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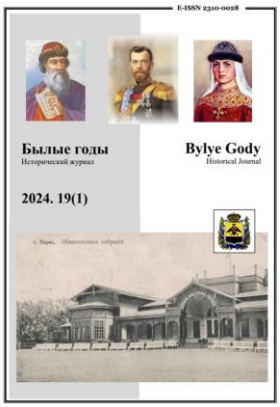

The Liubech Town Plan in 1651 by Abraham van Westerveld

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Abstract

The publication analyzes a little-known Liubech plan described by Abraham van Westerveld in his report on Janusz Radziwiłł's march to Kyiv in 1651. The latter was a Lithuanian hetman. The article concerns topographic drawings and geodetic tools used in that time. Modern topographic plans and early modern ones are compared (including respective mistakes). The drawing meets the West European cartographic school: orthogonal projection without decoration and description. It combines fortifications, separate buildings, infrastructure objects, etc. The plan is provided with a scale and English cardinal points. Such a draft was drawn by a skilled cartographer. The above-mentioned can determine the land survey, its methods and tools.

The survey was conducted after the Liubech seizure by Janusz Radziwiłł. The geodesist could get acquainted with the object and determine the stages of plan creation. The work was completed properly. There was only one deviation on the plan: the corner tower orientation shift. Besides, several surveying techniques were applied to the plan, which confirms high skills of the geodesist. The plan is almost centered. No pasting or wall direction changing are detected. Such techniques are usable for surveying unknown objects. However, plan errors themselves are typical for surveying tools and methods of the 17th century. Unfortunately, such a plan was created in a single copy. Therefore, we cannot make any assumptions about its authors.

Keywords: fortification, Liubech, Abraham van Westerveld, 1651, topographic plan, armed conflict, war, good governance.

1. Introduction

In the 16th-17th centuries, the cartography development of the Western Europe was significant. There was a transition from the biblical geography to the real one. Mathematic and astronomic measurements provided an opportunity to create maps of separate countries and continents. The first world maps were drawn. At the same time, the cartographer profession was a great secret to plan a successful military march based on fortifications, roads, ferries, etc.

A large contribution to the cartography development was done due to the Cartesian coordinate system. The same principles were applied for topographical survey of any object: a land, a town or a fortress. New geodetic tools increased the drawing accuracy. In contrast to the Western Europe, it was quite rare for Ukrainian lands under the Polish–Lithuanian Commonwealth to plan towns or fortifications. Usually, such properly colored drawings emerged at the beginning of the 18th century in case of siege. As an example, we can mention the Poltava plan made by Swedish engineers in 1709 (Gol'denberg, 1959: scheme 6). The plan we selected to analyze is a unique cartography heritage of the 17th century in terms of geodesy.

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2. Materials and methods

The article analyzes the Liubech fortress plan as of 1651. This drawing is one of maps by Abraham van Westerveld who accompanied Janusz Radziwiłł during his march to Kyiv. The former was a Dutch artist, the second was a Lithuanian hetman. The original is stored in the archive «Kralovska kanonie premonstratu na Strachove» with the report on Janusz Radziwiłł's march (sheet 24). The research object is a geodetic task to make guide images of fortifications. To visualize the plan data as of 1651, we added a layer for indicating these marks. The dotted line stands for alleged geodetic points of measurements and observations.

The methodological basis of this article comprises the objectivity principles. Via the source criticism principle, we comprehensively examined Westerveld's plan to detect inaccuracy. The comparison method contributed to this task as well. It is based on a contrast between geodetic techniques of the contemporary and early modern periods. The authors analyzed two Liubech images and defined similarities in drawing some elements and units. Simultaneously, the two-layer application allowed detecting sections with possible deviations. Such a method lets us understand the general plan idea and its finest details.

3. Discussion

The Liubech town history of the early modern period was studied by many Ukrainian and foreign researchers. In particular, a special interest concerns works on Siveria in the 16th-17th centuries (Rusina, 1998; Kulakovs'kyy, 2006; Bobiński, 2000). A comprehensive paper on the Liubech history is a monograph by I. Kondratiev "The Liubech Starostwo in the 16th-17th Centuries" (Kondrat'yev, 2013).

The archeological research of Liubech was conducted in the 20th century with a focus on excavations of the Castle hillfort (Rybakov, 1985: 94-132). At the beginning of the 21st century, excavations were resumed with an interest in the early modern heritage. Consequently, it resulted in the topographical survey of most archeological sites (Veremeychyk, Bondar, 2011: 60-61; Veremeychyk et al., 2012: 485-486; Bondar, 2017: 86-91; Sapozhnykov, Kuzmishchev, 2022; Sapozhnykov, 2022).

The image sources on the Liubech fortress history were also studied in detail. The Liubech plan of the 17th century was first published by Yu. Mytsyk and O. Berezenko (Mytsyk, Berezenko, 2013: 4). Later, it was reviewed by other experts. In particular, there was a Liubech plan comparison as of the 17th century with the drawings by Abraham van Westerveld. Besides, the fortress plan as of 1651 was compared with the contemporary topographical survey. As a result, we concluded its correspondence to written and archeological sources. Moreover, the drawing authorship is a question for further studies (Bondar et al., 2015: 50-52, fig. 4, 5).

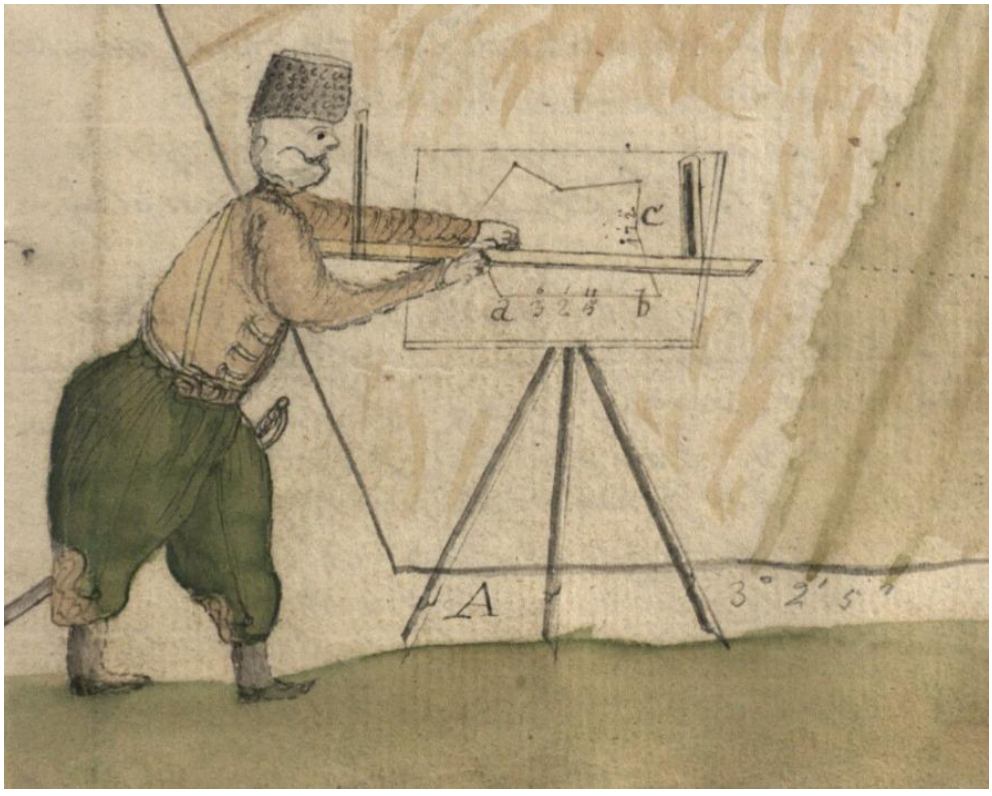


Fig. 1. The work of a surveyor. Picture from the book «Arithmetyka albo Nauka Rachunkow», XVIII century

This article represents a new insight into plans, maps and drawings of the early modern period. The research aim is to analyze drawing elements and methodology of their design. Previously, we studied two maps of the first half of the 18th century (Osadchij, 2022: 161-169; Osadchij, Degtyarev, 2023: 209-217).

4. Results

Methods of geodetic survey and main tools for it

Now, we are going to review certain geodetic tools for such surveys. The most typical equipment for surveys was a plane table. It consisted of one or three legs and a desktop with a compass and sights (Figures 1, 2). Distance was measured via Gunter chains with a length scale. Sometimes, even surface distances were measured with a field compass. For angle measurements, an optical square and a magnetic compass were used. Geodesist assistants had also a stick or spear as a measuring rod (Figure 3). These tools were applied for topographical survey and its paper visualization (Warner 2005: 372-375).

Fig. 2. Surveyor with an assistant. Picture from the book «Arithmetyka albo Nauka Rachunkow», XVIII century

The Liubech fortification plan includes two layers. The first layer is an initial broken-line guide image drawn with a lead or silver pencil (walls, towers and church within the Liubech fortress). The second layer comprises a scale, marks and cardinal points. The Liubech fortifications are represented almost in the sheet center, which confirms high geodetic skills. There were some simple survey techniques. As an example, we can mention the polar topographical survey implemented in gradual steps.

Step 1. Surveying via one or several control points (for closed areas with a distinct center providing an edge view).

Step 2. Laying routes via control points and azimuths (for long curved routes: ramparts and defensive lines).

Step 3. Measuring angles via the triangulation method when points are put on the straight-line intersection defined with a deviation angle (for fixing basic survey points and observation shifts).

Step 4. Calculating locations via astronomic measurements (for obtaining geographical survey coordinates and topographic adjustment).

Such a method had own advantages and disadvantages. When working, geodesists put some marks on the drawing (dots and dashes). Barely visible, they are very informative (Figure 4). The same marks were made by the author of most Liubech plans (Bondar, 2017: 89).

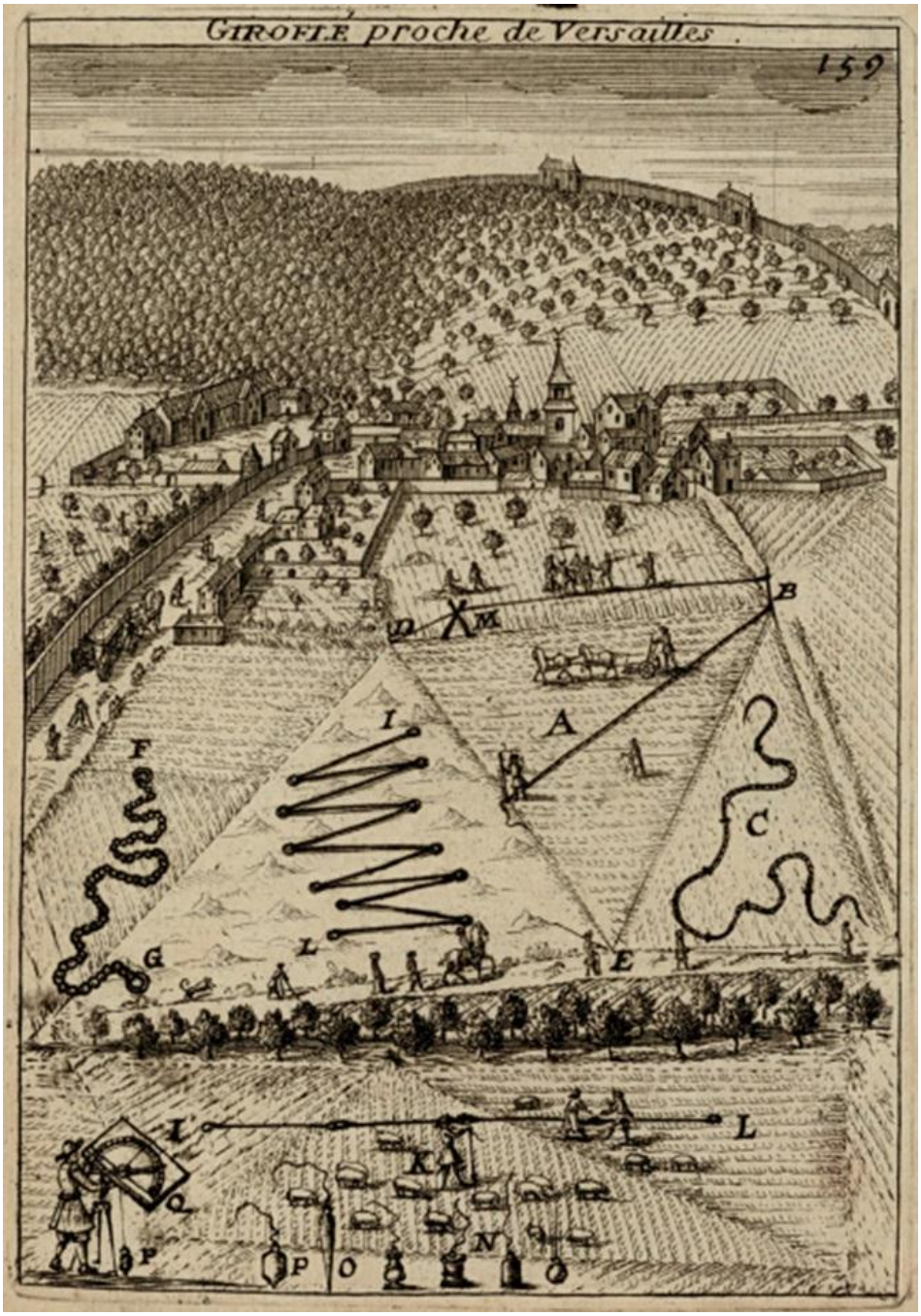


Fig. 3. Basic surveyor's tools. Picture from the book «La Géométrie pratique», 1702

Guide image analysis. Geodetic points and infrastructure objects

The guide image of the Liubech fortress is a complex cartographic task. It consists of two or even three parts. Firstly, it is the Castle located on a cape of the left Dnipro bank. In this case, the survey difficulty was explained by the hillfort development. Some points were found to observe and fix defensive locations. These points were marked on the plan. There were three points in the lower third of the Castle square. Their positions were adjusted concerning the south-north line. It was this place where the survey was conducted.

On the drawing by Abraham van Westerveld, we see the Castle with main buildings in its northern part (Bondar et al., 2015: 46, fig. 1). That is confirmed by archeological data: the development as of the 16th-17th centuries prevailed in the northern-western part of the Castle (Sytyy, Kondrat'yev, 2012: 17-18, fig. 4-5). Therefore, the northern wall was not directly observed (dashes) in contrast to the southern and western ones (dots). The dots stand for accurate distance measurements and their fixation. The northern part was fixed concerning the azimuth tower positions. Towers themselves were linked directly.

Then, the defensive line required drawing. The central street and descent divide it into two parts. This defensive line leads from the gate to the gate tower in the stream valley between two capes. In archeological literature, they are called the Western and Southern Fortifications (Bondar, 2017: 89).

The Western Fortification survey was conducted inside and outside. Today, the hillfort area is densely developed with private buildings and fences. The similar situation occurred the early modern period. In that time, the town was surrounded with wooden walls, which prevented measuring. For more accurate results, it was necessary to measure outside fortifications. The esplanade in front of defensive buildings simplified geodesist's work who could locate his plane table before fortifications.

The most difficult task was the point transfer from one object to another via wooden walls. On the drawing, we can understand how this transfer was done. From the northern-western wall of the Castle, an azimuth was taken to the place outside fortifications opposite the Piatnytska Church (Kondrat'yev, 2013: 30-33). It was the place to transfer measurements and observation results marked by a dot. This dot is vividly discerned between dashes standing for the wall guide image. The towers are also drawn clearly because the geodesist directly sees them. The further survey transfers the plane table data on control points and fixes the tower and wall locations. The drawing has three dots near the western corner of the Western Fortification (control points).

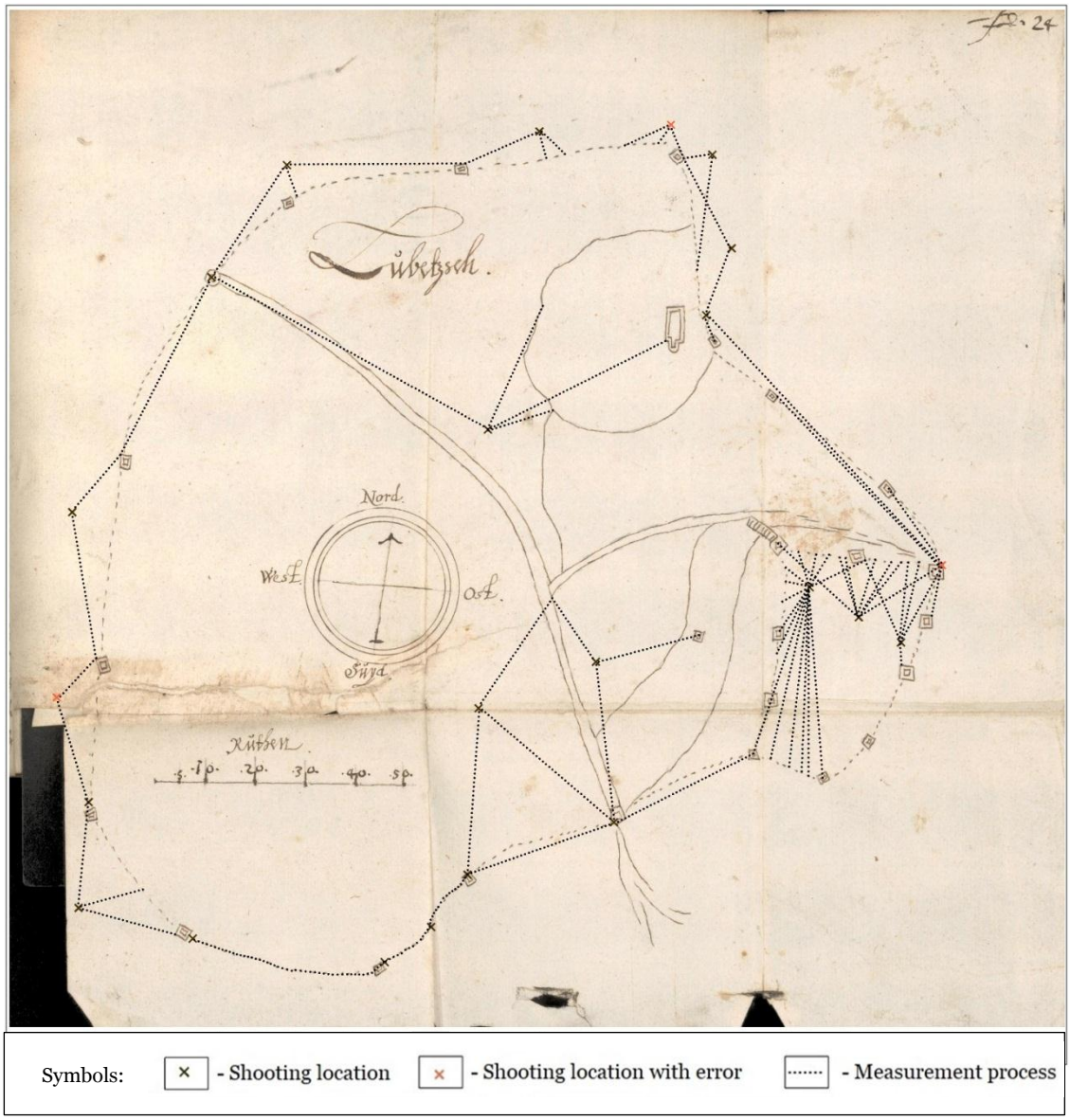


Fig. 4. Abraham van Westerveld's plan with the marking of the survey route and measurement control points, 1651

Here, azimuths were taken and distances were defined from control points to measuring objects.

Between towers of the south-western wall of the Western Fortification, there are two dots and dashes. Here, we can see three towers with opposite unclear dots. They stand for the observation place (the removed measuring angle). The distance from these dots to the wall image is scaled as 15 meters. That corresponds to the average ditch width not represented on the drawing.

Among land fortifications, there was a gate tower. On the drawing, it was round with a dot in the middle. That was a starting point to measure the inner space of the Western Fortification. Here, azimuths were taken for main streets. Later, the control point was transferred to the north along the street axis which bisected the fortress. This surveying reference point is important. The latter fixed the main landmarks, for example the Piatnytska Church whose sanctuary is oriented to the north-east. The church apse foundation has also a dot represented on the drawing.

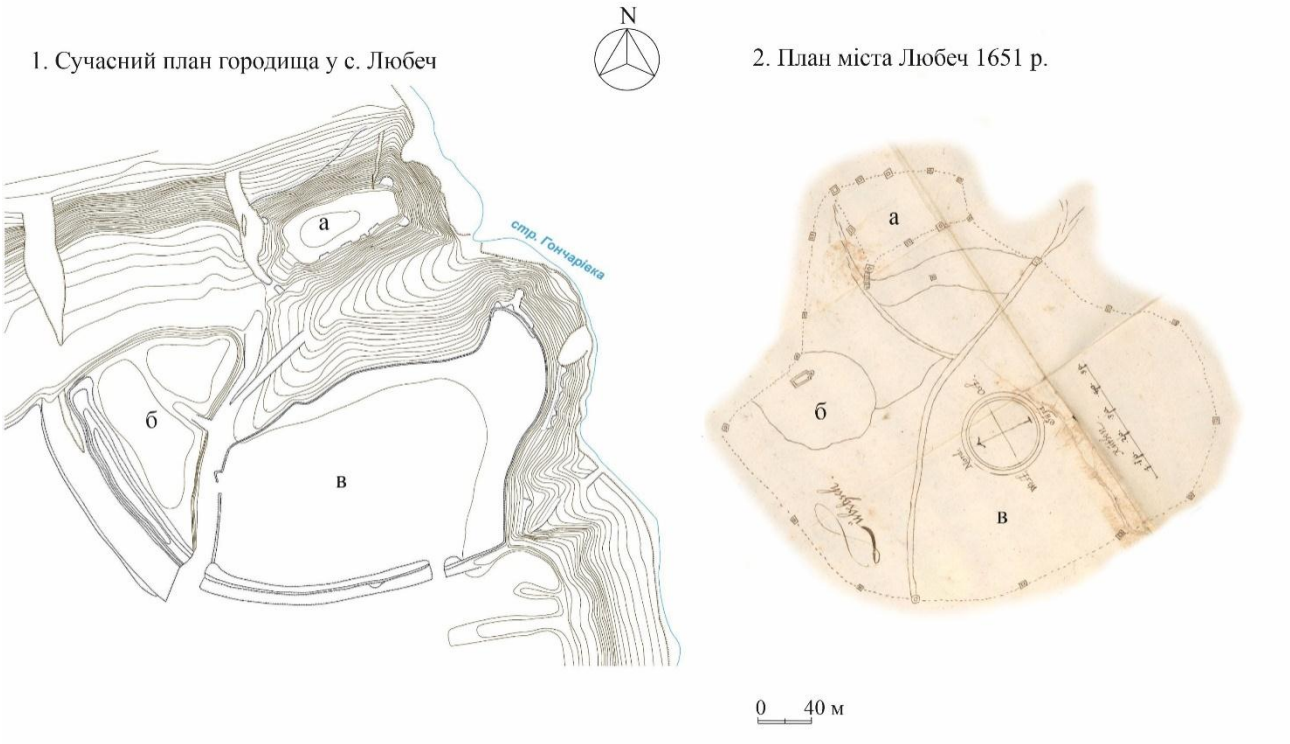
Then, the Southern Fortification wall was surveyed from the gate tower. It led to unclear dots along the defensive line with a larger distance between them. The reason is the almost straight form of the southern wall of the Southern Fortification with no need for too many control points. The fixed towers were linked via dashes. More attention was paid to curved or hard-to-reach locations. First of all, that concerns the eastern wall of the Southern Fortification. There are dots rather than dashes between towers, which show the geodesist's effort to display the wall as accurately as possible. Besides, this wall was situated on the very cliff edge. For survey, it was necessary to move from one point to another linearly.

Between the Southern and Western Fortifications, we have a deep descent to climb from floodplain to town. The fortifications were built on cliffs of two high capes (Figure 5: 1). The next step was survey of two cliffs from the left bank plateau to the Honcharivka stream floodplain. Here, the geodesist took azimuths from the left part of the Castle and the northern part of the Southern Fortification.

In this case, there was only one mark at the tower down the descent. This place produced further measurements and fork leading to the Castle. The drawing had a point between the scale sign and the "wind rose". It corresponds to the cliff edge of the Southern Fortification. Opposite to that, we had another tower and floodplain descent.

The towers and ditch bridge are quite sketchy. Corners of some towers are marked with dots connected via lines. The same concerns the church. All towers are drawn simultaneously (except for the southern one of the Western Fortification). The initial image was corrected by 20 degrees.

The author tried to represent the relief, which was not typical for large-scale plans. The geodesist defined the relief range for the Castle and the Western Fortification. The high position of the Piatnytska Church was marked with a solid line. The low position of the castle on the southern cliff was represented as well.



Symbols:
A – Castle, b – Western fortification, v – Southern fortification

Fig. 5. Comparison of the modern topographical plan of the settlement in the village of Lubech and the plan of Abraham van Westerveld, 1651

Horizontal survey errors

Now, we are going to discuss differences between the modern plan and the drawing as of 1651. Both pictures were turned to the north and converted to the same scale (Figure 5). Most accurately, the author produced the Castle – a trapezium with the shorter eastern side. On the modern plan, the trapezium sides are almost equal. The northern-eastern corner of the castle was destroyed because of the soil fall, which distorted the

image slightly. Other fortifications generally correspond to the modern survey. Most often, errors were made when the geodesist transferred the control points. A great problem was representing the transition from the Castle to the Western Fortification. The azimuth was likely measured from the southern-eastern tower.

Till the western corner of the Western Fortification, the measurements were more or less accurate. Simultaneously, the geodesist made mistakes from the turn along the southern guide image of fortifications. However, they are stable and match the modern drawing till the central gate tower. Then, measurement errors are critical; the fortress plan has quite significant deviations from location of real objects. This is explained by linear curve measurements via azimuths and distance between points. No triangulation use caused many errors. It concerns measuring the eastern part of the Southern Fortification. Here, the wall image requires correcting by 23 degrees to match the real plan. Less mistakes occur for the survey in the northern corner of the Southern Fortification (when azimuths are taken to the Castle). Such errors were not exceptional: the same took place for the surveys of British colonies in North America (Estopinal, 2009: 19-20).

Therefore, we can conclude that main survey mistakes were made in fortress corners. Here, the geodesist could not take a back azimuth to the previous survey point.

Scale and cardinal points

The second layer has the scale ruler and cardinal points. The latter is the most problematic to produce. For survey, the geodesist should fix the deviation angle. This task requires fixing the north or south. In our case, we fixed the north according to the wind rose direction. The English cardinal points are marked on the cartouche over the drawn lines, which led to main errors of this plan. The cardinal points must have been marked after the plan survey itself (a cross-like sign is shown inside the fortress). Such a mistake may have been done because of the magnetic compass: its swinging needle could lead to a deviation by 5-10 degrees. Consequently, there were many errors on the final survey stage. However, the aligned drawing shows a north deviation by 240 degrees, which cannot be explained by a sum of compass errors.

The scale ruler has even marks from 0 to 50 ruthes. The ruthe is a land length unit used in the Western Europe of the early modern period. The Bavarian or Württemberg ruthe was 2.9 meters (Brokgauz, Yefron, 1899: 368). Nevertheless, it is difficult to say what length unit Abraham van Westerveld applied indeed. When comparing the plans, the scale ruler corresponds to the modern one: 10 meters are 5 ruthes.

Therefore, these two layers were produced in different periods of time. Letters and main lines are thick and clear, other images are thin and not so clear. It shows that the author created guide images of defensive fortifications on the survey site. The drawn lines were so thick that the image revealed itself on the opposite sheet side.

5. Conclusion

The Liubech plan as of 1651 is a field plan drawn during the topographical survey. It has marks typical for geodesists. The drawing must have been a basis for the Liubech map. Because of the unknown reason, the map was not finished. We can argue the survey was done after the Liubech capture by Janusz Radziwiłł. The control points inside and near the fortifications confirm this fact. The plan is quite realistic. Mainly, the guide image of defensive lines corresponds to the modern topographical survey (except for locations destroyed during the last centuries).

6. Acknowledgements

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