

AN ANALYSIS OF MERCATOR’S MAP: “TRANSSYLVANIA”

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Abstract: *The aim of this paper is the analysis of Gerardus Mercator’s map “Transsylvania”. The map was published by Jodocus Hondius II in 1616 in “Atlas Minor”. Firstly, we produced a description of the topographic information and secondly, we evaluated the map’s planimetric accuracy, comparing the position of cities and towns on Mercator’s map with their actual location, as depicted on a modern map of the region.*

Keywords: *ancient map, Mercator, georeference, Helmert transformation*

1. Introduction

Old maps possess not only a great historical importance, but also a scientific one, reflecting knowledge specific to the era in which they were drawn. Behind each carefully drawn symbol, a keen eye can potentially discover valuable geographical information. In order to fully unravel their mystery, it is essential that these old maps be georeferenced. Unfortunately, the oldest of maps do not feature the meridian and parallel network which would make georeferencing them an easy process. Furthermore, it is not always known what meridian the cartographer used as the prime meridian. In cases such as this, other common points must be identified between the old map and a modern map overlaid on top of it, so as to compare the old reality to the present one.

In the current study, we have attempted to conduct just such an analysis on a map from the 16th century, namely a map of Transylvania drawn by Mercator and which nowadays is part of the special collections of the National Library of Bucharest.

2. Describing the map

The map denominated “TRANSSYLVANIA” was created by the well-known Flemish cartographer Gerardus Mercator (1512-1594) and was published by Jodocus Hondius II in 1616 in “Atlas Minor”, page 147. “Transsylvania” is a black-and-white map drawn in a 16x21 cm format.

The title of the map is written in an ornamental cartouche found in the lower right corner. Under this cartouche, one can find the map’s graphic scale, representing distance in German miles (“*Miliaria Germanica comunia*”). Unfortunately, there is no value written on this scale bar, but knowing that a German geographic mile *is defined as* being equal to 1/15 equatorial degrees [3], we can calculate that the length of every segment on this scale represents 3 German miles. A characteristic of ancient maps is that they only have a graphic scale and no ratio scale.

Mercator’s map includes a network of labelled meridians and parallels.

The geographical features depicted in the map are: relief, rivers, woodlands and settlements. Mountains are illustrated using hill profiles, whereas woodlands are represented as clusters of tree-symbols. Regarding settlements, the author used four types of symbols. For villages he used a circle with a point in the center (e.g. *Rotberg*). Towns are represented with

three different symbols, based on their importance. These symbols consist of one, two, or three small buildings with a spire, overlapping the same circle mentioned above, as may be seen for Hermenstad (today's Sibiu), representing the first category, Neumarck (i.e. Târgu Mures) - the second, and Weißenburg (i.e. Alba-Iulia) - the third category.



Fig. 1: Map symbols for settlements

The map maker used letters of different sizes and styles in order to emphasize the differences between the features. Some towns have their name written in German, and below that, their name in Hungarian, followed by the letter "h", for example: "Clausenburg" and below, "Colosvar.h".

3. A comparison between Mercator's map and a modern equivalent

We assume that Mercator's map of Transylvania was drawn using the cylindrical conformal map projection which bears his name (having the true scale on the Equator). In order to evaluate the planimetric accuracy of this map, we compared it with a modern one. Both raster images were georeferenced in the same projection. For the calculation of Cartesian coordinates, we approximated the Earth as a sphere with a 6,378 km radius.

As one can read from Mercator's map, the represented territory extends latitudinally from 46° to 48° and longitudinally from 46° to 50° , while the real territory covers an area from 45°N to 47°N and from 22° to 27° , respectively, to the East of Greenwich. Mercator's values of longitude differ by an approximately 24° compared to their actual values. Taking this into account, we assumed that he used as a prime meridian one which passes through one of the Cape Verde islands, most probably São Nicolau Island, since it extends on longitude from 24° to $24^{\circ}25'$ W. In support of this idea, we also reference Mercator's explanation given in the legend of his world map from 1569 (i.e. *Nova et Aucta Orbis Terrae Descriptio ad Usum Navigantium Emendate Accommodata*) [2]:

"Now, since it is necessary that longitudes of places should, for good reasons, have as origin the meridian which is common to the magnet and the World, in accordance with a great number of testimonies I have drawn the prime meridian through the said Isles of Cape Verde."

The rectified modern map was overlaid on top of Mercator's map. The comparison of settlement positions between the two analysed maps revealed that Mercator's map is displaced by almost $20'$ to the East and $1^{\circ}20'$ to the North of the real position. By observing

the layout of the mountains and the river network, one will find that Mercator's map is actually rotated to the left.

Since the result proved unsatisfactory, we decided to apply a different method. We have identified on both maps 24 towns and villages for which we interpolated geographic coordinates: (φ, λ) (see Table 2). These coordinates were converted to their Cartesian coordinate equivalents in the Mercator projection, using the old system with the origin in $\varphi_0=0^\circ$, $\lambda_0=24^\circ 12' \text{ W}$ (as considered for Mercator's map), and the new system with the origin in $\varphi_0=0^\circ$, $\lambda_0=0^\circ$ (as per the modern map). In order to transform the coordinates from the old system to the new system, we applied a Helmert transformation with 4 parameters. In an iterative calculation, 14 points were eliminated one by one, all of them having position errors greater than 12 km. We have thus determined the following parameters:

translation on N-axis : $\Delta N = 152,775.982 \text{ m}$
 translation on E-axis: $\Delta E = 2,616,322.897 \text{ m}$
 the scale factor: 1.091141
 the rotation: $34^\circ 28' 43''$

Applying these parameters to the old map and then overlaying it onto the modern map, using the weight centre for the base point, we obtained the result presented in Figure 4.

From the difference of the E coordinates of the origin, one can solve the longitudinal difference between the two maps and therefore determine the longitude of the prime meridian used by Mercator. Thus, for $\Delta E = 2,616,322.897 \text{ m}$, we have obtained $\Delta \lambda = 23^\circ 30' 12'' \text{ W}$ Greenwich.

In Table 1 we have presented the errors on the East and North axis and also the positioning errors that have obtained after the Helmert transformation:

Table 1





Town	s_E [m]	s_N [m]	s_P [m]
Mediaş	10621.465	579.807	10637.278
Braşov	-8020.978	-9016.801	12068.090
Alba Iulia	489.381	587.933	764.957
Abrud	-2603.668	-1678.094	3097.593
Zlatna	-7663.409	-7286.395	10574.468
Sibiu	4491.132	9613.680	10610.990
Cisnădioara	9543.797	-7123.143	11908.956
Cisnădie	3259.758	2987.453	4421.639
Sebes	-2005.690	7302.280	7572.720
Avrig	-8111.787	4033.279	9059.163



Fig. 2: The map of Mercator: "Transsylvania", found at the National Library of Romania, Special Collections, Cartography Cabinet

Table 2

Mercator's settlement names	Correct names German/Hungarian/Transylvanian Saxon dialect	Actual names	Symbol	Mercator's map coordinates		Modern map coordinates	
				φ	λ	φ	λ
Biſtricia/Beſtercze	<i>Bistritz/Beszterce/-</i>	Bistrița	1	47°48'	46°37'	47°08'	24°29'
Burglos Dees	<i>Desch/Deés/-</i>	Dej	2	47°33'	46°18'	47°05'	23°48'
Clauſenburg/Coloſvar.h	<i>Klausenburg/Kolozsvár/-</i>	Cluj Napoca	2	47°15'	46°26'	46°46'	23°36'
Segeſvar	<i>Schäßburg/Segesvár/-</i>	Sighisoara	1	47°18'	46°02'	46°13'	24°47'
Neumarck/Waſerhely.h	<i>Neumarkt/Vásárhely/-</i>	Târgu Mures	2	47°34'	47°12'	46°33'	24°34'
Medwiſch/Megies.h	<i>Mediasch/Medgyes/Medwesch</i>	Medias	1	47°17'	47°35'	46°10'	24°21'
Regen	<i>Sächsisch-Regen/Régen</i>	Reghin	1	47°45'	47°16'	46°47'	24°42'
Fogaras	<i>Fogarasch/Fogaras/-</i>	Făgăras	1	47°02'	48°31'	45°51'	24°58'
Czick	<i>Szeklerburg/Csíkszereda/-</i>	Miercurea Ciuc	1	47°42'	48°44'	26°21'	25°48'
Coroa Braſovia	<i>Brassovia or Corona (Medieval Latin)</i>	Brasov	3	47°09'	49°11'	45°39'	25°36'
Sereth	<i>Sereth/-/-</i>	Siret	2	47°45'	49°42'	47°57'	26°04'
Bachono	<i>Barchau/ Bákö/-</i>	Bacău	1	47°20'	49°45'	46°35'	26°55'
Weißenburg/Alba Iulia	<i>Weißenburg/-</i>	Alba Iulia	3	46°50'	46°59'	46°04'	23°34'
Abruck baya	<i>Altenburg/Abrudbánya/-</i>	Abrud	1	46°48'	46°21'	46°16'	23°04'
Zalatne rudera	<i>Schlatten, Goldenmarkt/Zalatna</i>	Zlatna	1	46°43'	46°33'	46°10'	23°13'
Hermenſtad/Cibinium	<i>Hermannstadt/Cibinium (Medieval Latin)</i>	Sibiu	1	46°52'	47°48'	45°48'	24°09'
Agnletin	<i>Agnethehn, Agnethlen/-/Agnitlen</i>	Agnita	1	47°08'	48°06'	45°58'	24°30'
Michelſberg	<i>Michelsberg/-/-</i>	Cisnadioara	1	46°44'	47°41'	45°42'	24°07'
Helten	<i>Heltau/-/Hielt</i>	Cisnădie	1	46°46'	47°50'	45°43'	24°10'
Millempach	<i>Mühlbach/-/Melnbach</i>	Sebes	1	46°45'	47°08'	45°58'	23°34'
Rotthurn	<i>Rothenturm/-/-</i>	Turnu Rosu	c	46°43'	47°00'	45°39'	24°18'
Hatzag	<i>-/Hátszeg/-</i>	Hățeg	c	46°17'	47°09'	45°36'	22°57'
Argiſch		Curtea de Arges	c	46°15'	48°20'	45°08'	24°41'
Feck	<i>Freck/ Felek/ Frek</i>	Avrig	c	46°46'	48°06'	45°42'	24°22'

Where the symbols represent:  - c,  - 1,  - 2,  -3.

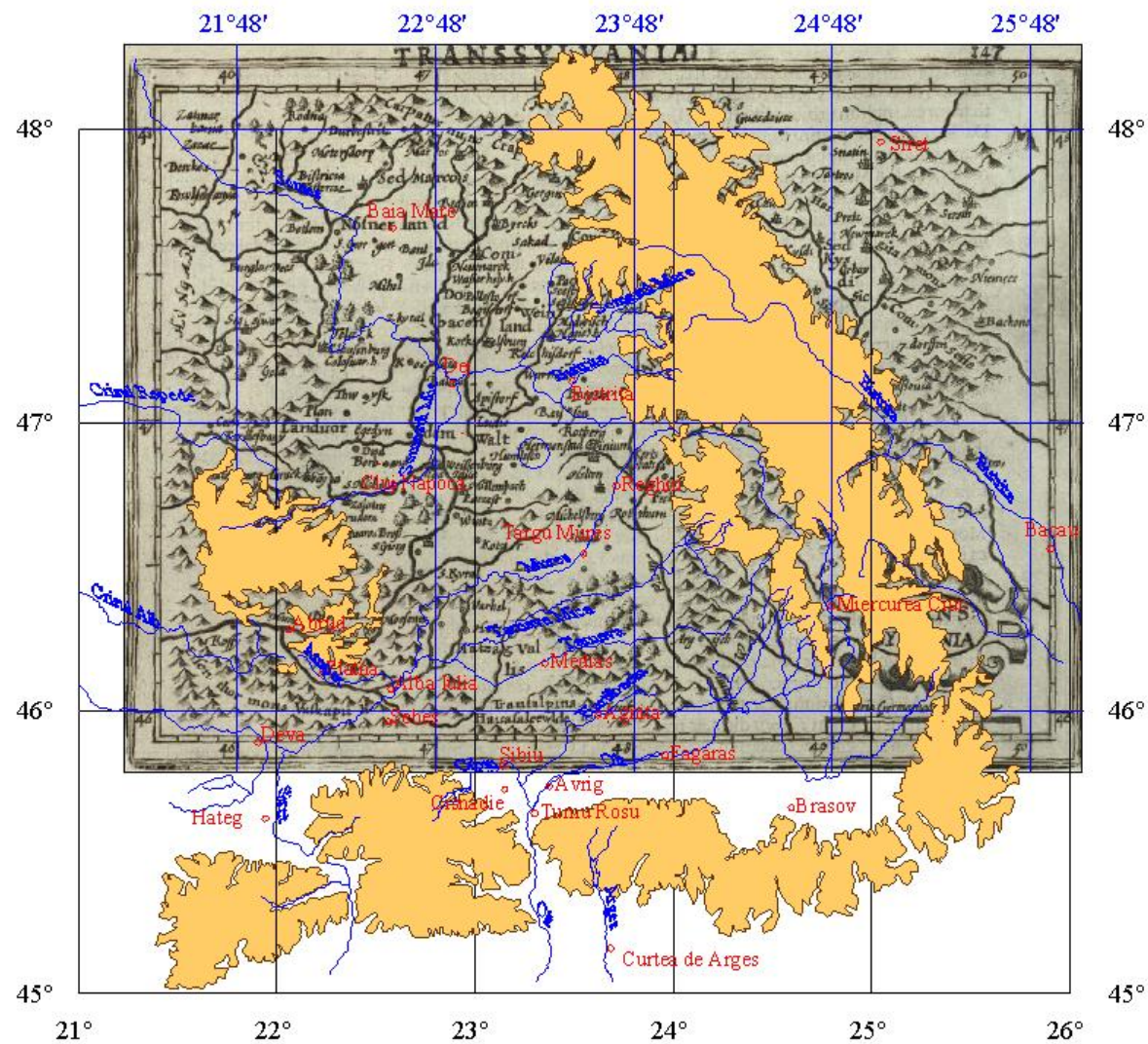


Fig. 3: Mercator's map georeferenced on a modern map of Romania, using the meridians and parallels grid

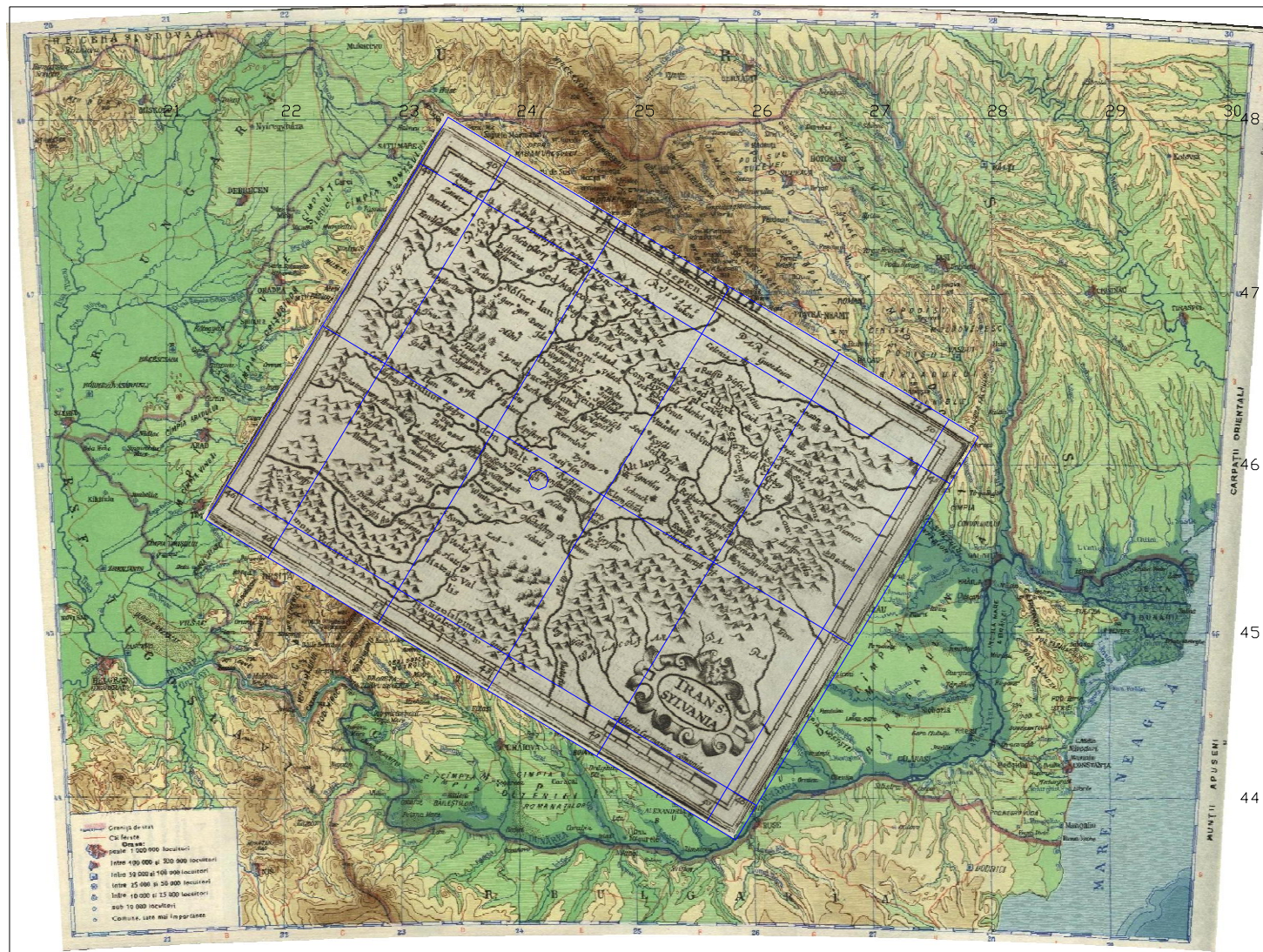


Fig. 4: Mercator's map overlaid upon a modern map of Romania [5], after applying the Helmert transformation parameters

Conclusions

Based on the present study, we can conclude that even though Mercator represented Transylvania using a map projection, the result is not precise because he did not possess coordinates determined from geodetic measurements. It is quite possible that Mercator used the same method as cartographers from the 16th century, as described in the literature [1]. This would mean that he placed a few towns defined by their geographic coordinates (known, for example, from Ptolemy's *Geographia*), and then drew all of the other details using travelers' geographic descriptions and other, already existing maps. This conclusion is supported by the fact that his map is rotated to the same degree that other maps from the same century are. It is likely that Mercator was familiar with several contemporary maps, such as the map of Central Europe drawn by Nicolaus Cusanus in the middle of the 15th century, Lazarus' map of Hungary published in 1528, the first map of Transylvania (*Chorographia Transylvaniae Sybemburgen*) created by Johannes Honterus and published in 1532, and also with Johannes Sambucus' map of Transylvania, published by Abraham Ortelius in his atlas: "Theatrum Orbis Terrarum" (*Atlas* of the Whole World).

The method proposed in this study offers the possibility of identifying towns and villages on the map that otherwise could not be recognized because of their old names. We can also determine the importance of some of them, by interpreting the symbol Mercator used for their representation. For example, we can discern some actual small towns, former mining centers: Zlatna (Zalatny rudera), Baia de Cris (Keresbany) and Abrud (Abruck), which were drawn on Mercator's map using the symbol of a small building with a spire, suggesting they had more importance at the time of drawing.

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