Carl Ivanovich Richter as a talented topographer and cartographer

A V Postnikov
S I Vavilov Institute for the history of science and technology of the Russian Academy of Sciences, 14, Baltiyskaya street, Moscow, 125315, Russia

E-mail: postnikov.1939@mail.ru

Abstract. The paper, based on the research of documentary materials of the Russian State Military History Archives, analyses the life and activity of relatively little-known Russian topographer and cartographer, Major General Richter. Particular attention is paid to his leadership in the creation of the Topographic Map of the Polish Kingdom, in which he compiled original instructions for checking the work completed earlier (from 1818 to 1831) by Polish specialists, instructions for field geodetic and topographic work to complete the survey, make and publish the Topographic Map of the Polish Kingdom, as well as - its subsequent updates. At the first stage (till 1831) the work was carried out by Polish quartermaster officers, and the participation of the management of the Russian Military Topographical Depot was limited only to providing the General Quartermaster of the Polish Army with instructional materials on map compilation and design. Later, the accuracy of astronomical and geodesic control of the Topographical Map of the Polish Kingdom was significantly increased during the continuation of the work by officers of the General Staff and the Corps of military topographers.

1. Introduction
Carl Ivanovich Richter was born into an impoverished noble family of "Evangelic-Lutheran faith" in the town of Mitava, Kurland province (now — Latvijas Republika) in 1793. He received a good education at home that allowed him to join the Quartermaster's Department of the Russian Imperial Since in 1811, and the rest of his life, with the exception of a short break of less than a year (1828), he was connected with the Russian army and military cartography.

In 1816 with the rank of lieutenant K. Richter was attached to the Office of the Quartermaster-General of the General Staff. In 1817-1818 he spent in surveying military settlements in Novgorod province, perfectly finishing this job for which he received the rank of captain. In 1821 together with the rank of Lieutenant Colonel he was charged with the task of creating a "military map of the western border of Russia", in the process of which he was able to get acquainted with the territory of the Polish Kingdom and the cartographic materials available for it. For making these maps he worked out his first technical instruction, which after reviewing at the General Staff was sent to him as an "Instruction of the Quartermaster General of the General Staff to Lieutenant Colonel and gentleman Richter" (17th of April 1823). The service and life of K. I. Richter were quite typical of the quartermaster officers of the Russian General Staff, who learned the military and topographic science in almost continuous battles of the early 19th century. It should be noted, however, that the theoretical knowledge of K. Richter was, apparently, quite solid, as evidenced by both dry lines of the form list and all his military
topographic activities and, especially, work on the Topographic Map of the Polish Kingdom in 1832-1842.

2. Topographic survey participants
On April 23, 1832 K.I. Richter was appointed Head of the Topographical survey of the Polish Kingdom. At the time of renewal of surveys of Topographical map of Polish Kingdom, nine officers of General Quartermastery of Polish Army were in Warsaw, who took part in the initial stage of making of the map. Their names, unfortunately, are not known to us [1]. The first Polish officers enrolled in K. I. Richter's team were Lieutenant Colonel Coryot and Lieutenant Leschinsky, who had previously served in the Engineer Corps of the Polish Army [1]. In total, 25 officers (including the chief and his assistant) and 8 topographers took part in the survey at the first stage of work [2].

In 1833 one of the best in the Corps of military topographers company No. 7 joined the work on the correction and continuation of the topographic survey of the Polish kingdom. It consisted of 32 officers and 60 topographers. 40 of them were sent for visual survey, 10 - for instrumental surveying; 20 were engaged in drawing and design work in the drawing room. Nine officers were assigned to check the Polish survey in the western part of the kingdom. Although the main work after 1831 was carried out by Russian officers of the General Staff and the Corps of Military Topographers. The following Polish officers also took part in surveys, mapping and descriptions during this period: Colonel of the Corps of Military Topographers Stanislaw Dengoff (Dengov), Lieutenant Colonel of the CMT Jozef Koriot, Lieutenant of the CMT Franciszek Leszczynski, Lieutenant of Artillery Bonawentura Glebowski and Lieutenant of the Corp of Engineers Viktor Mochulski [3]. Viktor Mochulsky participated in 1832 in triangulation works, and in 1833, after illness and leave, was transferred to the Russian General Staff. B. Glebovsky was engaged in drawing original maps from 1833 to 1835.

The most significant contribution was that of S. Dengoff, J. Coriot, and F. Leschinsky, who worked on the Topographical Map of the Kingdom of Poland almost to its completion (Dengoff and Leschinsky until 1839, and J. Coriot until 1843). C. Dengoff played a leading role in the development of the program and compilation of geographical descriptions of the Kingdom of Poland. F. Leszczynski was engaged in composing of original maps and works on correcting of surveys of officers of General Quartermastery of the Polish Army. The most varied activities were those of Lieutenant Colonel J. Coriot, who took part in reconnaissance and updating of the Topographic Map of Polish Kingdom. He was also responsible for the original plan of Warsaw. He supervised the instrumental survey of the Vistula River valley in the vicinity of Warsaw, compiled the original maps and geographical descriptions of the Polish kingdom [4].

3. Initial stage of work
Having received the appointment as the head of the topographic survey of the Polish Kingdom, K.I. Richter immediately started, "first of all, to search on what grounds the survey of the Polish Kingdom was made [by Polish topographers]; second, to collect all the remaining materials from it and, third, to plann the work" [5].

Regarding the finished materials of the surveying, compiling and engraving of the Topographical Map of the Polish Kingdom, it was found that the engraver Minter had all the engraving boards and most of the 27 originals ready to be drawn during the uprising. The rest of the materials taken by Polish officers to Prussia were requested by Field-Marshal General Pashkevich-Erivansky from the Prussian king and they were delivered to K. I. Richter in Warsaw in spring 1832. In general, by the beginning of field works of the 1832 season, the following materials of Polish officers-quartermasters were at the disposal of the new management of surveying and making the Topographic Map of the Kingdom of Poland.

Having analyzed the preserved topographic and geodesic materials, K.I. Richter sent to F.F. Schubert his preliminary considerations on the possibility of using them in the future work. In particular, he considered it possible to keep among the main points of astronomical-geodetic control of
the map the points defined by the triangulation network from Warsaw through Sierock "down the Bug to Dubienki", for which the journal of calculations and map was preserved. He planned to use this trigonometric network not only to control the survey, but also to connect it with the Russian border. Richter considered it possible to triangulate the Narew’s flow from Wisna to Pultusk, but he thought it could be connected with the triangulation of the Bug river. The possibility of using triangulation on the Narew was provided by the fact that for it survived a map showing the coordinates of all points of the trigonometric network. In addition K.I. Richter pointed out the triangulation network developed on two bases for control of surveying and leveling during the survey of the Augustov canal route, but he considered its use impossible at that stage because "although there is a map of this triangulation. But neither the sizes of the sides of triangles nor coordinates of points are shown nor there is no journal of calculations". K.I. Richter supposed to use the survey materials in the area of the future Augustov canal route having in mind that they "topographically show only the flow of rivers and the space between them is not depicted".

In order to use the preserved networks of geodetic control of the Survey of the Kingdom of Poland K. I. Richter considered it necessary to urgently conduct a reconnaissance on the ground of the state of signals of triangulations, especially Nadbuzhnaya, and, if necessary, restore them.

Having carefully studied the materials sent to him by K.I. Richter, F.F. Schubert in general approved them. During the development of additional networks of triangulations F. F. Schubert found it possible to use theodolites of twenty-second’s accuracy, and the measurements could be entrusted to officers of the General Staff and the Corps of Military Topographers without organizing a special trigonometric unit for them. F.F. Schubert considered it necessary to survey positions at a scale of 200 sazhens to the inch, and roads and rivers at a scale of one verst to the inch [6].

On the basis of the work he had done earlier on the analysis of the basic materials and recommendations of F.F. Schubert, K.I. Richter compiled and sent to Schubert in his report of May 22, 1832 "Instruction for the Head of the Topographic Survey of the Polish Kingdom". Since this document outlines the basic methods and principles of the organization of work on the continuation of surveys and the compilation of the Topographic Map of the Kingdom of Poland, determining to some extent their reliability and accuracy, I believe it appropriate to consider in detail the main provisions of this instruction.

The aim of the trigonometric survey is the connection of the triangulation made by the officers of the Polish General Staff with the frontier trigonometric points of the Russian Empire and the connection of the branches of it with each other. This is done by measuring a number of triangles from Lomza and Zizna to the north-west of the Russian Empire. Lomza and Zizna to Kovno were connecting with the border trigonometric points of Major-General Tenner; and from Magnuszew for internalthere was the connection of the trigonometric network up the Vistula and Weprz rivers to Krasnystan and Zamosc. In continuing the trigonometric survey along the above two directions we try to connect the triangulation points along the Bug river with the points of the newly laid trigonometric network by directions to the side.

4. Initial stage of work
The works in the field start on April 15 and last six months, i.e. till October 15.

Each person surveying shall sign the plan he has surveyed and drawn. Section Chiefs verify the survey of their section officers or surveyors and sign it. The Assistant Chief of Survey annually inspects the visual survey, verifies it and signs all sheets of the visual survey. The chief of survey annually inspects and verifies visual and instrumental surveys. All heads of divisions submit monthly report maps by the 20th day of the month about the success of the work. The assistant head of the survey presents the same reports to the head of the survey on the success of the visual survey by the 20th day of the month [6].

The chief of the survey (in the absence of the chief, his assistant) was mainly responsible for the survey and was obliged to submit monthly (by the 30th day) the report maps to the Director of the Military Topographic Depot and to the Quartermaster-general of the Active Army. The survey director
was also obliged to provide the surveyors with detailed instructions on the performance of trigonometric, instrumental and visual surveys. For the officers who had been transferred to the General Staff or attached to it, a special training survey of the Warsaw surroundings was established. This survey was to be done, according to a special instruction, by one of the experienced officers.

The instruction stipulated that if a surveyor discovered an error, he would correct it or completely redraw the plan (at the discretion of the survey director) at his own expense.

In winter time each of the surveyors was instructed to finish their sheets, make the original three-verst map on them and prepare the survey network for the next summer.

According to the instructions of the engraver, Minter was directly subordinate to K. I. Richter [6].

K. I. Richter and the management of the Russian Military Topographical Depot were very keen on the methodical development of the continuation of the surveys of Polish officers. In spite of the intention approved by the emperor to carry out this work "with the same rules as it was already carried out up to 1831", the program of further actions formulated by Russian military topographers was directed not only at the maintenance of the already achieved by the Polish officers quality of survey on the remaining unmapped part of Polish Kingdom, but also at the improvement of the astronomical and geodetic basis of the already executed works, checking of their survey networks and increase of informative value of the obtained materials. The implementation of this program provided the Topographic Map of the Polish Kingdom with a much more "rigid" system of astronomical and geodetic basis, allowing to carry out checking out and, subsequently, improving of the triangulation chains laid earlier with the support of first-class, points determined by K. I. Tenner in Russia.

The new one, in comparison with the Polish instructions, was the requirement to check in the field the survey network, plotted in the office conditions, consisting of landmarks from the published topographic maps and trigonometric points, defined specifically to control the map. This requirement guided the topographers to check out the work already done before them and improve it. Also new was the recommendation to use as materials for making boundary plans of private land holdings, taken from the Russian instructions for making semi-topographic maps. It should be noted, however, that for European Russia this recommendation was quite justified due to the availability of sufficiently good quality and unified large-scale materials of the General Land Survey, then for the Kingdom of Poland, where the boundary maps were very unequal, their use as a source for the topographic map was not widely spread.

Completely new in comparison with the previous stage of work on the Topographical Map of the Kingdom of Poland was the requirement to compile military and statistical descriptions of the territories, on which surveys were conducted, in order to create a general military and geographical description of the kingdom. Such descriptions were a mandatory part of the Russian military-topographical works, but, judging from the instructions of 1818, the Polish quartermaster officers were not required to draw them and therefore in the set of documents were only scattered brief descriptions, prepared apparently on the initiative of surveyors, and old surveys of area, based probably on the materials of Karol Pertis. Thus, the compilation of military and statistical descriptions of the Polish kingdom became an independent task for Russian military topographers, in the solution of which they could not rely on materials of officers of the Polish army's General Quartermastery.

In parallel with the development of instructional materials for the survey and compilation of the Topographic Map of the Kingdom of Poland, K. I. Richter began without delay the practical implementation of the planned program to continue the work on the map. It is necessary to note that this work was considered by Russian military command as extremely important, and the commander-in-chief of the Active Army in the kingdom of Poland, Field-Marshal, General Pashkevich-Erinansky himself supported him and personally supervised the preparation for the survey. Already at the end of March 1832 the "government places" of the Polish kingdom were ordered to provide the head of the topographic survey all the necessary information about the area. At the same time Pashkevich-Erivanski sent to K. I. Richter "maps of the forest area in Augustow voivodeship, surveys of Augustow canal and the flow of the river Ganczy" [1]. The Russian army command was interested in quickly surveying the most strategically important places [6].
5. Checking the accuracy of the survey and identifying errors

In parallel with the field works, under the direction of Major-General Richter, the accuracy of the two easternmost sections of the Polish survey was evaluated. Colonel Coriot had a special triangulation for the Warsaw. He included these surveys into his general plan. The Warsaw's location was found to be different from previous astronomical determination of it as 570 sazhens to the west and 350 to the north, but coincided with the latest determination made at the Botanical Garden Observatory in 1832. The results of the analysis were reported to F. F. Schubert and, in accordance with his decision, the coordinates of the city of Warsaw on the Topographic Map of the Kingdom of Poland were accepted according to the results of observations in 1832 [2].

The most typical of the identified shortcomings were errors in the representation of relief, mainly consisting in the inconsistency of its display with hydrography and in a general poor coordination of the forms of relief displayed in the hachures. For Russian military topographers, who paid great attention to the issues of geographically accurate representation of the relief in hachures, these shortcomings, quite justifiably, seemed quite serious and worthy of correction. Equally great attention in Russian military topography was paid to content coordination of neighbouring sheets of large scale maps and this aspect of the works of Polish quartermaster officers also did not fully satisfy the Russian specialists who analyzed the finished sheets of the Topographical Map of the Kingdom of Poland. In connection with the deficiencies of the surveys carried out by Polish topographers, it was decided to fully verify and correct these works, for which Company No. 7 of the Coopus of Military Topographers was transferred to Warsaw from the surveys in Moldavia and Wallachia, and the contract with Minter was extended from three to four years. On the sheets where the errors were minor, their correction was planned to be carried out during the drawing up of the descriptions. Because of the need to further check the work done by Polish officers, K.I. Richter reported to F.F. Schubert in his report of October 12, 1832 that he had ordered Minter to stop engraving mountains and forests [6].

After the triangulation between Bug and Neman it was found out that the grid of the Polish survey as well as the lines, dividing it into sections, had measured wrong. Therefore a new grid in Flamsted projection on the scale of the engraved map (three versts in an inch) was made up for the rest of the kingdom under the supervision of C.I. Richter. By the end of 1833, Minter was given the first original of the new survey for engraving, and in the spring of 1834, his studio began work on five more originals. In 1834 were completed trigonometric works in the Kingdom of Poland. At the same time a line was laid from the triangulation of public lands of the mining department through the Vistula and triangulation Zamosc to the upper Bug. It turned out that that all the southern part of the kingdom surveyed by Polish officers is shown on their survey sheets a few versts to the west of its present position, as opposed to the northern part (Płock Province), stretched by them for several versts to the east. In addition to triangulation work and verification of surveys of Polish officers, in 1834 K. I. Richter, at F.F. Schubert’s request, received all the initial materials and maps of Russian provinces bordering the Kingdom of Poland, including preliminary drawn originals of K. I. Tenner's Vilna survey for their connection with the relevant sheets of the Topographic Map of the Polish Kingdom [2].

In 1835 on the basis of triangulation of 1834 and using Nadbuzhnaya trigonometric network 8628 and 3/9 versts of visual surveys were made. The surveys in Augustov province were corrected on the basis of a specially compiled instrumental network. Surveys along the left bank of the river Neman were made for 769 ¾ square versts. Polish survey of 8589 8/9 square versts was also checked and corrected, produced 9 originals for engraving [2].

Since the surveys had been completed, and for many sheets were also finished correcting and updating surveys of Polish officers, the question arose about the printing of the Topographical Map of the Kingdom of Poland. For this purpose, even before 1831, by order of the General Quartermaster of the Polish Army Gauke, Basel printing paper (Baseler Kupfer Drück-papier) was purchased for the map publication of small royal format. Initially, it was supposed to print the map in 2,000 copies, but the Nicholas I ordered to print only 300 copies of the Topographic Map of the Polish Kingdom [1, 4].
By August 15, 1837 they completed the correction and description of sheets of survey conducted by the Polish quartermaster officers, and, in total, from 1833 to 1837 corrected survey on the area of 62075 8/9 square verstas was performed [4]. At the final stage of creating the Topographic Map of the Polish Kingdom, checking, updating and correcting previous surveys and originals were the main tasks of Richter's topographers. Thus, in 1839 a detailed check of the eastern part of Płock province was made. In 1840 during the construction of the railroad, its route turned out to be a bit different from the project, according to which it was marked on the map in 1838, so there were made additional surveys and corrections on the appropriate survey sheets and original maps. This work continued into 1841, when changes were required in the postal roads as well.

In 1841 a second reconnaissance and update of the 50-sazhens plan of the city of Warsaw was carried out. In connection with the supposed manoeuvres of the Russian army in the same year was checked in detail the survey in the area between Warsaw, Piaseczno, Łowicz and Nowogieorgujewski. As a result of this inspection, not only the field sheets and original maps were corrected, but also the corresponding engraved printed forms. The engraving of the map was completed on March 1, 1841.

Despite the considerable efforts of Richter's team to correct the surveys, made by Polish quartermaster officers, their complete remaking was considered inexpedient at that period; that is why the first edition of the Topographical map of Polish kingdom left uncorrected some mistakes of Polish officers' surveys. Knowing these mistakes is necessary when using the sheets of this map as a historical and geographical source [8, 9]. However, F.F. Schubert found it necessary to mention that the greatest discrepancies in relative distances not exceeding 4 verstas are divided in the area of 64 verstas length, these differences in military aspect are not noticeable at all and the map of Polish Kingdom in general may be called completely satisfactory [2].

The topographical map of Polish Kingdom was published in full in 1843 since "1839", which obviously meant the time of finishing the basic surveying and compilation work, which actually lasted, as shown above, until 1841. The Russian State Military History Archive has three complete copies of the Topographical Map of the Kingdom of Poland, 1843 edition [10].

6. Conclusion
In 1843 officers of the General Staff and Corps of Military Topographers of Russian army finished works on the Topographical map of Polish kingdom, which were started by the General Quartermaster of Polish army in 1818. The history of map creation reconstructed above reflects an interesting experience of creating a large-scale cartographic work by the joint efforts of two distinctive military topographic services. At the first stage (till 1831) the work was carried out by Polish quartermaster officers. And the participation of the management of the Russian Military Topographical Depot was limited only to providing the General Quartermaster of the Polish Army with instructional materials on map compilation and design. They were directive documents for Polish topographers and thus provided a certain unification of their originals with the similar materials of the Corps of Military Topographers. On the other hand, when Russians revived surveying the Topographic Map of the Polish Kingdom after 1831, the management of the Russian Military Topographic Depot and the new head of the work, Major General K. I. Richter, analyzed the Polish methodological materials. They came to the conclusion that the survey conducted by Polish officers corresponded in quality to the Russian topographic and geodesic works of this class and "can therefore be continued "on the same grounds" on which it was performed before the Polish uprising". Later, however, it was found that the materials executed before 1831 did not always meet the high requirements of the Russian Military Topographic Depot. Most of all it concerned the accuracy of astronomical and geodesic control of the Topographical Map of the Polish Kingdom. This precision was significantly increased during the continuation of the work by officers of the General Staff and the Corps of military topographers [11] thanks to the laying of additional triangulation chains and connection of trigonometric points of the Polish Kingdom with the triangulation of K. I. Tenner in Vilna and Grodno provinces. In spite of such "strengthening" of astronomic and geodetic system of the topographic map of the Kingdom of Poland, the management of the Military topographic depot at that time could not reach full parity of map
sheets in its western and eastern parts, since a complete re-mapping and re-creation of the majority of completed sheets by Polish officers was not thought advisable.

Military topographic and statistical descriptions of terrain, which were an obligatory and integral part of field cartography in Russia, were almost completely absent in materials of Polish works. Those works had to be carried out for the whole territory of Polish Kingdom by Russian military topographers with the assistance of their Polish colleagues in the period after 1831. As a result, a unique fifteen-volume body of historical and geographical sources on the territory of Poland in 1830s-1840's was created.

References
[1] Russian State Military Historical Archive 846 16 # 25207
[2] Russian State Military Historical Archive 846 16 # 19445
[3] Paćko T, Trzebiński W (eds) 1983 Centralny katalog zbiorów kartograficznych w Polsce. Z. 5: Wieloarkuszowe mapy topograficzne ziem polskich, 1576-1870. (Wroclaw, Warszawa): 55–56
[4] Russian State Military Historical Archive 40 1 # 165
[5] Russian State Military Historical Archive 846 16 # 19445
[6] Russian State Military Historical Archive 40 1 # 106
[7] Russian State Military Historical Archive 40 1 # 123
[8] Puziene R and Anikieniene A 2020 Investigation of Forest Area Change in the 19th–21st Century Using Military Topographic Maps 11th International Conference “Environmental Engineering”. DOI: 10.3846/enviro.2020.659.
[9] Postnikov A V 2014 Steven Seegel's "Mapping Europe's Borderlands: Russian Cartography in the Age of Empire" The Association of American Geographers Review 2(4) 154-157
[10] Russian State Military Historical Archive 846 16 ## 21154, 21155, 21156
[11] Postnikov A V 2017 The corps of military topographers of the Russian Empire Archives internationales d'histoire des sciences 67(179) 274-340