³ He praised Marsigli's Jupiter observations made in Vienna and sent him lists of books, a catalogue of books on natural history by German authors and even books to a military camp somewhere in Hungary. It was not, as it turned out, simply a friendly favor. He had received, he said, what he was due for his services. Eimmart won Marsigli's unconditional confidence. He told the German master that the emperor had granted him two thousand florenas for the preparation of the Danube book, and even invited him to Hungary to draw maps.¹⁵⁴ Eimmart declined the respectful request and proposed instead his 23-year-old student, Johann Christoph Müller,¹⁵⁵ who seemed to be more suited for such an adventure.

¹⁴⁸ BUB Mss di Marsigli Vol. 82. p. 129. Lelio Trionfetti; Bologna, 19. April 1703. In Italian.

¹⁴⁹ *Archivio di Stato*, Bologna; Assunteria di Istituto - *Diversorum* - B.n. 7. fasc. 5.

¹⁵⁰ The currency is not named in the text, only the character Σ marks the sums.

¹⁵¹ BUB Mss di Marsigli Vol. 79. p. 78. Nürnberg, 25 May 1696.

¹⁵² BUB Mss di Marsigli Vol. 79. p. 79. Nürnberg, 22 June 1696.

¹⁵³ Vol. I. Pars II. According to Eimmart, the moon-method requires simultaneous measurements from two distant spots. Certain spots on the eastern side of the moon should be determined when it is waning and the spots on the western side when it is waxing. With this method thought Eimmart, one could determine the distance of the moon from the meridian of the Sun and also from the fixed stars on the zenith.

¹⁵⁴ BUB Mss di Marsigli Vol. 79. pp. 81-82. Nürnberg, November 16, 1696. Dürer's complete works, which are available for 300 florenas, astronomical problems and available books are also discussed in the letter.

¹⁵⁵ Müller was talented in mathematics, mapdrawing, astronomical observations and drawing, perfectly fulfilled the task of a secretary and proved to be an ideal collaborator. For seven years he worked hard in his patron Marsigli's service. He collected and organised the data for Marsigli's main work, the *Danubius Pannonico-Mysicus*, drew the Roman monuments *in situ* and made maps of the way they occurred. His astronomical observations helped in the determination of the direction of the courses of the Danube and the Tisza. Parallely, he drew maps based on Marsigli's demands, almost without break. This was especially the case in the period between May 1702 and the autumn of 1703, when he drew maps, from dawn to dusk, according to Marsigli's wishes and instructions. In one of his letters to his former master, Marsigli mentioned Eimmart's room.

A few months later, in the spring of 1697, Marsigli was looking for people who could help in the preparation of his book.¹⁵⁶ He asked Eimmart the following questions: 1. Are there experts in Nürnberg who could engrave the figures in the book on copperplate? Answer: There are. 2. Would these artists be willing to move to Vienna to work there on the book? The answer was, after some apologies: No. 3. How much would they ask for their work? Answer: Less than the French. 4. Would there be an experienced expert among them who could be charged with the supervision of the work? The answer (put simply): Yes, Eimmart himself.

The people from Nürnberg did not send word until 1700.¹⁵⁷ Sturm saw the text of the *Produmus*¹⁵⁸ at Eimmart's and heard that only the engraving of a few figures was missing.¹⁵⁹ Could this have been Eimmart's prototypic work? Namely, in the summer of the next year, he had already signed a bill concerning a large sum, since, as he wrote, he would soon finish the Antiquities volume, volume II of the Danube monograph concerning Roman antiquities.¹⁶⁰

He had already engraved in copperplate, Eimmart wrote, two of the previously sent pictures of forts and ruins in Hungary, and two more remained. As soon as he finished them, he would start to work on the volume about birds.¹⁶¹ Nevertheless, it can also be read from Eimmart's letters written in August and September that the work did not proceed smoothly. The greatest problems were financial in character. For example, he could not engrave the picture of the famous Römerschatz¹⁶² on copper because he did not have money. Some more drawings arrived meant for the Roman antiquities volume as well, and, in parallel with the volume of the birds, he also engraved insects on copper. By September 24 he had completed the engraving of 54 insects.¹⁶³ The letter contained two more interesting pieces of information. First, it revealed that Marsigli had met *Clara*, Eimmart's daughter, in Nürnberg, who was also a renowned astronomer. Since then he had sent her a fox pelt, and second, *Joh. Heinrich Müller*, the distinguished professor of mathematics and physics at the University of Altdorf and Eimmart's daughter's husband, was already a member of the team.¹⁶⁴

Eimmart happily replied in November of the same year that he had received the 100 florenas for the engraving of the insects.¹⁶⁵ The letter implies that Marsigli found Eimmart's work expensive. And while excusing himself for the expenses incurred when working on the Birds volume, he conveyed the impression that he himself had engraved the volume of Fishes as well: *If you consider that he had engraved 41 copperplates for the fish volume*, he wrote, *he had much more work with the birds, especially because they had to be reduced to a certain size*. Sums were also mentioned: 71 plates had cost 355 florenas, so if he wanted to make a profit on the work, he had to ask 500 florenas. The name of another eminent collaborator also appeared: August Christian *Fleischmann* engraved the legends for the figures.

I have found a copy of a contract dated to about a year later among Marsigli's manuscripts. In this contract, Eimmart undertook to prepare the Geography volume as well, except for the legends. For this work he would get 650 florenas including the price of the copperplates.¹⁶⁶ I will quote from the contract written in German but translated here:

¹⁵⁶ BUB Mss di Marsigli Vol. 79. pp. 89-90. Nürnberg, May 10, 1697.

¹⁵⁷ BUB Mss di Marsigli Vol. 80. C. p. 8. Joh. Christoph Sturm's (Sturmus) letter to Marsigli. Altdorf, September 3, 1700.

¹⁵⁸ The promotion of the Danube monograph.

¹⁵⁹ This message suggests that Eimmart engraved the illustrations for the *Produmus*.

¹⁶⁰ BUB Mss di Marsigli Vol. 79. p. 203. Nürnberg, 23 June 1701; p. 204. July 9, 1701, and *ibid.* July 23.

¹⁶¹ BUB Mss di Marsigli Vol. 79. p. 205. Nürnberg, July 23, 1701.

¹⁶² Ever since, archaeologists have been unable to agree on the origin and function of the cited Roman rampart.

¹⁶³ BUB Mss di Marsigli Vol. 79. II. Nürnberg, September 24, 1701. Eimmart's letter to Marsigli.

¹⁶⁴ Doppelmayer: *Historische Nachricht von den Nürnbergischen Mathematicis und Künstlern*. Nürnberg, In Verlegung Peter Conrad Monaths, 1730.

¹⁶⁵ BUB Mss di Marsigli Vol. 79. Nürnberg, 1 November 1701.

¹⁶⁶ BUB Mss di Marsigli Vol. 82. pp. 52-53. Joh. Chr. Müller; Nürnberg, January 6, 1702. In Latin and German.

Today, on 2 July 1702, the undersigned parties entered into the following agreement:

First: Mr Eimmart finishes, with full dedication, what remains from the “Roman antiquities” volume in the Danube monograph. In return, His Excellency General Marsigli hands over 327 florenas as fee and including the price of copperplate.

Second: Mr Eimmart similarly will prepare the “Geography volume”, except for the legends, for which his fee will be 650 florenas, including the price of the copperplate.

Altogether 1803 florenas.

(L. S.) Luigi Ferdinando Marsigli (L. S.) Georg Christoph Eimmart

Eimmart’s work was continuously hampered by financial shortages: he had finished two large figures from the Geography volume by August 10, but made the rest of the work depend on the arrival of the *graciously promised money*.¹⁶⁷ It can be felt from his following letters that he had lost confidence and carried out his work more and more haphazardly. This was in part the result of ever new figures which arrived to be included in volumes he had thought finished, and in part related to the fact that the engraving of the map exceeded his skills. A gentleman called Schoder (Schoeder)¹⁶⁸ who highly estimated Fleischmann, immediately took steps. As soon as he learned that Marsigli did not like the test prints of the Danube sections,¹⁶⁹ he penned a letter to expound his opinion of Eimmart saying that *he was not suitable for such a large task... Fleischman is the only suitable artist*.¹⁷⁰ Eimmart was stricken to feel that he gradually lost Marsigli’s confidence. Perhaps this was the reason why he felt it necessary to make an account of his work accomplished in 1702 and the sums he had touched.¹⁷¹ *An account of the sums I received in 1702 from His Excellency General Count Marsigli in accordance with the contract:*

		<i>for myself</i>
On July 21		100
On September 4	200	
Of which Mr Schoder and Mr Müller received each 30 florenas – this is altogether:	60	140
On October 16	200	
Of which Mr Schoder recieved	80	
Mr Müller	30	90
On January 30, 1703	600	
of which Mr Schoder recieved	60	
Mr Müller for parchment	50	390
.....		
The sum I received for myself:		720

The following account can be found on a 10x15 cm piece of paper together with the above document, also from Eimmart:¹⁷²

The list of the things that I, G. C. Eimmart, had to prepare for the Danube monograph, and

¹⁶⁷ BUB Mss di Marsigli Vol. 80. B p. 238. Nürnberg, August 10, 1702.

¹⁶⁸ BUB Mss di Marsigli Vol. 80. B Nürnberg October 18, 1702.

¹⁶⁹ BUB Mss di Marsigli Vol. 80. B p. 116. Nürnberg, October 13, 1702.

¹⁷⁰ BUB Mss di Marsigli Vol. 80. B , Nürnberg, October 18, 1702.

¹⁷¹ BUB Mss di Marsigli Vol. 82. pp. 52-53. Joh. Chr. Müller; Nürnberg, January 6, 1703. In Latin.

¹⁷² The document is not dated. It can be found between the pages of letter BUB Mss di Marsigli Vol. 82 No. 46.

<i>the sums that were allocated for copperplate and fees:</i>	
<i>For the Geography volume</i>	290
<i>For the Astronomy volume</i>	330
<i>For the Roman antiquities volume</i>	327
<i>For the Birds volume</i>	826
<i>Furthermore for Diana and a bull's head for the volume on miscellaneous observations</i>	30
.....	
<i>Altogether in accordance with the contract</i>	1803
<i>Works accomplished up to now:</i>	
<i>Half of the Birds volume, for which as fee and the copperplates</i>	413
<i>The entire Roman antiquities volume</i>	327
.....	
<i>Altogether:</i>	740

In the meantime, his student, J.C. Müller's respect began to fade. A certain superiority towards his former master can be felt in Müller's letters to Marsigli written in this period. When Marsigli asked Müller to advise Eimmart on how to find a way of using sufficiently fine lines he pleaded *he was not to blame that Eimmart did not work up to Marsigli's standards.*¹⁷³ *He had explained him how the lines of the Danube sections should be engraved and Eimmart had promised do so, but the result appeared to be the contrary. He had carried out the work on the Buda section with great care to show Eimmart how fine the lines should be that he used. If the repeated trials should prove fruitless, he suggested that Fleischmann be charged with the work, who, it seemed, was born for such fine jobs.*

Eimmart became sick and spent the winter in bed so he had not finished anything apart from the Antiquities volume, Müller reported to Marsigli, but as soon as he recovered, he would start engraving the astronomical part of the Geography volume.¹⁷⁴

The work was finally accomplished by Fleischmann after Eimmart's death.¹⁷⁵

August Christian *Fleischmann* was originally charged with the engraving of the legends of the figures since he was an expert in the use of fine lines. One of Müller's letters tells us that he engraved the legends on the maps as well.¹⁷⁶ It is possible that he would have been given the work of engraving the 18 Danube sections if Marsigli had not fallen out of favor with the emperor in 1704. Even Müller, and especially Schoder, who we shall meet later, would have liked to pass this part of the work on to him. The fruits of lobbying for Fleischmann, however, never had time to ripen. The consequences of an unexpected turn in the Spanish war of succession, led to fatal consequences for Marsigli and his work. At that time Marsigli was serving on the German front and this was where Müller and his colleagues sent him the test drawings and prints for checking.

The unexpected end of Marsigli's military career was connected with the castle of Breisach where he served as deputy to the Castellan, Count Arco. Since some of their canons had been taken to Freiburg and not been returned as requested, until the enemy arrived, they decided to surrender the castle to the French who were superior in number in the hope of being allowed to retreat freely, saving the lives of the soldiers. The Castellan Count Arco was beheaded, while Marsigli was humiliated and dispossessed. The decree concerning his fall from favour was delivered to him on February 25, 1704. He went into exile in France. This

¹⁷³ BUB Mss di Marsigli Vol. 80. B. pp. 112 – 115. Nürnberg, October 11, 1702.

¹⁷⁴ BUB Mss di Marsigli Vol. 82. pp. 118-119. Nürnberg, February 2, 1703.

¹⁷⁵ BUB Mss di Marsigli Vol. 80. C, pp. 33-34. Joh. Heinrich Müller, Nürnberg, March 19, 1705.

¹⁷⁶ BUB Mss di Marsigli Vol. 82. II. 94. J. C. Müller, Nürnberg, September 8, 1702. (Fleischmann has finished one of the works and will soon be ready with the other. He has completed the engraving of the two Danube sections. He will draft the next one in ink to work out how the inscriptions should be arranged.)

determined the fate of the Danube monograph as well since he lost the support of the emperor. He had to steal the plates of his figures away from Nürnberg. The situation became even more complicated with Eimmart's death (January 1704) since the engraving of some of the illustrations was left to Fleischmann who was insecure and untrusting in financial matters, and who did not respect Marsigli's reduced financial situation. Thus, he was not willing to obey his commissioner's order to carefully wrap up the ready plates and hand them over to Baron Löffelholz until he had been given the entire sum of his fee. Namely, Fleischmann had undertaken the part of the work Eimmart was unable to finish. This was not entirely covered by the 458 florenas that were his due and which he finally got. Marsigli asked Heinrich Müller to mediate and Fleischmann was finally willing to hand him over the plates in return for a guarantee. J. H. Müller collected Marsigli's notes and manuscripts in boxes and, together with the plates, passed them on to Baron Löffelholz on March 19.¹⁷⁷

Marsigli asked for other people's help in the ultimate composition of the figures as well as of the text. I. We know from the balance of the paid sums and from one of J. C. Müller's letters that Schoder (Schoeder), mentioned earlier, had intrigued against Eimmart and organised Marsigli's text. Müller wrote Marsigli that he had handed over everything that Marsigli had requested to Löffelholz. Among *other things this included the volume on Roman antiquities as organised and annotated by Dr. Schoder*.¹⁷⁸ Schoeder had won Marsigli's confidence with his previous work. He had a prominent role in preparing for printing and translation (into Latin)¹⁷⁹ the books on coffee¹⁸⁰ and phosphorus.¹⁸¹

J. C. Müller played the most important role in the collection of the material for the Danube monograph and in the drawing of its figures. His work in Marsigli's service can be divided into three periods.

We have already described the period of *frontier demarcation*.

From the point of view of the *Danubius*, he had an important job before this phase as well. Marsigli made him responsible, not only for astronomical observations and the drawing of maps, but also involved him *in the collection and organisation of the material for the book and the ultimate resolution of the texts and the illustration*. Several pages have survived among the manuscripts in Bologna that carry Müller's marks. Since they are single sheets without dates and names, only the context and the stylistic traits suggest when they were made and by whom. To illustrate Müller's role in the first phase of the preparation of the book we shall cite some maps and drawings, without aiming at completeness, which were included mainly in volumes I and II.

Of the *maps*, it is the *Mappa Generalis* that grabs one's attention at first glance. It depicts the Hungarian and Serbian reaches of the Danube. Its size is impressive and the drawing has an imposing three-dimensionality. Marsigli was aware that the depiction of the Danube, which he designed from many sketches, numerous personal experiences and using astronomical positionings, would determine the new cartographic picture of Hungary as well. Until then, however, the road would be long and rough. The various versions kept in Bologna bear witness to the evolution of the representation.

A *Danube monograph version in two volumes*, which Marsigli dedicated to Emperor Leopold also survived.¹⁸² The volumes each consist of three parts. Volume I was to have dealt with the Danube from Kahlenberg to Jantra, with a summary map and 20 section drawings, as well as the plants, animals and Roman antiquities found along the way.

Volume II would have collected the geographic maps of the war-ravaged territories of

¹⁷⁷ BUB Mss di Marsigli Vol. 80. C pp. 33-34. Johann Heinrich Müller's letter to Marsigli, Nürnberg, March 19, 1705.

¹⁷⁸ BUB Mss di Marsigli Vol. 82. Letter no. II. 67. pp. 174-177. Nürnberg, April 17, 1703.

¹⁷⁹ BUB Mss di Marsigli Vol. 82. Letter no. 104. Nürnberg, September 11, 1702. Schoeder's letter to Marsigli.

¹⁸⁰ *Bevanda Asiatica*, brindata all'eminetissimo Buonvisi, Nunzio Apostolico. Vienna, 1685.

¹⁸¹ *Dissertazione epistolare del fosforo minerale o sia dell pietra illuminabile Bolognese...* Lipsia, 1698

¹⁸² BUB Mss di Marsigli Vol. 12.

Hungary, natural scientific observations and monuments in countryside towns. The *Danube map* in the volume shows the old, traditional concept: the Danube still runs eastwards at Vác. The colouring lacks taste and the map itself is confusing. It is possible that this failure prompted Marsigli to look for a good cartographer in Nürnberg. This means that the map must have been made before Müller's arrival (1696). The dedication of the book, however, came from after 1697, since it mentions the final victory (the battle of Zenta) as a recent experience. The sheet with the legend *Mappa Geographica Antiquitatum Romanorum Militarium*¹⁸³ was made after this map, although the morphological and contextual elements already hint at Müller's hand. We know of a draft version of it as well: the place of the legend was marked in by pencil and the remark *dahero man recht seyn kann*¹⁸⁴ was written there in brown gall ink.¹⁸⁵ The legend of the final version was in Latin and the map itself was finely designed and coloured: The Danube, the Tisza, the Adriatic Sea and the Black Sea are green, the mountains are grey. It ranks as a masterwork. The course of the Danube, however, is traditional, just as on the map that served as its model.

Müller drew the sheet with the legend *Theatrum antiquitatum Romanorum in Hungaria*¹⁸⁶, which was probably a working copy sent to Marsigli in the camp. This is suggested by the traces from three wax seals and the additions written on small pieces of paper and glued to the page later on by someone other than Müller.¹⁸⁷

Of the geographical maps in volume I, three versions have survived of the *Mappa Potamographica* (hydrographical map). The first¹⁸⁸ depicts a similarly false and traditional hydrographical picture as the above-mentioned *Mappa Generalis*¹⁸⁹. Yet this could be the source of the version on which Müller drew the correct course of the Danube. The depth, speed and water level differences were measured at two places on the Tisza – below Szeged and at the mouth of the Maros river - below the Karaza [Karasica] river, at Pétervárad, before Belgrade and also before the Morava and the Kerka rivers on the Danube, and at two places before Belgrade on the Sava river. Müller marked these places with short red lines.¹⁹⁰ The lines of intersections marked by ABCD, which may be found in the volume, are already present on both previous versions.

Several drafts of Müller's maps have survived. These include one *from Margaret Island to Arasti* (Dunaharaszti)¹⁹¹ or another one of Petrovatz¹⁹² with the quadrangular ditch of the earthen fort shown on it. The map shows the swamps around the earthen fort and the ditch running toward Kopinik and Mitrovitz [Mitrovica]. In the same place, he depicted the ground plan of the earthen fort between Mitrovitz [Mitrovica] and Nagjalos (?) in Sirmium. Facing the legend in Latin, there is a German remark on the right side of the picture: *Hier unten ist ein breiter Wall*.¹⁹³ Müller's drawing can be seen on a version of this sheet as well: *Motrovitz Sirmii olim Metropolis rudibus suis antiquioribus, huc representata*.¹⁹⁴ The Sava river runs along the upper edge of the picture, the letters *a* and *b* mark antiquities and a paved road is shown on the left side. Underneath, drawings of these features are enlarged to 21 x 30 and 11 x 13 cm, and two stone fragments with birds depicted on them are depicted with the remark: *Fragmenta lapidum in Mortovitz*.¹⁹⁵ Another drawing showed the village of Vinkovci

¹⁸³ Geographical map of Roman military monuments.

¹⁸⁴ You can make adjustments to this.

¹⁸⁵ BUB Mss di Marsigli Vol. 6. p. 1. and p. 2. Measurement: 51 x 75 cm

¹⁸⁶ The sites of Roman antiquities in Hungary.

¹⁸⁷ BUB Mss di Marsigli Vol. 32. Measurements: 31 x 65 cm. E.g. Completion above Eszél: *Pons ligeneus a Turcis superiectus in aggere terra, et lapidibus a Romanis strato*

¹⁸⁸ BUB Mss di Marsigli Vol. 46. p. 12. Measurements: 51 x 71,5 cm

¹⁸⁹ Summary map, on which the borders of the 18 sections were indicated.

¹⁹⁰ BUB Mss di Marsigli Vol. 46. p. 14. 47 x 73,5 cm, with scale

¹⁹¹ BUB Mss di Marsigli Vol. 6. p. 8. 51 x 36,5 cm

¹⁹² BUB Mss di Marsigli Vol. 6. p. 51. 20 x 32 cm and 21 x 32 cm

¹⁹³ There is a broad valley down here.

¹⁹⁴ The oldest ruins of Mitrovitz, the former capital of Sirmium, are shown here.

¹⁹⁵ Stone fragments from Mitrovitz.

and two ramparts in its vicinity.¹⁹⁶ He remarked at Vinkovci that it was surrounded by a Roman rampart. The water flowed into the ditch through the Herbenitz channel which branched off the Vuka river. He drew profiles of both ramparts and provided a stepped scale. There are drawings from Müller that he made on spot and on which he noted the height, width and depth of the stones in German.¹⁹⁷ On page 56, he drew a Roman rampart, which was called *Nadrany*, he said, and which could be found one and a half hours' walk from the Maros river at a right angle to it, eight hours' walk from Szeged and two and a half hours' walk down from the village of Betska [Pécska]. He drew an outline of the profile of the rampart in the upper left corner.

Many more of Müller's figures exist beside ones listed here. The drawings made on spot and the figures that decorated the Roman antiquities volume deserve special mention. Nearly one hundred of these drawings can be found in the Marsigli archives.¹⁹⁸ Müller played the lion's share in the final shaping and organisation of the figures. There are also numerous drawings on which a piece of paper containing the final versions of the legends was later glued onto the map by Müller.¹⁹⁹

The *third period* in Müller's work in Marsigli's service can be dated to between 1702 and 1704. At that time, he was already in Nürnberg.: *After I had chosen a place in Mr Eimmart's house where I could comfortably pursue my studies and work, the first thing I did was to prepare a sample of the Danube section maps so that Your Honour could tell his opinion. Two are already finished. Mr Fleischman has only to engrave the names on them –* he wrote to Marsigli, who was at that time fighting against the French in the war of succession. It was probably there and approximately at that time that Müller prepared his lovely Danube maps, which were to be the highest quality illustrations in the book. The manuscript items, after which the engravings were drawn, have survived in a separate volume. Although somewhat worn, they are beautiful.²⁰⁰ The coloured figures of the Roman antiquities were also collected in a separate volume.²⁰¹ Due to the wartime circumstances, however, they struggled with communication difficulties. Marsigli's assistants in Nürnberg were also afraid that their work would be lost. Nevertheless, Marsigli insisted on seeing the Danube section drawings, so he asked them to send samples. Müller sent two sheets of each section and eagerly awaited his *patron's* opinion. He chose the sheets that contained the greatest number of characteristic elements: *I have, so-to-say, lifted them out from among the others since they contain all the features that can be found in the rest as well, namely, a little of the mountains, the forests, the swamps, the banks – both sandy and rocky; at the same time, they illustrate what tasks await Mr Eimmart's copperplate engraving art.-* he wrote.²⁰² A month later they were still looking for the right concept for representation. He drew the borderline running along the Sava not in the middle of the river but along the bank. He did it after deep consideration and after seeking the advice of others. He considered the river a single and undivided unit, which contains nothing that could exclusively belong either to the Austrian or the Turkish emperor. The division of the river would also contradict the spirit of the peace treaty. Nor could he leave the drawing of the borderline to the end, as Marsigli had wished, since if he applied colour on the black contours of the mountains at the end it would show through and spoil the map.²⁰³

¹⁹⁶ BUB Mss di Marsigli Vol. 6. 52.

¹⁹⁷ BUB Mss di Marsigli Vol. 6. p. version no. 78.

¹⁹⁸ BUB Mss di Marsigli Vol. 6. Especially pp. 54, 55, 59.

¹⁹⁹ BUB Mss di Marsigli Vol. 6. Especially pp. 61-86.

²⁰⁰ BUB Mss di Marsigli Vol. 31. After the 18 sections we can find the 14 depictions of the moon, the hydrographical maps and the prints of the soils in the Danube basin, the banks and plates 38-46.

²⁰¹ BUB Mss di Marsigli Vol. 32. Made by J. C. Müller.

²⁰² BUB Mss di Marsigli Vol. 82. pp. 279-280, letter no. 103 from Müller to Marsigli, Nürnberg, September 18, 1702

²⁰³ BUB Mss di Marsigli Vol. 80 B. pp. 112-115. Nürnberg, October 11, 1702. (He also expresses his joy that the astronomical matters in Bologna have been successful and the idea that was born yesterday has

After another month it turned out that Marsigli was pleased neither with the Buda section or Eimmart's work. Müller promised in a letter that he would do his best to redraw the disputed section according to Marsigli's taste but, as he said, *he could not direct Eimmart's hands*. In parallel, he was working on the frontier sections as well, he wrote, 14 of which had been finished, *although he could hardly draw more than two in a week*. And he was happy that Marsigli had sent his fee, because he could free himself of his debts. A month later Müller was confronted with some difficulties: an Roman inscription had gotten mixed up in the *Roman antiquities* volume and he wanted to know where to put it. It was the inscription, he wrote, that Marsigli had had sent him to Vienna when he was last time in Sopron and when he had written that he had found it in the village of Orka. But he had to know if the village could be found in Sopron's environs or somewhere else, if he wanted to put the inscription in the right place. He had to stop working on the frontier sections as well, because he had come to the territories *beyond the Danube* and could not decide if he should start from the interfluvium of the Danube and the Tisza. At the same time, he sent a sample to check if he had placed the names of the provinces properly. At the end of the letter, we can read Eimmart's lines in a postscript: he had run out of money and could not pay Müller to buy parchment.²⁰⁴ According to Müller, there was a slight misrepresentation in the matter: Eimmart had spent the 30 florenas intended for Müller to buy parchment on copperplates, Müller complained, and he could not get on with his work.²⁰⁵ A few days later Müller sent his sixth unanswered letter. He complained once again that he had had to suspend work due to a lack of money and parchment.²⁰⁶ He had, however, finished the drawing of the Danube sections, and they were ready to be engraved in copper.²⁰⁷ We can also imagine after seeing these the letters, the great care with which Müller worked on the Danube sections: a Danube section, especially the one of the Szigetköz, took at least as much time as two frontier sections, he said.²⁰⁸ He also intended this comment as a response to Marsigli's accusation that they always pressed him for money, although the work proceeded slowly and there was little progress. In his reply, Müller made a comparison of the work he had accomplished and the maps that still awaited drawing. It reveals that he suggested that the Danube sections should be made to a larger scale because in that way they turned out better and were more appealing than the solution on which they had agreed, and we also learn that he had also yet to complete the drawing of the hydrographical map, the map of Roman antiquities and the map of minerals. He also planned to visit Marsigli and take the Fish and Antiquities volumes. Marsigli, however, was impatient. He ordered the prepared materials to be handed over to his faithful courier Baron Löffelholz. So, Müller immediately wrapped up the Roman antiquities volume, as it had been organised and annotated by Dr. Schoder. He, nevertheless, did not dare to trust him with the maps he had made, the Danube maps, the frontier maps and the maps of the Hungarian Monarchy, because he feared, as he said, the lurking perils of the wartime situation.²⁰⁹

He attached a balance sheet to the letter he sent with the finished maps, which Löffelholz himself could see.²¹⁰

Borderline sections

28 pieces

Bosnia, Serbia, Croatia, Herzegovina, Banat, Temes Banat, Transylvania, Moldva, Wallachia

magnificently come to fruition today.)

²⁰⁴ BUB Mss di Marsigli Vol. II. B. Müller to Marsigli, Nürnberg, November 7, 1702.

²⁰⁵ BUB Mss di Marsigli Vol. 80. II. B. Müller to Marsigli; Nürnberg, December 2, 1702.

²⁰⁶ BUB Mss di Marsigli Vol. 80. B. Nürnberg, December 8, 1702.

²⁰⁷ BUB Mss di Marsigli Vol. 80. B. pp. 17-19. Nürnberg, December 12, 1702. (He also finished the 24 frontier sections from this side of the Danube.)

²⁰⁸ BUB Mss di Marsigli Vol. 82. p. 52. Nürnberg, January 6, 1703. (He again presses for more money saying *Tempus enim consumitur, debita crescunt* – Time is consumed, the debts increase.)

²⁰⁹ BUB Mss di Marsigli Vol. 82. pp. 174-177.; Joh. Chr. Müller Nürnberg, April 17, 1703, In Latin and German.

²¹⁰ Ibid.

Danube sections 18 pieces
General map of the Danube
Hydrographical map of the Danube

(On the next page:)

“The balance of the works I have finished and the contract:

<i>According to the agreement I get for each frontier section</i>		5 florenas
<i>For the states of the Hungarian Monarchy per piece</i>		12 florenas
<i>Although I made three frontier sections during the time that took one Danube section, yet I charge only</i>		6 florena/piece
<i>The works I have finished are the following:</i>		
<i>Frontier sections in number,</i>	24 pieces	
<i>Price:</i>		5 florenas/piece [120]
<i>The states of the Hungarian Monarchy: Bosnia, Serbia, Croatia, Herzegovina, Banat, the Temes Banat, Transylvania, Moldva, Wallachia</i>		
<i>Price:</i>		12 florenas/piece
<i>In total:</i>		96 florenas [108!]
<i>Danube sections</i>	18 pieces	
<i>Price</i>		6 fl/piece
<i>In total:</i>		120 florenas [108!]
<i>Finally the frontier sections beyond the Danube</i>	5 pieces	
<i>Price:</i>		5 fl/piece
<i>In total</i>		25 florenas

		361 florenas

On the 12th of May 1703, Müller reported with relief to Marsigli that he had finished the drawing of the maps and suggested that the ready copperplates be placed in Löffelholz’s house wrapped in canvas, lest they should become the victims of the war.²¹¹

Among Marsigli’s helpers appeared Wurstbain’s name, who recommended to him a book on mushrooms. At the time of the demarcation of the frontier, Marsigli’s interest was caught by the mushrooms in the forests and mountains of Croatia. He asked for books on mushrooms from Wurstbain, who recommended Fr. Sterrebec’s book *Teatrum Fungorum* edited in 1676. It was missing from his library, but he hoped to get one from his friends in Belgium. It would be useful since the author used the observations of many scientists published in Clusius’s *Historia brevis Fungorum in Pannonia observatorum*.²¹² Wurstbain’s real role, however, does not really become evident from the letter.²¹³

Pfeffer’s role is also unclear. He was a copperplate engraver in Vienna, and both Marsigli and Müller were content with his work. His name was raised with regard to the engraving of the Danube sections that had exceeded Eimmart’s skill.²¹⁴ He is only the artist from Vienna who is mentioned in the letters. So he was probably the engraver of the 49 copperplats in the list of Eimmart from June 30 1703.²¹⁵

²¹¹ BUB Mss di Marsigli Vol. II. B. letter no. 63. p. 164. Nürnberg, May 12, 1703.

²¹² BUB Mss di Marsigli Vol. 79. pp. 253-254. Vurstbain, Joh. Paul. Nürnberg, June 23, 1701.

²¹³ Gilberto Govi: Luigi Ferdinando Marsili micologo Bolognese (1658 – 1730). Bologna, 1984.

²¹⁴ BUB Mss di Marsigli 80 B Vol. II. B. letter no. 63. pp. 163-164. May 12, 1703. Nürnberg

²¹⁵ BUB Mss di marsigli, 104. Vol. fol. 80.

Marsigli also asked *Scheuchzer*, the renowned Swiss scientist, to send him his catalogue of minerals. At the same time, he inquired after maps, mentioning the atlas by Mercator and Huner Jaillot (1689).²¹⁶ Encouraged by Lochner from Nürnberg and Fayus from Basel, Scheuchzer wrote another letter to Marsigli offering to help him in his “splendida” work, the *Danubius*, by presenting his own study.²¹⁷ The study, called *Observationes Naturales Factae per Decursum Anni 1704 a Johanne Scheuchzero*, contained the notes made by Scheuchzer on his journey to Vienna: observations in Bohemia (p. 3); observations in the ore mines in Hungary, especially at Selmebánya (here we can find the drawing of the *vena metallica*, ore vein, also published in the Danube monograph) (pp. 3-4); the salt mines in Lower and Upper Austria (pp. 4-5); and the metal mines (pp. 5-10).

Tobias *Styger* sent maps, which had been recently made in 1689, of the salt mines in Hallstatt (pp. 11-22).

Thobias *Zahler*, a forester in Hallstatt in Upper Austria answered Marsigli’s 26 questions concerning the vegetation of the region.

We can find Jakob *Tollius*’s observations on the metal mines of Bohemia in the same volume (pp. 28-33).²¹⁸

ON THE THRESHOLD OF PUBLISHING: PRODOMUS

By the end of the 1690’s, Marsigli felt that his work was ripe enough both in its context and structure to edit a promotion, a so-called *prodomus*, with the purpose to propagate the book he wished to publish before beginning printing and to call the attention of book handlers to his work.²¹⁹ He dedicated the book to Emperor Leopold, but addressed the foreword to the Royal Society, *the wise men of merit in the preeminent sciences*. The ca. 60 page promotion was published in 1699 and 1700.

First he introduced himself, the soldier who was interested in science, whom *the dubious glory of the God Mars, the weapon-clatterer*, could never bind tightly enough to deter him from the desire aroused by the sights of nature to learn its mysteries. This passion was so strong that it never slumbered even during his military and political commissions. *And those*, he wrote, *who would demand and even expect greater efforts and more outstanding results from a man who had spent most of his life in tents and dressed in a military coat should judge with caution...* Then a little later: *I am a soldier who has always found it necessary that the appreciation of books and sciences should not be left last in my life*. After he had introduced himself to the world and the Royal Society, he called on the members of the Society to help him with their benevolent criticism to correct the faults in his work *so that nothing incorrect would remain* in the structure and depiction of the material. Finally, he expressed his reverence to *Mr Niuthun (Newton), the most meritorious chairman of the English Scientific Royal Society*.

While Marsigli was occupied by the editorial tasks surrounding the text of the *Prodomus*, his people in Nürnberg began rapidly working on the drawing and engraving of the illustrations still missing from the Danube monograph. Thus, there was a realistic chance that the work could be published in 1704. However, as a consequence of the events at Breisach, *the unfortunate work lost its protector and supporter* - the favour of the emperor was withdrawn. Hopes of publication were left to an uncertain future.

²¹⁶ MUB Mss di Marsigli, Vol. 82. letter no. 56. Scheuchzer, Zürich, March 18, 1703.

²¹⁷ BUB Mss di Marsigli Vol. 82. p. 66. Scheuchzer, Joh, Jakob. Zürich, April 15, 1703. The cited study can be found in Vol. 23.

²¹⁸ It was annotated and illustrated by Henr. Christian Hennius and printed in Amsterdam in 1700.

²¹⁹ Frontispiece: Aloysi Ferdinandi Comit. Marsigli: *Danubialis Operis Prodomus*. Ad Regiam Societatem Anglicanam. Auspicio Anni ac Saeculi Novi 1700.

BREISACH – THE VICISSITUDES OF WORK AND THE AUTHOR

*I have lost all my spiritual strength and the opportunity to send it to the print, since blows pounding upon me from all directions have robbed me of the necessary peace of mind and the countless worries make it impossible for me to engross myself in work – he wrote about this period in the foreword to his *Danubius*.*

Guicciardini and Scheutzer, Marsigli's new secretary, left Vienna on the 12th of August 1704.²²⁰ The manuscript of the *Danubius* must have been hidden in their luggage. The author of the manuscript also turned his back on Vienna and travelled first to Ferrara and Modena, then to Milan in the hope that he could win Prince Lorraine, the governor of the Spanish king's, sympathy and perhaps as an experienced soldier be offered a suitable position and support to publish his *apologia*, in which he could explain himself to Vienna and the world concerning the Breisach affair.²²¹ Although he was received with courtesy, he was deceived in his expectations. He left Italy and travelled to Switzerland across the Alps²²² as we can learn from the elder Scheutzer.²²³ He had barely settled in his new home when he set out for the Po valley across the St Gotthard pass, probably on the invitation of the French. On his way through the mountains he made altitude measurements with his barometer. He arrived in Milan on the 4th of August 1705. By that time, the copperplates of the Danube monograph sent from Nürnberg and the notes and manuscripts connected to the book²²⁴ had arrived to their destination in Bologna. It had been necessary to smuggle them out of Emperor Leopold's empire, since the Danube monograph, together with the highly valuable copperplates, were made from the emperor's money, so Marsigli's ownership rights were rather questionable. Aware of this, he emphasised when he donated his protected treasure to his native town that, *apart from a few copper plates*, the whole work had been carried out through the emperor's financial support.²²⁵

On his arrival in Italy, Marsigli first went to the camp of Louis XIV's fighting army. He was to face, however, another disappointment. The French needed his services but only on conditions that Marsigli could not accept. Namely, they would have liked to send him as an experienced military engineer with an intimate knowledge of Hungarian conditions to Hungary in the company of a group of French officers and military engineers to help Ferenc Rákóczi II in his war of liberation against Vienna.²²⁶ Marsigli, a convinced monarchist, did not like the idea of fighting on the side of the rebels, and found it too dangerous as well. He refused the offer and returned to Switzerland. He arrived in Luzern around September.²²⁷ However, he felt out of place in a world enclosed by mountains, and planned, on Cassini's suggestion, to settle in Montpellier, a French town with a lively intellectual life. Torcy,²²⁸ the French minister, attached a letter to his passport stating King Louis XIV's wish that he should travel via Paris. In October, he crossed the St Gotthard pass once more, and with this ended the Swiss chapter in his life.

²²⁰ Scheuchzer Mss, Zentralbibliothek, Zürich

²²¹ John Stoye: Marsigli's Europe 1680-1730. Yale University Press New Haven and London 1994: 257.

²²² Johann Georg Scheuchzer's name was already mentioned among Marsigli's informants. His son Johann Jacob became Marsigli's secretary after J. C. Müller yielded to the temptation and left for Vienna.

²²³ The Hapsburg court in Vienna charged J. C. Müller with an independent task, the survey of the hereditary provinces.

²²⁴ BUB Mss di Marsigli Vol. 80. C pp. 33-34. Nürnberg, March 19, 1705. Joh. Heinrich Müller to Marsigli.

²²⁵ Archivio di Stato, Bologna; Assunteria di Istituto - Diversorum - B. 20 n. 7. fasc. 3.

²²⁶ Ferenc Rákóczi II (Borsi, 1676 – Rodostó, 1735) asked the French join forces with him against the Hapsburgs as early as 1700. He was betrayed and imprisoned. He fled from the prison in Bécsújhely and went into exile in Poland. He returned in 1703 and took to the field for the liberation of the country. He was abandoned and had to sign a peace treaty with Vienna in 1711. He spent the rest of his life in exile, first in France and then in Turkey.

²²⁷ Stoye op. Cit: 262.

²²⁸ Torcy, Jean Baptiste Colbert (1665 – 1746), under-secretary of state for Louis XIV from 1699 –1715.

He spent the January and February of 1706 in Paris. The king received him benignly, but he soon saw that he should abandon all hope of an appropriate position in the French army stationed in Italy or in Spain. So, according to his original plan, he settled in Montpellier. This happened at a time when Louis XIV conferred the title *Royal* to the freshly established academy in the town (1706). The Scientific Society, to match the traditions of a town famous for its medical university, botanical garden and, hydrographic department, placed natural sciences at the focus of its activities. Among scientists, Marsigli regained his composure, and forgetting about his derailed military career, found consolation in science. He became the first corresponding member of the academy. He made a summary of the results of his research into the seas for the Society,²²⁹ and it was to his great merit that he urged them, just as he had done in London, to inform foreign scholars concerning their scientific results by means of correspondence as well, collecting as much information as possible from them. It seemed to him extremely important that scientists inform each other about the results of their work and discoveries and also attributed great significance to publication. He even initiated contacts with states that were at war with France! In order to help the Scientific Society in these endeavours, he, a scientist with experience of the world, sent a letter with the addresses of European scientists, with whom, he thought, contacts should be established. He mentioned eight physicians and anatomists, five mathematicians, four physicists, three astronomers, three botanists and three professors from various European states. In acknowledgement of his work, he was elected member of the Academy of Montpellier.²³⁰

In January 1708, Marsigli wrote to Scheuchzer explaining his long silence. He told him that he had travelled a lot and had finished writing his work on the physical aspects of the sea, in which he was the first to demonstrate that corals are living beings and not rocks. The work was first edited under the title *Histoire Physique de la Mer*²³¹ in 1725. It has recently been re-edited with an English translation (1999).²³²

In the spring of 1708, he was invited to the Papal army, where, in preparation for a possible attack from the Hapsburgs, he had to work out a proposal for the defence of Central Italian towns. In this way, he returned to his native town after twenty years. On the 15th of January 1709, the Papal state contracted a peace settlement with the Hapsburgs without war, which brought an end to Marsigli's last martial experience. Although it brought him no military glories the experience proved useful in that he could find his way home. His brother could not long endure the chaos he brought to the parental house (questo bordello in Palazzo) by the art and science lover Marsigli and his friends. Marsigli's collection was also under foot. So, he set about transporting it to Provence, although his brother Filippo would have liked to keep it in the family as a pledge against the debts Marsigli had incurred after the events in Breisach and not send valuable property away from Bologna. Thus, Marsigli left for France without his collection, but the news that his brother the bishop was dying brought him urgently back. He was too late. He restored peace with his family, and on the 15th of May 1711, the senate of the town disclosed that if Marsigli donated his valuable *treasures* to the town, they would see that they were housed in a fitting place. The choice fell on the palace of Cardinal Poggi's on via Donato, the present day via Zamboni, which was ornamented with 16th century frescos.²³³ The donation contract was ceremoniously signed and the bequest was

²²⁹ A shorter version of his study on the seas appeared in Italian in 1711: *Brieve ristretto del saggio fisico intorno alla storia del mare* A. Poletti, Venezia, 1711. 72 pp. 1725 a full version was published by a company, perhaps of bookhandlers, in Amsterdam in French with the title „Histoire physique de la mer”.

²³⁰ The data concerning the Academy of Montpelliere came from the study: J. Carpine-Lanera and A. McConnell: *Le comte L. F. Marsigli et la société royale des sciences de montpelliere*.

²³¹ It was edited in Amsterdam in 1725 with forwards in Latin and French by Herman Moerhaave.

²³² The facsimile edition of the book was published with Anita McConnell's valuable introduction in English and French: Luigi Ferdinando Marsigli: *Histoire physique de la mer*, a cura di Giortio Dragoni; Bologna, 1999

²³³ John Stoye op. Cit: 283-284.

thus not lost.²³⁴

“YET IT WILL BE REALISED...” - THE DANUBIUS IN AMSTERDAM

His fortunes changed for the better at last in 1723: an opportunity came along to publish his work in Amsterdam. However, the ownership of his works – or lack of it – created serious legal problems. Marsigli did not have the absolute publishing right to his manuscripts nor the copperplates of the Danube-monograph. Despite all of these problems however he managed to sign a contract with booksellers to publish his works in Amsterdam and the Hague on the 16th of March, 1723.²³⁵

The *Contract* contained 17 conditions. Among them the most important were:

- Marsigli will have to send those copperplates of the Danubius that were done already, the drawings that were not engraved yet, and the manuscripts without delay as soon as he got home. This was required so that the work at the printing shop could start as soon as possible.
- The still missing drawings will have to be made in Italy but engraved in copper in Amsterdam, Holland.
- In order not to lose time the booksellers wanted the geographical and hydrographical maps that will have to be engraved in Holland to be sent to them by mail either as a whole or in parts packed in metal boxes at the booksellers' cost. The reason for this condition was that the booksellers wanted to make sure that everything arrives in good condition and in a timely manner.
- The Company will be responsible for returning the manuscripts, drawings and copperplates after printing – with the exception of those copperplates that the Company would engrave here, meaning in Holland. All these items are listed in point 1., 2., 3. and 4 where the Danube-maps are mentioned also which “*were made with such perfection and fine art that had never been seen in this country.*”
- The Publishing Company will compensate Marsigli for his work by giving him books chosen from the Academy of Bologna, ten thousand Duchy Forints in value.
- The owner of the engraved copperplates, drawings and manuscripts – namely Marsigli and the Science Academy of Bologna – agrees not to publish the book within the next one hundred years.
- At last: The Count would get twenty copies of the published book and can make use of them as he wishes.

After that the preparations to publish the book began in earnest. Illustrations had to be revised and prepared and other details revised as it is described in Marsigli's preface to the book. The whole work was subject to the decisions and preferences of the Dutch editor.

In the summer of 1724 the Danubius project arrived at another exciting and critical milestone. On the 13th of July the copperplates that were ready to be transported were carefully inventoried and then they were packed for the long and dangerous journey across the mountain passes of the Alps. First of all the plates were carefully counted, then measured and finally put into the boxes.

The notes that I found in the Archivio di Stato allowed me to reconstruct the story of the Danubius with its many twists and curves.

But let us first follow the book after it arrived in the Netherlands in a form still far from ready for printing. Not only did the above-mentioned ornamental figures and the frontispieces have still to be made but the missing elements had to be filled in as well. Several instructions can be read on the leaves of the manuscript with regard to new illustrations which

²³⁴ The objects listed on plate 111 of *Instrumentum Donationis* were handed over as specified in the contract signed in 1711.

²³⁵ Bologna, Archivio di Stato, Assunteria di Istituto, Diversorum, B. n. 7. Fasc. 8. Informazione mandata al S. Ambasciatore. July 7, 1725.

had to be made. As the contract stipulated, the drawing was produced in Italy but engraved in copper in Holland in master Schenk's workshop, according to the editor's instructions.

We can guess on the basis of the editor's instructions that these were prepared in Master Schenk's workshop in the Netherlands. Here follow some remarks from the manuscript pages returned from the Netherlands: *Tab 14. te maaken by Schenk*;²³⁶ *Tab. 15. te maaken by Schenk detto* (p. 32); *folio 49 te maken* (p. 64); *fol. 49. te maken* (p. 77); *fol. 60 te maken* (p. 78). In the same place the drawings and their printed versions can be found in pairs. In another place,²³⁷ the suggestions of the Dutch editor can be read glued to the end of the volume saying that the correction must be made on the drawings as well as on the plates according to the instructions. He suggested that as many drawings of the minerals should be put on a folio as it can bear. One must not forget, however, about the missing legends.

The editors fostered another business project as well at this time: the edition of a separate volume of Marsigli's beautiful maps and mine depictions, which contained many scientific novelties. This is implied by the fact that all these plates can be found in the list of missing items made in Bologna. Namely, in January 1730, a list was made in Marsigli's native town of the plates which had been returned from the Netherlands.²³⁸ The individual plates are listed with their inventory and ordinary numbers as well as by their weight:

Sixteen plates were returned from volume I – the ones marked as numbers 26, 27, 28, 29, 30, 31, 32, 33, 36, 37, 39, 40, 41, 43, 44 and 46 – although 23 items were sent to them. That is, 7 plates, those with numbers 21, 22, 23, 24, 35, 38 and 45 have disappeared. In total these plates weighed 91.6 kg. However, the weight of the returned plates was 17.6 kg less than this. Fifty-eight plates were sent for volume II (weighing 235.6 kg) and 4 more plates were returned (weighing 28.6 kg).

Tragically, many of the plates from volume III have disappeared. Fifty-nine of the plates, weighing 52.6 kg, were sent. Only seven of them, nos. 1, 2, 3, 4, 5, 6 and 7 weighing 26 kg were returned. There are, accordingly 52 missing plates weighing 26.6 kg.

Thirty-three plates, weighing 157.10 kg, were sent for volume IV. These plates were returned without loss.

Seventy-four plates, weighing 329.6 kg, were taken for volume V. All were returned.

Fifty-three plates, weighing 135.4 kg, were used for volume VI. Seventeen of the plates were returned 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 20, 21, 22, 23, 27 and 28, altogether weighing 83 kg. That is, 35 plates, weighing 52.4 kg, are missing.

The Dutch wrapped up the plates to be returned with definite anticipation. It seems likely that all this happened with Marsigli's knowledge and consent during his lifetime.²³⁹ A nice volume was actually edited in 1741 under the title *La Hongrie et la Danube...*²⁴⁰ with 31 figures, maps from the *Danubius*. It is interesting that the French introduction was written about 10 years earlier, in 1731! This fact seems to support our view that Marsigli was still alive when the edition was planned and it could have been Marsigli himself who asked the author to write the introduction. Because of its beauty, the depiction of the mine from Selmeç, published in the Mineral volume in the *Danubius* (III), was inserted among the maps as figure six, and a French legend was added to it: *Map VI represents the interior of the mine in Selmeç as the author saw it in 1695.*²⁴¹

²³⁶ It must have been made at Schenk's

²³⁷ BUB Mss di Marsigli Vol. 34. 121

²³⁸ Archivio di Stato, Bologna; Assunteria di Istituto - Diversorum - B. 20. n. 7. In the pallium with the inscription *Ricupera dei Rami sequita in Gennajo 1730.*

²³⁹ Archivio di Stato, Assunteria di Istituto - Diversorum - B. 20. n.7.

²⁴⁰ The full title of the edition: *La Hongrie et le Danube, par M. le conte de Marsigli, en XXXI. cartes tres-fidelmente gravees d' apres les dessins originaux et les plans leves sur les lieux par l'auteur meme...avec un preface...par M. Bruzen de la Martiniere.*

²⁴¹ La VI. Carte represente l' interieur des Mines de Schemnitz, telles que l' Auteur les vit en 1695

Here, I would like to make small detour to the problem of copper engraving of the 18 Danube sections, those missing from the Bologna list. Probably they were not finished until 1724. It is highly likely that a Dutch copperplate engraver was charged with the task of producing the plates.²⁴²

A similar enterprise was inspired by the copperplates of the birds and the fishes. In Bologna, where the plates of this volume arrived in complete numbers, the eye-catching figures were re-edited without the indication of the year under the title: *L.F. Marsigli: Pesci che nascono nel Danubio e Volatili che vivono lunga d'esso*.²⁴³ The edition was intended to be a picture book, the texts were entirely omitted.

Curiously enough, the whole work appeared in 1744 in French together with the illustrations! The place of the edition was the same: the Hague, Netherlands. Knowing about the above, we have to ask: how could it happen? There are two possibilities. One is that the plates that had not been returned to Bologna had not been lost but simply retained and the plates that Gabrielli Manfredi²⁴⁴ inventorized once more in January 1730 were returned to the Netherlands. However, we could not find anything suggesting this solution and nor did the above-mentioned publication refer to anything like that.

The other possibility is that the French edition was planned together with the Latin one, the prints being made at the same time, but published only 18 years later in 1744. It is certain that the figures for the French edition were printed from the same plates as those in the Latin one since the measurements and the fine details are identical and even the legends were left in Latin. What's more the wording of a footnote in the document suggest that Latin and French translations of the book – at least at the beginning – were made also. The first two volumes were finished in December 1724. The price was 214 Bologna currency / volume. As far as the French volumes are concerned their prices can be found on the pages enclosed.²⁴⁵ Two years later, in 1746, a mysterious, unindiefied person turned up at the trustees of Marsigli inheritance saying that he would like to buy the copperplates of the work. He thought that republishing the work would not be profitable and it would be illegal for one hundred years anyway because of the contract but the beautiful engraves could be sold be either organized into a volume or sold separately one by one. So once again they countef the plates that were done originally in Bologna, estimated their value while the unidentified, mysterious person offred them valuable books in return.²⁴⁶ Although I could not find the bill of sale, some archival references and the pictures of fish and birds in the above-mentioned special addition suggest that the sale was made.²⁴⁷

III. DANUBIUS PANNONICO-MYSICUS, 1726

The *Danubius Pannonico-Mysicus* is often called shortly the Danube monograph or even the anatomy of the Danube.²⁴⁸ This latter name is most fitting. The river is quasi-dissected. Marsigli examined and mapped its course and pulsating veins, the tributaries. He

²⁴² Bologna, Archivio di Stato, Assunteria di Istituto, Diversorum, B. n. 7. Fasc. 8. Conditions reciproques pour L'impression de L'ouvrage du Danube. pp. 4. ; Il a été excepte du dit renvoi, les planches, que la Compagnie aura fait graver icy... (Condizioni reciproce per L'impressione de L'Opera Danubilale: e sono stati ancora eccetuati dalla dedizione I Rami che la Compagnia avrà fatto intagliare qui, e de quali si é parlato nelli articoli 1. 2. 3., e. 4.)

²⁴³ Archiginnasio - Bibliotheca -, Bologna; 17. L.I.3. Marsigli, L.F. Diligentemente delineati ed incisi in tavole CVII. In Bologna. Nella Stamperia di Lelio dalla Volpe Impressore dell Istituto delle Scienze". The only texts added to the volumes were: "PESCI Tavole XXXIII." and "VOLATILI Tavole LXXIV."

²⁴⁴ Secretario dell Assunteria dell Istituto

²⁴⁵ Archivio di Stato, Assunteria di Istituto, Diversorum, B. 2o.

²⁴⁶ Archivio di Stato, Bologna; Assunteria di Istituto - Diversorum - B. 20. n. 7.

²⁴⁷ Archivio di Stato, Bologna; Assunteria di Istituto – Diversorum – B. 20. n. 8.

²⁴⁸ The Hungarian and Serbian stretch of the Danube described from geographic, astronomic, hydrographic, historic and physical observations. *Organised in six volumes [and edited] by count Luigi Ferdinando Marsili, member of the Royal Societies of Paris, London and Montpelier.*

noted all its components and accompanying elements of the great river such as its bed, banks, flood deposits, chemical constituents, the life in it and around it, both flourishing cultures and those that have survived as legacies.

It was published in two versions: in 6 volumes and in 3 volumes. It measures 53 x 43 cm in a leather binding.

The author launched his work with a solemn foreword, of relevance to the whole work. Referring back to the ending of his career in January 1704, he began with a question: *Would anybody have thought that this work would ever come to light after all the many vicissitudes of my life? Yet it has been realised, that which had seemed nearly unbelievable, nearly hopeless...* The turn in his luck was due to his journeys to England and Netherlands, the original purpose of which was *to collect everything that had been missing for the foundation of the Academy of Science and Art of Bologna*. Then the baroque eloquence was replaced by simple words. He spoke about the content of his work: *detexi, quod potui, in idemque congressi*, that is, I have explored everything I could and collected it in this book. Leafing through the book we can share his conviction: Marsigli really explored everything that he could and put it into words and pictures of artistic value.

Volume I describes the environment of the Danube. Geographic and hydrographical aspects dominate in it, and a separate part is attached to the maps along with astronomical observations.

Volume II is very important for archaeologists since it contains the Roman monuments along the Danube.

Volume III concerns the minerals and mineral waters in the Danube region. It contains 7 large folio pictures and is illustrated with drawings of the discussed minerals.

Volume IV describes the fishes of the Danube and the animals living in the water, illustrated in 33 folios. Some of the fish species were described for the first time in a scientific way in this volume. The names of the fishes are given in Latin, German, Turkish, Hungarian and Serbian.

Volume V is about the birds living along the Danube and their nesting habits. This volume contains the greatest number of illustrations, 74 large engravings, which are unique artistic representations of these avian species.

Volume VI contains all the observations and descriptions that could not be organically incorporated into the first five volumes because of their topics such as the expansion of the Tisza, or because of the specific method of description. This mixed and unconventional volume is often considered the most exciting part of the work. Its value is further increased by 28 folio pictures and 9 smaller engravings.

VOLUME I.

PEOPLES LIVING ALONG THE DANUBE AND THE GEOGRAPHIC AND HYDROGRAPHIC ENVIRONMENT

The luxuriousness of the book charms its readers from the very first. Those, who take the author's honest words to heart will make allowances for any errors in this pioneering work and bow their heads in respect to the huge spiritual enterprise. *I was the first to shed light on this distant and secret world hidden in barbarian obscurity; so I think it can be excused that I did not explore everything and that not always perfectly* – he relates in his foreword with a certain pride. By the *distant and secret world* he referred to territories which had been recently liberated from the Turks. His remark is especially valid with regard to the cartographic representation of the region. Marsigli's discovery should be understood in the strict sense of the word. The territory reaching from Vienna to the mouth of the Tisza had been, because of the Turkish presence, inaccessible to scientists. He had been able to move about freely in this territory as a member of the imperial army or with their protection. At the same time, he also visited even more remote, isolated parts of the Balkans, where he made his observations in *stealth*, since *either in a boat or on foot or on horseback, he was always under surveillance by*

the barbarians. He then organized his collected knowledge and notes in winter camps or *in tents, wrapped up in his military coat* during intervals between fighting.

Geographical, historical part

The maps

From his youth, Marsigli consistently drafted the territories that grabbed his attention. The idea to methodically map the Danube, however, was probably derived from the Royal Society through an Englishman called George Ashe,²⁴⁹ secretary to the English ambassador in Vienna. Ashe described his journey along the Danube and his impressions of the cultural life there in a letter sent from Vienna²⁵⁰ to E. Halley, the renowned astronomer²⁵¹. Ashe noted the inaccuracy of the maps, where the river and often also the settlements were *indicated very incorrectly*. He found Vienna to be an extremely *unknowledgable place*, where, *despite the old and famous university, you cannot find a mathematician*, he wrote, *and should I unfold my telescope, I would be hauled off to the inquisitors for being a sorcerer*. Then he continues: *I searched in vain for some engineering officers in the army to persuade them (as you wished) to make maps of the freshly conquered territories, but there is no hope of finding one*. A few months later he met Marsigli, the man who could provide him with *acceptable information about the terra incognita* held by the Turks. As an *engineer general*, Ashe went on, *he often found an occasion to visit the recently liberated territories, which, according to him, are shamefully poorly represented on every modern map he has seen, and I have the reason to believe it on the basis of the little that I saw from Hungary last year, where (having checked on the best available maps) I often found that towns, villages, mountains and even entire rivers were ridiculously misplaced*.²⁵²

Marsigli did not feel sufficiently dedicated to fight alone against the contradictions that had become commonly accepted in the cartographic representation of Hungary. How Marsigli resolved this problem will be described in the section on the *Summary map*. He obtained the necessary instruments and got J. C. Müller to help (1696). By that time, Marsigli had accumulated a rich collection of map drafts and notes dealing with the environs of the Danube. According to the plans, Müller's main task was to make the summary.

It is not known when the first Danube representation was drawn in which he marked the decided north-south turn the river takes at Vác. The Danube Bend already appeared in this form on the commercial map enclosed with the frontier report from the 16th of October 1699.²⁵³

The correct depiction of the course of the Danube was of great significance with respect to the cartographic representation of the whole country, since the rich hydrological system of the Carpathian Basin, which was the basis for the maps of Hungary, comprised the

²⁴⁹ George Ash, member of the Royal Society and later also of the Philosophical Society of Dublin, was ambassador Lord Paget's secretary in Vienna. It was probably he who passed on the project of the Royal Society to Marsigli, in which they called for data from scholars and travellers on history, "natural history", geology, cartography and solar observations. Thus, he also collected materials for the Philosophical Transactions.

²⁵⁰ I got hold of the letter through the mediation of Anita McConnell from the Early Letter, Royal Society, London.

²⁵¹ Edmund Halley (Haggerston, 1656 – London, 1742). In 1698 and 1699, he carried out geomagnetic surveys along the coasts of Africa and America and created the first map of geomagnetic declinations. He calculated the orbits of more than 20 comets and invented a method for determining lines of longitude based on observations of Venus as it passed in front of the Sun. In 1718, he discovered the inherent motion of stationary stars.

²⁵² Ashe continues: This gentleman wishes to be admitted into the Royal Society, so if you think that he can earn it with his statements promised here and his future services, he would probably be greatly inspired in his future efforts upon hearing from you that he has been admitted. Please write to him either in Latin or French or Italian and to my address. – On the meeting of the Royal Society on 25 November 1691, Marsigli was elected a member.

²⁵³ Bécs; ÖStA KA HKR Akten 1701 BLG July 42. Supplement Relation 10.

area of the Danube watershed. In this way, the new representation of the Danube afforded a more correct cartographic representation of Hungary as well. It is an irony of fate that the Frenchman, de L'Isle, who had never seen the river, published the first map with an authentic representation of the Danube Bend using Marsigli's astronomical positions (*Carte de la Hongrie...*).²⁵⁴ This, nevertheless, does not reduce the value of the maps of the *Danubius Pannonico-Mysicus*. Never until then, had such a careful and beautiful cartographic description of the *Danube* been made. Not only was the course ascribed to the river new (*Mappa generalis*) but also the representation of the region and, within it, of Hungary. The thematic maps illustrating Roman antiquities and mines in the country were ahead of their time. In order, the Danube maps were as follows:

The Danube and its tributaries (39 x 27 cm)

This map shows a schematic depiction of the river from its source to the Black Sea and indicates its tributaries. *He found it necessary*, he wrote in the dedication to the map, *to start with a summary map of the Danube so that the reader could locate the the river stretch under discussion* since previous maps did not afford this possibility.

Summary map (70 x 91 cm)

The summary map of the Danube shows the river from Kahlenberg to the Jantra river in Bulgaria, based on 18 detail maps which followed.

With all the novelty of the representation, it contains most of the mistakes of other contemporary maps. This came partly from the inaccuracy of distance measurements, partly as the result of the low number of astronomical positions. As is well known, impassable swamps bordered most of the Danube along both sides. These had to be bypassed and so the stretches where the river flowed in a definite direction could not be measured with authenticity even in steps. The problem could be solved only by establishing astronomical positions. Accordingly, in 1690, Marsigli decided that he would get training in astronomy and obtain a quadrant necessary for making observations. He ordered the quadrant from Eimmart in Nürnberg while his correspondence with Cassini the famous astronomer evidence the earnestness of his decision.²⁵⁵ Cassini and Eimmart had to instruct him in the theory of astronomic observations at a distance, methodically teaching Marsigli through letters. He purchased Riccioli's book as well.²⁵⁶ It was perhaps the confusing atmosphere of military life that contributed to his decision to charge J. C. Müller, a young man adept in the use of a quadrant, with making most of the observations. Naturally, he himself also made observations. In 1699, for example, during the demarcation of the frontiers, he observed the eclipse of the sun on the banks of the Corana river in Lower Croatia. *Nearly all the Turks swarmed out from their tents*, he wrote, *to see the observation being made, so miraculous in their eyes, since I was doing something that nobody had ever seen done in their country.*²⁵⁷ Marsigli himself was not satisfied with the exactitude of his measurements. Luckily, Cassini was against his destroying the measurements, on the contrary, he insisted that even if, in

²⁵⁴ The D' L'Isles', father and son, were active in geography, astronomy and cartography in France at the turn of the 17th – 18th centuries. It was due to them that the new and more authentic representations of Marsigli's Danube maps became generally known. The inscription on the map cites "many manuscripts and published" maps besides those of Marsigli among the sources. De L' Isle, Guillaume (1675-1726).1703. 55,5x79 cm; Museum of Water Affairs of Hungary 23.77.17.

²⁵⁵ *I decided in 1690*, he wrote in the foreword to the astronomical part, *that I would make more observations to help in mapping of the more distant environments of the Danube...I have purchased a scaled astronomical quadrant with a radius of 2 ½ feet made of brass which also comes with a brass azimuthal ring that can be turned around it.*

²⁵⁶ Riccioli (Jo. Bapt.) *Geographiae et Hydrographiae reformatae, nuper recognita et aucta libri XII*. 1672. 691 pp. „It should be mentioned that the values of the refraction of atmospheric rays subtracted from the local high points were borrowed from Riccioli. He, of course, observed the same on the horizon of Bologna.. (Vol. I. Pars II.)

²⁵⁷ DPM Vol. I. Pars II. Introduction

Marsigli's words, the *Danubiale Opus* would never appear, he should edit them separately, since such measurements had never before been made in Hungary²⁵⁸, and because, on the other hand, this work could not be expected from any of the armchair scientists who operated free from any kind of disturbing circumstances.

Examining Marsigli's above-mentioned latitude measurement results we can see that the distortions of the map were caused not so much by the inaccuracy of the measurements as by their low numbers:

The geographical position of Vienna given by Marsigli	48° 14', today 48° 14'
The geographical position of Buda given by Marsigli	47° 25', today 47° 29'
The geographical position of Baja given by Marsigli	66° 10', today 66° 10'
The geographical position of the Dráva mouth given by Marsigli	45° 36', today 45° 33'
The geographical position of Szeged given by Marsigli	46° 16', today 46° 16'
Geographical position near Titel in the military camp	45° 20'
The geographical position of Szolnok given by Marsigli	47° 9', today 47° 10'
The geographical position of Eger given by Marsigli	48° 0', today 47° 54'

The chart reveals that these measurements occasionally diverged from the modern values but by no more than a few minutes. Furthermore, they were certainly much more accurate than other contemporary latitude measurements.²⁵⁹

The section drawings of the Danube

The eighteen maps were made with nearly topographic accuracy. It is not far from the truth to say that Marsigli and Müller were, in a certain sense, ahead of Cassini with these maps.²⁶⁰

They depicted the terrain, the mountains, the swamps and the dry territories spectacularly while the settlements were indicated by small houses and towers in numerical proportion to the size of the settlement. The names were given not only in Latin or Hungarian but, where applicable in German and Slavic as well. Furthermore, Marsigli meticulously marked the location and kind of the Roman antiquities he encountered.

This also indicates that he intended the maps to fulfill the same function he commonly used them for: to support and illustrate his texts. In his book, he always referred to these maps when describing settlements or islands.

The eighteen sections are not equally accurate or rich in detail. The ones representing territories where more material was collected or that had a greater strategic importance which were investigated by Marsigli himself are more reliable than those depicting enemy territory, since the only sources for these latter were the sketches he had made during his diplomatic sea voyages. Those sections, rich in detail, show nearly every settlement along the Danube, sometimes even the small farms or dry lands rising above the swamps, all with their names.²⁶¹

The towns and settlements along the banks of the river were not simply symbolically indicated, but miniature views of them were also drawn. The depiction of the lands along the banks is so three-dimensional, that they provide a true impression of the landscape even without the description. Section II of the Csallóköz and the Szigetköz is an excellent example.

²⁵⁸ Cassini was wrong since latitude had been measured in a few places for Wolfgang Lazius's map; it is certain that instrumental measurements were made in Nagyszombat in the 1670's. Cassini could not have known about them and nor could, regrettably, have Marsigli (Lajos Bartha's oral communication).

²⁵⁹ Bartha Lajos: Magyarország első tervszerű felmérésének 300. Évfordulójára (The 300th anniversary of the first planned measurements in Hungary) (Manuscript).

²⁶⁰ Domenico Cassini. Bologna, 20 November 1695 – Paris, 2 June 1698. The first topographic map is attributed to him. The Hungarian, Sámuel Mikoviny, asked for a directive to prepare a topographic map of Hungary in his proposition submitted to the emperor in 1746, which began with the word *Conditiones...* (see: Deák András: *A Hungaria Nova megrajzolója* (The drawing of *Hungaria Nova*). Budapest, 1987. pp. 110-114.) Had he been granted the directive he would have preceded Cassini by three decades.

²⁶¹ VII. Sectio: Tira polie campus, Tinthasa campus, Handok campus; X. Sectio: Kandel, Tuganiva, Zunta

We can imagine the region from the map as Marsigli saw it: *They seem to be islands within a trap or some kind of a labyrinth. They are nearly totally covered by swamps, among which it is easy to lose your way since, as you search for the right path, you may find yourself entrapped by water and you can extricate yourself only at risk of your life.*²⁶²

His markings are so impressive that even those not familiar with maps can imagine the landscape: how large the forests and swamps were and how the human settlements of various size among them look. Towards the end of the area under discussion, however, the sheets have less and less detail on them. In this way, the Danube arrives to the mouth of the Jantra, where, as Marsigli believed, it changes name and proceeds to the Black Sea as the Ister river.

After he had drawn this picture of the country and its main river the Danube through maps, he carried on sketching the history of the Hungarians who had founded their state within the Carpathian Basin. The idea of the double conquest, frequently mentioned by modern historians, is foreshadowed in his description. *The Hungarian Kingdom*, he wrote, *owes its existence to the despot Attila, ... who conquered everything with his soldiers, invaded Pannonia, set up his royal seat there, and finally changed its name from Pannonia to Hungaria.* After his death, his successors laid waste to the country through strife and returned to their *barbarian home*. They did not, however, forget *the richness and fertility of the Hungarian Lands and decided to return under the leadership of the seven princes.* They first conquered Transylvania and from there the whole of Pannonia, *which they called Hungaria in memory of the Huns.* In the time of St Stephen and Louis the Great, the country flourished, but the country was driven to the edge of ultimate destruction partly by dissension among its own people and partly through the greediness of foreigners.

With this, Marsigli came to his own time. Loyalty to the Hapsburgs determined his general attitude. He thought of Emperor Leopold as having been sent by God, who, having swept away the dread Turks from the better part of the country, restored the ancient rights and power of the Hungarian Monarchy. Furthermore, the country was not entirely destroyed after the tragic battle at Mohács against the Turks because *our glorious ruler, Emperor Leopold of the Hapsburg dynasty that has given ranks of successors to the Hungarian throne, has watchfully protected the countries conquered by his ancestors through wisdom and the sword. And what losses befell the old dignity of the country, he will restore with God's help.*

Then, he introduced the administrative structure and the public offices of the country, dividing it into two parts: the territories beyond and on this side of the Danube. He also spoke about the countries that belonged to the Hungarian Empire: Croatia, Slavonia and Dalmatia, which were headed by *voidas*, and Transylvania, which had a governor.

After this historical sketch, the Danube is returned to the focus of the work. Marsigli deals with the etymology of the name and gives his opinion about the names Danube and Ister. The fast flowing stretches are called the Danube, he said, while the slower stretch of the river after the cataracts on the Lower Danube are called the Ister. Then he describes the counties, the countries, the settlements of various sizes²⁶³ and the peoples found along the Danube. At the same time, he relates various interesting things such as the ethnic politics of the Turks in the southern part of the country: *The inhabitants of the barren, mountainous Serbia were enticed and collected there... It was an inexpressible blessing for these people to exchange their barren homelands for the spacious, fertile fields of the Hungarians and could settle around the swamps of the Danube, the Tisza and other rivers, which abounded in fish.*

The astronomical section

Marsigli made and had others make astronomical observations to determine latitude and

²⁶² DPM Vol. I. Pars I

²⁶³ The list arranged in chart form promises to give the distance between settlements. However, it was published only on the first page, probably due to a misprinting.

longitude. He needed the data for the maps. The application of an astronomical method was becoming increasingly accepted at that time for mapping larger territories. The *astronomical base*, as Sámuel Mikoviny called it later,²⁶⁴ afforded mapmakers with the position of places according to their latitude and longitude and the cardinal directions. With these in hand, cartographers were able to calculate the distances between points of measurements. Marsigli, although he himself made relatively few measurements, got reference points that helped him to reliably determine some cardinal points on the Danube and its main tributaries. He or Müller calculated latitude using a quadrant with a 2.5 foot (ca. 80 cm) radius, which he had obtained from Nürnberg with Eimmart's help. For other astronomical observations they probably used a 7 foot 3 inch long refracting telescope with an objective-lens with a diameter of 3-4 cm, capable of magnifying 30-60 times.²⁶⁵

Marsigli first published charts of his observational data in his book and then good depictions of the moon. The charts contain the *polar altitudes of the various stationary stars measured in 1699*.²⁶⁶ Most of the measurements were made by Müller whose diary of observations tells us that he made astronomical observations in Vienna (15 - 28 April 1696), in Buda (24 - 28 May), in Baja (1 - 6 June), at the mouth of the Dráva - *ad confluentes Danubium et Dravum* (12 - 14 June), at Szeged (17 June - 14 July), at the mouth of the Tisza - *in Castris prope Titul* (18 - 25 July), in Szolnok (9 - 13 August), in Eger (18 - 21 August) and once more in Buda (24 - 30 August), that is, from the middle of April to the end of August.²⁶⁷ He made two observations in Buda. First, he measured 47° 25' and the second time 47° 24'. The latter measurement was included in the comprehensive chart, which was the right choice. Marsigli or possibly Müller also measured the *zenith of the sun* at the same place.²⁶⁸ Jupiter and its moons were observed in Vienna, in Buda, 4 miles south of Buda, near Gobinum (?)village on the Danube, on an island one and a half hour's walk down from Tolna, in Baja, at the mouth of the Dráva, in Szeged, Zenta and near Titel in the military camp. *Mercury passing in front of the sun* was observed in Vienna on the morning of the 3rd of November 1697. He added a picture to illustrate the chart of measurement values.

Finally, he listed his *lunar observations*. He observed and made Müller observe the alterations in the light of the moon in Vienna and in Szeged, at Sablia (Zsablya), in Szolnok, on the bridge over the Zerna (Cserna) swamp near Utvar (Udvar), at Titel and in Eger. The 18 captivating moon depictions were probably made by Eimmart's daughter Clara (1676 - 1707) to whom about 350 lunar depictions are attributed.²⁶⁹ The prototypes for these depictions are preserved in the observatory of Bologna. On them, I think I can recognise not only the lady-astronomer's marks but the form of the legend which also matches that published in the book.²⁷⁰ We know from Eimmart's letter²⁷¹ that Clara sent, *as a token of her gratitude, the rest of her drawings of the phases of the planet with the humble request that he accept this small work with grace*. At that time, every able person around Eimmart was working on the *Danubius*. So Clara evidently sent the Moon depictions of Marsigli's book for inspection. It means that the drawings were made not at the end of the 17th century, as cited in the technical

²⁶⁴ Mikoviny Sámuel (1700 - 1750) expounded the essence of the application of the method in his *Epistola* (1732). Deák A.: *A Hungaria Nova megrajzolója*. Bp. 1987. 59. pp.

²⁶⁵ Bartha Lajos: *Egy elfelejtett holdtérkép*. (A forgotten map of the moon). *Meteor* (Ung. Astr. Verein) Bd. 26. 4. 1996.

²⁶⁶ (The polar altitude is identical with the latitude.

²⁶⁷ BUB Mss di Marsigli Vol. 100, Pars I.

²⁶⁸ The data I could find did not always reveal when and where Marsigli himself made the observations.

²⁶⁹ *Ibid.*

²⁷⁰ Bologna, Via Zamboni 33. Inscription: *Plenilunium. pinxit ad Archetypum M. C. Eimmarta. Norimb.* [Full Moon. Painted as a model by M. C(lara) Eimmart] The author adds the remark to the picture published on the back cover of the guide to the Bologna Astronomical Museum and edited by the Observatory of Bologna, that Clara's father gave Marsigli 10 paintings depicting this celestial body. I am convinced that Clara completed the Moon depictions in the book as well since her father must have been extremely burdened by the engraving of the figures for the book. The letter suggests that Heinrich Müller also assisted.

²⁷¹ BUB Mss di Marsigli Vol. 79. p. 20. G. C. Eimmart, Nürnberg, 24. September 1701.

literature, but in 1701. Yet another problem emerges with regard to the Moon depictions. Did Clara Eimmart draw the lunar phases observed in Hungary for the copperplate engraver in Nürnberg who had prepared the versions that served as models for Clara. It is obvious that the timed results of the observations made in 1696 at the places listed in the book were noted, not by Clara, but either by Marsigli or someone else. Müller's above-mentioned diary of observations answers this question as well. It contains, namely, lunar depictions drawn by Müller in an arrangement identical to that published in the *Danubius*.²⁷² He exactly registered the place and time of the observation and sketched the observed phenomena with a pencil. However, he did not depict all of the moon but only the zone of interest with respect to the observation. Thus, the whole process can be reconstructed as the lovely and finely detailed lunar illustrations from the book come to life, first from Müller's sketches and then by Clara's hand.

The moon phases were given such great emphasis in the book, because astronomers thought at that time that their accurate observation would help in calculating longitude. They were only able to get correct results, however, if their watch kept good time, if they correctly judged the moment of the shadows were entered, which largely depended on the alertness of the observer, and if parallel observations were made at several points. The error limits of the method were relatively large. Only a series of careful measurements could reduce the number of errors to an acceptable level. It was this aspect and also the complexity of the process that led to the abandonment of the method.²⁷³ Perhaps this was the reason Marsigli wanted to *sink* and *destroy* his measurements.²⁷⁴

Regrettably, something else also fell through the cracks. Marsigli was the first in the world to order methodical measurements of terrestrial *magnetic declination* in Hungary. These measurements were necessary because the northern pole of a compass does not point exactly to the astronomical north pole of the Earth but it diverges from it in varying degrees at different points on the earth's surface: towards the west in Europe, Africa and in the Atlantic Ocean. A knowledge of the degree of the declination was essential, especially for sailors. Halley, the English astronomer, produced a map of magnetic declinations valid in the ocean. He connected the points with identical magnetic declinations with an arched line. These lines were first called Halley's lines, later isogones.

Lajos Bartha has called my attention to the astonishing fact that Halley's map, which solely depicted marine isogonal lines contains a single terrestrial element, composed of data relevant to Eger – Szolnok – Szeged – Tital.²⁷⁵ He suggested that Halley may have come across them in the 1700 edition of Marsigli's *Prodomus*, in which Marsigli published the Hungarian magnetic measurement data. However, the question of how Marsigli procured the measurement data was not answered. The answer can be found again in Müller's register of observations. Between the leaves describing the position of the stationary stars and the results of the lunar observations I found a note occupying half a page. The chart, written in pencil, contains the measurement values for magnetic declination. Accordingly Müller made measurements with four compasses arranged according to the cardinal directions in Vienna, Buda, Baja and at the mouth of the Drava and with two compasses in Szeged, in the military camp at Tital, in Szolnok and in Eger. The date and places of the measurements were identical to the relevant data in his astronomical positions.²⁷⁶

Hydrographical section

The hydrographic section starts with the first thematic hydrographic map of Hungary

²⁷² BUB Mss di Marsigli Vol. 100. Pars. I. pp. 1-47.

²⁷³ Bartha Lajos: Egy elfelejtett holdtérkép (A forgotten lunar map). = Meteor Bd. 23. No. 4. 1996. =

²⁷⁴ DBM Vol. I. Pars II. Introduction

²⁷⁵ Bartha Lajos: A mágneses deklináció korai adatai a Kárpát-medencében (Early Data on Magnetic Variation in the Carpathian Basin). Technikatörténeti Szemle, Vol. XVI. 1986-87. Bp. 1988. pp. 97, 101, 103.

²⁷⁶ BUB Mss di Marsigli Vol. 100. Pars I. p. 12.

the *Mappa Potamographica*, which depicts the hydrological system of the Danube from Vienna to the Black Sea with many details and river names. *This map provides an overall view of nearly every important river and stream flowing into the Danube, and lakes and swamps in the territory of the Hungarian Monarchy*, Marsigli wrote in the legend on the map. In the upper left-hand corner of the map he thought it important to call attention to the fact that *the places where he had measured the width and depth of the rivers were indicated by small lines crossing the Danube, the Tisza, the Sava and the Maros*. These lines, however, cannot be seen on the map. Probably the copperplate engraver forgot them. Nevertheless, the places where the measurements were made were listed separately in a chart in volume VI, so, in the end, the points of measurements can be identified.

The four straight lines spanning the chain of mountains rising above the Carpathian Basin are interesting elements on the sheet. The author intended to show the altitude of the beds of some larger rivers compared to the Danube. On a separate page, he drew the cross-section of the Carpathian Basin along these straight lines, so he could illustrate the relative altitudes of the mountains, valleys and rivers crossed by the lines: the Danube, the Olt, the Maros, the Szamos, the Tisza, the Boszna, the Drina, the Sava, the Temes, the Verbas, the Drava, the Ipoly, the Garam and the Vág rivers are illustrated in the four section drawings. The altitudes were measured with a barometer.

Seventy years later, Miksa Hell and János Sajnovics measured the altitudes of the places using the same method on their journey to the island of Vardö to observe Venus as it passed in front of the Sun.²⁷⁷

After having drawn the picture of the watershed area, Marsigli described one by one the rivers running into the Danube, naming their source region, their mouth and length and classified them into groups II, III and IV depending on their size. Then, he returned to the Danube and examined the structure and composition of its bed and its banks. Then cross-sections followed to provide a visual aid to the values hidden within the numbers. He then measured the width and the depth of the Danube river in 8 places, of the Sava in 2 places, at one place on the Tisza and also at a single place on the Maros river. He made the same measurements at Vienna, Pest and Komárom as well, but these cross-sections have been lost, he added, excusing himself. He published an interesting cross-section here, which depicts the Danube (at Dömsöd) on one side and the Tisza (at Szeged) on the other and the two areas spanned by the Danube-Tisza interfluvium with an indication of soil quality.²⁷⁸ This picture reveals Marsigli's interest in the connection between rivers and swamps and rivers and lakes, and the *underground connections between individual bodies of waters*. According to popular belief, he said, both Lake Fertő and the Balaton were fed by the Danube. In another place: *There is a whirlpool beneath Komárom, he wrote, near the village of Almás, from which people say the Balaton originates, lying as it does between the hills on this side of the Drava in Hungary*.

He was convinced about the existence of some kind of an underground connection between bodies of waters, even if not in this form. He noted a phenomenon in the Danube-Tisza interfluvium that had not yet been explored although experts corroborated its existence. He described it in the chapter *The underground connection between the swamps of the Danube and the Tisza*. He probably intended to place the above-mentioned cross-section of the Danube-Tisza interfluvium in this chapter. *We also examined that part of the territory*, he wrote, *which is enclosed by the lower reaches of the Danube and the Tisza at Backa and I supposed that there existed ramifying underground water courses that connected the swamps of the Danube and the Tisza. I deduced it from the supposition that the two rivers ran parallel to each other, that is, both have the same course, while the tilt of the Plain is slight*.

He observed a demonstration of this theory. In the summer of 1693, the water in the Tisza rose very high and the flood was long lasting. The water retreated very slowly because

²⁷⁷ Sajnovics's diary 1768-1769-1770. (translated by András Deák) Budapest, 1990
²⁷⁸ DPM Tom. I. p. 75.

of the great bends (at that time the Tisza meandered along a path 453 km longer than at present) and the wide swamps. At the same time, Marsigli recounted, *there was barely any water in the Danube and its swamps. Yet, the low-lying fields of the Danube-Tisza interfluvium lay beneath water* and the seepage of groundwater flooded the crops in the flood plain of the Danube at Backa. This meant that the water flowed from the east to the west in the Danube-Tisza interfluvium, that is, from the direction of the Tisza towards the Danube.

Specialists now think that underground water flows through the loose alluvial soil influencing the development of groundwater in the plains which seems to support Marsigli's observations and the hypothesis built on them. In the summer of 2000, when groundwater caused particularly many problems, water surfaced in places where its appearance would not normally be expected. In this respect, there is an increasingly accepted theory that there exists a flow of underground waters in the Hungarian Plain. Thus, Marsigli's hypotheses about the *ground current* from 300 years ago seems to be confirmed.²⁷⁹ He also realised that it was not only the rivers that fed the swamps but that this process worked in the opposite direction as well: *The river feeds the swamps through channels called fok, or flows over the above-mentioned lines and cuts itself reservoirs where the excess water from the huge river is retained for a few days before flowing from one territory to another; namely, it has to fill them up first.* He observed this phenomenon in July 1694 when he was stationed with the army at Culut (Kula?). He received threatening news from Vienna about the flooding of the Danube, yet there was no trace of the flood although it should have arrived in a short time.

He explained the phenomenon by the fact that the flooding river first had to fill the swamps. This water retaining capacity of swamps is important when water was low as well. *It is also due to these swamps that the mass of water in the actual bed of the Danube does not start receding obviously, quickly and instantaneously even though the rains and the melting of the snow, the causes of the flood, have already stopped; namely, the waters seeping back from the swamps into the Danube postpone the dropping of the water level.*

He also realised the destructive, compounding effect of the various barrages. In these cases, the current of the river becomes unsteady, and islands or new swamps develop. Among the barrages he mentioned locks, dams, strong bends and straits.

He illustrated in a picture how the water flows in and out of the swamps through the channels called 'fok' at high or low water. The picture on page 81 and its legend make it evident that he regarded these channels as natural phenomena, an umbilical cord between the river and the swamp: *If the level of the water in the Danube would drop down even below level C, a new channel would develop, and so it would go until it reached the level of the bottom of the lake and masses of fish would perish, poisoning the very air.* In his description he also mentions that these channels are not formed by the flood that inundated the floodplains at high water but by the mass of water covering the lower terrain during the high water period. This water sought its way back into the river when the water level drops. It always pushes toward the deepest parts of the terrain, feeding swamps in the depressions, and building itself basins depending on the ground features in the area until it finds its way back to the river.²⁸⁰ His theory is corroborated by recent observations as well.²⁸¹

He would have liked to have been able to show variations in the water level of the Danube as well: at low, medium and high water. Lacking a water gauge, however, he could illustrate them only in relation to the depth and the cross-section of a given river bed. He

²⁷⁹ Deák Antal András: A földárja (The Ground Current). *Élet és Tudomány* vol. LV. No. 11. 17 March 2000.

²⁸⁰ Deák Antal András: Fokok és árvizek. (Fok channels and flood waters) *Élet és Tudomány* vol. LV. No. 23. 9 January 2000.

²⁸¹ Dr. Tóth Albert, professor at the Sámuel Tessedik High School (Mezőtúr) observed them in May-June 2000 as the flood retreated at Szajol and Tiszavárkony. The former is 10-40 m broad, the latter 15-20 m wide. He wrote the following about the way they developed: *a large mass of water broke through the left side of the river bank as it headed from the floodplain gulf back into the river at Szajol. Consequently, the channel was evidently opened up by the erosion of the retreating water.* (Manuscript).

marked the month and the year observations of the water levels were made. He measured the highest water mark in June 1694 and the lowest one in August-November, 1693.

When he had the luck to go to the northern part of the country, to Rimaszombat in the spring of 1693 and to the mining towns during the winter camp of 1694-95, he was already working on his *Danubius*. Since the waters of the springs that well up here also run down to the Danube, he found it necessary to deal with *the sulphuric springs of Hungary, which are believed to be poisonous*.

He had seen something similar to the springs in the northern part of the country and in Transylvania during an excursion in his youth: *A small hole can be seen near a lake called d'Agnan near Naples, which is covered to the height of about 1 foot by a fog-like vapour resembling the morning mist in the fields and if a living creature enters this vapour and inhales the air it will be dazed, and if it stays there longer, it will die*. However, he thought it only a popular belief that those who were poisoned by this effluvium revived and regained their health after repeated immersion in the healing waters of the lake. In Zólyom county, he went on, he had encountered a similar phenomenon: *There is another hole 24 feet wide and 10 feet deep north of the village of Rivari not far from the banks of the Garam river. A small oak stands on its brim. Once I descended into the deep hole and found common hard ground on its bottom, while on the northern side vapour burst forth with constant murmur as if water was bubbling down in the depths. When I had the ground loosened by a hoe hoping that water would surface I felt some ill-smelling vapour, which caused quick death to animals and young plants in the vicinity similarly to the circumstances near Naples except that the vapour could barely be seen here*. Herders said that they often found dead birds on the bottom of the hole and, a few months before Marsigli's visit, a cow had the bad luck to wander there. It inhaled the vapour and as the cowherds were not there to help, it died.

He described a simple chemical experiment to discover the chemical constitution of the vapour, one which would easily convince anybody about the correctness of his idea.

He dedicated the closing chapter of the hydrographical part to the baths of Buda. He had sketched them on the occasion of the siege in 1686.

Beside the 21 large maps already discussed, more than 50 illustrations enrich the volume.

VOLUME II.

ROMAN ANTIQUITIES

The volume is extremely rich in original discoveries and observations,²⁸² and the numerous drawings makes it especially important for local historians. Although he constantly referred back to the maps in volume I where the Roman antiquities are indicated on the sections, he found it necessary to localise them on the drawings of the sites. To help provide a better view he started once more with a map, which resembles the hydrographical map and contains the provenances of Roman remains in Hungary.²⁸³ He used separate markers for the forts, the shapes of which could still be discerned, and for those that had been totally destroyed. The same method was used for ramparts and ditches. He included the larger part of the Italian peninsula as well to show how the roads beginning in Rome joined the paved Roman roads he found in the Carpathian Basin. He used distinctive marks for mounds raised by the Romans and for the places where he found inscriptions or other remains.

Emperor Trajan's bridge was especially emphasised in his introduction. He was deservedly proud of its discovery, similarly to the *Römer-Schanz* known as Csörz's trench in

²⁸² For a more intimate knowledge of the volume BUB Mss di Marsigli Vol. 6. Co. Aloysii Ferdinandi Marsili Diario geographica in itinere limitaneo, cum antiquitatibus Romanis circa Danubium can be useful.

²⁸³ The documents described above tell us that it was drawn by J. C. Müller.

Hungary. He followed this latter one from the south at Kastolatz on the Danube continuing north. The trench passes by Arad and runs until Tokaj, where it turns to the northwest on the other side of the Tisza, then runs westward from Eger to the upper tip of Szentendre Island. The legend for its picture reads: *Vila Iarca fossa et aggere constructa*.²⁸⁴ Sámuel Timon described it again more than 30 years after Marsigli, although he knew only a short section of it but it was so large that blocked the path of the travellers, who could pass only where a gate was opened in it.²⁸⁵

Marsigli was convinced that it was certainly Roman in origin and had been raised to defend the empire against the looting, pirating barbarians attacking from their mountain eries in the Carpathians. The ditch part of the construction ran along the threatened side. The ditch was 20 steps wide at the top and 7 steps wide at the bottom. The rampart was made from the earth scooped out of the trench. At its foot the rampart was 20 steps broad and 5 steps broad on its top. A road ran along a ridge at the height of 10 steps for the soldiers who defended the rampart. He described its function and operation not only in words but also in drawings. Figure VIII shows its construction, figure IX sketches the ramparts running in a triangle at Titel and the mystery of the earthen constructions providing defence from the direction of the swamps of the Danube, which was a problem, he admitted, he could not resolve. Nevertheless, the drawing reveals that the author scrutinised the region with incredible care.²⁸⁶

He dedicated the greatest part of the volume to Emperor Trajan's bridge. Classical authors knew about it. The bridge can be seen carved into the stone of Trajan's famous column in Trajan's Forum in Rome. The exact location of the bridge among the wild mountains of the Lower Danube had been forgotten, however.

It was only after the victorious battles against the Turks in 1689 that Marsigli was able to look more closely at the region of the Lower Danube. This is how he came to 'discover' the bridge that had been built for Trajan's army as they marched against the Dacians. Its place was carefully chosen. There was enough space at the foot of the mountains on both banks for the army to pass, and the Danube, which pored through cataracts and straits higher up stream, flowed calmly at this place. He could spot the remains of several piers outlined in the low swirling water. He estimated their number at 23. On the bank he found a memorial plate and inscriptions from the Roman period and a stone-paved road leading to the bridge. Marsigli, who had built more than one pontoon bridge over the Danube, was awed by this view of the remains of the permanent bridge. The question of how the craftsmen of Antiquity coped with the huge power of the river piqued his fantasy. This is why he spent so much time on this topic. He even tried to reconstruct how the Romans were able to insert the blocks of stone lowered onto the riverbed into the correct places.

His descriptions often contain useful guidelines for archaeologists: *Pentele ... is abundant in Roman remains; not far below [the island] there are vineyards in which the ruins of the forts can still be seen (aa)... In additon, an elevated road runs in a straight line from Pentele to Földvár (bb). On its western side were eight watchtowers placed at certain*

²⁸⁴ In word-by-word translation: Iarca road built from a trench and a rampart. This probably means that it was built on a rampart in the plains. The earth for the rampart came from next to it creating a ditch.

²⁸⁵ Csörsz's trench (King Csörsz's trench) runs between Poroszló and the Tisza, and also Füzesabony (Fözes Abony) towards Dormand and Erdő-Telek along Atány, Kál, Boddo, Zsadány, Fényszaru and Tura. It ends at Ecsed a mile from the Danube and Vác on the eastern bank of the Zagyva. Abony, Kál and Árokszállás named after it can be found in this section. There is a passage in the place of an old gate between Dormand and Füzesabony, which is useful to know if a traveller does not want his way to be stopped by the ditch. Dormand is two thousand steps from Poroszló. Timon Sámuel: *Tibisci Hungariae fluvii notio Vagique ex parte*. Kassa, 1735. Translated by Antal András Deák (manuscript).

²⁸⁶ DPM Vol. II. Tab. 4. 57,5 x 76,5 cm

*distances from one another. Probably, legionaries were stationed in the watchtowers.*²⁸⁷

The drawings on old coins, tomb inscriptions, statues, stone fragments and sarcophagi were, of course, also included in the volume. I will not mention them separately. The number of the circa 280 illustrations are themselves sufficient to give an idea of the magnitude of the research invested in the volume. Among them are some folios, two folio-sized picture plates, in addition to a summary map and the map of Transylvania depicting the territories south of the Maros river.

VOLUME III.

MINERALS

The rich metal and mineral deposits carried by the left side tributaries of the Danube directed Marsigli's interest in the famous mines of Upper Northern Hungary. He was lucky to be provided with an exceptional opportunity to get acquainted with the underground world, a world that the mineralogists he knew never saw. He was allowed to descend into the mines and collect numerous rare rocks and ores on the recommendation of the emperor and the friendly support of a count who supervised the operation of the mines. In addition, he developed fruitful personal contacts with the inspectors of the mines, which were to prove very useful for his book, as we have already mentioned. Some samples of the minerals he collected at that time can be seen even today in the Museo Archeologico in Bologna.

He illustrated the method of exploring the topic with an example borrowed from anatomy: *if we want to present a man, he says, we usually first speak about his outlook, feelings etc, and only then about his more hidden organs. Similarly, first we have to give a general picture of the minerals and only then can we proceed to the anatomy of the rocks.*

Sand and stone on the bed of the Danube

He started his substantial discussion of the topic with the microscopic analysis of the sand. The analysed samples were collected from the northern bank of the Danube near Vienna and at Pest and from the sands of the Tisza above Szeged. He similarly dealt with the sands of the Maros, the Lajta and the Rába rivers. Then, he discussed the semiprecious stones, the less precious stones and ordinary stones. He illustrated these rocks in more than 150 drawings.

The first thematic mining atlases

*A summary map of minerals begins the description of the stones and ores found in the mines.*²⁸⁸ In this map he indicated the mines of northern and southern Hungary and Transylvania, from where the rivers carried deposits into the Danube. The mountains in which mines were opened stand out with stronger hatching and small, horizontal and oblong entrances drawn in their sides. The mark beside them indicates whether it is a gold, silver, copper, iron, salt, mercury or lead mine. Then, another map follows of the same size, which was intended to be an annex to the previous one. It shows the mines in northern Hungary on a larger scale, ignoring the actual distances between them. He drew straight sections through the mines so that he could indicate in which direction the ore veins ran in the individual mines. At the same time, he divided the whole field of the map by 24 straight lines numbered counter-clockwise, so that the above-mentioned directions could be discerned from the angle at which they ran to these straight sections.

We can find three famously well-drawn and suggestive drawings of mines under this heading. They show how the mines and their shafts penetrate into the belly of the mountain

²⁸⁷ DPM Vol. II. p. 6. Fig. VII

²⁸⁸ Müller's drawing; measurements: 45.5 x 67 cm

and how the miners worked down there. The description following the *map of the famous ore mine in Selmec in Northern Hungary*²⁸⁹ reveals that Marsigli was awed by the view of the, according to him, most famous mine in Europe. In the drawing he shows all the operations carried out as the veins of ore were followed deep into the mine in 1695. He was obviously enchanted by the way the ore and sterile layers were dug out, transported and lifted to the surface and huge masses of water pumped out. His description came from personal experience: *The surface of the hill is occupied by the town of Selmec and the multitude of the shafts that the craftsmen covered with timber constructions. Down in the depths, the workers put the ore into leather sacks, which are lifted to the surface with the help of wheels powered by people or horses.*

Water caused the greatest difficulties to the men who ran the mine. Because of water they had to spend great sums of money on machines and horses, because they had to make many sacrifices to get rid of it. *The water is pumped day and night, we can read here, and if they stopped it, exploitation of the mine would become impossible. The first step is to collect the water. It is directed into ponds through channels, from where people try to drive it outside the hill through other channels.* If the surface did not allow this method to be used, it was pumped up using wheels. In 1695, when this drawing was made, the deepest point from which water was pumped lay at a depth of 110 inches. Naturally, intuitive and clever mechanics could be found there as well, he wrote with some malice. They spent considerable effort, in his words, *to replace people and horses with ridiculous contraptions.* Marsigli found their ingenuity – *speculations* - dubious. He put more trust in the water lifting machinery of a pulley construction that had passed the test in the mine. Yet, it was these same intuitive engineers who greatly contributed to the fact that the mine of Selmec was to become world famous in the following decades.²⁹⁰ The mine galleries, marked with dotted lines in the picture, ran nearly parallel in the real mines as well, following the veins of metal ore.

In the depiction of the mine with the legend *Herregrund*, can be seen the mechanical constructions which hoisted the ore up the shafts to the surface. At the same time, it shows the cross-section of the ore-bearing mountain, the veins of metal ore, the galleries, the miners, the underground streamlets, the ponds in which these waters were collected and the channels that funnelled the water out of the hill.

The third picture with the legend *the mines of Selmec*, illustrates the two water-lifting machines of the copper mine establishments.

The inner structure of the mountains

In 22 illustrations this part of the *Danubius* contains a description of the declination of the rock layers (horizontal, oblique and vertical stratification) and the branching varieties of various metal ores (gold, silver, copper, iron etc).

Not genuine rocks: In his description of *rock salt, petrified bodies and mineral salts* he primarily dealt with Transylvanian salt mines, and spent an astonishingly long time with them. The rock salt hills, such as the one that can be seen at Sófalu, and the springs welling up from these hills, intrigued him. He analysed their waters, described the flames that soldiers had observed in 1685 above the marshes created by such mineral springs. He illustrated the cross-sections of the rock salt hills and the positions of the *flaming* springs of the hills (*situm fontis ignei*) in 12 pictures.

Among the *less valuable, larger rocks and crystals*, he discussed larger, soft and less valuable rocks; smaller but hard, less valuable rocks, larger valuable rocks e.g. crystals; larger valuable rocks, which, as he said, were also called precious stones due to their value and included 41 figures to illustrate them.

²⁸⁹ DPM Vol. III. p. 22. 45.5 cm x 70.5 cm

²⁹⁰ For example, Sámuel Mikoviny's genuine water lifting constructions and the early application of the steam engine in mines.

Of the *precious metals* he dealt with real precious metals, gold and silver, which he introduced in the form of various lumps and sand. He described the famous gold and silver mines in Northern Hungary, and incorporated his personal experiences and adventures within the description. He also wrote about less precious metals such as copper and iron ore and the waters coming from the copper mines in a separate chapter illustrated with 76 pictures.

Among the *metals which were not genuine* he discussed, among others, antimony crystals, mercury and lead together with 28 illustrations.

Origin of the metals

Marsigli tried to reconstruct the development of metals from his observations of the structure of rocks and mountains. He thought that the soul of the earth's interior was expelled to the surface in volcanoes due to the specific arrangement of the rocks in the mountains, where it solidified. A branched formation similar to the crater of a volcano is shown in the illustration. He hypothesized that all metals developed from the same exhalation which erupted from the abyss and only the circumstances which followed determined which ones they developed into. He tried to support his idea with an analogy: as the sown seed of wheat can develop into pure cereal or turn into refuse wheat and weed depending on the soil, the sunshine and other circumstances, so it is with the materials that erupt from the depths of the earth. Figure II of the four illustrations contains an interesting topographic detail. It shows the gold mine, the thermal baths and the medicinal springs between Zólyom and Ribar village in the valley of the Garam river.

All together, he illustrated the rich world of rocks, metals and petrified matters in and around the Danube in nearly 350 figures.

VOLUME IV.

FISH

The opening picture of the volume, which was engraved by the Dutch artist Houbraken, illustrates the fishing and contains a description of the great sturgeon. The description of the *royal fish* that swims up the Danube from the Black Sea to spawn is especially stressed in the book. This is underlined by the fact that beside the autochthonous fish species of the Danube, the book discusses fish that are attracted by the fresh water from the sea, lakes and swamps, and others, alien to the Danube, that come into its waters in another way: *from other rivers or lakes the fishmongers put them into the Danube so that they can live there longer and grow or just for conservation.*

He worked mainly following descriptions by Aldrovandi, Gesner, Villugbei and Rondeletius. He wove his observations into these scientific descriptions.

He classed the fish species living in the Danube and its swamps into four groups:

- *River-fish*: they have bones, their skin is scaly (e.g. eel or sheath fish) – four species are described; they have bones, their skins are scaly (e.g. orfe) – ten species are listed; river-fish with spiny fins (goby), which are described in two groups.

- *Marine fish living in rivers* (fluviatiles marini). They are divided into two groups based on their skins: smooth or scaly.

1. Of those fish lacking scales he pays the greatest attention to the great sturgeon, which swam up the Danube from the Black Sea. He dissected it – the drawings can be seen in volume VI. By his meticulous study of them he contributed many new details to science. Concerning its fishing he learned, for example, that it was even hunted with guns. If the huge fish was injured or dazed, a rope was quickly passed through the gills and the mouth. Then a picket was fixed to the end of the rope so that the rope could not slip out and the fish was dragged to the bank by a boat. People then surrounded it where it lay and, enveloping it a very long and loosely woven net, pulled from a boat. If the nose of the fish

had not been caught in the net by then, they tickled it, and the fish, which did not like being tickled, retreated, then the fishermen drove the fish with continuous tickling close to the bank where it became stranded in the shallow water or even jumped out onto the bank. Then it was bound to the trees standing on the bank or to strong poles in the manner described above and put back into the river, so that later it could be hauled by boat to the market of a large town. Mátyás Bél also witnessed and described this latter method of the fishing the great sturgeon.²⁹¹ He thought that the caressing of the fish was meant to calm the animal down.

2. Of the species that resembled the great sturgeon but had rough skins (*cute aspera*) he devoted most attention to sterlet since its meat was said to be better than that of the great sturgeon. At the end of the chapter he remarked that all the fish that swam up from the sea turned back two miles under Komárom. According to the observations of the fishermen, they always followed the same route.

Swamp fish. These fish species are also discussed in two groups: those with smooth skin and those with scaly skins. Fish with scaly skin include the *Veres Szárnyukeszég* (roach), the *Karasak* (crucian carp) and the *Varjahal* (tench).

River and swamp fishes. All of these fish species have scaly skins but their fins can be either spiny or not spiny. The latter ones are discussed in five chapters. Among them we can find the descriptions and the drawings of the *Dewerkesegi* (bream), *Pontty* (carp), *Kenig* (king-carp), which are mentioned by their Hungarian names as well. Even the scales of the king-carp were drawn to full-scale. He described his personal carp fishing experience as well. On the 5th of March 1701 he caught a 4 feet long carp weighing 27 kg in the Temes river on the border with Transylvania. He also discusses northern pike. He related an experience with regard to this fish as well: *it lays its eggs in March, when it comes up from the bottom and usually withdraws to the reeds. In this period, is it nearly totally blind and so disoriented that it can be lifted from the water with bare hands when it strays near the surface. I myself saw such a thing in the flowing Danube branch at Vienna. A circa 4 kg pike was seen floating on the surface. After it had laid its numerous eggs on a stone, it did not become frightened and did not flee when two people approached it in a boat, but was so much dazed that they could lift it into the boat with their bare hands. However, since they did not watch it, the fish recovered, sprang back into the river and escaped.*

Fish living among stones. These fish are also divided according to their skins. Three species were separated out from among the fish with smooth skins. One was the *Menyhal* (burbot), which is mentioned by its Hungarian name as well. The fish with scaly skins are described in six chapters. Among them he mentions trout and even salmon.

Following the description of the fish, he described four more animals that live in water or favour habitats close to water: crayfish, shellfish, water snail and turtles. These animals are illustrated in 70 figures altogether, mostly in picture plates. Beside the Latin names of the fish species, he provides the German, Serbian and sometimes also Greek and Hungarian names.

VOLUME V.

BIRDS LIVING BY THE WATERS OF THE DANUBE AND THEIR NESTS

Marsigli dealt with both the nests and eggs of the birds because, as he said, no researcher had ever paid attention to the descriptions and observation of the nesting places and eggs of the described birds.

²⁹¹ Bél Mátyás: *Der re rustica Hungarorum*. The part on fishing was translated by Antal András Deák: *A magyarországi halakról és azok halászatáról*. Bp. 1984.

He did not restrict his investigation to the Danube but was also interested in the birds of the Tisza (p. 5). Regarding the classification of the birds he followed Willugbei, while in the descriptions he relied on work by Aldrovani, Gesner and Jonston. He described some new species as well. He believed, for example, that he had discovered the golden yellow heron (*asrea cinerea flavescens*), a *nova species*, he wrote proudly (plate 8), similarly to the greenish, yellowish heron (*ardea viride flavescens*, plate 9) or the dark brown heron (*ardea fusca*, plate 10).

Sometimes we find aspects of his work that are shockig to modern people who know these birds only as protected animals: *Its meat is extremely soft and tasty* (p. 56).

In his description of the eggs, he paid attention, not only to the exterior features but also to their interior structure and properties. He found that the shells of the eggs of the birds that lived along the Danube was harder than those of other birds. He also discovered that the white of the egg was larger in the eggs of water fowls. Sometimes he mentioned the way they tasted. When for example, he described the eggs of the dark brown ducks living along the Danube he remarked that they were less suitable for consummation, because they had too 'wild' a taste.²⁹² The volume is enriched by 59 depictions of birds (42 x 29 cm) and 15 drawings of bird nests along with the eggs (also 41 x 29 cm).

VOLUME VI. MISCELLANEOUS OBSERVATIONS

The 'miscellaneous' volume is a collection of those observations and scientific results that did not fit organically into the topics of the other volumes. In the Prodomus, he still intended to call the volume *Tomus analectorum*, but then, as he explained in the preface, he found the title *Miscellaneous observations (miscellaneorum observationum)* more appropriate. Although the volume is rather multidisciplinary or even eclectic, the uniqueness of his observations give it remarkable value.

He studied the sources of the Danube in 1702, when he was able to spend a few weeks in the Black Forest. An earlier misconception held that the source of the Danube lay in the Donaueschingen estate of the Fisseberg family. Marsigli had sent two engineers to the location to survey the area, measure heights and discover water-courses.²⁹³ According to their data he came to the conclusion that the real source of the Danube must be elsewhere, namely near Brukelrein. He proved his statement with the help of three maps on which he showed the springs welling up above Donaueschingen. With the help of a barometer, he measured the altitude of the springs above sea level. These data are indicated on map no. I (plate I). Besides this, he drew the trough from which animal drank, the pens, the sheds or barns and an artificial pond above Brukelrein, the water of which had been diverted to drive a mill. Map II shows the territory between Brukelrein and Donaueschingen with all the water courses. He remarked that the springs of a brook could be found there at Donaueschingen, which was traditionally called the Danube. Topographic drawing III shows the Donaueschingen branch, which was mistakenly identified as the Danube, the Brige brook, and the brook that local people called Brege and that Marsigli thought to be the veritable Danube.

Then, he made a detour beyond the source area of the Danube and represented in a summary map the sources of the brooks, mostly in Swiss territory, that fed the Rhein. Finally, he drew the cross-section of the whole territory applying the well-tried methodology from volume I, in which the relief, the larger mountains and mounds that could help with orientation were depicted with altitude values measured with a barometer.

²⁹² Volume V, p. 124.

²⁹³ BUB Mss di Marsigli Vol. 61. Itinerarium Villinganum és Itinerarium Schaffhusense.

He made *anatomical observations* on water fowls, the great sturgeon and an otter.

Of the birds he encountered, he dissected an eagle, birds that feed on fish and wading birds, all of which are illustrated in three figures.

That the great sturgeon really captivated him is indicated by the 13 picture plates of its dissection.

This huge fish, which can reach a thousand kilograms, was, as is well known, only a visitor in the Danube: it swam up from the Black Sea in search of a suitable spawning place to the great delight of the Danubian fishermen. The dissected specimens were caught by fishermen below Orsova in 1690 when Marsigli was stationed with the army on an island in the region. Here, as he told the story, fishermen caught and *opened up 50, 60 or even 100 great sturgeons a day*.

He did not mention any personal experiences concerning the otter. He believed it spent most of its life in water. The dissected inner organs are illustrated in two plate pictures in altogether 5 figures.

The *velocity measurements of Danube and the Tisza* are important from a hydrographical point of view, not because of the resulting values, but due to the measurements themselves. The method that was applied with the velocimeter quadrants of his day did not permit accurate measurements to be made. The reason is that the cord that indicated the value of the speed on Marsigli's quadrant which was fixed to a boat was bent into a curve in the direction of the flow and, thus, did not show the actual place of the weight at the end of the cord. A reliable velocimeter was constructed only about 200 years later. Nevertheless, he conscientiously measured the speed of the water close to the surface, near the bottom of the riverbed and in the middle. He made such measurements at the Pétervárad bridge on the Danube, at Zsablya on the Tisza and at the bridge near Becse also on the Tisza. He tried to discover the connection between depth and speed from these measurement data. From the data measured at Pétervárad he concluded that the speed of the water was nearly three times faster near the bottom than on the surface (the quadrant displayed a value of 12 degrees on average on the surface, 26 degrees in the middle and 30 degrees near the bottom). He listed the measurement data in three charts.

Marsigli also investigated the *waters in the collection area of the Danube*: flowing waters, stagnant waters, the water in wells, mineral waters, waters coming from hail and rain and the water from thermal springs. He analysed their composition and arranged the data in 5 charts the size of a double folio, in which he also indicated the places where the analyses were made.

In the following pages, he summed up and evaluated the results. He deduced that the water of the Tisza was the worst among the rivers he examined (he made the observations on the north bank at Szeged). As he said, *it smelled very much of earth* when he examined it in October, and found that it had a bad tang of swamp, its colour was dark and contained much silt and many insects.

He judged the water of the Maros the best, which he examined on the 4th of October near Makó: it was clear, odourless and tasted very good. He evaluated the waters of the tributaries of the Danube and the waters described above from the collection area of the Danube using the same method.

He collected information on the *indigenous plants of the Danube region* in a chart with four columns. The plants were named and classified according to the *Historia Tabernamontana reformata* a German language catalogue (the details were not given) in the first column and following Gasparus Bauhin in the second column. The provenance of the plants (on roadsides, hillsides, sandy slopes etc) was indicated in the third column, while the fourth column contained their actual occurrence (at Buda and at the mouth of the Drava, in the environs of Esztergom, at Baja etc.).

He did not omit quadrupeds from the description of the fauna along the Danube, although he dealt in detail only with red deer antler.

He made series of measurements with *barometers* and *thermometers* during an inquiry against him²⁹⁴ in Vienna between the 11th of December 1696 and the 30th of August 1697. In the short introduction to the chapter, which he probably wrote just before the manuscript went to press, he himself emphasised the pioneering quality of his work. Namely, he did not know of anybody who had made similar thematic measurements either on the seashore or in the middle of a continent. He believed that similar observations were regularly pursued in Europe only thirty years later on the initiatives of the English Royal Society.²⁹⁵

He worked with two barometers and four thermometers. When necessary, he also used a microscope for the analysis of snow crystals, as he himself had used it for studying minerals and insects. A wind vane showed the direction of the wind and registered values to the exactitude of secondary cardinal points. He could not measure the force of the wind but he found it important to register relative strength: gently blowing, strongly blowing, no wind, the air is pleasant and calm...

He arranged the measurement values in charts by month and day, the hour, the value read from the thermometer, the value read from the barometer, the shape of the snowflakes, the degree of frost, the wind direction, the brightness of the sun, the clouds, snow or rain. Until the 28th of December, the chart is amply illustrated with drawings, the degree of frost is marked by the symbols 0, 00, 000, which indicated slight, temperate and strong frost. He started to register the temperature readings from the thermometers only on the 24th of January 1697. From the 29th of December he no longer indicated the degree of frost except for three days (January 6, 7 and 9), the drawings of snowflakes, clouds and the sun disappeared, while he described the direction of the wind and other weather conditions under the heading of *air quality*, which contained only written information. This assortment of many pieces of data allowed him to recognise the connections between them. Using the charts, he summed up the results which he divided into three groups in ten pages.

First, he examined the characteristics of his barometer measurements from December 1696 to August 1697. He found that when the barometer was placed in the south it showed more than the double the value read from the barometer placed in the north in winter and in spring until 8 May, while the results were just the opposite from the 21st of May to the 30th of August. He explained the phenomenon as the result of a defective instrument.²⁹⁶ Then he surveyed the values the barometer showed *when it snowed, the sun shone or when there were clouds in the sky*. Finally, he discussed *the conclusion he drew from the values indicated by the thermometer*. He perceived connections but could not always explain them. A mystery he could not solve was e. g. why the barometer reacted differently in subsequent seasons. Regarding the connection between the cold and the wind he thought that that the degree of cold did not depend on the wind. Finally, he arrived at an interesting conclusion concerning comparison of the values read from the thermometers and the barometers. He realised that the connection between the changes in temperature and atmospheric pressure was that when the atmospheric pressure increases the temperature sinks and vice versa.

The volume closed with a description of the *insects living along the Danube and the Tisza*. He mentions in the introduction that he was especially interested in the question of the reproduction of insects. It was the phenomena he experienced in the military camps that aroused his interest. Clouds of mosquitoes made life unbearable in the vicinity of swamps.

²⁹⁴ He was accused of misdirecting funds but was acquitted of the charge.

²⁹⁵ Lajos Bartha: The first experimental Central European meteorological station was established 300 years giving a written overview of Marsigli's meteorological work. He believes that Marsigli used a methodology followed by some English scientist such as Boyle, Halley, Hooke or Newton (= Légkör, 42. évf. 3. sz. 1997 =).

²⁹⁶ In the opinion of Lajos Bartha this was probably caused by a fault in one of his instruments.

Epidemics raged during sieges. He mentioned the siege of Buda because of the rotting corpses. And with favourable weather conditions, the earth became an ideal nest for locust eggs, which ended in locust invasions.

He noticed that worms also laid eggs and rotting organisms served as their breeding ground. There they multiplied and infested living organisms by inhalation or through the water during washing or from the vessels used for eating and drinking. The observations made during the dissection of an eagle, which feeds on carrion as well, supported his theory. His knowledge proved useful during epidemics and he rescued the lives of people by taking strict preventive measures in the military camps: the sick people were isolated, and the people who had come from infected territories were quarantined. He even forbade acceptance of customary gifts from the Turkish negotiating delegation if their camp had been contaminated by an epidemic.²⁹⁷

Following the usual introductory thoughts, he listed the insect species in a comprehensive chart, then described the terrestrial species (dipterous, hymenopterous, apterous insects and arthropods), those that live near the water and finally those that live in water together with nearly 80 illustrations. He coloured the descriptions by personal experience. This he how he described for instance the phenomenon called “the blooming of the Tisza”. *Around the 20th of August in 1688, when I hastened to the camp to captain Karl von Lotharingen in a boat I saw flying masses of some kind of a winged insect on the Danube not far from the mouth of the Tisza ...*

Regarding locusts, he mentioned the locust invasions in 1689, 1690 and 1691. Concerning the last one he mentioned that *the dead bodies of more than a thousand locusts covered the road near Lippa at the time of the autumnal equinox. They were lying in holes in clods of muddy earth. I saw some kind of matter in these holes, which were certainly eggs...*

I am ending my study with the same uneasy feeling that Marsigli admitted to in his preamble: I am aware that I was not able to uncover everything and what I did is not complete. There is probably one who could completely succeed in such an endeavour. Marsigli’s life, interests and relationships with other people were very complex. Anybody who wishes to evaluate the scientific historical merits of the Danube monograph must be familiar with nearly all fields in the natural sciences, and have a deep understanding of the scientific and artistic life of Europe in the 17th – 18th centuries. But even this would not be enough! First, cartographers, historians, geographers, hydrologists, archaeologists, mineralogists, mine historians, botanists, ichthyologists any many other specialists need to make a detailed analysis and scientific historical evaluation of the book, something which has probably not been accomplished yet, since the book discusses nearly exclusively regions within the Carpathian Basin. In Bologna he is acknowledged as a prominent patron of sciences as written on the commemorative tablet placed next to Michelangelo’s work in the Dominican church.²⁹⁸ This must be one of the main reasons for the indifference European scientists show towards this work.

Another reason may be that it has not been generally recognised, and this is something we tried to demonstrate in this study, that the *Danubius advanced various branches of natural sciences by presenting numerous new results and, at the same time, reflected scientific life in the Europe of that time.*

These new results were rooted in Marsigli’s unique scholarly mentality: his systematic train of thought resulting from the contemplation of natural scientific problems was enhanced

²⁹⁷ Katalin Kapronczay: The legacy of L. F. Marsigli's manuscript writings on medical topics = Lecture at MTESZ on the 21 November 2001.

²⁹⁸ *Aloysio Ferdinando comit. Marsilio scientiarum et artium instututi munificentissimo promotori clementini academi patrono et parenti optimi.*

by genuine intuition. Illustration and visual demonstration were inborn requirements with him. This is how his pioneering maps came into being: the 39 frontier section maps, the first thematic commercial map, the first postal map, the first thematic hydrographical map, the first thematic map of mines, the plague map, and numerous plans of locations of importance to historians, archaeologists and scientists researching past natural conditions. Owing to his work and book, lacunae in the natural sciences were filled from the territory of the Hungarian Kingdom and *the Danube, the prince of European rivers* was represented in a new and accurate form. What is more, it was in this region that the very first terrestrial magnetic declination measurements and methodical meteorological observations were carried out.

All the above can only be properly evaluated and Marsigli given the respect and admiration he deserves in light of the activities of the multitude of scientists and artists from various countries in Europe who assisted him with their work, studies or in their answers to his letters. We could see how many scholars he relied on in the collection of his material and that the illustrations of his book were prepared by German, Italian, Austrian, Hungarian, Dutch and French masters. *The Danube monograph is a one hundred percent European achievement.* His work concerning the organisation of his research was helped by the fact that these different mother tongues did not yet act as barriers between scientists in Europe at the end of the 17th century where the spirit of the uniform Latin culture of the Middle Ages still lingered. The representatives of Hungarian, Croatian, Slovakian, Transylvanian, Austrian, German, Italian, French, Dutch and English nations, who all contributed to the book in one way or another, could communicate with each other with no difficulty and all understood the book edited in Latin. A similarly magnificent, unlimited flow of information seems to be evolving today with the spread of the English language. The facsimile and the texts and illustrations borrowed from the volumes represent not only an aesthetically exquisite work abundant in genuine theories by a splendid author who contributed to the development of several new branches of science but also the choice fruit of the exemplary joint work of the scientific and artistic community of Europe that was not constrained by borders or nationality.

REFERENCES

- Autobiografia di L. F. Marsigli messa in luce... dal Comitato Marsiliano a cura di Emilio Lovarini, Bologna, 1930.
- Bartha, Lajos: The first Weather Observatory was founded in Central-Europe 300 year ago. = Atmosphere: Volume 42nd. No. 3. 1997 =
- Bartha, Lajos: Halley, Marsigli and the first isogonal map of the Carpathian Basin. Wien, 1995. 16th International Conference on the History of Cartography.
- Bartha, Lajos: A forgotten Moon map. = Meteor, Bd. 26. No. 4, 1996 =
- Beliczay, Jónás: Marsigli élete és munkái (Marsigli's life and work). Budapest, 1881.
- Bevilaqua – Borsody, Béla: E. F. Marsigli di Bologna gróf tábornok XVII. század-végi magyarországi csillagászati megfigyelései (The astronomical observations of Count and General L. F. Marsigli of Bologna at the end of the 17th c.). Budapest, 1929.
- Cavazza, Marta: Bologna and the Royal Society in the 17th century, Notes and Records of the Royal Society, 35 (1980).
- Cavazza, Marta: Settecento inquieto. Alle origini dell'Istituto delle Scienze di Bologna. Il Mulino, 1990.
- Cavazza, Marta: Settecento inquieto. Alle origini dell'Istituto delle Scienze di Bologna. Il Mulino, 1990.
- Carpine-Lancre, Jacqueline et Anita McConnell: Le Comte L. F. Marsigli et la société Royale des Sciences de Montpellier (Actes du 110. Congrès National des Sociétés Savantes Montpellier, 1985. - Section d'histoire des sciences et des techniques Volume I. Paris CTHS 1985.)
- Epistola Comitum Ludovici Ferdinandi Marsigli de Ponte Danubii Traiano imperante extracti ad Reverend. et Doctissimum P. Bernardum Montefalione e Religione Benedictinorum Congregationis S. Mauri in Gallia – Kézirat, Esztergomi Főszékesegyházi Könyvtár 355. Hist. VII. e. 26. 348-361. pp.
- McConnell, Anita: A profitable visit: L. F. Marsigli's studies, Commerce and friendships in Holland, 1722-23. – Italian scientists in the low countries in the XVIIth centuries, Edited by C. S. Maffioli and L. C. Palm, 1989.
- Farinelli, Franco: Luigi Ferdinando Marsigli. (Storia illustrata di Bologna 13/VI - I novecento anni dell'Università)
- Farinelli, Franco: Multiplex Geographia Marsili est difficillima. I materiali dell'Istituto delle Scienze Accademia delle Scienze. 1979.
- Gaál, István: Marsigli kutatásai hazánkban (Marsigli's research in our country). Budapest, 1930.
- Gherardi, Raffaella: Luigi Ferdinando Marsili: Relazioni dei confini della Croazia e della Transilvania a sua Maesta Cesarea. Modena, Mucchi editore, 1986.
- Govi, Gilberto: L. F. Marsili micologo Bolognese. Bologna, 1984.
- Görög, Demeter – Kerekes, Sámuel: Magyar Országnek Közönséges Mappája (Common Hungarian maps) - 1798-1811.
- Herceg, Gyula: L'autobiografia di L. F. Marsigli e L'Ungheria, Venezia, Italia, Ungheria fra Arcadia e illuminismo Rapporti Italo-Ungheresi Dalla presa di Buda alla Rivoluzione Francesem. Budapest, 1982.
- Instrumentum donationis... A. F. Marsiliis Museum Britannicum (Bibliothecae Sloanianae H. 602.)
- Iványi, Béla: L. F. Marsili primo esploratore della grande pianura ungherese Bologna, 1930. Zanichelli 62.
- Kapronczay, Katalin: Writings concerning medicien in L. F. Marsigli's manuscripts. = Lecture, MTESZ 21st November, 2001 =
- Korabinsky, J. M.: Atlas Regni Hungariae. Wien, 1804.
- Longhena, Mario: L'opera Cartografica di L. F. Marsili Róma 1933-XI. (Publicationi dell'

- Instituto di Geografia della R. Universita di Roma Seria A. Num.3.)
Marsigli, A. F. Comit.: Danubialis operis prodromus. Wien, 1700.
Marsigli, L. F.: Danubius Pannonico-Mysicus I-VI. Amszterdam – Hága, 1726.
Mikoviny, Sámuel: Epistola de methodo concinnandarum Marum Hungariae topographicarum. Posonii, 1732.
Puppini, Umberto: L. F. Marsigli ingegnere d'acque. Discorso. Bologna, 1931. Zanichelli.
Silvani, Paolo: Il generale Luigi F. Marsili e la nazione ungherese. Bologna, 1931.
Stoye, John: Marsigli's Europe 1680 – 1730. New Haven and London, 1994.
Veress, Andrea: Il conte L. F. Marsili e gli ungheresi. Imola, 1929. Caleati.
Veress, Andrea: Il Conte Marsili (L.F.) in Ungheria. Budapest, 1931.
Veress Endre: A bolognai Marsigli-iratok magyar vonatkozásai (The Hungarian connections in the writings of the Bolognese Marsigli). Budapest, 1906.
Veress Endre: Gróf Marsigli Alajos olasz hadi mérnök jelentései és térképei Budavár 1684-1686-iki ostromairól, visszafoglalásáról és helyrajzáról (Count Alajos Ferdinánd Marsigli's, Italian military engineer, reports and maps of the siege, re-taking and local drawings of Buda castle between 1684-1686). In: Budapest Régiségei Budapest, 1906.