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The authorship of the Second Military Survey of Galicia and Austrian Silesia at the scale 1:28,800 and the consistency of sheet content based on selected examples

Abstract. The aim of this article is to expand the understanding of the history of cartography of the lands of southern Poland under Austrian rule in the nineteenth century. The Austrian Second Military Survey, at the scale 1:28,800, was produced for the province of Galicia between 1861 and 1864 and for Austrian Silesia between 1838 and 1841. In Galicia, work on 413 sheets was led by thirteen cartographers, and the content and descriptions were prepared by 106 cartographic technicians. On the 42 sheets of the Silesia maps, two directors and 11 technicians were recorded. The military cartographers who prepared the survey of the two provinces belonged to 71 multinational units of the army of the Austrian Empire. Work with nineteenth-century maps is fraught with uncertainty about the consistency of the series, which may be reflected in the content of the maps. The consistency of map content was tested on sheets covering the Polish Carpathians for two types of features: linear (roads) and area (forests). Expanding the understanding of these maps may contribute to reducing uncertainty in their use for various environmental and socio-economic analyses.

Keywords: history of cartography, topographic maps, data consistency, Galicia, Austrian Silesia

1. Introduction

The aim of this article is to broaden the understanding of nineteenth-century cartography and the maps of the Second Military Survey at the 1:28,800 scale for the area of southern Poland. This issue was the subject of many publications at the beginning of the twentieth century due to a lively interest in the cartographic legacy of the partitioning powers (L. Sawicki 1920; J. Słomczyński 1934). Today, it is also the subject of various review studies (F.P. Faluszczak 2011;

A. Czerny 2015; J. Wolski 2016; E. Konkoly-Gyuró et al. 2017) and detailed studies (A. Konias 2000). Selected qualities of using these maps in geographic information systems are being developed (G. Timar et al. 2006; A. Affek 2013; J. Kuna 2015), and their content is used in long-term analyses and studies of socio-economic and environmental data (G. Kovács 2010; A. Ziłinszky, G. Timar 2013; A. Affek 2016; K. Witkowski 2017; J. Kozak et al. 2018; D. Kaim et al. 2020a).

Nevertheless, limited access to the complete series of maps of the Second Military Survey means that working with them remains fraught with uncertainty and requires questioning of the series overall coherence. The lack of easy access to a complete collection in Poland and the fact that the original instructions for the Second Survey have not been preserved in

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Austrian or other sources make this task more difficult (A. Konias 2000). Maps of the Second Military Survey, apart from the Österreichisches Staatsarchiv, are available on the Internet at www.mapire.eu as a georeferenced mosaic. The sheets of this mosaic are cropped to the boundaries of the map content and are deprived of the margins along with the information contained therein. Hence, access to the entire content of the sheets is incomplete on this site.

One aspect of the uncertainty of working with historical maps (S. Leyk et al. 2005) includes doubts regarding how they were compiled. These doubts can arise from the appearance of sudden changes in content at the junctions of sheets, administrative units, or countries, especially if they were made by different authors. Such inconsistencies concern not only historical materials but also contemporary materials (e.g. different years for the attribute and geometric validity of data for districts in the National Database of Topographic Objects for Poland, BDOT10k). Nevertheless, maps are historical materials that arouse greater distrust among contemporary users (D. Kaim et al. 2014; M. Forejt et al. 2018). Expanding the knowledge of the conditions under which the maps were produced can contribute to discerning and understanding differences in map content (U. Gimmi et al. 2011). Therefore, for the purpose of this article, author designations regarding the map sheets of the Second Military Survey for Galicia and Austrian Silesia at the scale 1:28,800 were compiled for all available sheets and presented in an index made available in open shapefile format and open repository as an appendix to this publication (K. Ostafin et al. 2021). Similar studies are rare, and for maps of the Second Military Survey at the scale 1:28,800, only a tabular listing of map directors for Tyrol has been made to date (W. Beimrohr 2012).

2. Source materials

The object of the study is 413 map sheets of the Second Military Survey of Galicia from 1861–1864, which are part of the Military Survey of Galicia and Bukovina (ger. *Militär-Aufnahme von Galizien und der Bukowina*), and 42 map sheets of Austrian Silesia from 1838–1841, which are part of the Military Survey of Moravia and Silesia (ger. *Militär-Aufnahme von Mähren und Schlesien*). Digital images of the sheets of

Galicia and Austrian Silesia were purchased from the Österreichisches Staatsarchiv as TIFF files at a resolution of 300 dpi. This provided the ability to view the entire survey of Galicia and Austrian Silesia, including descriptions outside of the frame, which are missing from the Mapire site. Galicia had an area of 78,490 km² and Austrian Silesia (Cieszyn and Opava) of 5,147 km². Today, 40.5% of the Galician area belongs to Poland and 59.5% to Ukraine. Of the area of Austrian Silesia, 80.4% belongs to the Czech Republic and 19.6% to Poland (K. Ostafin et al. 2020b), and in a more detailed breakdown, 44.4% of the area of Cieszyn Silesia is Polish, and 99.9% of Opava Silesia is Czech. In this study, all Silesian sheets were examined due to the correction of the border between the Czech Republic and Poland in the 1950s. Some of the sheets of Opava Silesia cover the contemporary territory of Poland (K. Ostafin et al. 2020a).

The maps of the second survey for Austrian Silesia were produced more than 70 years later (A. Konias 2000), and for Galicia almost 80 years after the first military survey of these areas (W. Bukowski et al. 2012). During this time, the organisation of mapping services, equipment, and survey methods improved significantly (O. Regelle 1955; R. Rill 2012). The history of the creation of the maps of the second survey and the characteristics of their content and accuracy is described in detail by A. Konias (2000), based on extensive research in libraries and archives, especially in the Kriegsarchiv in Vienna. This author had eight sheets of the second survey at the scale 1:28,800 for the Polish part of Cieszyn Silesia and 69 sheets for Galicia available.

The territories of Austrian Silesia and Galicia were divided into sections (sheets) marked with section (ger. *Section*) and column (ger. *Colonne*) numbers for the purposes of compiling the 1:28,800 scale maps of the second survey. In Silesia, the column numbers diverged to the east and west from the Vienna meridian, and for Galicia from the Lviv meridian, hence, the inclusion of western (ger. *Westliche*) and eastern (ger. *Oestliche*) columns. The content of the individual sheets of the map is bounded by frames, usually 52.7 × 52.7 cm (A. Konias 2000), which corresponds to an area of approximately 230 km². Sheets of the provinces' borders often cover smaller areas, for example, Sect. 9, west-



Fig. 1. Information on the sheet margins regarding authorship: for Austrian Silesia, Sect. 1, oestliche Col. III (left) and Galicia, Sect. 6, westliche Col. XXI (right)

liche Col. XXV is only 9.5 km² of the western part of Szczyrk. In order to avoid sheets of small areas, border areas of the Austrian monarchy are generally included in neighbouring sheets, for example, Sect. 2, westliche Col. XI, which depicts 4.5 km² of the vicinity of the settlement of Popowice, belonging to Chwałowice at the confluence of the San into the Vistula.

The margins of the sheets include lists of towns and settlements (ger. *Ortschaften*), together with the number of houses and stables, and their potential for quartering people and horses. Hence, the dimensions of the whole sheet are generally 62 × 56.5 cm, although sometimes larger, for example, when including double columns of margins (Sect. 7, westliche Col. XX is 73.2 × 56.5 cm). Towns, villages and settlements are assigned administrative divisions: circle (ger. *Kreis*), district (ger. *Bezirk*), and commune (ger. *Gemeinde*). The seat of the parish is also indicated. In cases where a settlement or a major part of a town is located on a neighbouring sheet, a cross-reference is recorded, for example, *zu Wilcza Wola, Sieh. Sec. 4, v. C. X.*

At the lower part of the margins, the names of the individual sheets' authors and additional information are given (fig. 1). These include: the director (ger. *Unter der Direction*), director's affiliation (ger. *im*), surveyor (ger. *aufgenommen*), drafter of the map (ger. *ausgezeichnet* or *gezeichnet*) with affiliation, years of compilation (ger. *im Jahre*), and a description writer (ger. *beschrieben*). In eleven sheets for Galicia, infor-

mation about the name and affiliation of the reambulator (ger. *reambulirt*) appears. Ten of these are border sheets with Bukovina, with fieldwork conducted between 1828 and 1830 and reambulated between 1861 and 1864. Of the other Galician sheets, only one sheet, Sect. 20, westliche Col. 9, contains information regarding reambulation but without providing the year.

On many sheets, it is stated that they were created as a result of the reduction of cadastral maps at a basic scale of 1:2,880 (ger. *nach den reduvirten Cataster Mappen*). Cadastre measurements in Austrian Silesia and Moravia were performed between 1824–1830 and 1833–1836, and in Galicia between 1824–1830 and 1844–1854 (*Instruktion zur... 1907*; H. Rumpfer et al. 2015). The 1:28,800 scale maps are based on a tenfold pantographed reduction of the contents of the cadastral maps with subsequent field reambulation, including contents' updating, for example, land use and elaboration of the relief on the topographic table (*Die Entwicklung... 1949*; A. Konias 2000 after A. Fligely 1859).

3. Methods

In the first stage of this work, information in the margins of the sheets was analysed to create a digital database of information relating to the authorship and years in which the sheets were compiled. On the sheets for Silesia, the names of the compilers of the survey and the drafters are given, but there are neither names

of the persons who wrote the descriptions for the sheets nor information on reambulation. On the sheets for Galicia, the names of all the compilers are generally given. The recording of the same authors and military units may have differed between sheets, for example, Anton Hawelka (Sect. 10, westliche Col. VII) and Anton Heavelka (Sect. 13, westliche Col. XIX); however, names were often missing. Therefore, the recording and reliability of names and surnames on the Galician and Silesian sheets

were checked against the list of military units and soldiers (*Militär-Schematismus...* 1829, 1839, 1863).

In the second stage, the potential impact of changes in authorship within each of the three categories of direction, execution, and drafting, and the description of sheets for changes in linear (roads) and area (forests) features were checked. Due to the large area covered by the study (nearly 80,000 km²) and the high expense of vectorising map data (especially forests),

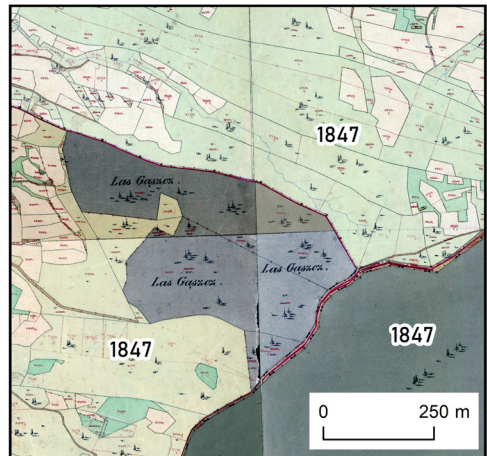
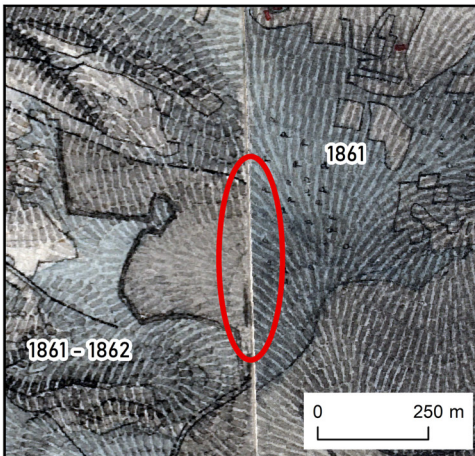
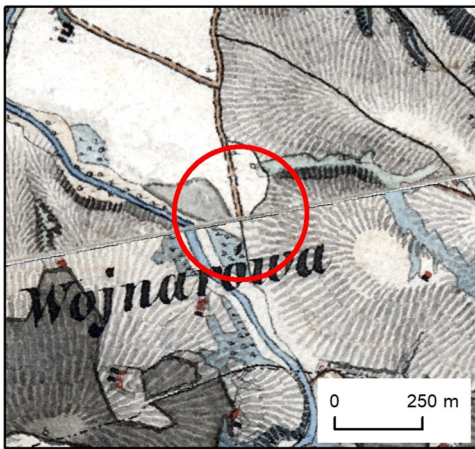
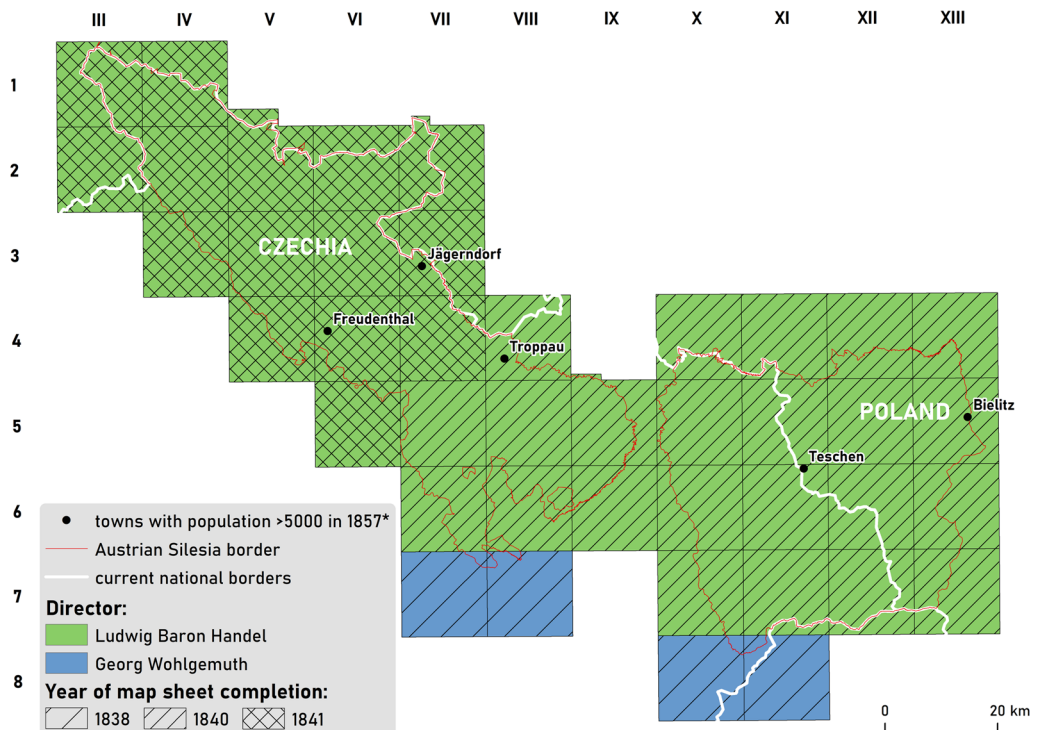


Fig. 2. Examples of content discrepancies at sheet boundaries. Top: change from the category of maintained road (ger. *Erhaltener Fahrwegen*) to unmaintained (ger. *Nicht Erhaltener Fahrwegen*) (left), and from first-class road (ger. *Chaussée I. Klasse, Kaiserstrassen*) to second-class road (ger. *Chaussée II. Klasse, Kaiserstrassen*) (right). Bottom: change of forest use to pastures (left). For comparison, the continuity of forest use at the junction of sections of the cadastral map 1:2,880 (right)

we limited the analysis to 117 sheets from the area of the Polish Carpathians in Galicia, on which roads and forests were vectorised. The Silesian sheets were rejected due to their temporal inconsistency with the Galician series. The selected sheets were made by seven of the thirteen directors, and 54 of the 106 cartographic technicians from all the sheets in the area of Galicia. Four main categories of roads were selected for analysis, according to a list of cartographic symbols compiled by the author of six sheets of the second image, Josef Zafauk Edler von Orion (1889): first-class roads (ger. *Chaussée I. Klasse, Kaiserstrassen*), second-class roads (ger. *Chaussée II. Klasse, Kaiserstrassen*), national roads (ger. *Landstrassen*), and maintained roads (ger. *Erhaltener Fahrwegen*) (D. Kaim et al. 2020b). For area features, vectorised forest areas were analysed (J. Kozak, D. Kaim 2016). In the area studied, all locations where the selected road categories crossed the map sheet boundary

($n = 341$) were located and marked (fig. 2). Thus, using the chi-square test of concordance (χ^2), the relationship between a change in road category and a change in map sheet authorship was tested, and the statistical significance was determined. For forests, fragments of forest area boundaries, with a length of at least 1 cm on the map and contained within a two-sided 30-m buffer from the map frames, were selected ($n = 1539$). The value of the buffer was based on the maximum root mean square error (RMS) of the georeferenced sheets to eliminate deficiencies or overlaps of the georeferenced sheets. In the second stage of selection, forest boundaries were restricted to sections parallel or approximately parallel ($\pm 10^\circ$) to the sheet frames ($n = 114$). In the third stage of selection, on the basis of visual inspection of each section in the second stage of selection, those sections that were actually parallel, or close to parallel, to the sheet frames were discarded. For the selection of these cases, the



* according to *Statistische Übersichten...1859*

Fig. 3. Map index of the Second Military Survey of Austrian Silesia, including the directors and years in which the sheets were completed. Place names are in the original spelling

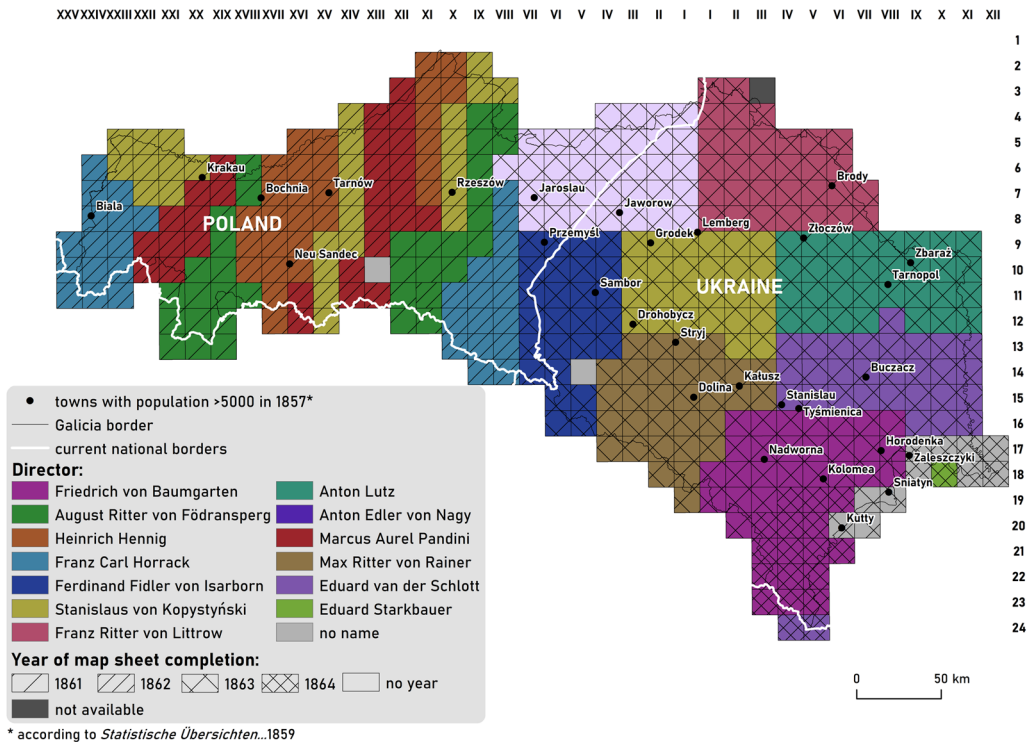


Fig. 4. Map index of the Second Military Survey of Galicia, including the directors and years in which sheets were completed. Place names are in their original spelling

criterion was that the forest boundary was a clear line drawn in a buffer from the sheet frames and there was non-forest use between the forest boundary and the frame, e.g. pasture, arable land, meadow. Sections of erroneously vectorised forest at the sheet junctions were also rejected ($n = 49$).

4. Results

The first part of the results concerns the map author database that we have developed. The second part includes an attempt to determine consistency resulting from changes in linear and area features at the boundary of map sheets.

4.1. Authorship database for the maps of the Second Military Survey

The temporal consistency of the mapping of such a large area was impressive. For Austrian Silesia, these were the years from 1837 to 1841

(fig. 3). Four sheets were completed in 1838, 23 sheets in 1840, and 15 sheets, west of Opava (ger. *Troppau*), in 1841. The range of years in which the sheets were prepared for Galicia was from 1861 to 1864. Of the Galician sheets, 33 were completed in 1861, 115 in 1862, 236 in 1863, and 26 in 1864. Two sheets have no date inscribed and one sheet (Sect. 3, oestliche Col. III) is not available in the collections of the Österreichisches Staatsarchiv (fig. 4). All the Silesian sheets, and most of the Galician sheets, have a two-year compilation interval recorded on them. The date of compilation is recorded as one year for 37 Galician sheets.

In Silesia, the work was directed by two cartographers: Ludwig Baron Handel and Georg Wohlgemuth, both from the Quartermaster's Office of the General Staff of the Austrian Army (ger. *Generalquartiermeisterstab*). The former produced 38 sheets and the latter four for the southern edge of Silesia, which mainly covered the territory of Moravia.

	VIII	VII	VI
7	<p>Cl. V. Vesque 45. Lin. Inftr. Regmt</p> <p>Victor Raschek 55. Lin. Inftr. Regmt</p>	<p>Ferdinand Schifkorn 69. Lin. Inftr. Regmt</p> <p>Victor Raschek 55. Lin. Inftr. Regmt</p>	<p>Ferdinand Rtt.v.Pittoni Generalquartiermstrst.</p> <p>Victor Raschek 55. Lin. Inftr. Regmt</p>
8	<p>Felix Pegan 80. Lin. Inftr. Regmt</p> <p>Victor Raschek 55. Lin. Inftr. Regmt</p>	<p>Ferdinand Schifkorn 69. Lin. Inftr. Regmt</p> <p>Victor Raschek 55. Lin. Inftr. Regmt</p>	<p>Ferdinand Rtt.v.Pittoni Generalquartiermstrst.</p> <p>Victor Raschek 55. Lin. Inftr. Regmt</p>
9	<p>Marcel von Wutzelburg 67. Lin. Inftr. Regmt</p> <p>Victor Raschek 55. Lin. Inftr. Regmt</p>	<p>Isidor Bosnyak 30. Lin. Inftr. Regmt</p> <p>Gustaw Pelikan 5. Artillerie Regmt</p>	<p>Isidor Bosnyak 30. Lin. Inftr. Regmt</p> <p>Gustaw Pelikan 5. Artillerie Regmt</p>

Fig. 5. Excerpt from the index with the sheet authors and their military units listed. Surveyors and drafters are in black, and description writers are in red

The Silesian sheets were prepared by eleven technicians belonging to five military units, mainly the *Generalquartiermeisterstab* – 22 sheets, and the line infantry units (ger. *Linien-Infanterie-Regiment*) – 15 sheets. Five sheets were prepared by second Lieutenant Wenzel Unschuld from the 1st Field-Rifle Battalion (ger. 1. *Feld-Jäger-Bataillon*). Of the Silesian sheets, five had a second technician, and one had a third technician.

In Galicia, the work on 53 sheets was directed by Stanislaus von Kopystyński and on 42 by

Friedrich von Baumgarten. The remaining directors were affiliated with about 30 sheets each. On eleven sheets, the name of the director was not given. The directors of 224 sheets belonged to the *Generalquartiermeisterstab*. The remaining sheets were attached to five different line infantry regiments and one rifle regiment (ger. *Kaiser Jäger-Regiment*). The sheets reambulated along the southeastern border of Galicia have a director listed only in two cases. In the western part of Galicia, the sheets assigned to directors generally had a meridional

Tab. 1. Relationship between change of authorship and change in road category at the sheet boundary (n = 341)

Authorship type	Number of authors	Chi-square value (χ^2)	Statistical significance (p)
Director	7	26.509	0.0000002623
Surveyor and drafter	44	2.3595	0.1245
Description writer	10	9.6056	0.00194

arrangement, from the northern to the southern borders of the province, while in the eastern part, they tended to have a latitudinal arrangement. The range of sheet assignments did not follow the administrative division of the time for districts or counties. A total of 106 cartographers belonging to 66 units made surveys and drafted maps (fig. 5). They came mainly from the line infantry but also from the border infantry units (ger. *Grenz-Infanterie-Regiment*), field riflemen, or artillery units (ger. *Feld-Artillerie-Regiment*). Among the surveyors, Alfred Urbaschek compiled the most sheets: twelve, followed by Marcel von Wutzelburg: 11, Franz Hůša, and Ernesto Zanini: ten each. The areas compiled by individuals were not always geographically consistent, for example, Alfred Urbaschek worked on the areas around Wa-

dowice, Piwniczna, Ulanów, Rohatyn, and the area on the border between Galicia and Bukovina. The location of the headquarters of the unit to which the cartographers belonged similarly did not determine the location of the survey, for example, Moritz Roth of the 30th *Feld-Jäger-Bataillon* stationed at Wieliczka surveyed the areas around Kalusz – Roźniatow, Sidzina near Jordanów, Wysowa, and Czudec. Descriptions were written by twenty cartographers, the most prolific being Victor Raschek with 63 sheets, Josef Frenzl Eleven with 59, and Franz von Russenstein with 57. The surveyors, drafters, and describers were not permanently assigned to sheet directors, but sheets usually had common directors and describers. Biographies of some cartographers can be found in the studies by O. Regele (1955) and A. Konias (2000).

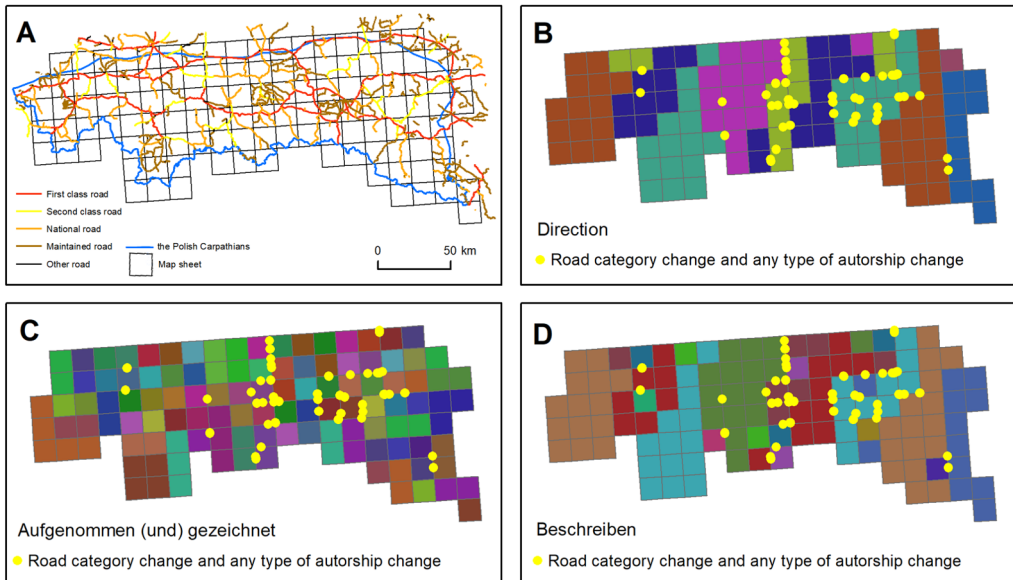


Fig. 6. Changes in road category on map sheet boundaries: study area (A), changes in regard to director change (B), changes in regard to drafter change (C), changes in regard to description writer change (D). Note: road category change locations on maps B–D are the same; only the authorship type changes

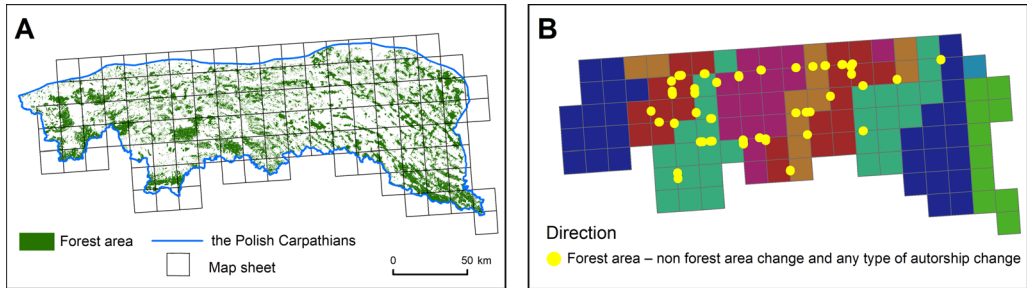


Fig. 7. Changes to the 'forest – non forest' category on the boundaries of the map sheets: study area with indicated forest areas (A), changes in regard to director change (B)

4.2. The influence of sheet authorship on the consistency of linear and area features

The analysis conducted on 341 cases showed that a change in road category at the sheet boundary, coinciding with a change in at least one of the authorship categories, occurred in 50 cases (14.6%). The analysis of the relationship between changes in road category and changes in authorship type showed that only in the case of a change in the director and descriptor could one speak of statistically significant relationships ($p < 0.005$). However, in the case of a change in the director, the relationship was characterised by a significantly higher statistical significance (Table 1).

The spatial distribution of road category changes in relation to changes in authorship type showed that these changes were more frequent when one of three authors was responsible for the directorship of the sheet: Stanislaus von Kopystyński, August Ritter von Födransperg, and Marcus Aurel Pandini (74% of total cases; fig. 6).

The analysis of the coherence of area features showed 49 sections (fig. 7) in which, on the borders of the sheets, the classification of forest areas changed into non-forest due to discrepancies between the junctions. The total length of the 'forest – non-forest' border in the Polish Carpathians on all the sheets of the map is 50,387 km, and erroneously drawn segments on the sheet contacts make up only 21.7 km (0.04%).

By visually comparing the maps in figures 6B and 7B, it can be seen that errors in drawing linear and area features do not accumulate on the same sheets.

4.3. Conclusions

The 1:28,800 scale maps of the Second Military Survey of Austrian Silesia and Galicia provide a valuable source of data on the state of the landscape of the area in the nineteenth century. The temporal consistency within the Galician and Silesian sheets is impressive, but the difference of at least 20-years in the compilation of the two series' can be an obstacle if the study area is located in both provinces. It was found that there are differences in the classification of linear and area features within the Galician series, which are caused by the different authorship of the map sheets and the lack of content agreement at their junctions.

Further qualitative analyses, for example comparison of vectorised forest areas with values from statistical censuses of comparable years, are needed to verify the consistency and accuracy of the content of maps of the Second Military Survey. Comparisons with 1:2,880 cadastral maps would also be useful for expanding the assessment of the quality of the sheets. Such analyses may reduce uncertainty about the quality of the content of the maps, not only at the junctions of the sheets.

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