THE DEALUL SIBIULUI BASE POINT OF THE TRANSYLVANIAN SURVEYS

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ABSTRACT

The history of the set up of the temporary astronomical observatory near Sibiu (Hermannstadt, Nagyszeben), Romania, is briefly given as well as the coordinates of the later geodetic base point in its place in the historical and modern geodetic networks. This overview is completed by the description of the present terrain situation around the base point. According to our research, the observatory was not a permanent one. It was in a small, temporary wooden house and the astronomic equipments were there only during its location definition campaign in summer and autumn of 1841. No traces of the observatory site are found in the field search. Its place is kept by the modern base point and it can be deduced as identical to the old observatory as the fitting of the second survey sheets using this point as a base control point, is accurate.

Key words: Sibiu; Hermannstadt; Vízakna; Second military survey; Habsburg Empire; Transylvania; geodetic network

1. INTRODUCTION

The second military survey of Transylvania has been carried out in the 1860s but the geodetic fieldworks preceded the cartographic phase. In these times, geodetic works start with astronomical latitude and longitude determination of some distinct points, or at least of one astronomical base point. For this purpose, astronomical observatories offered the best locations.

In the middle of the 19th century, the astronomy for geodetic purposes was developed enough for using provisional or temporary field observatories. For example, even a hundred years earlier, during the 1769 expedition of Maximilian Hell and János Sajnovics to Vardø (NE Norway) for observing the passage of the Venus before the Sun, a temporary observatory was constructed and used properly (Csaba, 1997).

For the astronomical base point in Transylvania, a hilltop northwest of Sibiu (its historical German name is Hermannstadt; Hungarian is Nagyszeben) was selected. Why a point so far from the geometric center of Transylvania was was chosen? The main reason could be the fact that the area was densely populated the ethnic Germans (Saxons) and this population was utterly loyal to the Habsburg régime. Later, in 1890, under the direct Hungarian jurisdiction, the similar reason was considered in the selection of the later geodetic center near Tîrgu Mureş/Marosvásárhely, a place with Hungarian population. The selected place beside Sibiu is now called Dealul Sibiului but in the Hungarian literature it is mentioned as 'Vízaknai-hegy' (Jankó, 2001), Mt. Vízakna, after the nearest village further northwest of the point, which is Vízakna in Hungarian (Ocna Sibiului in Romanian and Salzburg in German). In the German literature the base point is simply referred to as

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'Hermannstadt' (Hofstätter, 1989) or 'bei Hermannstadt' (Hawliczek, 1841). The German name of the mount (Salzburger Berg) is not mentioned as a name of the base point. On this hilltop, a small, provisional astronomical observatory was set up in 1841. We have no information on how long it worked as an observatory, later it was converted to a simply geodetic base point. Nowadays, it is used also as this, as a part of the Romanian first-order triangulation network.

2. THE SET UP AND THE USAGE OF THE "OBSERVATORIUM BEI HAERMANNSTADT"

The real start of the geodetic works of the second survey of Transylvania was the set up of the observatory and the determination of its astronomical coordinates during the summer of 1841. The full documentation of these measuring campaign can be found in the ÖstA Kriegsarchiv, Vienna (Hawliczek, 1841; Fig. 1), describing the measurement methods and data as well as a plan of the observatory building.

Listronomische Beobachtungen bei Hermanstadt vom Oberstlieutnant Hawliczek im Jahre 1841 ausgeführt, in den Jahren 1844 bis 1846 under der Seitung des Oberstlieutenant Marieni Directors des Triangulirungs & Calcul Bureau, berechnet. manyan

Fig. 1 The title page of the record of the field works at the Hermannstadt observatory by Hawliczek (1841) The observatory building was relatively small, apparently made of wood; according to its plan, the length of the structure in east-west direction was 10 meters (5 fathoms, 1 foot and 8 inches in Viennese units), the width in south-north direction was 3.8 meters (2 fathoms) and the inner height was 1.89 meters (1 fathom) with a 1.5 meters (4 feet and 9 inches) high roof, so the highest point of the roof was 3.4 meters. The astronomic center was slightly east of the center of the building and the universal instrument was placed on its eastern side (Fig. 2).



Fig. 2 The plan of the provisional observatory building (Hawliczek, 1841) Note that all distances are given in Viennese

The determination of the astronomical (geographic) latitude was based on several hundred star culmination observations from 29 July to 2 October 1841 (Fig. 3) using a pendulum clock as auxiliary instrument. Culmination of distinct stars was determined by several hundred observations (Fig. 4) and the drift of the pendulum clock wwerealso recorded to get the correction between the star and the clock time (Fig. 5). The azimuth from the observatory to the base point 'Presbe' was also determined by astronomical measurements (Fig. 6).

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Fig. 3 Results of the latitude measurements of the observatory

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Fig. 4 The stars (left row) and their reduction constants used for the measurements

The longitude of the observatory was not measured. It would indeed a measurement of longitude difference with respect to another point, involving *simultaneous* astronomical observations in real time. This was a very hard task at that time, involving e.g. the eclipses of the Jupiter-moons that can be observed simultaneously from different locations of the Earth. Indeed, the meridian of the observatory could be used a real prime meridian for Transylvania. The value of its longitude is important if only we convert the coordinates from the Hermannstadt-centered system to another (e.g. to a modern) one. Even in this case,

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| - 0 | Jus | ag. | madh you | 87 | este bunn | frend no | In in | | go Saun | a | 359-16.33,78 |
| | | neny | ins my | N | adding | a | 10000 | 1 | 1. 1 | | 154 16 . 27 31 |

a more or less precise but consequently used value works well. Later, the longitude difference between the Hermannstadt observatory and Vienna was determined by triangulation.

Fig. 5 Record of the drift of the pendulum clock used for time measurements

| aus | Beob | achtungen | ul der | h des Punc Polaris in | tes der | Preste va | n Su | I gegen as | t | ession |
|-------------|----------------------|---|-------------------|--------------------------|-------------|--|--------------------|-------------------|-------------------|-------------------------------------|
| 91 | | Ocula | er l | Ist | | Ocul | ar | vel | | Durchschnitt |
| 1841 | der Beob | aus einzelnen Reihen | N. der Beob | Mittel | der Beob | aus einzelnen Reihen | Nº- der Beab | Mattel | No der Beeb | der beiden ge nommenen Mittel |
| 13. August | 14 10 12 10 | 0. 42. 44, 83 45, 88 49, 40 44, 71 | 46 | 0: 42:46,20 | 12 10 14 10 | 0° 43 54,71 56,48 52,89 53,43 | 46 | 0" 43' 54,37 | 92 | e°.43'.20"28 |
| 19 august | 10 | 0.43.11,99 8,32 17,02 | 30 | 0.43.12,44 | 10 10 | 0. 43.51,75 49,63 48,53 | 30 | 0.43.49,97 | 60 | 0.43.31,20 |
| 1 October | 14 10 | 0. 42. 42,89 58,25 | 24 | 0.42.50,57 | 14 | 0.43 48,74 | 24 | 0.43.58,07 | 48 | 0.43.24,32 |
| ang J | Beok | backtungen | Jer | Polanis in | 9er | Nake De | r a | ertlichen . | Dig | ression |
| 12 angust | 12 10 12 10 | 0 43 13,61 845 11,10 11,50 | 47 | 0° 43' 11'49 | 12 14 | 0 - 43 31,31 2420 | 26 | o 43-277 | 75 | 0. 43.19,63 |
| 13. August | 2 14 | 0.42.57,58 | 24 | 0.42.56,12 | 14 | 0. 43. 49,00 | 25 | 0. 43.46,65 | 49 | 0.43.21,40 |
| 18. august | 9 | 0. 42. 52,37 | 2 | 0-42-52,37 | 9 | 0. 43. 449 | 9 | 0- 63-64,22 | 18 | 0.43 18.29 |
| 10. | 10 | 0 42 50,78 | 20 | 0.42.51,26 | 10 | 54,00 | 30 | 0.4349,4 | 50 | 0.63.20,36 |
| 1-October | 10 9 12 | 6.42.5991 43 0.90 47.53,80 | 31 | 0.42.58,24 | 10 | 0.43.41.33 45,17 42,03 | 33 | 0.43.42,83 | 61 | 0.43.20,54 |
| Man | fal | alfor Int | Pa | imuth 6 | ni . | Mapus | ðigr. | evion in m | 19 | 0.43.25,26 |
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| Nap | and | the Loub | f | Engra tor | Cu | Ininctionen | 2 | m Annun Mittel | | 359 58 41,44 |

Fig. 6. Results of the azimuth measurement to the Presbe point

The observatory, or at least the base point on its former position and its coordinates were later used during the first triangulation of Walachia (Oltenia and Muntenia) and

Dubrudsha, made by the Habsburg military triangulation institute during the Habsburg occupation of the Danube Principalities in the Crimean War, between 1855 and 1857 (MGI, 1859; Timár, 2008). The Dealul Sibiului base point was the northern end of the triangulation chain along the Olt River that reached the Danube-line at its southern end.

3. THE OBSERVATORY ON THE TOPOGRAPHIC

Although we have no information about how long the observatory building remained on the Dealul Sibiului (the portable instruments were surely carried back to Vienna after the measurement campaign), we can see the observatory on later maps of the area.

As a center of the Transylvanian coordinate system of the second survey, this location was a corner point of four sheets. No more than a sign of a single triangulation point with the inscription 'Observatorium' were indicated on all four sheets, completed at the end of the 1860s (Timár et al., 2007a; Fig. 7).

The point was a member of the first order geodetic network of the Habsburg Empire compiled in the 1870s and 1880s, later, after its proper geodetic adjustment, resulted in the unified Hermannskogel 1892 datum (of the Bessel 1841 ellipsoid) of the Empire. The coordinates of the point in this system are indicated in *Table 1*.

As a normal geodetic base point, it is indicated on the 1:75,000 scale sheet of the third survey, compiled in 1878, even before the completion of the geodetic network adjustment. Later, this sheet was used as a basis of the 1:25,000 scale sheet in the 'Marosvásárhely' system (Timár et al., 2007b), on which we find also a text 'Observatorium' although the map was completed after 1890 (Fig. 8). Our opinion is that these texts are referred to the *former* observatory and not even as a working one or a reserve building.



Fig. 7 The place of the observatory is at the corner of four different sheets in the mosaic of the second military survey (Timár et al., 2007a)



Fig. 8 The place of the observatory in the 1:25,000 sheet of the third survey (magnified from the 1:75,000 sheet from 1878; Biszak et al., 2007)

4. THE LOCATION NOWADAYS

After these historical, archive and cartographic analyses, let's take a tour to the location of the former observatory to see the present topography of the neighborhood. Knowing the modern Stereo-70 coordinates of the base point, we can easily deduce its WGS84 coordinates (*Table 1*). Putting these coordinates into a GPS, we can find the terrain position of the base point that is supposed to be identical to the former observatory. It is on the southeastern end of the Dealul Sibiului ridge, in a bush (Fig. 9) near to the southeastern end of a row of walnut trees (Fig. 10) that can be identified also in the high-resolution satellite images provided by the Google Maps (Fig. 11). The other, smaller bush northeast to the point covers the water reservoir that is indicated in the modern map (Fig. 12). Around the base point in the bush, chain remnants were found that seemed to be quite old but not a real sign or evidence of the former observatory site were detected (Kovács & Bartos-Elekes, 2007).



Fig. 9 The bush covering the Dealul Sibiului base point in 2007 (Kovács & Bartos-Elekes, 2007)

Fig. 10 The walnut tree row pair leading to the former observatory site (Kovács & Bartos-Elekes, 2007)

No wonder, a small, temporary wooden house built more than one and a half century has no sign on the field nowadays. There is no direct evidence of its location just two indirect ones:

- the location of the modern basepoint that is supposed but not proven to be identical with the old observatory place, and

- the accuracy of the fitting of the second survey map sheets (with the projection center at the old observatory site) to the modern ones, based on the location of the old basepoint (Fig. 13).



Fig. 11 The base point site in the data of Google Maps with the size of the former observatory building



Fig. 12. The surrounding of the base point on a modern 1:25,000 Romanian military map



Fig. 13 Fitting the shetts of the second military survey to the modern databases: the sheet of Kolozsvár/Cluj combined with the SRTM elevation dataset (Farr et al., 2007) to get a three-dimensional view

5. SUMMARY

The observatory on the Dealul Sibiului was the first known astro-geodetic base point in Transylvania. It was set up, supposedly for just one season, in 1841. Astronomic measurements for the determination of its latitude and the azimuth to the point Presbe were carried out from July to October 1841. The longitude of the point was later deduced from triangulation campaigns from Vienna. It was the geodetic and projection center of the second military survey of Transylvania.

As the base points of the second survey of different territories of the Habsburg Empire are usually the projection centers of the stable cadastre of the 1850s, we can suppose that this point is also a theoretical cadastral center (Marek, 1875). Although till now, no evidence of the stable cadastre in Transylvania is known by the authors. Its importance is in the science history and the rectification of the map sheets of the second military survey in Transylvania (Timár et al., 2006; Fig. 13).

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Anexes

| | | | | | Table 1 |
|------------------------|-----------------------------|-------------------|--------------------|----|---------------------|
| survey | Ellipsoid | latitude | longitude | m. | reference |
| 1841 astronomical | astro. (geoid) | 45° 50' 29.40" | not specified | | Hawliczek (1841) |
| Walachia 1855-1857 | Walbeck 1821 | 45° 50' 35.75" | 41° 46' 38.44" | F | MGI (1859) |
| Cadastral overview | Zach-Oriani | 45° 50' 25.13" | 41°46' 32.713" | F | Marek (1875) |
| 3 rd survey | Bessel 1841 (Hermannsk.) | 45° 50' 24.8802'' | 41°46'37.0834 " | F | MGI (1902) |
| modern | Krasovsky (S-42) | 45° 50' 26.014" | 24° 6' 35.634" | G | |
| modern | WGS84 | 45° 50' 24.918" | 24° 6' 29.986" | G | |

The coordinates of the Dealul Sibiului base point in various surveys and geodetic datums