LUIGI FERDINANDO MARSIGLI (1658-1730) AND EARLY THEMATIC MAPPING IN THE HISTORY OF CARTOGRAPHY

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LUIGI FERDINANDO MARSIGLI (1658–1730)
ÉS A KORAI TEMATIKUS TÉRKÉPEZÉS A KARTOGRÁFIA TÖRTÉNETÉBEN

Összefoglalás

A tematikus kartográfia gyökerei a 17. századig nyúlnak vissza, de rohamos kiterjedése a 19. század első felében kezdődött. A modern kartográfiában az általános térképeket a tematikussal vetik össze, utóbbit a topográfia térképen alapuló, később kifejlődött típusnak tartják. A tanulmány kétségbe vonja ezt az elfogadott nézetet és történeti megközelítést javasol. A tematikus probléma megoldásához a kartográfiát különböző térképezési módok együtteseként kell felfogni. A tematikus térképészeti mód az európai Felvilágosodás idején rohamosan fejlődött, de a kezdetek és a korai története homályos. Luigi Ferdinando Marsigli (1658–1730), a művelt olasz gróf a török háborúk idején katonai térképészként szolgált Magyarországon. Marsigli tudományos érdeklődésének középpontjában a Duna állt. Az 1699-es karlócai békeszerződés után a Habsburg–Ottomán határvonal kijelölését és térképezését irányította. Johann Christoph Müller segítségével tematikus térképeket készített: számos térképet a határvonalról, és különleges témákat bemutató mappákat (kereskedelmi, postai, járványügyi). A kéziratos térképek a nyomtatott tematikus térképek, diagramok és metszetek előfutárai voltak, amelyek a gazdagon illusztrált, hat kötetes monográfiában, a Danubius Pannonico Mysicus-ban jelentek meg (1726). Az első kötet földrajzi része (általános és részletes) hidrográfia térképeket, a történelmi kötet a római emlékeket bemutató régészeti térképeket tartalmaz. A Duna-monográfia harmadik kötete az első bányászati atlasznak tekinthető. Marsigli tematikus térképész volt, akinek azonban saját maga számára alaptérképeit is el kellett készítenie. Ez a fő oka annak, amiért nem tematikus térképészként, hanem az ország pontosabb, felmérésen alapuló általános térképe szerzőjeként tartják számon. A Marsigli-kérdés jól példázza a felvilágosodás kori európai térképészet összetettségét.

Summary

The roots of thematic cartography can be traced back to the 17th century, but it started to expand rapidly from the first half of the 19th century. In modern cartography the general or topographic map are compared with thematic, the latter type is considered to be based on topographic map and developed historically later. This paper attempts to challenge this accepted view and suggests a historical approach. To solve the thematic map problem we should comprehend cartography as a complex of different modes. The mode of thematic cartography developed rapidly in the European Enlightenment but its origin and early history is obscure. Luigi Ferdinando Marsigli (1658–1730), the educated Italian count served as a military surveyor in the Turkish war in Hungary, at the same time he was the scientific explorer of the country. Marsigli focused his scholarly interest on the Danube and maps were essential tools for his project. After the Karlovac peace treaty (1699), as a commissioner he directed the mapping and marking of the Habsburg–Ottoman border line. With the help Johann Christoph Müller, Marsigli produced thematic maps: numerous border maps and maps representing special subjects like commerce, postal service, etc. The manuscript maps were forerunners of the printed thematic maps, diagrams and sections of the richly illustrated, six-volume monograph Danubius Pannonico-Mysicus. (1726). The geographical part of the first volume contains hydrographical maps (general and sectional), in the historical volume the Roman antiquities are represented on an archeological maps. The third volume of the Danube monograph can be considered as the first a mining atlas. Marsigli was a 'thematic' map maker who had to create his own 'base' maps. This is a major reason why he is not considered as a thematic map maker, on the other hand, he is acknowledged as maker of a more accurate, general map of the country, which was based on survey. The Marsigli-problem is a clear indicator of the complexity of map making in the European Enlightenment.

Introduction: the historical nature of thematic cartography

The study of thematic maps has been a rather neglected field in the history of cartography as a scientific discipline. On the other hand, thematic cartography is considered as one of the substantial lines of the development of the modern cartographic paradigm. In modern, 20th century cartography thematic map making played a major role. The importance of thematic cartography and scientific visualization has been increasing in age digital cartography, GIS and other advancaed information technologies (SLOCUM et al. 2005).

In the multi-linear phase model of the history of cartography as an independent discipline, the integration of the field of thematic cartography in the second half of the 19th century is the indicator of the constitutional period (KLINGHAMMER – PÁPAY – TÖRÖK 1995). From other point of view, the extension of the scope of cartographic theory (the meta-sphere) reflected the enlarged object sphere, the map making practice. The history of cartography should not be interpreted, however, as a multi-linear progress.

The critique of cartographic empiricism by EDNEY (1993) suggests the reinterpretation of the historical development of mapmaking. It must be stressed, cartography is interpreted here as a practice in this conception. Instead of one monolithic enterprise, cartography can be considered as a complex amalgam of different cartographic modes. These modes are sets of specific cultural, social and technological conditions. According to this approach, the different types of maps, fulfilling different functions for different social organizations, demonstrate different cartographic modes. The development and the interaction of the cartographic modes is illustrated by the historical overview of the early modern European cartography. In the period 1500–1850, which is called 'the period scientific reformation', the convergence and divergence of formal cartographic modes is demonstrated. In the early 18th century the four Renaissance modes converge into a single one, called 'mathematical cosmography'. Around 1800 begins the fragmentation of this monolithic cartography and one among the new formal modes is thematic cartography. Regarding the development of thematic cartography after 1700, Edney put an emphasis on the institutional elements. He also notes: 'The connection between the development of systematic mapping and of thematic mapping is clear: while the first allowed the state to understand and control the physical of the European state or European colonies, the second allowed the state to understand and control the social contents of those territories.' (EDNEY 1993, p. 63.)

The scope of this paper is the historiographic identification of the thematic cartographic mode in the early history of thematic cartography. The mapping activity of Luigi Ferdinando Marsigli, the scientific explorer of Hungary, is studied here to reveal the complexity of European cartography in the Enlightenment. The consequences of this historical case study may also contribute to the better understanding of the nature of thematic cartography.

The problem of 'thematic' in modern cartography

Thematic maps represent the distribution objects or phenomena (or a limited set of them), their characteristics, structure or functions. They are also called special purpose maps as their function is to display the spatial pattern of the theme by showing its changing value(s) from place to place. Thematic maps are usually contrasted with the general-reference map, which shows the location of different objects or phenomena to help geographical orientation. For thematic maps a geographical background, a base map is used only to give the special subject the necessary spatial reference. (KLINGHAMMER – PAPP-VÁRY 1983) The historical development of cartography and the practical organization of the work explain why topographical maps have a special place (HAKE – GRÜNREICH, 1994. p. 414)

In the classic monographs on thematic cartography the problem of the dichotomic map categorization is clearly realized. IMHOF's definition of the thematic maps is a typical example of the negative definition: thematic maps are not topographical maps (IMHOF 1972, p. 13). It also emphasized that these map groups are based on practical considerations, as every map has got topographic as well as thematic content. Regarding the definitions in cartography WITT argues that it is incorrect to contrast topographical with thematic maps (WITT 1967, p. 14). He also remarks that topographic maps preceded their thematic counterparts by centuries for the historical development. Thematic maps are told to be based on topographical maps, the special subject of the map is represented on a simplified, selected, that is a generalized topographic basis. These examples from monographs on the thematic cartography may well reflect the accepted view on the nature of thematic maps. In modern cartographic literature the special subject, the map content, and the graphic appearance of the thematic map are considered as their characteristic features (KLINGHAMMER – PAPP-VÁRY 1983).

It is remarkable historical evidence is involved in the argumentations, it is to explain why priority is given to general or topographic maps. In '*The nature of maps*' ROBINSON and PETCHENIK expressed the opinion thematic cartography involved a more complex level of spatial articulation and it is a more sophisticated intellectual task for the map reader, 'although emphatically not necessarily more difficult than general mapping'. They also find it not surprising that thematic cartography a relatively recent development (ROBINSON – PETCHENIK 1974, p. 121).

It must be also realized, the rather loose and negative definition of the thematic map in modern cartography is based on the practice of map construction in the period when thematic mapping were already part of the cartographic discipline. This was, one may rightly suppose, not always the case.

In the early 18th century map making was still a practice, but the development of the meta-sphere had already started. The 1724 map catalog of Eberhard David HAUBER (1695–1765 Hauber listed historical as well as contemporary maps, and he mentioned the 'remarkable representations', the thematic maps separately (HAUBER, 1724). It is clear that these had been published by the early 18th century. In the next one and a half century, however, the making of topographic maps became the dominant mapping mode in Europe (SCHARFE 1997). By the mid-19th century the conditions had changed: modern thematic map making was based on the geometrically accurate, base maps, there were large collections of scientific data with sufficient density, the graphic methods of thematic representation and the new reproduction methods had been invented (KRETSCHMER – DÖRFLINGER – WAWRIK, 2004).

Cartography as an independent scientific discipline was born in the period 1869–1925, which was the phase of constitution. This period started with the publication of the book of Ágoston TÓTH, who already included thematic maps (historical and statistical maps). (TÓTH, 1869). The publication of the two-volume work of Max Eckert (1868–1938) was a milestone in the history of cartography (ECKERT, 1921–25). The second volume of the '*Kartenwissenschaft*' (1925) is mainly devoted to 'applied maps' (*Angewandte Karten*), that is thematic cartography. It is interesting that Eckert's opinion on the thematic maps was rather contradictory. It is also important that his scientific cartography included the historical research on maps, which meant the historical approach to modern cartography. In Eckert's short historical overview, however, general or topographical maps had a dominant role, he also held the opinion that thematic maps developed later. This view was supported by historical evidence given in the thematic chapters. However, it was actually the graphic appearance of the thematic map, the base map and the thematic content, that was the conceptual basis of this concept. His approach is best demonstrated by this sentence: „The thematical map design is done at the desk of a geographical scholar, because the practical

cartographer has done enough in drawing a perfect base map…" (ECKERT, 1925, p. III.) The monographs on thematic cartography on the German-speaking area, the books of Arnberger, Witt, Imhof in the 1960–1970s are considered to have been based on Eckert (SCHARFE 1986). From this point of view, the problem of thematic is historically seems to be rooted in the theory of 'scientific' cartography.

Early thematic cartography

The first general history of early thematic cartography, the 1982 book of Arthur ROBINSON, was a milestone in the study of this genre of mapping. In the preface of the volume, however, the author emphasized: „This book is concerned with the growth of thematic mapping in northwestern Europe… and perhaps gives less attention to other areas than they might deserve." It is somehow surprising that, despite the awareness of the apparently missing research, in the following paragraph it is stated „that there is no question that the first major developments centered in that region." Robinson's conclusion is even more surprising as he used one of the first comprehensive monographs on the subject. In the 1966 handbook of Erik ARNBERGER included a whole chapter on the history of thematic mapping. The more than one hundred pages listed many early examples of thematic maps, produced from the 16th century in Austria.

It is remarkable, that both authors agree thematic cartography had its beginning in the second half of the 17th century. Robinson linked thematic mapping to the rapid development of science: the earliest examples he mentions, are related to scholarly activity. Edmond HALLEY is considered to be the first thematic mapmaker for two reasons: he constructed four clearly thematic maps and another quasi-thematic one, and he also introduced a new graphic technique, the method of isolines (his 'curve lines') to represent quantitative data. ARNBERGER's approach and starting point is apparently different: from his Central-European, regional and historical perspective the first thematic maps appear to have been made for military purposes. From the 16th century Austria and the Habsburg lands (including Hungary) were involved in several wars, the most important and the longest of these being the Turkish Wars. For military purposes special maps were made with special symbols and methods of representation. The war maps (*Kriegskarten*), battle or fortification plans represent a special, military cartography in the region, and – according to Arnberger – its development is continuous and uniform.

Marsigli as a 'thematic geo-cartographer'

Three hundred years ago Hungary, the „remote world hidden in barbarian obscurity" still awaited for her explorer. The scientific explorer of the vast region in Central Europe was Luigi Fedinando MARSIGLI (1658–1730). 'Marsili', how his name is also spelled in modern literature, is not an unknown person in the history of Enlightenment science. He was not only an academic: general Marsigli is also recorded as a talented soldier, a surveyor and military engineer. Marsigli served in the Habsburg imperial army in the liberation war against the Turks. He spent the period 1683–1704 mainly in the enormous Hungarian battle field.

Recent studies on Marsigli's scientific activity support the thesis we propose here: the decades spent in Hungary had decisive influence on his scientific work. Through the study of the scientific works of Marsigli, his colleagues and assistants we can study the context and network of Enlightenment science in the Eastern part of the European continent, especially in Hungary. Map making played a crucial role in Marsigli's life during the years in Hungary: the new maps were made for practical, military-political purpose, at the same time they reflected the intellectual curiosity of the naturalist.

Marsigli was interested in natural science, he studied mathematics and astronomy as well. He joined the Habsburg army to liberate the Christian lands occupied by the Turks and took part in several military campaigns, including the successful 1686 siege of Buda, capital city of the Kingdom of Hungary. In the following years the theatre of war shifted to the southern part of the country and Transylvania. In 1691 Marsigli was sent to Constantinople to start peace negotiations and he visited there on diplomatic missions after 1697. At this time Marsigli considered himself a soldier: '*miles sum*' (I am a soldier), he characterized himself in the *Prodromus* (1700) dedicated to the *Royal Society*. He was certainly a learned soldier: during his military career he took every opportunity to make scientific observations, took notes or sketch maps. Marsigli was a born a map maker, he used graphic representations as an effective research tool for visualization of scientific problems. On the other hand, he clearly relalized the importance of maps in the communication of his research findings or scholarly ideas. Marsigli started to systematically collect data and took astronomical measurements in Vienna in c. 1691. He was most probably encouraged by George ASHE, than the English Ambassador's secretary and member of the Royal Society.

As a summation of his scientific work in Hungary, Marsigli wrote the *Danubius* monograph, published eventually in six volumes in Amsterdam and the Hague in 1726. In 1725 he published the first treatise on oceanography, *Histoire physique de la mer*. In 1712 he founded the *Academia delle Scienze dell'Istituto di Bologna*, which became an active center of scientific research. Marsigli was member of of the Royal Socety (1691), the scientific academies in Paris and Montpellier.

Marsigli's 'thematic' maps

In 1699, as commissioner of the Habsburg–Ottoman Border Demarcation Commission he mapped the region and marked the border line. Marsigli directed the work, but most of the maps were actually drawn by his assistant, Johann Christoph MÜLLER (1673–1721). Müller was not only a draughtsman, with his knowledge of astronomy and geography also he contributed to the project. Most of the maps that are attributed to Marsigli, were actually drawn by Müller, who is considered as co-author of these works (DEÁK 2005).

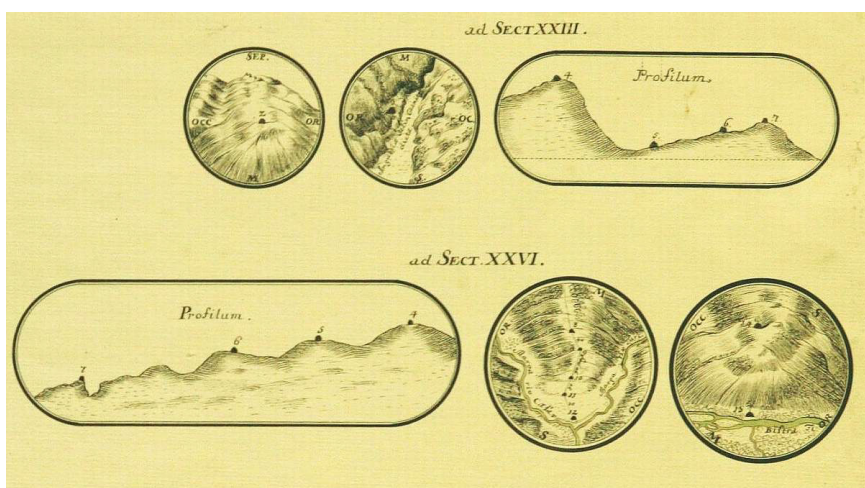

Figure 1. Situation of the border marks represented on the sectional map of the Habsburg–Ottoman border line (1702); ÖStA Kriegsarchiv, Vienna

The most important task of the commissions was to mark and document the border. The location of the border marks was very important and Marsigli's famous border map on 39 sections (*Mappa Geographica limitanea in qua Imperiorum Ceasarei et Ottomani confinia…* 1702–1703) included two separate sheets representing their exact situation. It must be emphasized here, the geographical location of the border line was the subject of the whole mapping project, consequently, Marsigli's border maps were thematic. Among the map corpus found in the War Archives by Antal András DEÁK in 1998, there are more than a dozen maps of the military frontiers.

The new southern borders of the Habsburg Empire required the re-organization of the state administration and communication in the region. Emperor Leopold I commissioned Marsigli to study the new possibilities of commerce. In 1699 he sent his report '*Allgemeiner Discurs über den Traffico*', accompanied by a remarkable thematic map. The '*Mappa Geographica facta in usum Commerciorum*' is a pioneer cartographic representation of the suggested trade routes with dashed lines in red color. The map also indicates flood dikes in Hungary. DEÁK considers it as the earliest commercial map in the world (DEÁK 2004, p. 29). The first postal map of Hungary was also found among the manuscripts. This was drawn around 1700 for the use of couriers and postal sevice. The purpose of the map was to show how the liberated Croatian and Sclavonian territories could be connected with postal service. The '*Mappa Geographica facta in usum Officialum, ab Officio Postarum…*' shows the new postal routes in yellow. This map is south-oriented, clearly indicating the whole region is viewed from the Vienna perspective. On a similar thematic map Marsigli represented how to prevent the spread of the plague along the southern border. On the c. 1700 manuscript '*Mappa Geographica qua Precautio Contra Pestem…*' the new border line is shown in red, however, the graphic emphasis is on the yellow band showing the prevention zone separating the infected areas from the rest of the Empire.

Figure 2. Detail of Marsigli's manuscript thematic map showing the prevention of the plague (c. 1700); Biblioteca Universitaria di Bologna

These manuscript maps were the forerunners of the maps published in the *Danubius Pannonico-Mysicus* in 1726. The surveying and mapping during war times and after the Karlovac peace treaty made it possible for Müller to construct a geometrically more correct map of the Danube for Marsigli's monograph. The six volumes of the richly illustrated work, rightly called 'the anatomy of the river', include many thematic maps.

The importance of mapping is demonstrated by the first volume that begins with the general map of the Danube. The '*Mappa Generalis*' is a graphic summary of river, it shows the the strech of the river under discussion. Despite its rather misleading title, it is a hydrographical map. It is not a geographical map of the country, the map clearly shows its subject the Danube. The other elements of the hydrography are strongly generalized (see e.g. the missing Lake Balaton or the indication of the tributaries). The blank spots on the map are telling, and the large wind rose is also a thematic element: it represents the magnetic declination. (It must be mentioned that the only continental isogon on Halley's 1702 declination world map was based on Marsigli's observations.) The following 18 maps show the individual sections in larger scale with more details. It is also interesting to note, Marsigli intended to separate the two banks of the Danube with different coloring. In the explanation to the map the Cisdanubian side is mentioned red colored, the Transdanubian bank colored yellow, however, hand colored examples of the work is not yet known.

In the hydrographical part of the volume the '*Mappa Potamographica*', the first hydrographical map of the Carpathian Basin, is also a truly thematic map. The Roman antiquities are represented on a separate map in the second volume (*Theatrum Antiqvitatum Romanorum*), which is an archeological map. There are further maps in the volume showing the situation of individual sites. Beyond the individual printed thematic maps, the group of the thematic maps in the third volume of the *Danubius* can be called the first mining atlas. There is a general mineralogical map, showing the mines in Upper Hungary and in Transylvania. The different signs indicate the place of gold, silver, copper, iron or salt mines. Another sheet represent the mines in Northern Hungary. This map is not drawn to scale, and also shows the directions of ore veins with the help of a diagram. Three further views of the mines in the Schemnitz (Banska Stiavnica) region demonstrate mining work in the world famous mines. The '*Mappa Metallographica Celebris Fondinae Semnitziensi*' is one of the most spectacular illustrations of the monograph, it was included in the 1741 edition.

Was Marsigli an early thematic map maker?

This paper is the first attempt to answer this apparently simple question above. However, as one may have guessed, the Marsigli problem not only a historical case study. To solve the problem one must face some inherent problems of the theory of cartography as a science, at the same time the approach to the history of cartography based on this theory ahould also be reconsidered. In seeking answers we review the cartographic literature below.

Although one would expect the contrary, Marsigli's name is not mentioned at all in Robinson's 1982 book on early thematic cartography (ROBINSON 1982). Some years later, however, Marsigli is called the author of the earliest printed map, '*Carte du Golfe de Lion*', published in the foundation work of modern oceanography, to show 'an isobath' (WALLIS 1976, p. 31). The single line of equal depths is also interpreted as the earliest distinction between the continental shelf (*Plaine*) and the oceanic slope (*Abyme*) (SARTORI 2003).

Arnberger would include count Marsigli's name once (ARNBERGER 1966, p. 116), but this only reference is rather misleading. Actually, Marsigli's map of the Roman military camps along the Danube is included in the paragraph on historical maps. It is remarked that this thematic map was published in the atlas '*La Hongrie et la Danube*' (La Haye, 1741),

and this otherwise correct reference is a good indicator of the Marsigli-problem we try to expose here. In her chapter on the development of thematic cartography in Austria, Kretschmer included some remarkable 18th century works (KRETSCHMER 1997). It is somehow strange that MARINONI's manuscript atlas, showing the imperial hunting area, is mentioned first, although it was compiled 1726–29 and was never published. Marsigli's 1726 Danube monograph is listed in the following paragraph and considered 'the first large thematic map publication on Hungary and the Danube'.

In the latest general history of Austrian cartography, Marsigli is mentioned as an Italian military engineer who worked in Hungary and surveyed the Danube. In a footnote the author of the study adds a reference to the *Danubius*, in the main text it is emphasized the work was published twenty five years after Marsigli completed the work with the assistance of Müller (KRETSCHMER – DÖRFLINGER – WAWRIK 2004, p. 76) In the volume the manuscript map of the Habsburg–Ottoman border is reproduced and described. Marsigli is mentioned here as the commissioner, but the map is attributed to Johann Christoph MÜLLER. (KRETSCHMER – DÖRFLINGER – WAWRIK 2004, p. 152-153).

Marsigli is well known in the history of Hungarian cartography, he is frequently mentioned in cartographic literature. In the first general history of Hungarian cartography, Ferenc FODOR gave an scientific evaluation of Marsigli's cartographical activity. According to Fodor, Marsigli's most important work is his 'great map of the Danube', which was published in the first volume of his Danubius. The map is called a 'hydrographical map', and it added that Marsigli also produced the first archeological and mineralogical map of the country (FODOR 1952–54, p. 80-81). Interestingly, these maps are dated 1741 and the title of famous Danube map is given in German. This cartobibliographic confusion was taken over by later cartographic literature in Hungary (e.g. STEGENA 1998, KLINGHAMMER 2005, p. 39-42), as a clear indication that the authors did not consult the original map.

Marsigli's isolines are noted in the cartographical handbook, published in Hungarian (KLINGHAMMER – PAPP-VÁRY 1983, p. 142), but he is not mentioned in the chapter on the history of thematic cartography, although his name is included in the diagram showing the evolution of isolines (KLINGHAMMER – PAPP-VÁRY 1983, p. 95). More recently MÁRTON (2002) studied the 1725 map and corrected the another cartobibliographic misunderstanding by making clear: there was only one line showing the equal depth of the sea. Marsigli is acknowledged elswhere in the book for the correction of the course the Danube, which was incorretly represented since the Lazarus map (1528), and his thematic maps are also noted. The duality of the interpretation is characteristic: Marsigli's is known as a thematic map maker but his appreciated for the geometrical accuracy of his maps (PAPP-VÁRY – HRENKÓ 1989, p. 16), although among the illustrations the mineralogical and archeological maps of the *Danubius* are given (taken from the 1741 atlas edition) (PAPP-VÁRY – HRENKÓ 1989, p. 96-97).

In the first historical overview on thematic mapping in Hungary (STEGENA, 1998 p. 19), Marsigli's map of the Danube (1726) is mentioned again as a hydrographical map. On the other hand, it is acknowledged as being the first realistic representation of the course of the river, based on survey and resulting in a generally acceptable geographical image of the whole country. This statement is a reflection of the special situation: although it was originally a 'thematic' representation, the representation of the river, Marsigli's map is usually interpreted as a general-reference map.

This could have been the contemporary opinion as well. It should be reminded that mapping was the most important part of the Danubius project. The astronomical measurements and the survey of the country resulted in a more accurate map, and this was considered as the most important achievement of Marsigli's cartographic activity in Hungary. Unfortunately, it was not the Danubius, where the new hydrography was first published. Based on '*Marsili's observations*', and giving credit to him, the geographer

Guillame DELISLE published his *Carte de la Hongrie* in Paris as early as 1703, while Johann Christoph MÜLLER's large map of Hungary was printed for the Hungarian Chamber in Vienna in 1709 (SZÁNTAI p.142, p. 410). Müller's map is mentioned as the first modern map of Hungary by Eckert (ECKERT 1921–25, I. p. 423).

For the twenty-five years delay Marsigli's great work could not be a cartographic novelty. As a scholarly work it could not be as highly appreciated as a similar work decades earlier. Moreover, it was published in Latin, and far from the peripherial region of Europe it attempted to describe. Three hundred years later, however, Marsigli's entire scientific work, including his hidden manuscipts or printed thematic maps, are considered again European cultural heritage.

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