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Front cover photography: The central part of the Durmitor mountains in Montenegro with the highest peak, Bobotov Kuk (2523 m), and distinctive high-mountain karst shaped by glacial processes (photograph: Jure Tičar).
Fotografija na naslovnici: Osrednji del gorovja Durmitor v Črni gori z najvišjim vrhom Bobotov kuk (2523 m) ter značilnim visokogorskim krasom, ki so ga preoblikovali ledeniški procesi (fotografija: Jure Tičar).

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DETERMINING THE LENGTHS OF MILES AND NUMERICAL MAP SCALES FOR VOLUME VII OF THE GRAPHIC COLLECTION ICONOTHECA VALVASORIANA

Marina Viličić, Emilia Domazet, Martina Triplat Horvat

A section of a panoramic view of Wagensberg, which is included in Volume VII of the graphic collection of the *Iconotheca Valvasoriana* (Sig. VZ VII, 110) and in Valvasor's *Die Ehre des Hertzogthums Crain*, Book XI. The graphic author is Andreas Trost, the publisher is Johann Weichard Valvasor.

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Marina Viličić[1], Emilia Domazet[2], Martina Triplat Horvat[3]

Determining the lengths of miles and numerical map scales for Volume VII of the graphic collection Iconotheca Valvasoriana

ABSTRACT: This article presents the procedure for determining numerical scales based on the graphic scales drawn to process the graphic material in Volume VII of the Valvasor collection. To calculate the numerical scales, the miles drawn on the maps and their lengths in relation to one degree of the meridian were studied. A total of 22 different miles were drawn on the maps studied, of which the German mile was the most common. After calculating the numerical scales, it was found that the largest scale of the maps examined was 1:220,000 and the smallest was 1:11,200,000.

KEYWORDS: *Iconotheca Valvasoriana*, graphic scale, length of miles, numerical scale, Valvasor, Metropolitan Library of the Archdiocese of Zagreb

Določanje dolžin milj in številčnih kartografskih meril v sedmem zvezku grafične zbirke Iconotheca Valvasoriana

POVZETEK: Avtorice v članku preučujejo grafično gradivo v sedmem zvezku Valvasorjeve zbirke, pri čemer predstavijo postopek določanja številčnih meril na podlagi vrisanih grafičnih meril. Za izračun številskih meril so preučile milje, narisane na zemljevidih, in njihove dolžine v razmerju do ene stopinje poldnevnika. Na preučevanih zemljevidih je bilo vrisanih skupno 22 različnih milj, med katerimi je bila najpogostejša nemška milja. Po izračunu številčnih meril so avtorice ugotovile, da je bilo največje uporabljeno merilo 1 : 220.000, najmanjše pa 1 : 11.200.000.

KLJUČNE BESEDE: *Iconotheca Valvasoriana*, grafično merilo, dolžina milj, številčno merilo, Valvasor, Metropolitanska knjižnica Zagrebške nadškofije

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1 Introduction

After being kept in various institutions for several centuries, the Valvasor graphic collection is now in the Metropolitan Library of the Archdiocese of Zagreb of the Croatian State Archives in Zagreb. The collection is the result of a private project by Johann Weichard Valvasor (slo. *Janez Vajkard Valvasor*), a Slovenian polymath, collector and owner of a copperplate engraving workshop, who collected 7,935 prints and bound them in 18 volumes (Abaffy 2004). To this day, the collection has been partially preserved in its original form, only Volume IV has been lost over time (Magić 2012).

Valvasor's personal interest and knowledge of cartography led him to collect valuable cartographic and topographic works, vedute and maps of most European countries and cities, and to include them in Volume VII of the graphic collection. Although most of the maps are from the 17th century, the volume also contains copies of maps from the 16th century. The volume contains editions by famous European cartographers, topographers and publishers such as the Dutch families Visscher and Blaeu, works by Georg Matthaeus Vischer from Vienna, etc. The majority of the city vedute were published by the Nuremberg publisher Paulus Furst and his successors. As far as the accuracy of his maps and vedute is concerned, Valvasor's works are in no way inferior to the works of the aforementioned publishers. Worth mentioning here is the unique copy of the oldest map of northern Croatia by the Jesuit Stjepan Glavač from 1673 (Magić, Pelc and Abaffy 2016).

The research for this article was conducted using a facsimile of Volume VII of the Valvasor collection. A verification of the original map with a facsimile was conducted as part of Viličić's dissertation (Viličić 2019) on the map of Stjepan Glavač. For the purposes of this study, an additional verification of the preservation of the dimensions of the maps published in the facsimile was performed on some selected maps. This comparison showed that the facsimile of the maps was made in the actual dimensions because there were

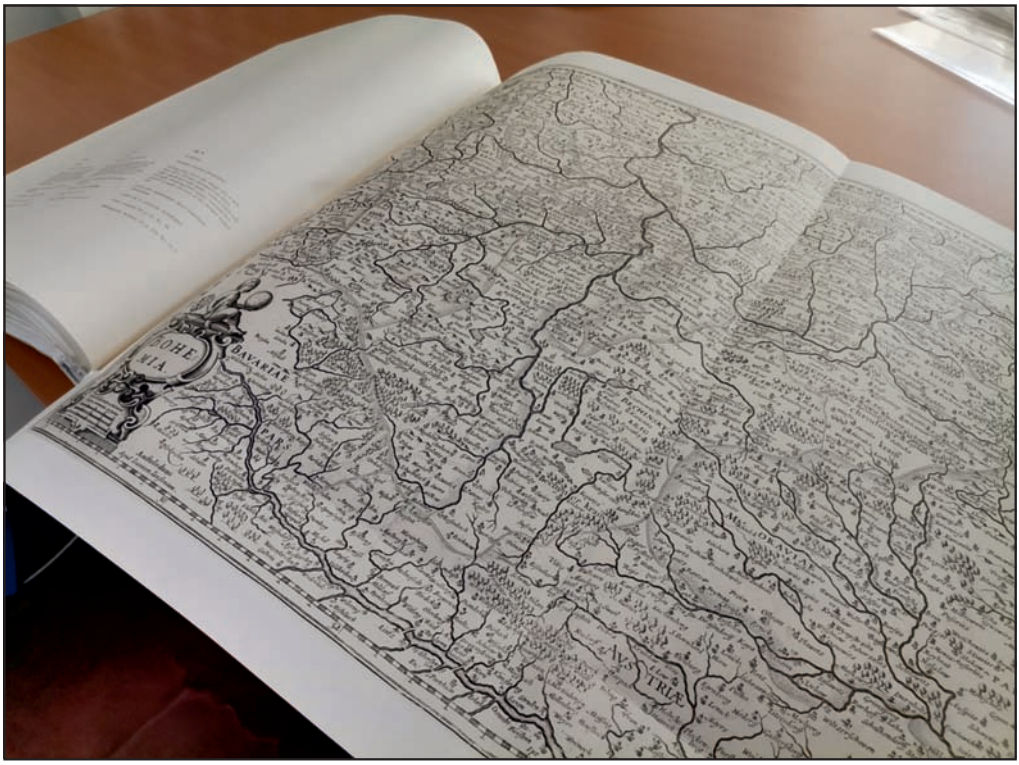

Figure 1: Layout of Volume VII of the graphic collection of the *Iconotheca Valvasoriana*.

no changes in the dimensions of the map. The facsimile edition project began in 2002, and in 2010 a facsimile edition of all 17 volumes of the Valvasor collection was published in cooperation with the Slovenian Academy of Sciences and Arts (Franc 2011, https://www.zg-nadbiskupija.hr/mobile.aspx?id=4935). The *Iconotheca Valvasoriana* (Figure 1) was published by the Janez Vajkard Valvasor Foundation at the Slovenian Academy of Sciences and Arts in Ljubljana. The co-publisher was the Archdiocese of Zagreb, Metropolitana Library, which provided the originals for the preparation of a facsimile edition (Gostiša 2004).

Since no one has yet dealt with the calculation of the scales for the maps contained in Volume VII of the Valvasor graphic collection, this article aims to fill this gap by presenting the procedure for determining the numerical map scale using graphic scales based on the facsimile edition.

1.1 Literature review

For recalculating measurements expressed in old measures, the literature (Riccioli 1661; 1672; Belostenec 1740; Anonymus 1798; von Alberti 1957; Vlajinac 1968; Herkov 1977; Mušnjak 1982; Kretschmer 1986; Viličić and Lapaine 2016) dealing with the lengths of the old linear measures was examined. In the previous literature, there are works that deal with a similar topic, such as Krejčí and Cajthaml (2009) who used an approximation for the length of the Moravian Mile, as they did not know its reliable length. Viličić and Lapaine (2016) calculated the length of the Croatian Mile using the graphic scales on the analysed maps. Jupp (2017) deals with the standardization of the length of the Chinese unit li. In his calculation, the author used the knowledge that the Earth was considered a sphere in Europe at that time, and to calculate the length he used the radius of a sphere with the same centre and surface as the WGS84 ellipsoid.

In the analysed literature there are several approaches to determine the numerical scale of the map. Mušnjak (1982) showed the calculation of the numerical scale in three different ways: by applying a graphic scale, by using a degree grid of latitude, and by comparing it with a map of the same area but with a different scale. Beineke (2001) explains the determination of scale using two methods: direct determination of scale using an old map and indirect determination of scale by comparison with modern maps. Krejčí and Cajthaml (2009) determined the numerical scale of Muller's map of Moravia in several ways: by using a graphical scale bar, by measuring distances between towns, by measuring the map frame, and by using MapAnalyst software. Rajaković, Kljajić and Lapaine (2014) determined the scale of the Mercator map of *Sclavonia, Croatia, Bosnia cum Dalmatiae parte* using the scale bar in German and Italian Miles. Jupp (2017) used the digitized facsimiles to determine the scale by calculating the ratio between the size of the scan points and the average pixel size. In addition to using the graphical scale to calculate the numerical scale, Viličić and Lapaine (2023) determined the scale of the Glavač map by applying the calculated amount of the radius-to-scale ratio obtained after determining the map projection and latitude of the standard parallel of the Glavač map. In addition to Krejčí and Cajthaml (2009), there are examples of other articles in which the MapAnalyst software tool was used to calculate the numerical scale (e.g., Bower 2009; Cajthaml 2009; Bitelli and Gatta 2012; Selvi and Bekiroglu Keskin 2019).

2 Materials and methods

2.1 Materials

Volume VII of the graphic collection of the *Iconotheca Valvasoriana* (Figure 1) contains 46 maps, including map sheets by Georg Matthaeus Vischer: Upper Austria of 1669 and Styria of 1678. However, other graphic representations refer to vedute. Within Volume VII maps are marked with the signature VZ VII and the ordinal number of its occurrence within the volume. Of the total number of maps illustrated in Volume VII of the Valvasor collection, only 35 maps have a graphic scale, which was used to calculate the approximate numerical scale. In addition, the article contains a list of the miles drawn on the analysed maps and their lengths (Table 4). Since some miles are not listed in the contemporary literature (e.g., von Alberti 1957), it was necessary to find them in the literature published at the time of the publication of the maps analysed or to obtain them by calculation in relation to the other mile drawn on the map.

2.2 Methods

For maps with drawn graphic scales (Table 1) whose length is denoted in miles, an approximate numerical scale was calculated. Before calculating the scale, it was necessary to research how the mile lengths were expressed, whether they were divided into meridian degrees, walking hours, etc. This information was obtained by consulting the literature (Riccioli 1661; 1672; Belostenec 1740; Anonymus 1798; von Alberti 1957; Vlajinac 1968; Herkov 1977; Mušnjak 1982; Kretschmer 1986; Viličić and Lapaine 2016), calculating from the ratio to a mile of known length, or, in the best case, by specifying the data with the graphic scale plotted on the map. When length was expressed as a proportion of the meridian degree, it was necessary to express that length in today's metric system of units and to determine for each map when it was published. To obtain the desired length, it was first determined whether the Earth to which the fraction of the meridian degree refers was considered a sphere or an ellipsoid at that time, and then the possible dimensions of the Earth at that time and the length of the meridian degree were converted to today's metric system of units (Chapter 3.1 and Table 2).

For the calculation of the approximate numerical scale in Table 5 (Chapter 3.3), the values of each author for the radius of the Earth's sphere and the length of one degree of the meridian were used, which are given in Table 2. Table 5 shows the calculated numerical scales in relation to different values of the Earth's radius and the average numerical scale calculated from these scales.

In calculating the numerical scale of the map, the concept of approximate scale (Table 5) is used because it should be taken into account that the ellipsoid and the sphere cannot be mapped onto a plane without distortion, so the scale cannot have the same value at every point on the map and different scales exist in different parts of a map (Frančula 2000; Robinson et al. 2017). Moreover, it is difficult to determine with certainty the exact numerical scale, i.e. the main scale, since the exact length of those miles (Chapter 3.2) and the dimensions of the Earth at that time are not known (at that time there were several surveys of the Earth, Table 2).

The entire process of determining the approximate numerical scale of the map from the graphic scale was divided into the following steps (Figure 2):

1. Defining the main aim: calculating the numerical map scales for Volume VII of *Iconotheca Valvasoriana*,
2. Analyzing the time frame, i.e. the year and/or the century in which the map was published,
3. Determining whether the geographic coordinates on the map are defined on a sphere or an ellipsoid,
4. Determining the possible dimensions of the Earth at that time,
5. Reading the length of the graphic scale from the maps and the units in which the length of a mile is expressed,
6. Determining the possible length of a mile at that time (checking in the literature, calculating in relation to a mile of known length or on the map),
7. Converting the length of the mile into today's metric system of units, and
8. Calculating the approximate numerical scale of the map.

On the analysed maps (Table 1), graphic scales are expressed by the length of a given mile. Herkov (1977) states that some miles have had different lengths throughout history, some have not changed, and some have remained unknown. Since measurements have changed over time, Mušnjak (1982) points out that when recalculating measurements expressed in old measurements, it is necessary to know the year in which the map was made and the area in which it was made. For this reason, before calculating the numerical scale of the map, it was necessary to study and calculate the lengths of the miles of that time, expressed as part of a degree of the meridian, an hour of walking, the number of steps, etc.

In the following, using the example of Figure 3 and expressions 1–3, we showed how to calculate the length of a mile (*Milliaria Gallica*) when its length is not known, for example, when the part of the mile in one degree of the meridian is unknown and the length of the second mile (*Milliaria Germanica*) drawn on the map is known as the 15th part of a meridian degree.

The numerical scale M is a map scale which can be given in terms of a ratio or fraction (Frančula, Lapaine and Jazbec 2020). In the form of a fraction, we write it as:

$$\frac{}{100{,}000}, \tag{1}$$

where n is the total number of miles read from the graphic scale, d is the length of the entire length of the graphic scale on the map in centimetres (Figure 3), l is the length of one mile in centimetres, L is the part of a mile in a degree of the meridian (Table 4) and k is the length of a degree of the meridian in kilometres given by each author (Table 2).

Table 1: List of analysed maps from the graphic collection of the *Iconotheca Valvasoriana* with information about the signature, the title of the map, the year of creation, the name of the author and other remarks (Gostiša 2004). If the data for individual maps are not known, the fields in the table are left blank.

Signature	Title of map	Year	Author	Remark
VZ VII, 5	*Nova totius REGNI POLONIAE. . . Exacta Delineato. . .*	1685	Guillaume Le Vasseur de Beuplan	Hollstein (Paas 1994) dates the map to around 1685.
VZ VII, 7	*NOVA TOTIVS GERMANIAE DESCRIPTO*	1631	Willem Blaeu	Copy according to W. Blaeu's map from 1631.
VZ VII, 12	*NOVA hactenus. . . SCLAVONIAE et CROATIAE. . .*	1673	Stjepan Glavač	
VZ VII, 13-24	*Archiducatus Austr[iae Superioris Geographica Descriptio facta Anno 1667]*	1669	Georg Matthäus Vischer	The map was completed in 1667 and printed in 1669.
VZ VII, 25-36	*Stijriae Ducatus Fertilissim[i Nova Geographica Descriptio. . .]*	1678	Georg Matthäus Vischer	
VZ VII, 37	*KARSTIA, CARNIOLA, HISTRIA et WINDORVM MARCHIA*	1589	Gerhard Mercator	The map was first published in Mercator's 1589 set entitled *Italiae, Sclavoniae et Graeciae tabule geografice*.
VZ VII, 38	*Celsissimo ac. . . GUIDOBALDO Archiep*	1666	Franciscus Dückher	
VZ VII, 39	*Erzhertzogthum Kärnten*	1688	Johann Weichard Valvasor	This map was published in Valvasor's work from 1688.
VZ VII, 40	*CARNIOLIA KARSTIA HISTRIA et WINDORVM MARCHI. . .*	1684	Johann Weichard Valvasor	It is assumed that the map was created in 1684.
VZ VII, 41	*CROATIA*	1684	Johann Weichard Valvasor	It is assumed that the map was created in 1684.
VZ VII, 42	*CARNIOLIA KARSTIA HISTRIA et WINDORVM MARCHIA*	1681	Johann Weichard Valvasor	The map was also printed in the work *Carniolia antiqua et nova* by J. L. Schönleben.
VZ VII, 45	*REGNI HVNGARIAE Superioris, et maximae partis Inferioris. . .*	1682	Johann Alwxander Reiner	
VZ VII, 46	*TVRCICVM IMPERIVM*	1634–1663	Willem and Joan Blaeu	The map appears in the atlases of Willem and Joan Bleau between 1634–1663.
VZ VII, 47	*NOVA ITALIAE DELINEATIO*	1631	Willem and Joan Blaeu	The map appears in the atlases by Willem and Joan Blaeu from 1631, and is based on the 1617 map of Italy by G. A. Magini.
VZ VII, 48	*MAGNAE BRITANNIAE et HIBERNIAE Nova DESCRIPTIO*	1629		The map is probably a copy of W. Blaeu's 1629 map.
VZ VII, 49	*NAMVRICVM COMITATVS*	1647	Cornelis Danckerts	The map is a copy of the Willem and Joan Blaeu map, for example, in 1647.
VZ VII, 50	*VTRIVSQVE BVRGVNDIAE, tum Ducatus tum Comitatus, DESCRIPTIO*	1634–1663	Willem Blaeu	The map appears in the atlases by Willem and Joan Blaeu between 1634 and 1663.
VZ VII, 51	*LUTZENBURGENSIS DUCATUS VERISS. DESCRIPT.*	1579	Jacques Surhon	This is a copy of the map published in Ortelius' *Theatrum orbis terrarum* from 1579.
VZ VII, 52	*STIRIA Steyrmarck*	1649		The map appears in the atlases by Willem and Joan Blaeu, for example in *Theatrum orbis terrarium, sive, Atlas Novus*, Amsterdam, 1649, part 1, no 5.

VZ VII, 53	*POLONIA Regnum, et SILESIA Ducatus*	1634		The map was created around 1634 according to the map by W. Grodecki.
VZ VII, 54	*TRANSYLVANIA Sibenburgen*	1595		The template for this map was Mercator's 1595 map of Transylvania.
VZ VII, 55	*MORAVIAE NOVA ET POST OMNES PRIORES ACCURATISSIMA DELINEATIO*	1664	Johann Amos Komensky	The template for this map was issued by Claes Jansz Visscher's father in 1621.
VZ VII, 56	*SILESIA DVCATVS*	1579	Martin Helwig	The map was created according to a map from Ortelius' 1579 *Theatrum orbis terrarum*. Ortelius used Helwig's map of Silesia from 1561 as a template.
VZ VII, 57	*SCLAVONIA, CROATIA, BOSNIA cum DALMATIAE PARTE*	1589	Mercator	Mercator's map was first published in Mercator's set entitled *Italiae, Sclavoniae et Graeciae tabule geographice* in 1589.
VZ VII, 58	*BOHEMIA*		Publisher: Joannes Janssonius	
VZ VII, 59	*TABULA GERMANIAE emendata recens. . .*			
VZ VII, 60	*BELGII REGNII accuratissima Tabula*		Nicolaes I Visscher	
VZ VII, 61	*BELGIUM FOEDERATUM emendate auctum et novissime editum,. . .*		Nicolaes I Visscher	
VZ VII, 62	*Novissima et accuratissima XVII PROVINCIARUM GERMANIAE INFERIORIS Delineatio*			
VZ VII, 63	*DUCATUS GELDRIA et ZUTPHANIA Comitatus*			A reduced copy of Visscher's large map of Gelderland.
VZ VII, 64	*GALLIA Vulgo LA FRANCE,..*			
VZ VII, 65	*Totius FLUMINIS RHENI Novissima DESCRIPTIO. . .*			
VZ VII, 67	*Totius Regni HUNGARIAE Maximaeque Partis DANUBII FLUMINIS. . . Delineatio*		Nicolaes I Visscher	
VZ VII, 68	*AUSTRIA, HUNGARY AND THE NEIGHBOURING AREAS*	1674	Antonio Francesco Lucini	
VZ VII, 69	*NOVANET ACCURATA TOTIUS. . . REGNI HUNGARIAE DESCRIPTIO*	1682	Corneo	

If a mile with an unknown length is denoted by a and a mile with a known length is denoted by b, and following the expression 1, the expression for calculating the fraction M is:

(2)

After equating both expressions, we obtain the ration of the known mile l_b to an unknown mile l_a:

(3)

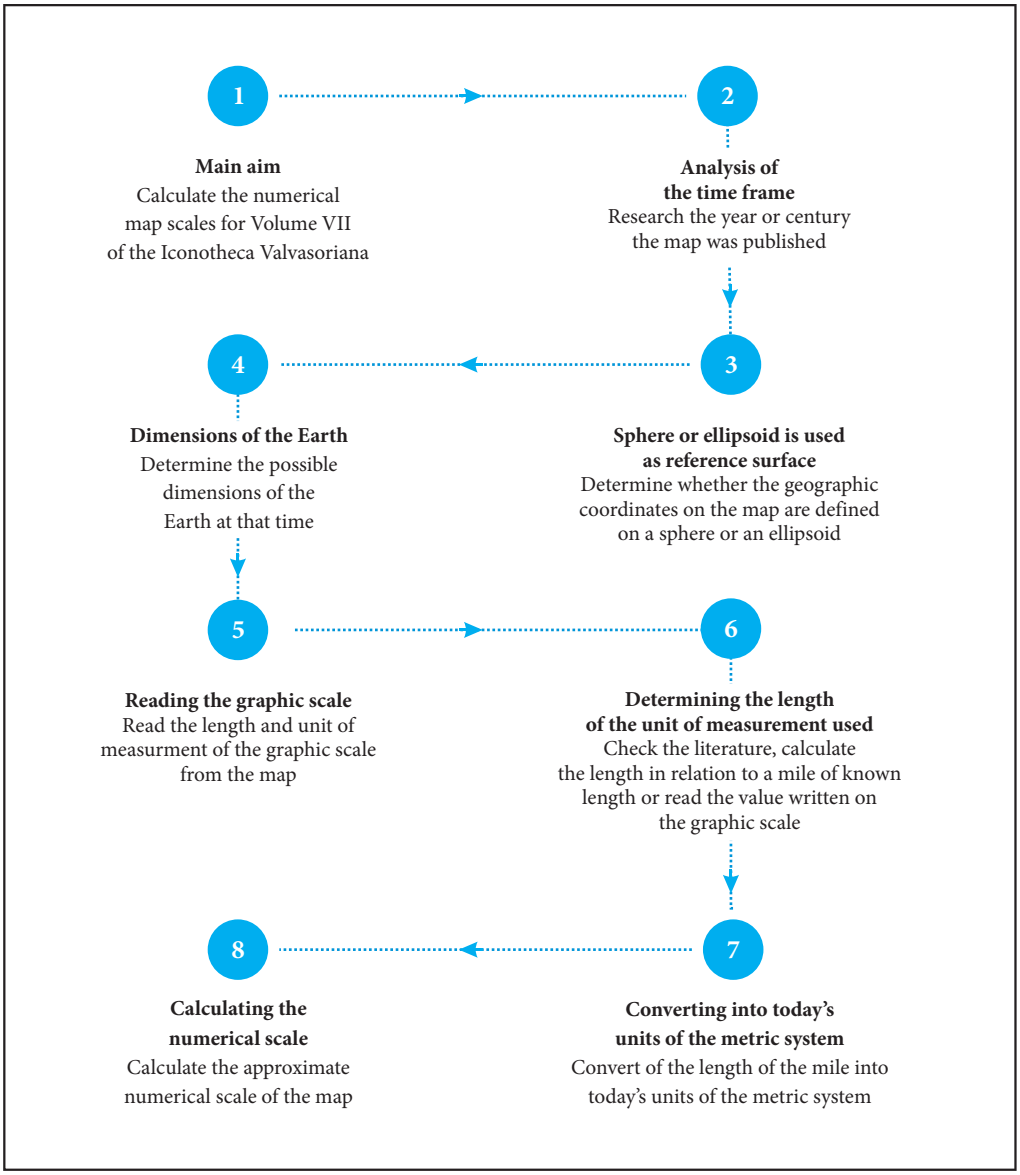

Figure 2: Research flow chart.

Figure 3: Display of the graphic scale on the map VZ VII, 50 with additional explanations of the graphic scale.

From the graphical scale, it was measured that 10 Gallic Miles (*Milliaria Gallica*) are 7.5 cm and 8 German Miles (*Milliaria Germanica*) are 8 cm. The known variables are $n_a = 10$, $d_a = 7.5$ cm, $n_b = 8$, $l_b = 1/15$, $d_b = 8$ cm, and the unknown variable is l_a. Using expression (3), it is established that one Gallic Mile l_a is equal to 0.75 German Miles, i.e. one Gallic Mile is 1/20 of the degree of the meridian.

On the maps of that time, it is difficult to determine the exact numerical scale with certainty because the lengths of these miles were expressed as a proportion of the meridian degree or a walking hour, and the exact radius of the Earth sphere at that time is not known in today's metric system of units. In determining the numerical scale of the map, the average numerical scale for various radii of the Earth sphere was first calculated, and then the obtained scale value was rounded to the nearest whole number, every 100,000 if the scale was smaller than 1,000,000, or every 10,000 if the scale was larger than 1,000,000; e.g., if the calculated scale was 4,449,280, the rounded value would be 4,500,000.

3 Results

3.1 Shape and dimensions of the Earth at the time of the publication of the maps

Volume VII of the graphic collection *Iconotheca Valvasoriana* dates from 1685, and the earliest known dating of a map within this collection refers to the map *Lutzenburgensis Ducatus Veriss. Descript.* (Sig VZ VII, 51) by Jacques Surhon, and the map *Silesia Dvcatvs* (Sig VZ VII, 56) by Martin Helwig from 1579. The last known dating of a map within this collection refers to the map *Erzhertzogthum Kärnten* by Valvasor (Sig VZ VII, 39) from 1688.

Table 2: Chronologically ordered values for the radius of the Earth's sphere and the length of one degree of the meridian, listed by Viličić and Lapaine (2023). The period given in the table covers the time of publication of the maps in Volume VII of Valvasor's graphic collection.

Year	1528	1602	1645	1668/1670
Author	Jean Fernel	Tycho Brahe	Riccioli	Jean Picard
Length of one degree of the meridian *k* [km]	111.232	111.282	120.658	111.212
Radius of the Earth's sphere *R* [km]	6371	6376	6917	6372

Accordingly, the published maps can be dated to the period from 1579 to 1688, i.e., from the end of the 16th century to the end of the 17th century. Since it was not until the end of the 17th century that Isaac Newton and Christiaan Huygens, with their theoretical deduction from mechanics, concluded that the Earth should have the shape of a rotating ellipsoid flattened at the poles (Solarić and Solarić 2016), it can be assumed that the Earth was considered a sphere at the time these maps were made.

Since there have been several attempts to determine the size of the Earth throughout history, which differed significantly based on the method of determination, it is important to consider the possible known values of the radius of the Earth's sphere at that time.

Viličić and Lapaine (2023) studied the possible radii of the Earth's sphere at the time of publication of the 1673 Glavač map, which is also part of the Valvasor collection, and whose publication date coincides with the dating of other maps in the collection.

Since the values determined by Snellius were published in 1729, 100 years after his death and after revisions by Petrus van Musschenbroek, later than the maps from Volume VII of the graphic collection, Snellius' value was not considered in the calculation. The results obtained earlier were published by Snellius in 1617 in the work *Eratosthenes Batavus*, but he made some errors in his first measurements (Lapaine and Frančula 1998). In this article the values of Blaeu's measurement were also not further analysed because they are not known and the only known fact is that the measured length of one meridian degree on the coast of the North Sea differed by 60 fathoms compared to more accurate Picard's measurement that followed more than 50 years later (Stevenson 1914; Lapaine and Frančula 1998; Luminet 2014). In addition, the arc length measured by Norwood is not known exactly. The measured length was about 550 m too long, but this was the best approximation made in England at that time (Laughton 2020). Since the value of Riccioli's radius differs considerably from the values of other authors, his value should be taken with caution. Piccard's value for the length of the 1° meridian followed almost at the end of the 17th century, so his value should be considered only for maps made after the publication of his length. Table 2 lists the known lengths of the 1° meridian that were used to calculate the approximate numerical scale and these values are from the time when the analysed maps were created.

3.2 Determination of lengths of miles on the analysed maps

Considering the period in which the analysed maps were published, the lengths of the miles drawn on the graphic scales are described below. Since miles are easier to interpret in relation to another mile, they are described with at least one additional mile drawn on the maps.

German Mile and Great Italian Mile

Viličić and Lapaine (2016) studied the length of the German Mile (*Milliaria Germanica*), on Glavač's map of 1673. The authors found that one German Mile was equal to four Italian Miles (*Milliaria Italica*), which corresponds to the ratios of the two miles marked on the map VZ VII, 57. Herkov (1977) concluded that the Italian Mile has not changed over the centuries and that it is equal to 1/60 of a meridian degree. Riccioli (1672) also gives the same value for the length of the Italian Mile, although it should be noted that his work was published at a time when most of the maps in the analysed graphic collection were produced.

In their works authors (Riccioli 1672; Herkov 1977; Viličić and Lapaine 2016) use the term Italian Mile for 1/60 degree of the meridian. Since there were two types of Italian Miles on the maps of the Valvasor collection, the suggestion by Herkov (1977) and Mušnjak (1982) was followed and a distinction between the miles was introduced: the Great Italian Mile (1/60 degree of the meridian) and the Small Italian Mile (1/75 degree of the meridian).

Small, Medium and Large German Mile *(Milliarium Commune, Maiusculum* and *Magnum)*

Vischer's map of Upper Austria from 1669 consists of map sheets (Sig VZ VII, 13-24), where on sheet Sig VZ VII, 23, three graphic scales of the *Scala Milliarium* are drawn (Figure 4).

A review of the literature revealed no information about these miles or their length. To solve the problem, the 1678 map of Styria by the same author was consulted. On the sheet Sig VZ VII, 33 three miles are marked, the length of which is given in walking hours (Figure 5).

Herkov (1977) states that in Germany a walking hour was calculated as 3710 m or 2000 geometric steps, so the lengths for 1.5, 2, and 2.5 walking hours were calculated using this value (Table 3).

A review of the literature revealed that Riccioli (1672) listed three types of German miles, calling them *Germanica Parua* (1/18 degrees of the equator), *Medicora* (1/15 degrees of the equator), and *Magna* (1/12 degrees of the equator). Herkov (1977) also noted that there were three German miles in the 16th century: Large (1/12 of a degree of the equator, 9275 m), Medium (1/15 of a degree of the equator, 7402 m), and Small (1/18 of a degree of the equator, 6183 m), whose values are very similar to the mile lengths calculated by the walking hours in Table 3.

It follows that Riccioli's (1672) *Germanica Parua* would be a Small German Mile, corresponding to the *Commune* mile; *Germanica Medicora* would be a Medium German Mile, corresponding to the *Maiusculum* mile; and *Germanica Magna* would be a Large German Mile, corresponding to the *Magnum* mile from the map sheets Sig VZ VII, 13-24.

Figure 4: Representation of the graphic scales on the map sheet Sig VZ VII, 23.

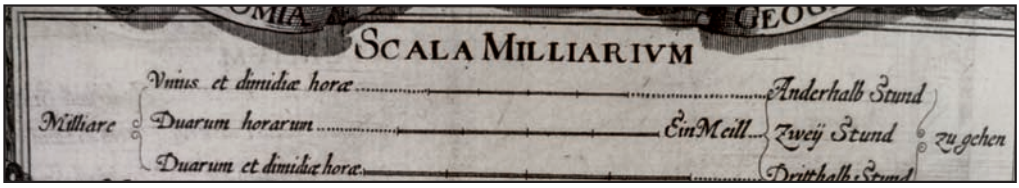

Figure 5: Representation of the graphic scales on the map sheet Sig VZ VII, 33.

Table 3: Length of a walking hour in meters calculated for the map Sig VZ VII, 25-36.

Walking hour	Length [m]
1.5 hours (*Vnius et dimidiae horae = Anderhalb Stund*)	5565
2 hours (*Duarum horarum = Zweij Stund*)	7420
2.5 hours (*Duarum et dimidiae horae = Dritthalb Stund*)	9275

Small, Medium and Large German Mile *(Milliarium Parva, Communia* and *Magna)*

In Volume VII of the Valvasor collection, another map (Sig VZ VII, 58) is also marked with three miles – *Scala Milliarium continens Magna, communia and parua*. It was necessary to investigate to which miles the miles indicated on the graphic scale of the map refer. The investigations have shown that they are German miles. Following the terminology used by Herkov (1977), we have given these miles the same English designations Small, Medium and Large German Miles, but with different Latin designations and different lengths than the German miles mentioned above.

A review of the literature revealed that Riccioli (1672) listed several lengths of the German Mile (*Germanica*) as a part of a degree of the equator: *Minima* (15 ½), *Parua* (13 ⅔), *Mediocria* (12 ½), *Magna* (10 ⅔) and *Maxima* (9 ½).

By applying expression (2), the read and measured values from the graphic scales (see Table 5) and for Riccioli's (1672) proportions of the German miles mentioned above, it was shown that *Milliarium Magna* on the map corresponds to the length of Riccioli's German mile *Germanica Magna* and is marked as Large German Mile. *Milliarium parua* on the map corresponds to Riccioli's German mile *Germanica Parua* and is marked as Small German Mile. *Milliarium communia* corresponds to Riccioli's *Germanica Mediocria* mile and is marked as Medium German Mile.

Small Italian and German Mile

On the map Sig VZ VII, 47, the *Milliaria Italica communia* is drawn next to the German Mile (*Milliaria Germanica communia*). From the measured and read mile values, and the application of expression (3), it was found that one *Milliaria Germanica communia* corresponds to five *Milliaria Italica communia*. Applying expression (3) for the read values and assuming that the German Mile is 1/15 of the meridian degree, the Italian Mile is 1/75 of the meridian degree. Based on the Mušnjak (1982) statement that there are two Italian miles: the Small Italian Mile (1/75 degree of the meridian) and the Great Italian Mile (1/60 degree of the meridian), the *Milliaria Italica communia* would correspond to the Small Italian Mile.

Moscow, Polish, Ukrainian and German Miles

According to Riccioli (1672), the Moscow Mile (*Milliaria Moscovitica*) is 1/80 of a degree of the meridian, while for the Polish Mile (*Milliaria Polonica cummunia*) he does not give its proportion, but the values *Pedes* and *seu Passus*. The ratio between the German and Moscow Mile from the map Sig VZ VII, 5 confirms Riccioli's value (1672).

The ratio between the German and Polish Mile from the map Sig VZ VII, 5 confirms the value (von Alberti 1957, 248) that one Polish Mile corresponds to 1/20 of a meridian degree.

No data were found in the evaluated literature on the length of the Ukrainian Mile (*Milliaria Ucrenica*), therefore its length was calculated from the ratio to the German Mile on the map Sig VZ VII, 5 and it was found that one Ukrainian Mile corresponds to 1/12.5 degrees of the meridian.

Croatian and German Mile

On the map Sig VZ VII, 12 the Croatian Mile is marked. Viličić and Lapaine (2016) examined the length of the Croatian Mile on this map and on several maps where the Croatian Mile is also shown. They found that the Croatian Mile corresponds to 1/10 of a degree of the meridian.

Hungarian and German Mile

On the maps Sig VZ VII, 45 and Sig VZ VII, 67 next to the German Mile (*Milliaria Germanica*), the Hungarian Mile (*Milliaria Hungarica*) is drawn. From the literature it is obvious that there were several types of Hungarian miles at the time of the publication of this map. For example, Viličić and Lapaine (2016) cite maps where one Hungarian Mile corresponds to 1/10 of a degree of the equator. Riccioli (1661) cites sources stating that one Hungarian Mile is equal to 1/14 of the length of one degree of the equator. Using the lengths of the German and Hungarian Miles read from the maps Sig VZ VII, 45 and Sig VZ VII, 67, the expression (3) and the length of the German Mile of 1/15 degree of the meridian, the calculated length of the Hungarian

Mile is 1/12 of the meridian degree. The calculated value matches the ratio of Hungarian and German Miles given in Anonymus (1798), for a German Mile of 1/15 meridian degree.

Small and Large English Mile in relation to the German Mile

On the map Sig VZ VII, 48, next to the German Mile (*Milliaria Germanica communia*), the *Milliar Anglica parva* and *Milliaria Anglica Communia* are drawn. Using the German Mile and expression (3), it was calculated that one German Mile corresponds to four *Milliar Anglica parva* and about three *Milliaria Anglica Communia*. If the German Mile is 1/15 of a meridian degree, then *Milliar Anglica parva* is 1/60 of a meridian degree, and if rounded, *Milliaria Anglica Communia* is 1/50, which agrees with Riccioli's (1672) data on the length of these miles. After reviewing the literature (Riccioli 1672; Herkov 1977), it was found that the values of these miles do not agree with the value of the English Mile given by Mušnjak (1982) in her work. In order to facilitate the distinction between these miles, the terms Large and Small English Mile were introduced.

Gallic and German Mile

On the maps Sig VZ VII, 49, VZ VII, 60, VZ VII, 61, VZ VII, 62, VZ VII, 64 and VZ VII, 65 the *Germanica Communia* and the *Gallica Communia* miles are marked. From the values read from the map, applying expression (3) and for the value of the German Mile of 1/15 degree of the meridian, it follows that the Gallic Mile is 1/20 of the degree of the meridian. The value for the Gallic Mile corresponds to the value given by Herkov (1977) and Riccioli (1672).

Table 4: Summary of the length of the mile in relation to the degree of the meridian.

Mile	Number of miles in one degree meridian
German Mile (*Milliaria Germanica, Milliaria Germanica communia, Milliaria Germanica Com, Gemeene Duytsche Mylen, Leghe Germanica, Scala Germanica, Scala Milliarium)*	15
Small German Mile (*Milliarium Commune)*	18
Medium German Mile (*Milliarium Maiusculum)*	15
Large German Mile (*Milliarium Magnum)*	12
Small German Mile (*Milliarium Parua)*	13 2/3
Medium German Mile (*Milliarium Communia)*	12 1/2
Large German Mile (*Milliarium Magna)*	10 2/3
Italian Mile (*Milliaria Italica, Scala Italica)*	60
Small Italian Mile (*Milliaria Italica communia)*	75
Polish Mile (*Milliaria Polonica cummunia)*	20
Ukrainian Mile (*Milliaria Ucrenica)*	12.5
Moscow Mile (*Milliaria Moscovitica)*	80
Croatian Mile (*Milliaria Croatica)*	10
Hungarian Mile (*Milliaria Hungarica, Milliaria Hungarica communia, Scala Hungarica)*	12
Small English Mile (*Milliar Anglica parva)*	60
Large English Mile (*Milliaria Anglica Communia)*	50
Gallic Mile (*Miliaria Gallica Communia Milliaria Gallica)*	20
Large Mile (*Milliaria magna)*	15
Small Mile (*Milliaria minora)*	20
Franch Mile (*France Mylen)*	20
Geographical Mile (*Comunia Geographica)*	15
Moravian Mile (*Milliarium Moravica)*	12

Table 5: Representation of the measured and read values of mile lengths from the maps, and the calculated numerical scales with respect to different values of the Earth's radius with the final approximate (average and rounded) numerical scale of the analysed maps. Because Riccioli's radius differs considerably from the values of the other authors, his value was not taken to calculate the final scale.

Sig VZ, VII	Mile length	Numerical scales according to different values of the Earth's radius				Average numerical scale	Approximate numerical scale
		Jean Fernel (1528)	Tycho Brahe (1602)	Riccioli (1645)	Jean Picard (1668/1670)		
5	20 *Milliaria Polonica cummunia* = 2.5 cm *15 Milliaria Germanica* = 2.5 cm *10 Milliaria Ucrenica* = 2 cm *80 Milliaria Moscovitica* = 2.5 cm	1:4,449,280	1:4,451,280	1:4,732,060	1:4,448,480	1:4,449,680	1:4,500,000
7	*30 Milliaria Germanica* = 6.4 cm	1:3,476,000	1:3,477,563	1:3,770,562	1:3,475,375	1:3,476,313	1:3,500,000
12	*5 Milliaria Croatica* = 19.3 cm *7 Milliaria Germanica* = 18.0 cm	1:288,273	1:288,402	1:312,701	1:288,221	1:288,298	1:300,000
13-24	*Scala Milliarium:* *Commune* = 5 cm *Maiusculum* = 6.6 cm *Magnum* = 8.4 cm		Using *Milliarium Commune* – 1:463,750 Using *Milliarium Maiusculum* – 1:436,471 Using *Milliarium Magnum* – 1:441,667 (mile lengths are calculated as an hour of walking)		1:447,296	1:450,000	
25-36	*Scala Milliarium, Milliare:* *Vnius et dimidiae horae* = *Anderhalb Stund zu gehen* = 3.5 cm *Duarum horarum* = *Zweij Stund zu gehen* = 4.7 cm *Duarum et dimidiae horae* = *Dritthalb Stund zu gehen* = 5.9 cm		Using *Vnius et dimidiae horae* – 1:636,000 Using *Duarum horarum* – 1:631,489 Using *Duarum et dimidiae* – 1:628,814		1:632,101	1:630,000	
37	*14 Milliaria Italica communia* = 4.2 cm	1:494,364	1:494,587	1:536,258	1:494,276	1:494,409	1:500,000
38	*5 Scala Miliarium* = 7 cm	1:529,676	1:529,914	1:574,562	1:529,581	1:529,724	1:530,000
39	*4 Milliaria Germanica Com* = 4.9 cm	1:605,344	1:605,616	1:656,642	1:605,235	1:605,399	1:600,000
40	*3 Milliaria germanica communia* = 4.3 cm	1:517,358	1:517,591	1:561,200	1:517,265	1:517,405	1:520,000
41	*4 Milliaria germanica* = 4 cm *3 Milliaria Croatica* = 5 cm	1:704,469	1:704,786	1:764,167	1:704,343	1:704,533	1:700,000
42	*3 Milliaria germanica communia* = 4.4 cm	1:505,600	1:505,827	1:548,445	1:505,509	1:505,645	1:500,000
45	*5 Milliaria Hungarica* = 6.2 cm *5 Milliaria Germanica* = 7.6 cm	1:603,923	1:604,195	1:655,101	1:603,814	1:603,977	1:600,000
46	*50 Milliaria Germanica communia* = 3.3 cm	1:11,235,556	1:11,240,606	1:12,187,677	1:11,233,535	1:11,236,566	1:11,200,000
47	*150 Miliaria Italica communia* = 7.5 cm *28 Miliaria Germanica communia* = 7 cm	1:2,966,187	1:2,967,520	1:3,217,547	1:2,965,653	1:2,966,453	1:3,000,000
48	*15 Milliaria Germanica Communia* = 4.4 cm *60 Milliar Anglica parva* = 4.4 cm *50 Milliaria Anglica Communia* = 4.6 cm	1:2,491,362	1:2,492,482	1:2,702,485	1:2,490,914	1:2,491,586	1:2,500,000
49	*3 Miliaria Germanica Communia* = 10 cm *4 Miliaria Gallica Communia* = 10 cm	1:222,464	1:222,564	1:241,316	1:222,424	1:222,484	1:220,000

50	*10 Milliaria Gallica* = 7.5 cm *8 Milliaria Germanica* = 8 cm	1:741,547	1:741,880	1:804,387	1:741,413	1:741,613	1:740,000
51	*3 Milliaria magna, quorum XV.* = 5.4 cm *4 Milliaria minora, quorum XX. Gradum efficiunt* = 5.3 cm	1:415,857	1:416,044	1:451,097	1:415,782	1:415,894	1:420,000
52	*2 Milliaria Germanica* = 3.5 cm	1:423,741	1:423,931	1:459,650	1:423,665	1:423,779	1:420,000
53	*40 Milliaria Germanica* = 4.7 cm	1:6,311,035	1:6,313,872	1:6,845,844	1:6,309,901	1:6,311,603	1:6,300,000
54	*6 Milliaria Germanica communia* = 6.4 cm	1:695,200	1:695,513	1:754,113	1:695,075	1:695,263	1:700,000
55	*Scala Milliarium:* *7 Comunia Geographica* = 10.85 cm *7 Moravica* = 11.9 cm	1:511,836	1:512,066	1:555,210	1:511,744	1:511,882	1:510,000
56	*8 Milliaria Germanica communia* = 6.2 cm	1:956,834	1:957,265	1:1,037,918	1:956,662	1:956,920	1:960,000
57	*5 Milliaria Germanica* = 4 cm *20 Milliaria Italica* = 4 cm	1:926,933	1:927,350	1:1,005,483	1:926,767	1:927,017	1:930,000
58	*Scala Milliarium continens:* *4 Magna* = 3.2 cm *4 communia* = 3.6 cm *4 parua* = 4 cm	1:813,893 – 1:1,303,500	1:814,259 – 1:1,304,086	1:882,863 – 1:1,413,961	1:813,746 – 1:1,303,266	1:813,966 – 1:1,303,617	1:810,000 – 1:1,300,000
59	*15 Milliaria Germanica communia* = 4 cm	1:2,780,800	1:2,782,050	1:3,016,450	1:2,780,300	1:2,781,050	1:2;800,000
60	*6 Milliaria Germanica communia* = 5.4 cm *8 Milliaria Gallica communia* = 5.4 cm	1:823,941	1:824,311	1:893,763	1:823,793	1:824,015	1:820,000
61	*6 Milliaria Germanica communia* = 7.2 cm *8 Milliaria Gallica communia* = 7.2 cm	1:617,956	1:618,233	1:670,322	1:617,844	1:618,011	1:620,000
62	*8 Milliaria Germania com: Gemeene Duytstche Mylen* = 6.4 cm *10 Milliaria Gallica communia. Uren Gaens* = 6 cm	1:926,933	1:927,350	1:1,005,483	1:926,767	1:927,017	1:930,000
63	*3 Gemeene Duytstche Mylen van 15 in een Graet* = 6.6 cm *4 France Mylen oste Uren Gaens* = 6.6 cm	1:337,067	1:337,218	1:365,630	1:337,006	1:337,097	1:340,000
64	*30 Milliaria Gallica communia* = 6.9 cm *25 Milliaria Germanica communia* = 7.65 cm	1:2,420,721	1:2,421,809	1:2,625,857	1:2,420,286	1:2,420,939	1:2,400,000
65	*8 Milliaria Germanica com: Gemeene Duytstche Mylen* = 6.5 cm *10 Milliaria Gallica communia. Uren Gaens* = 6.1 cm	1:912,205	1:912,615	1:989,507	1:912,041	1:912,287	1:900,000
67	*15 Milliaria Germanica communia* = 5.1 cm *12 Milliaria Hungarica communia* = 5.1 cm	1:2,181,020	1:2,182,000	1:2,365,843	1:2,180,627	1:2,181,216	1:2,200,000
68	*10 Scala di Leghe Germanica* = 6.8 cm *40 Scala millaria Italica* = 6.8 cm	1:1,090,510	1:1,091,000	1:1,182,922	1:1,090,314	1:1,090,608	1:1,100,000
69	*5 Schala Hungarica* = 7.2 cm *6 Schala Germanica* = 7.4 cm *24 Schala Italica* = 7.4 cm	1:584,751	1:585,014	1:634,304	1:584,646	1:584,804	1:600,000

Large and Small Mile (Miliaria magna and Miliaria minora)

On the map Sig VZ VII, 51, the miles of *Miliaria magna* and *Miliaria minora* are marked with an additional explanation about the length of these miles: »*Milliaria magna, quorum XV., minora quorum XX. Gradum efficiunt*« (eng. »The degree consists of 15 large or 20 small miles«), which clearly determines the length of these miles in the degree of the meridian and does not require additional insight into the literature.

French and German Mile

On the map Sig VZ VII, 63 the length of the French Mile (*France Mylen*) is calculated from the ratio to the German Mile (*Gemeene Duytstche Mylen*), which is indicated on the map as 1/15 degree of the meridian (*van 15 in een Graet*). The length of a French Mile calculated this way is 1/20 of a meridian degree.

Geographic and Moravian Mile

On the map Sig VZ VII, 55, the Geographic Mile (*Comunia Geographica*) and the Moravian Mile (*Morauica*) are marked. According to Riccioli (1672) the Moravian Mile (*Morauica*) is 1/12 degree of the meridian, and according to Herkov (1977) the Geographic Mile is 1/15 degree of the meridian.

Since the denominators of the scales resulting from the application of the Moravian and Geographic Miles differ by about 67,000, it is assumed that an error occurred in drawing the graphic scale on the map.

3.3 Calculation of an approximate numerical scale with the analysed maps

Using the mile lengths in relation to the meridian degree (Table 4), the measured values of mile lengths given in Table 5, and expressions (1), numerical scales were calculated for various values of the Earth's radius (see Table 5). These numerical scales in Table 5 are the average values using all drawn miles on each map. Using these values, the average numerical scale was determined and finally rounded to the nearest integer.

4 Discussion

Determining the numerical scale from the graphic scale of older maps requires prior research on the lengths of miles at the time the map was published. Only one map (Sig VZ VII, 51) has the length of a mile written, which was not the case for the other maps. It was thus necessary to conduct research on mile lengths, which are fundamentally linked to the shape of the Earth (Beineke 2001). The period of publication of the maps also had to be considered (Mušnjak 1982). Because the lengths of most miles have changed throughout history and a review of contemporary literature provides general information about the length of a mile for a large historical period, it is advisable to research the literature published at the time, such as Riccioli (1661; 1672), Anonymus (1798) in this article.

As described in Chapter 3.1, the published maps date from the end of the 16th to the end of the 17th century. Based on the period in which the maps were published, literature from this approximate period (Riccioli 1661; 1672; Belostenec 1740; Anonymus 1798) and literature that mentions the length of miles in this period (von Alberti 1957; Vlajinac 1968; Herkov 1977; Mušnjak 1982; Kretschmer 1986; Viličić and Lapaine 2016) were selected. The research revealed that the mile lengths were expressed as a proportion of the meridian degree (Table 4) and at the time the maps were published, the Earth was considered a sphere with several possible dimensions (Table 2).

In total, 22 different miles were mapped on the evaluated maps, of which the Ukrainian Mile and the Small, Medium and Large German Miles (*Milliarium Commune, Maiusculum* and *Magnum*) were not found in the evaluated literature.

Among the analysed maps, the German Mile is the most common, occurring on 30 maps with seven different names. On two other maps the German Mile is mapped, but under the names of Large, Small and Medium German Mile (Table 4). Mušnjak (1982) states that the German mile includes the names *Milliaria Germanica* and *Milliaria Germanica communia* (*Milliaria Germanica Com*). The name *Gemeene Duytsche*

Mylen is also connected with the German Mile, because it is noted on the map that this mile is 1/15 degree of the meridian, which corresponds to the length of the German Mile. From the relationship between *Leghe Germanica* and *Milliaria Italica* and the relationship between *Scala Germanica* and *Scala Italica*, it was concluded that the names *Leghe Germanica* and *Scala Germanica* correspond to the length and concept of the German Mile. The term *Scala Milliarium* is also associated with the concept of the German Mile, since on the map Sig VZ VII, 38 the type of mile could not be determined with certainty (Figure 6). The problem of the length of the *Scala Milliarium* was solved by considering the mile most frequently drawn on the analysed maps and the measurement of the distance between the cities.

Since miles with similar names are not necessarily the same miles, such miles must always be considered together with the miles with which they are plotted on the map (e.g., the Large and the Small German Mile are plotted on the maps Sig VZ VII, 13-24 and VZ VII, 58 with similar names but different lengths).

Of the miles drawn, the Croatian Mile has the largest proportion of the meridian degree, while the largest number of miles shown is between 1/10 and 1/20 of the meridian degree (Figure 7).

Errors in the lengths of the graphic scale were found on several copies of the maps. Thanks to the remaining miles on the map, the most probable lengths of the graphic scales could be calculated (Sig VZ VII, 48 and VZ VII, 51).

For the map Sig VZ VII, 57, the measurements show that one German Mile corresponds to four Italian Miles. Rajaković, Kljajić and Lapaine (2014) calculated the scale of a copy of this map from the Novak collection (Mercator 1630) using the graphic scales in miles. Mušnjak (1982) did the same for a copy of this map from the Croatian archives (Sig A II – 4 inv No 32). The authors obtained the same values as in this article. After the conducted research, the authors did not find any other studies with which they could compare their results. On the maps where one mile is marked (e.g., Sig VZ VII, 37, VZ VII, 46 and VZ VII, 47), the authors made a rough check by using a digital copy of those maps in online galleries (e.g. Yale Library, https://library.yale.edu/; Old Maps Online, https://www.oldmapsonline.org/; Geographicus Rare Antique Maps, https://www.geographicus.com/). In other maps (Sig VZ VII, 38 and VZ VII, 40), where only one mile is drawn, the authors measured the distances between the cities.

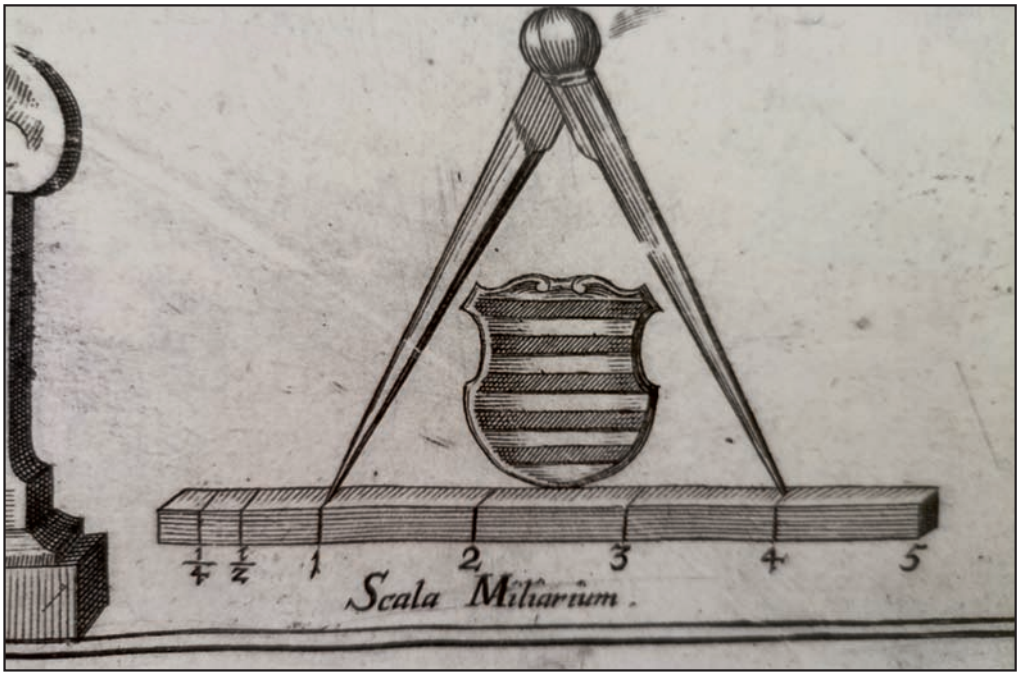

Figure 6: Representation of the graphic scale on the map Sig VZ VII, 38.

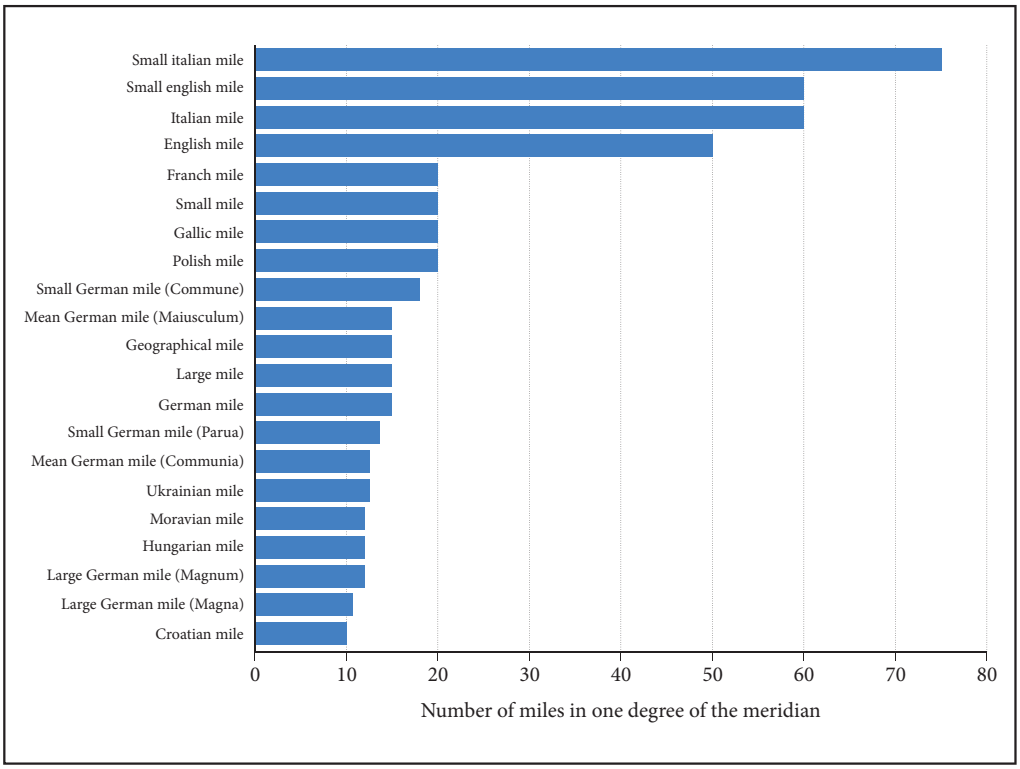

Figure 7: Plot of the range of proportions of each mile in a meridian degree.

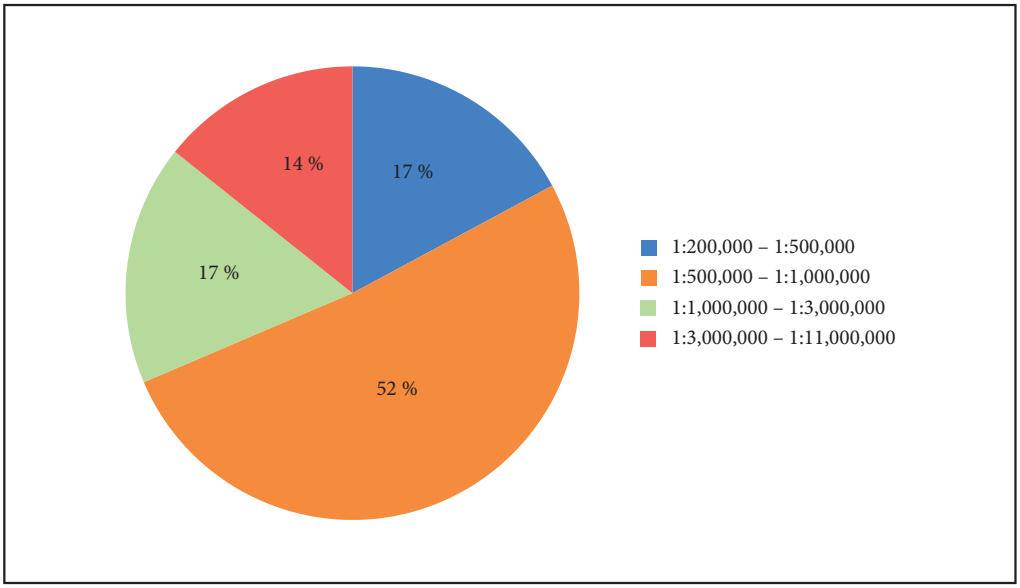

Figure 8: Proportions of the scales of the analysed maps.

It should be noted that calculating the scale based on the distance between cities is not a good method of calculation, since errors in the placement of cities were very common at that time, and the distances measured in this way are affected by the deformations of the map projection.

After calculating the numerical scales, it was found that the largest scale of the studied maps is 1:220,000 and the smallest is 1:11,200,000. Figure 8 shows that more than half of the maps have a scale of 1:500,000 to 1:1,000,000.

In addition to using the graphic scale to determine map scale, a map grid can also be used (14 maps in this graphic collection), the use of which requires knowledge of map projections. The determination of the numerical scale is also possible for the maps that have neither a drawn map grid nor a graphic scale (five maps in this graphic collection). For such maps, it is first necessary to research in which map projection the map was created, which requires individual consideration of each map. In such cases, many authors use programs that compare old maps with modern maps (e.g., MapAnalyst). This is not a bad approach, but it requires additional independent testing and great caution, as well as additional knowledge of transformations and map projections.

5 Conclusion

The processing of the cartographic material of Volume VII of the Valvasor graphic collection requires, among other descriptive data, the determination of mathematical elements – the numerical scale of the map. Since these data were not previously available, a numerical scale for the 35 maps in this collection was determined using the facsimile edition of Volume VII (Gostiša 2004) and the expression (1). The scale was determined by reading the graphic scale and converting the length of the graphic scale, expressed in miles, to the present system of units of measurement.

Since the length of the mile has changed throughout history, research had to be done on the length of the mile at the time the map was published, while converting the length of a mile to today's system of units required research on the dimensions and shape of the Earth at that time.

Since the length of the mile was expressed as a fraction of a meridian degree or a walking hour, and the exact radius of the Earth sphere at that time is not known in today's metric system of units, it is difficult to determine the exact numerical scale. Therefore, the average numerical scale for different radii of the Earth's sphere was first calculated and then the scale value was rounded to the nearest integer.

The research conducted has shown that in order to determine the length of a mile, it is not advisable to use only contemporary encyclopaedias (e.g., von Alberti 1957) that list mile lengths, but it is necessary to research literature going back to the time when the maps were published and/or literature that analyses mile lengths in specific historical periods in more detail.

For future research, it is planned to use the map grid to determine the scale of the remaining maps from Volume VII and to use the map grid to independently verify the previously determined numerical scales with the graphic scale. Since a possible error in drawing the graphic scale in Moravian Miles was found during this research (Sig VZ VII, 55), we could not confirm the length of the Moravian Mile given in the literature (Riccioli 1672). For future research, it is suggested to examine other literature and maps outside Volume VII that date from a similar period and have a graphic scale in Moravian Miles, as well as maps with graphic scales in the Ukrainian Mile and the Small, Medium and Large German Miles (*Milliarium Commune, Maiusculum* and *Magnum*) to confirm the lengths calculated in this article.

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