

# 14 Digitized Maps of the Habsburg Military Surveys – Overview of the Project of ARCANUM Ltd. (Hungary)

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## Abstract

This paper summarizes and overviews the scientific, technical and legal background of the rectifying project of the Habsburg Military Survey sheets at the Hungarian firm Arcanum. Rectified versions of the whole First, Second and Third Surveys are completed, however, till this moment, only the Hungarian part of the First and Second Surveys (in 1:28800 scale) were published together with the full Third Survey (in 1:75000 scale) because of legal issues. The rectification errors are quite high in case of the First Survey; this accuracy fits only for settlement finding applications. Accuracy of the Second Survey is surprisingly good in most parts of the Empire, the maximum error is cca. 200 meters, the same value that characterizes the Third Survey, too. This new, electronic cartographic version of the old map systems offers excellent possibilities to follow the changes of the natural and built environment of Central Europe in the last two and a half centuries.

## **14.1 Introduction**

The Habsburg military surveys represent an unique information source of the Central European geography in the late 18th and in the 19th centuries. Their scale, details, and quality put them among the best European cartographic works in this period. Rectifying them to the modern map projection systems offers a splendid tool to monitor the landscape changes, both natural and artificial, from the time of Maria Theresia to the reign of Francis Joseph. For a long time, the map sheets treasured in the archives were only available for the closed group of professionals of military cartography. The existence and, more importantly, the advantageous characteristics of the maps became known for the specialists of various branches like archeology, hydrology, forestry and nature protection from the beginning of the 1990s in Hungary. A number of reproductions of sheets portraying the most important territories, mainly as black and white copies, started to be distributed. There has been an increasing demand of specialists of river regulation and nature protection in terms of numbers and frequency.

The background of the map making of these giant works is discussed by far better authors (eg. Hotstätter, 1989; Kretschmer et al., 2004). In this short paper we summarize the project of the Hungarian firm ARCANUM from 2006 to complete a dataset, which contains all of the 1:28800 scale survey sheets of the First and Second Surveys of the Habsburg Empire, as well as the 1:75000 general sheets of the Third Survey of the Austro-Hungarian Monarchy. We describe the story of the project, with special attention to the scientific and technical background as well as the legal issues and barriers of the work and their publication.

## **14.2 Overview of the ARCANUM project**

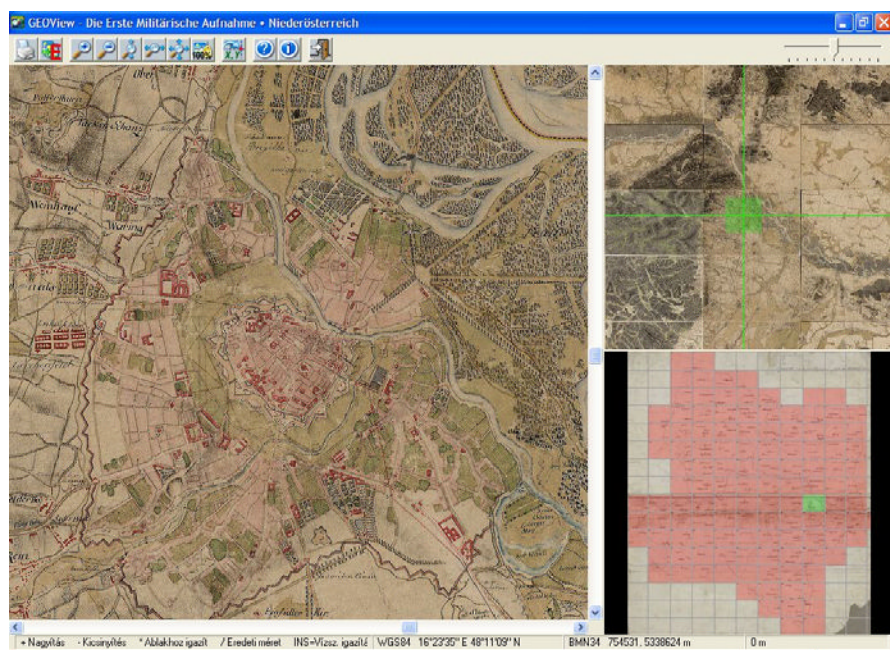
### **14.2.1 Early cartographic products**

Based on the Map Room Archives of the Ministry of Defense (MoD), Institute and Museum of Military History, Budapest, Hungary, some DVDs were issued, containing the scanned sheets of the First and the Second Military Surveys of the historical Hungary (Jankó et al., 2005).

The scanned sheets were not mosaicked or georeferenced, however, a settlement seeker utility was built in, based on the sheet numbers and image coordinates of the settlements centers. As the georeferencing methods for the Second Military Survey became available (Timár and Molnár, 2003; Timár, 2004) and known for the company, a new level of products were designed and later introduced.

### 14.2.2 Georeferenced products based on the Budapest archives

The new, mosaicked and georeferenced version of the Second Military Survey of the historical Hungary was published in the first half of 2006 (Timár et al., 2006), which made the above mentioned earlier product obsolete. The mosaicked appearance of the sheets is supported by the newly developed user software interface (GEOVIEW, see later). The earlier version of the settlement database (gazetteer) was transformed; the geodetic



**Fig. 14.1.** Wien in the First Military Survey shown by the Geoview software of Arcanum (25% magnification, in Bundesmeldenetz-34).

coordinates of the settlement centroids were applied instead of their image coordinates. The map sheets of the DVD cover not only the present territory of Hungary but also Slovakia, the Zakarpatska territory of Ukraine, Burgenland, the Voivodina in Serbia, the birder zone of Romania to Hungary and small parts of Poland, Croatia and Slovenia. The mosaicked content can be exported to the GIS software of the user in various projection systems used in these countries.

Later in 2006, the mosaicked version of the First Military Survey of the same area but without the historical Banat, the region around the modern town of Timisoara, Romania, was finished by ARCANUM. As the horizontal control and accuracy of these maps were considerably lower, the standard product does not offer a georeferenced output for the users. Later, the users required this function even for the inaccurate output and a patch was published to upgrade the software.

Using the two georeferenced sets of Transylvania (now in Romania), ARCANUM provided a synchronized DVD with the First and Second Surveys of the region (Timár et al., 2007). Synchronization means here that the user can roam one cartographic product in a software window and the other product follows it 'geo-linked' in another window. This DVD is fully supported by a gazetteer (Biszak and Timár, 2008).

The map sheets of the Third Survey were published also in 2007 (Biszak et al., 2007a; 2007b), in two scales. 1:25,000 scale survey sheets were published for the historical Hungary (the whole above mentioned territory and Croatia), based on the Budapest archives. 1:75,000 scale general sheets of the whole Monarchy were published as it was originally a printed product in the 1880s and there was no legal problem to use them for a DVD product. From 2008, Arcanum sells all of the above mentioned datasets on hard disks and Blue-Ray disks with full synchronization.

### **14.2.3 Georeferenced products based on the material in Kriegsarchiv Vienna**

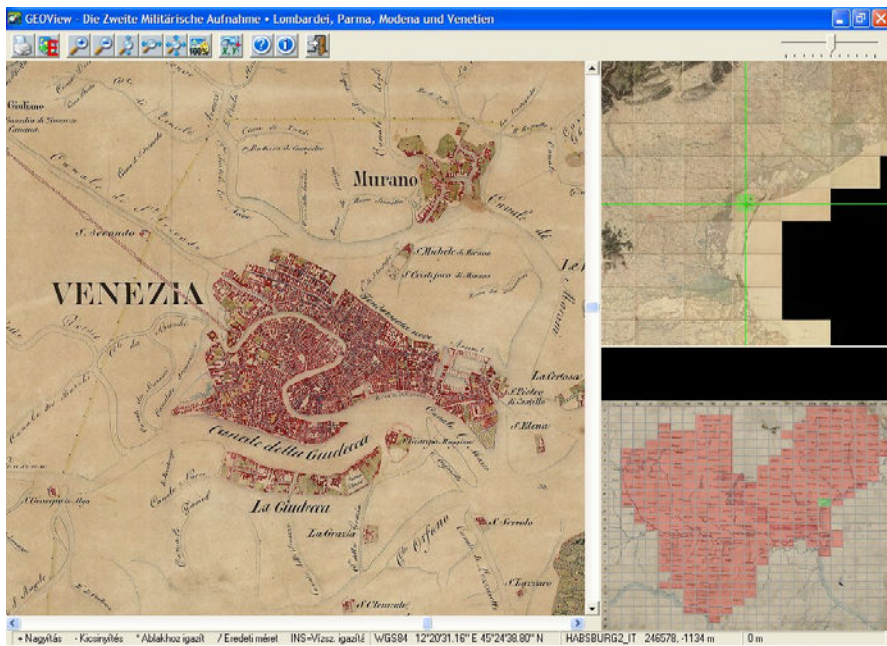
The full set of the First and Second Military Surveys are stored in this Viennese institute, a department of the Austrian State Archive (Staatsarchiv). This institute replied positively to the approach of ARCANUM to make a scanning project in Vienna. The work was carried out in the spring of 2006; several thousand sheets were scanned in the Kriegsarchiv building by Arcanum. Processing of these sheets took another three months by the methods described below. All datasets were scanned but the ones whose

copies were stored also in Budapest. The maps covers the full territory of the Habsburg Empire with Belgium in the First, and Northern Italy in the Second Survey. These products are ready from the summer of 2006 but not yet published because of legal issues, see that chapter below.

## 14.3 The Rectification Methods

### 14.3.1 The First Military Survey

The First Survey was carried out between 1763 and 1787. It covers not only the core part of the Empire but without the western provinces of Austria but also the Austrian-ruled part of the Low Countries, approximately the territory of the present Belgium. As there was no available projection definition for this cartographic products, we made separate mosaics for the different regions. Rectification of these mosaics



**Fig. 14.2.** Venezia in the Second Military Survey shown by the Geoview software of Arcanum (25% magnification, in the native coordinate system).

were made by reference points (in terms of the used GIS software: ground control points; GCPs). 30-50 GCPs were used for each region. The GCPs were defined by their image (mosaic) pixel coordinates and with their UTM coordinates in the respective zone. Quadratic polynomials were derived and used for all pixels of the mosaics to put them to the UTM plane.

The accuracy of this type of rectification is far from precise, it is just adequate for overview purposes and finding the settlements in the mosaic by their modern coordinates. The average accuracy is, in case of smaller provinces, around half a kilometer, while the maximum error is cca. 2 kilometers. The corresponding values for larger provinces are 1-4 kilometers. The errors perhaps can be decreased by defining quasi-projections for the different parts of the First Survey but this method is still not checked in the practice.

### **14.3.2 The Second Military Survey**

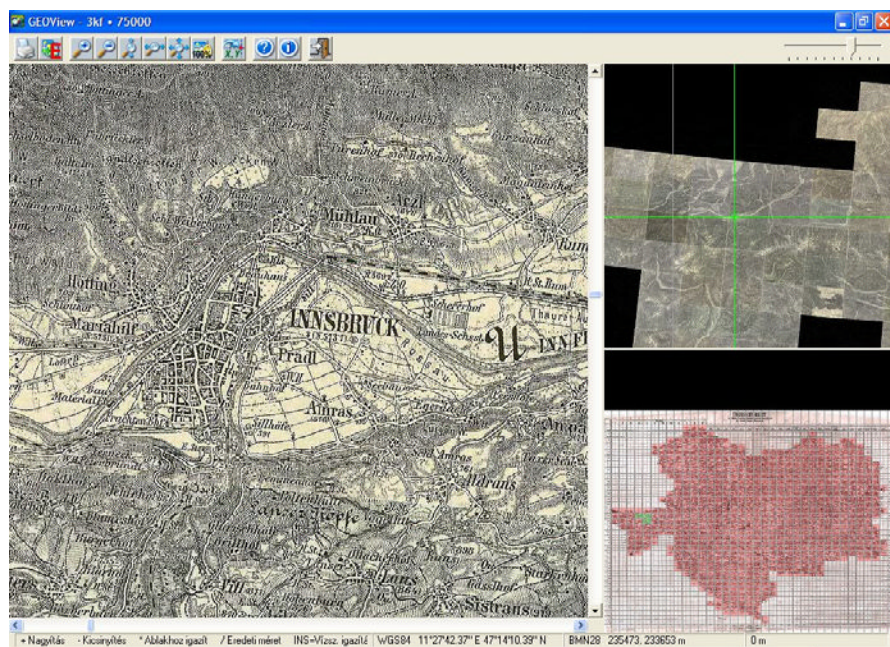
The Second Military Survey was carried out between 1806 and 1869. It covers a large, contiguous area in Central Europe from the Po Plains in northern Italy to the Galicia in western Ukraine. The survey had a real geodetic basis and a mapping protocol that can be more or less approximated by the Cassini projection (Veverka & Čechurová, 2003; Timár, 2004; Timár et al., 2006). Eight fundamental points were used throughout the Empire as projection centers (Timár, 2009a). The map sheets have no coordinate descriptions, the section numbering and the sheet sizes and sheets systems bear the georeference, so the four corner points of each sheet can be used as GCPs (Timár et al., 2006). This system cannot be applied for Tyrol and Salzburg; their rectification had to be done using the method of the First Survey rectification (Timár, 2009b).

The accuracy of the survey is far better than the first one; it is better than 200 meters in most cases, for the most populated and important parts of the Empire it is between 50 and 100 meters. In case of Tyrol and Salzburg, however, the maximum errors are 220 and 500 meters, respectively (Timár, 2009b).



### 14.3.3 The Third Military Survey

The Third Survey was carried out in the 1880s. It covers the territory of the late stage of the Monarchy; without Lombardy and Veneto but with Bosnia-Herzegovina. The compilation of this survey was simultaneous with the geodetic adjustment process of its own base point system (Molnár & Timár, 2009). Each sheet has its own Stereographic projection, their rectification can be made by the method of Čechurová & Veverka (2009) or Molnár & Timár (2009). The remaining (non-systematic) errors are in the range of 200 meters. An idea to decrease these errors is to apply modern geoid models. Deflection of vertical values, derived from global or regional geoid models (Jekeli, 1999), may be useful to provide better fit for these maps, which have a geodetic basis without proper adjustment process. This method, however, is still in experimental phase.



**Fig. 14.3.** Innsbruck in the Third Military Survey (50% magnification, in Bundesmeldenetz-28). Note that the small rotation is the consequence of using of a unified system for the whole survey instead of the sheets' own Stereographic projections.

## 14.4 The User Interface (GEOVIEW)

For the publication of the map sheets in georeferenced mosaic form, ARCANUM developed a user interface software to explore the product and provide data export link to the GIS environment of the users. As it is shown in the Figures, the window of this software consists of three parts, the overview map of the region (lower right), the intermediate zoom part (upper right), both with fixed zoom level, and the zoomable and roamable main map area (left and center). In case of synchronized products, this window is multiplied. The actual WGS84 coordinates of the cursor are shown at the bottom of the map area; right of it, projected coordinates are indicated (projection selected by the user).

Users can roam and zoom the map mosaic and, if required, the actual content of the map area can be printed or exported. Export has several options. JPG2000, GeoTIFF and ECW (Enhanced Compression Wavelet) formats are supported, and a worldfile is also presented at user's selection. The user can set the resolution from the maximum zoom of 2.45 meters/pixel, and also the map projection from a list containing the historical and modern map grids valid in the area.

## 14.5 Legal Issues

Apart from the printed version of the 1:75,000 scale sheets of the Third Survey, all of the mentioned maps were individually drawn in one or two copies. After the World War I, the peace treaty with Austria forces to cede the map sheets to the successor states, according to their new territory. However, these countries agreed to store this material in Vienna, while they insisted to have the cadastral sheets.

Austria and Hungary signed the Treaty of Baden in 1926. According to this agreement, Hungary accepted the right of Austria to store the formerly common archive material and was provided a full access to the documents. Hungarian delegation is working even nowadays in the State Archive of Vienna and, separately, also a military delegation in the Kriegsarchiv. The 'copyrights' of the old materials concerns the Austrian and Hungarian sides, according to the pre-WWI territorial separation. This is the legal basis of the publication of the maps of the historical Hungary; it is controlled by the 2005 agreement between the Institute and Museum of the Military History and the ARCANUM.



The Austrian part of the ARCANUM product, however, is not covered by any contract with the Austrian State Archive. The negotiations have been paused for more than two years; the Arcanum completed the scanning project, gave copies of the scan images and one disk with the full products but still there is no contract controlling the publication rights. Without this contract or agreement, the products containing the maps of the Austrian part of the former empire are still not published (however, some samples are shown in Figs. 1 & 2).

According to the policy of ARCANUM and to the existing agreement in Budapest, the customers bought the full publication rights with the DVD without any restriction.

## **14.6 Conclusions**

The rectification of the map sheet sets of the surveys enable us to making full mosaics of the provinces that were mapped in unified projection systems. Now, it is possible to provide synchronized version of these datasets. Settlement identification for the users are based on common georeference of the surveys (Biszak & Timár, 2008). The datasets led to interesting research results in various fields of the geosciences (eg. Pišút, 2006; Boltížiar et al., 2008; Timár et al., 2008; Zámolyi et al., 2009). The legal issues of the project, however, shows an example to how an uncertain background can block a publication that is waited for many users in Europe.

Nevertheless, the project can be considered as a significant action in the field of achiving and preservation. Scanning and publishing the described historical cartographic products provide backup copies, however in electronic format, showing the present physical status of the old paper maps. Moreover, adding georeference to the map sheets gives a 'new life' to them as they can be integrated to present and future cartographic projects and analyses.

## **14.7 Acknowledgements**

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