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Late Renaissance survey techniques revealed by three maps of the old Po river Delta

Keywords: pre-geodetic cartography, Po river delta, Late Renaissance, land-surveying techniques, map-drawing

Summary
This research was performed on a set of three maps depicting the Po river delta area (Northern Adriatic Sea, South of Venice) at the end of the 16th century. They were drawn by three famous land surveyors; today they are preserved in the Venice State Archive. The maps were mutually cross-compared in order to understand some late Renaissance land-surveying techniques.
The kinds of evidence taken into account consist of technical signs preserved either in the palimpsest of the maps or in their final drawing. The meaning of some of the signs is explained by the authors themselves in the legend or in the accompanying notes, whereas the meaning of other ones can be inferred by Fabri's methodological textbook, containing the description of a new topographical instrument which he invented and used. All of these signs highlight a very interesting class of information related to the hidden steps of pre-geodetic map construction, which up to now is still poorly known and studied.

Introduction

This research was performed on a set of three maps depicting the Po river delta area (Northern Adriatic Sea, South of Venice) at the end of the 16th century. They were already studied from various viewpoints (Cremonini 2007; Cremonini & Samonati, 2009; Bitelli et al. 2009). The same cartographer, Ottavio Fabri, is author of all the three maps, even though he is single author in the first map, and co-author in the second and third one, in which the main authors are Gerolamo Pontara and Bonaiuto Lorini, respectively. All of them were very famous land-surveyors (*Savi ed Esecutori delle Acque della Serenissima Repubblica*). The first two maps were made in 1592, whereas the third map was made a few years later (1599). The maps are now preserved at the Venice State Archive (ASVE). ASVE put the documents at our disposal as digital images, derived from high resolution scanning (map by Fabri and map by Lorini) or digitization of photographic images (map by Pontara).

Map samples analysis

The three life stages of a map (i.e. field surveying, drawing and styling, use and preservation) leave traces of various importance and complexity on the document itself. Thus type and location

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of these traces in the map should be searched and found out. Just below we list several minor evidences not always considered in the georeferencing technique applications.
The kinds of evidence consist of technical signs preserved either in the palimpsest of the maps or in their final drawing. The meaning of some of the signs is explained by the authors themselves in the map, whereas the meaning of other ones can be inferred by Fabri's methodological textbook, containing the description of the *squadra mobile* (mobile square), a new topographical instrument which he invented and used (Fabri, 1673). The instrument was useful for many types of topographic measurement (i.e. heights, distances, depths) in urban and land surveying and map drawing (Fig. 1). The book by Fabri seems to be a powerful record of the author's whole technical experience derived from surveying the geographical areas drawn in the maps here studied, and this is especially true for the first map.

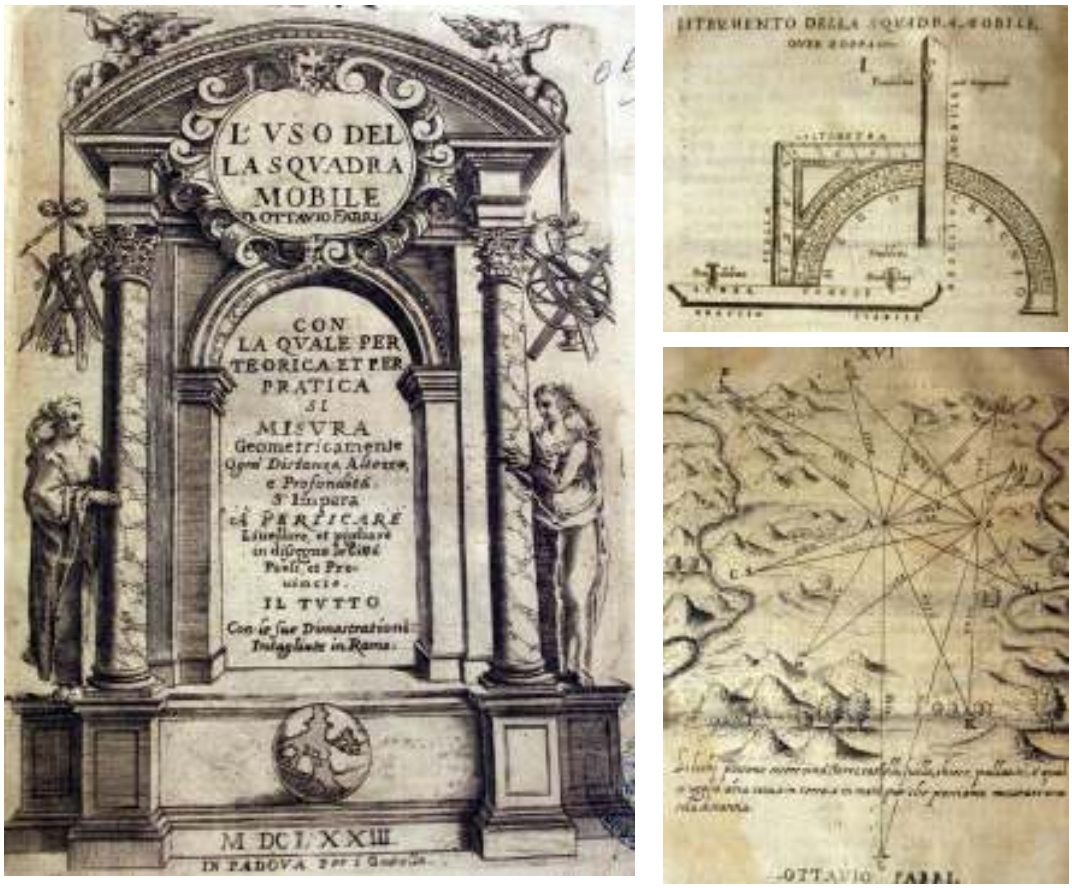

Figure 1: on the left, the title-page of the textbook by O. Fabri, *L'uso della squadra mobile* (1673 edition, preserved in the Engineering Faculty Library of the University of Bologna); on the upper right, a picture of the *squadra mobile*; on the lower right, an exercise of forward intersection proposed by Fabri.

Nine classes of evidence have been recognized in the three maps:

1. Written information in map cartouches: it states that the documents were done partly by merging a lot of previous maps and partly by means of direct topographic measurements using different surveying techniques;
2. Technical grids: in all maps, a small sized square mesh grid is drawn parallel to the map edges and to the North branches of the compass-card; moreover, only in one map, a larger sized square mesh grid is drawn parallel to a rectilinear artificial canal;

3. Topographic measurements: length measurements, bathymetric surveys, some selected riverbed transects, special coloured lines;
4. Sighting tracks, in order to define the correct distance between selected points of the delta coast and well visible landmarks on the opposite coast;
5. "Land-markers": signs of unclear meaning, for example little crosses;
6. Preparing/correcting/updating, in plan form and/or location, of former drawings of topographical details;
7. Unsolved questions: method and age of assemblage on canvas of the single sheets;
8. Additional iconography: *appliques* (showing ancient vessels) sticked on the maps, and images (for example fishes) drawn on the maps;
9. Restorations (kind and entity) performed on the maps through time.

Conclusions

All of these signs highlight a very interesting class of information related to the hidden steps of pre-geodetic map construction, which up to now is still poorly known and studied. Ancient maps study should start from philological analysis (i.e. origin, target, models, cultural atmosphere of that time) and subsequently it should become a "stratigraphic" reading of both relationships existing among the drawing details and the accidents to which the map exposed.
Although many problems still remain open, one result of our study was to show that pre-geodetic maps should not be regarded as completely original technical products but as assemblage of various data coming from previous sources. Thus the technical analysis of the ancient cartography (in particular the pre-geodetic one) cannot be reduced to a simple georeferencing attempt, performed in a "cold manner". The analysis should be done in a "hot manner", starting from the recovery of the inner data hidden in maps.
A more profound comprehension of the ancient field surveying techniques (i.e. pathways, distances, contemporaneous use of various kinds of instruments, etc.) is essential in order to understand genesis and size of the surveying errors recorded in the map. In this way usual georeferencing techniques can be implemented to define the real topography/morphology of those areas not still existing due to natural environmental processes.

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