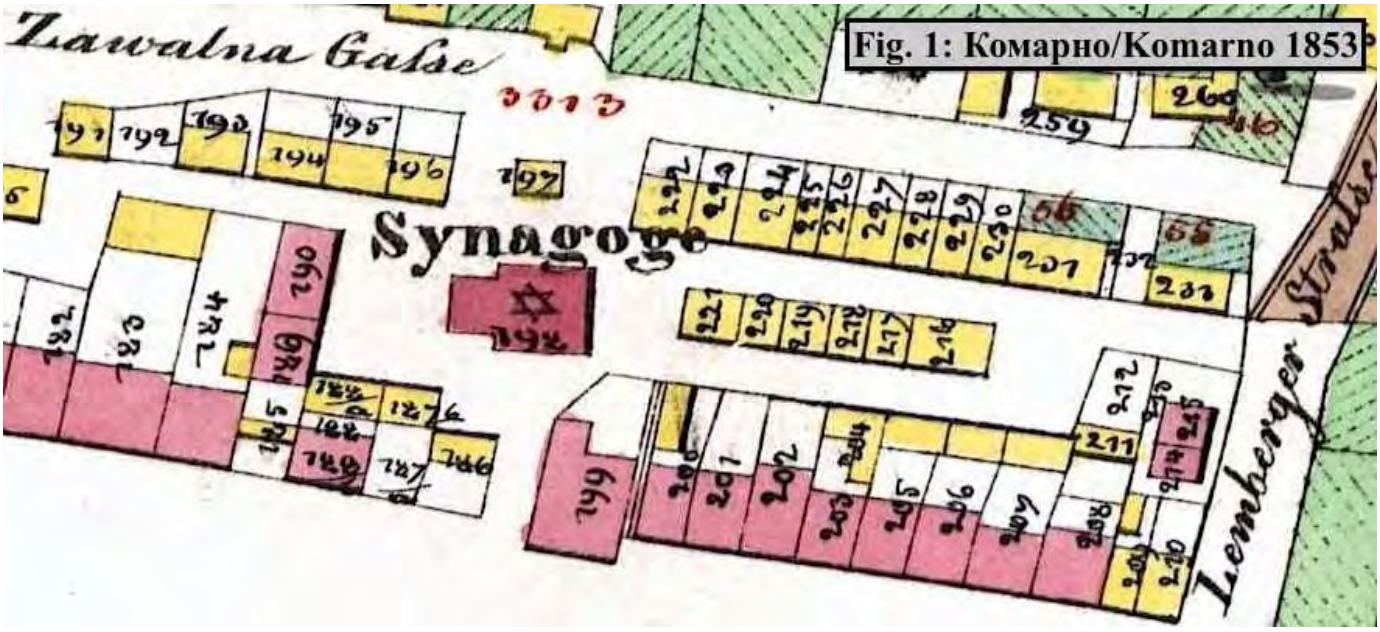
Gesher Galicia's Online Cadastral Map Room: Evolution and Opportunities

Jay Osborn



Introduction

The Gesher Galicia (GG) online "Map Room" (http://maps.geshergalicia.org/) is a component of the organization's Cadastral Map & Landowner Records Project, described in a companion paper by Pamela Weisberger. Working from GG's inventory of archival records, the map website presents digitized historical cadastral maps of towns in the former Austro-Hungarian Empire province of Galicia, a region which once spanned portions of what is now Eastern Poland and Western Ukraine. The Map Room aims to offer graphical descriptions of historical towns and neighborhoods over time, and to integrate non-graphical historical data about the landscape, buildings, and especially the people who lived and worked there. GG's purpose is to provide freely-accessible, simple online tools and data for use by historians, genealogists, and Holocaust researchers studying the past of Galicia. Beyond the cadastral maps and data, other historical map types (regional, transportation, communication, and "memory maps") are being added to supplement the core research resources.

To date, more than 35 cadastral maps have been assembled and presented; several times that number remain in the GG inventory awaiting processing, and our researchers continue to work in archives, libraries, and other repositories to gather more map images and data. As a member-funded US 501(c)(3) non-profit organization, a key challenge for GG is amplifying the limited skills and capacity of our volunteers and tools to achieve our goals for breadth, depth, and quality of our presented data.

This paper gives a retrospective of our map processing methods, outlines current experiments to expand the data presentation, and proposes cooperative work to adapt our data and methods to standards in development and use in the ongoing cadastral mapping programs of European countries. We hope to learn from participants in the ENArC and ICARUS projects, their working groups, and the attendees to the 2013 Cartography and Cadastral Maps workshop.

Evolution of the Map Processing Methods

From the beginning of the GG project, it was clear that a simple way to make the historical paper maps accessible was needed. As elsewhere, Galician cadastral maps for individual towns are divided into multiple sheets. Further, allowable digitization methods in the archives (macro camera and/or A4 scanner, at high resolution to capture map details) mean that each sheet must be divided into multiple images. Most researchers interested in the maps and related land and family records are not able to integrate the separate images and sheets, nor relate them to current geography.

A first attempt to assemble a georeferenced Galician cadastral map was made in early 2011 by Dr. Alex Feller, using separate map sheet images in the Google Earth

application. This trial allowed users to selectively enable map sheets on the globe surface, and to vary opacity of the layers, but the application was found to be too complex for many end users, and the large map files required very long download times. Instead, a browser-based, tiled-map approach was selected for ongoing work.

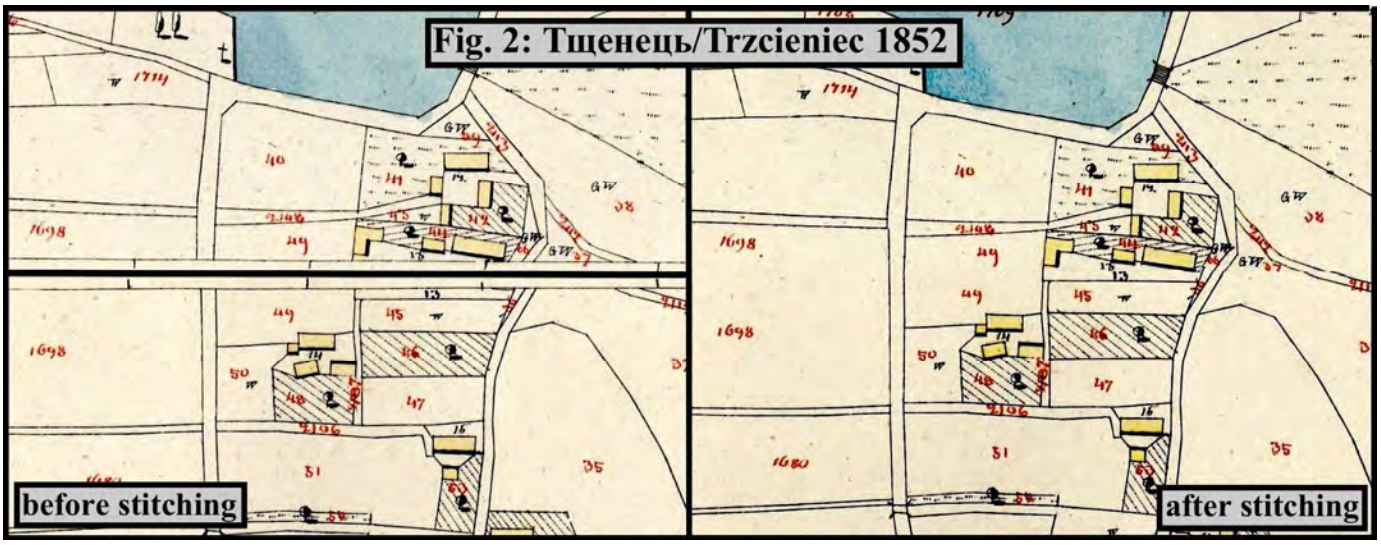
Lacking a true GIS platform and related skills, we opted for relatively simple/manual tools for map rubbersheeting, assembly, tiling, and web presentation. Map image fragments are cut and then re-assembled in a "stitching" process using Adobe Photoshop Elements; the same method applies both within a map sheet (from the separate scans necessary to capture an entire sheet) and between sheets of the original lithographed or sketched map. Image distortion of even well-drafted maps (from scanner tracking errors, camera lens distortion, and map paper shrinkage) has often made alignment and stitching of features difficult. The APE program only allows distortion of quadrilateral image units (e.g. no 9-point adjustments), so in some cases a map image requires digital cutting into very small pieces to achieve a smooth fit. In other cases, the paper map edges are too worn to digitally assemble, so are aligned with visible gaps. Stitching a complete lithographed cadastral map of 4 to 150 images typically takes 1 to 30 hours of hand work (field sketches are more difficult, as noted below). We typically retain map defects and other signs of age, altering the original image only when it improves clarity. A simple example of separate and stitched map edges is shown here:

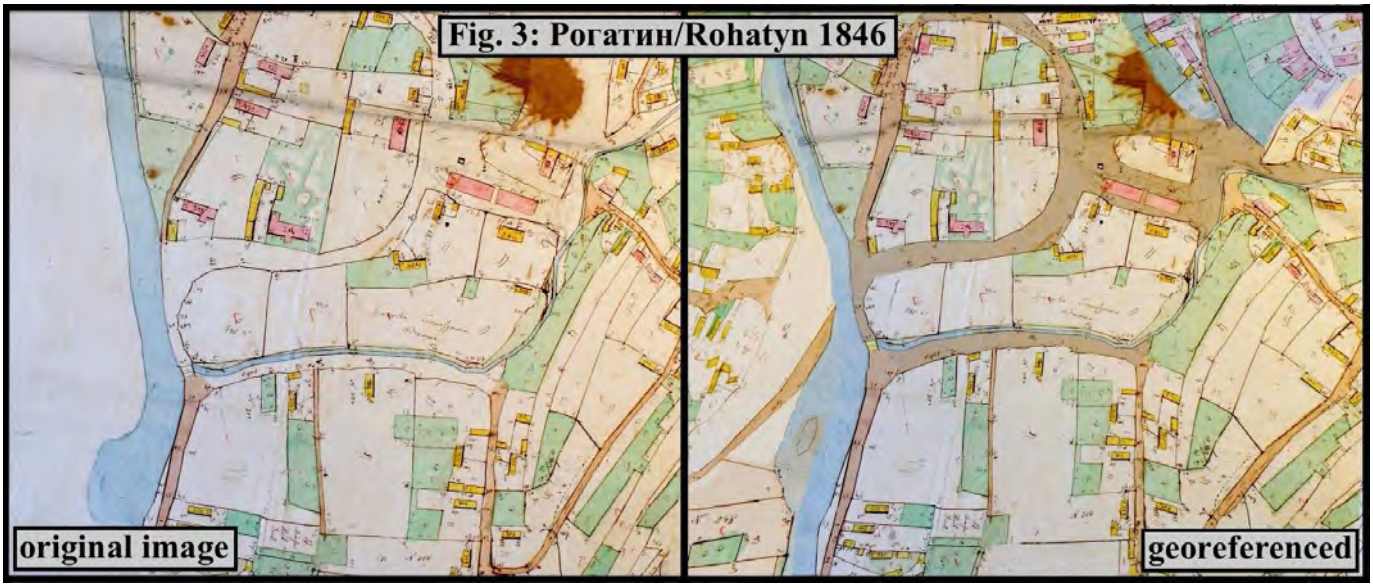
Another limitation of this method is the total image file size: APE permits a maximum of 30,000 pixels per side regardless of installed RAM; even on a dedicated machine, 25kpx per side is a practical limit. A workaround for this limitation is stitching a map in smaller subsections and then assembling those subsections into a complete map using the free and open-source application GIMP, which more aggressively swaps RAM to disc. Using this workaround, to date GG has assembled two very large cadastral maps, each measuring more than one gigapixel.

Few of the maps completed so far have been carefully aligned to Earth geography; none has been technically georeferenced. This is partly due to a lack of tools, but also reflects the difficulty we have experienced in working with the original paper maps. One 1846 map was successfully aligned to current natural and man-made Earth surface features using a high-resolution 1944 German aerial photograph from the US National Archives and a high-resolution modern satellite image from a commercial provider as base layers. However, the only cadastral map available for this town was a preliminary sketch (feldskizze), which lacked any scale or orientation within and between sheets. Extensive cutting and local distortion of map fragments was thus required to align and assemble the details, a task of more than 125 hours; before/after image excerpts of this 1846 map are shown in Figure 3 on page 16.

Even without georeferencing, the maps GG currently offers are valuable to researchers who are interested in the locations of family homes within towns, and the arrangement of neighborhoods around markets, religious buildings, and farmlands. However, we realize that extending the utility of the historical maps will require proper georeferencing and associated tools.

Following the assembly of a full town map, the large image is then tiled using MapTiler, a free and open-source desktop GUI for the GDAL2Tiles utility; MapTiler prepares tiles with or without georeferenced images, and in a variety of layer options. The tiles are then presented in a custom map viewer using





the OpenLayers API. A sample viewer from the GG Map Room is shown in Figure 4 below.

Each of the methods used by GG has evolved with experience and as we learn more about available tools; further growth and changes will be needed to add greater capability and utility to the site.

Expanding the Web Tools: Layered Maps and Linked Nongraphical Data

Features of other map-based websites suggest several ways the GG online maps may be expanded in the future to enable better analysis of former Galician towns in modern and historical contexts. Map development tools currently used by GG already enable several useful enhancements:

Layered map views: Layering historical maps over modern map and satellite images (from Bing, Google, OpenStreetMap, Yahoo, etc. in any local language) is an obvious way to aid historians and genealogists to understand structural changes in towns over time: rerouting of waterways and roads impacts transportation and business in towns; wartime destruction of buildings, neighborhoods, and religious centers shifts town focal points. The same approach can be extended to include historical maps from other years, where available. As an experiment, the full georeferenced map of Fig. 3 above was layered onto modern map data (using the Google Maps API) to indicate how the town has changed since the 1846 land survey; three levels of opacity are shown in Figure 5 on page 17.

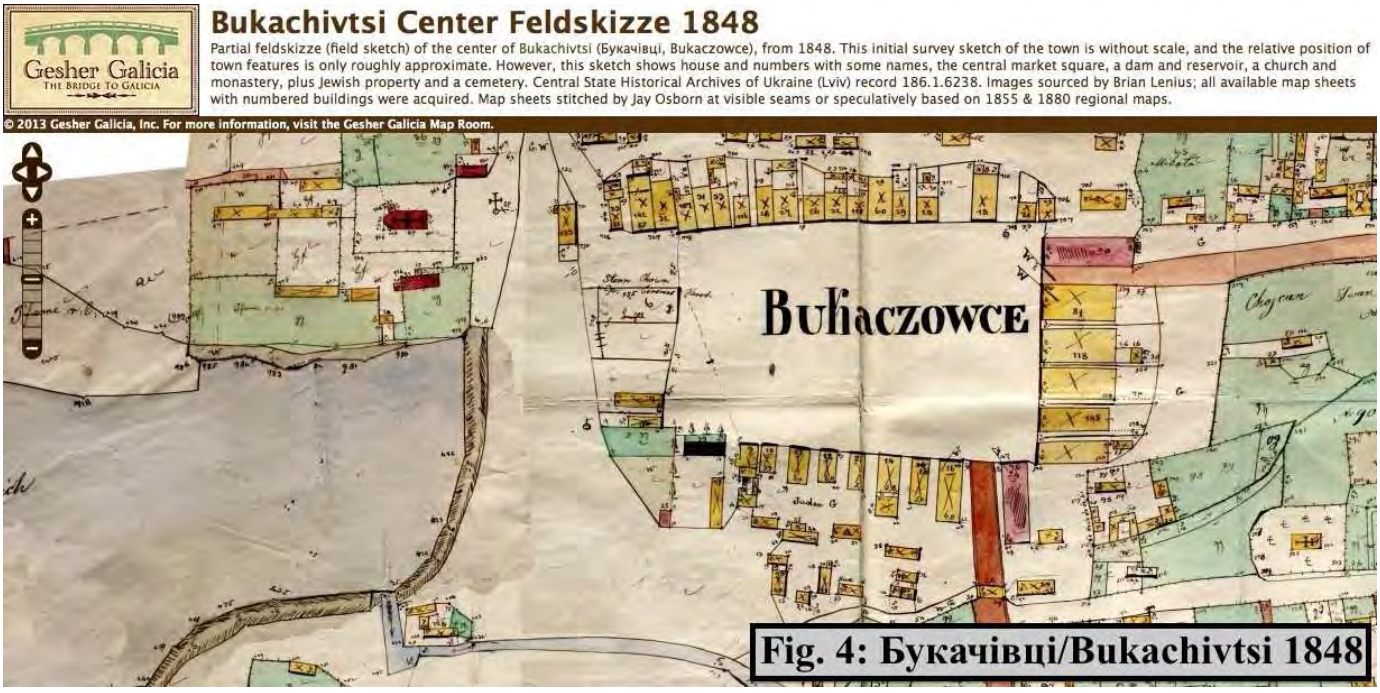


Fig. 5: Рогатин/Rohatyn 1846

Search tools: A dense historical map like the one above can be difficult to search for specific properties, as the original house and land numbering scheme was often chronological rather than by location. Adding a "house finder" tool (in OpenLayers) simplifies the search task for researchers, as can be seen in Figure 6 below.

Links to other data: Probably the most important future function of the Map Room will be integration with non-graphical property information, including property owner names and dates, plus other vital, metrical, legal, and image data organized in GG's extensive All Galicia Database. For researchers, having our Database tied to the maps via tooltips, tables, and search links will enable much greater analysis of historical demographics from single families to entire communities. The current Map Room software tools allow data to be linked to users' interaction with online maps, but our implementation of these links is still being planned.

Opportunities for Learning and Collaboration

Development of additional online capabilities will require further investment in tools, skills, and knowledge. Before embarking on this expansion of the Map Room, it makes sense for GG to consider the methods of other cadastral mapping organizations, to learn and adapt best practices to its own work. We recognize that many state archives, libraries, and land survey offices in Europe have already developed standards for converting, manipulating, and using historical maps, and are now working toward harmonization of data and methods across organizations. We hope that our alignment with common standards will allow GG to exchange data and ideas with experts in many fields and locales, and to grow our capabilities more rapidly.

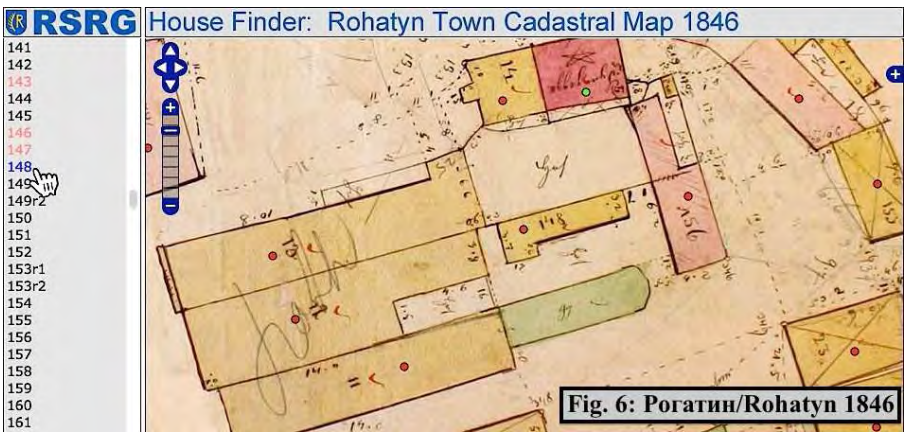


Fig. 6: Рогатин/Rohatyn 1846

In particular we hope to learn from and collaborate with other organizations on systems, methods, and standards for:

- digitizing historical paper maps: image capture settings, raster data and metadata formats
- rubbersheeting and assembly of digitized map pieces
- georeferencing historical maps
- historical map interpretation: manual/automatic extraction of shapes and features
- map data exchange
- database structure for historical property owner / tax roll information
- integrating records databases with online maps
- Internet publication of maps

Gesher Galicia is a nongovernmental research and educational organization with a broad base of website users well beyond our membership. Our ongoing Cadastral Map & Landowner Records Project and associated Map Room have been recognized internationally for advancing the objectives of Jewish genealogy, and are used by cross-cultural researchers studying historic Poland and Ukraine as well as lands outside the former boundaries of Galicia. To further develop our mapping capabilities and quality, we appreciate advice and information from experts in any map organization having similar interests, and we welcome opportunities to build virtual bridges between our organization and others.

Jay Osborn is the Gesher Galicia Map Room Coordinator. He can be reached at jay.osborn@gmail.com.