

METHODOLOGICAL CHANGES IN THE MAPS OF THE ARGENTINE MILITARY OFFICES: TOWARDS A SPECIALIZED TOPOGRAPHIC CARTOGRAPHY (1865-1912)¹

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1. Organization and goals of the first military cartographic offices

The maps produced during the second half of the XIX Century by the military offices were, in most cases, closely linked to military works and needs. For instance, they charted the frontiers of those terrains that were still under the control of indigenous people; they built small forts and made plans of the camps where tasks of military skills were developed. In other words, those maps were aimed at charting the movements of the armies. In addition, certain financial limitations did not allow the planning of cartographic works of a higher scope.

In that moment, the geographic and topographic information necessary for making maps was drawn from military campaigns, but these campaigns were not exclusively aimed at making topographic maps. On the contrary, the maps were one of all the objectives of the campaign, but not the most important one. This way of making cartography –which can be called *in situ* cartography since the map was developed while the military troop moved forward on the terrain- was not the only way of gathering the necessary information for carrying out the cartography. There was another method called compilation method. In this method, the map was made entirely indoors, in an office, and it consisted in gathering every possible cartographic antecedent of the region to be charted. The compilation practice was not an easy task because it implied comparing all the information of each map –which are generally made to different scales- and selecting those maps considered to contain the most accurate information. This method was intended to correct and complete the data of the already published maps.

These two ways of making cartography (*in situ* or by the compilation method) are not mutually exclusive at all, on the contrary, many times a combination of both cartographic practices could be carried out.

Another characteristic of cartography at that moment was that the scales chosen for making maps were very variable and depended on the army's needs. For example, if the purpose was to develop the plan of a military camp, they used a scale that allowed enough detail³, but if the military need was more regional, as it was the case for the planning of the route a troop would follow, smaller scales⁴ were used in order to chart a wider terrain.

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² Servicio Geológico Minero Argentino –SEGEMAR (Argentine Geological Mining Survey).

³ This kind of work can be exemplified by: the “Plano del Campamento de la división Norte de Buenos Aires en Trenque-Lauquen” 1:5.000 and the “Plano del Campamento de la División Costa Sud de la Frontera de la Pampa sobre el arroyo Puan” 1:157.800.

⁴ In this scale we can mention the works carried out by Cte. Wysoscki: in 1877 “Plano General de la nueva línea de Frontera en la Pampa” 1:1.866.700; “Plano General del telégrafo militar sobre la nueva línea de Frontera en La Pampa” 1:1.000.000, among others (IGM, 1912: 87).

This functional way of choosing the scale of the maps resulted in many charts having different scales, what did not allow the splicing of one to another making up a mosaic-type map. Another factor that impeded the union of two or more maps was the inexistence of a single reference system, meaning that each chart was made with a different system of coordinates, what also made difficult the measurements between two maps. All these works charted the terrain discontinuously, they followed a route determined by military needs and problems, and they did not chart the terrain under a singular criterion or to the same scale.

These cartographic practices were progressively modified at the time military topographic offices gradually began to define their work plans and methods.

The first military office was the Committee of Engineers⁵ (1865-1879). The organization of this Committee had been in charge of Engineers Colonel Juan Czets⁶ and depended on the “Inspection and General Command of Arms”⁷ (that depended on the Ministry of War and Marine), the function of which was to administrate and regulate everything concerning military subjects. In that moment, the precariousness and institutional disorganization of the armies was shown not only by the continuance of regulations and norms inherited from the colonial period⁸, but also by the recruiting system of soldiers, which did not have any kind of training in military subjects.

The Committee of Engineers had the objective of surveying the terrain topographically and carrying out military plans based on the data provided by the expeditions of the armies’ groups that worked in the field campaigns. It also had to centralize all the plans that were being developed by the Inspection and General Command of Arms. The Committee of Engineers functioned approximately during the same time that lasted the war with Paraguay (1865-1870). Many authors coincide in affirming that this war made evident, on the one hand, the need of organizing the structure of the army, and, on the other hand, the need of counting with a professional army. Thus, during the decade of 1870 the first “Military General Instruction” took place. It included general norms for the Army and taught the armies how they should act during the campaigns (Fazio, 2005b: 9).

The Nation’s Military School was created in this context of institutional organization. Two years later, in 1872, the Committee of Engineers was attaché to the Secretariat of the War Ministry and became the “Office of Military Engineers”. This modification did not imply staff changes (which continued to be the same: General Benito Nazar, in charge of the Direction of the Committee; Major Sergeant Federico Melchert; Jordán Wysocki; Francisco Host and the Engineers Alfredo Ebelot and Octavio Pico), but it is inscribed within the institutional changes that began to take place in the heart of the Army.

The Campaign to the Desert⁹ carried out by General Julio Argentino Roca in the indigenous territories of the Northern Patagonia in 1879, coincided with the creation of the Military Topographic Office¹⁰ (1879-1885). The Office kept in charge of General Manuel Olascoaga¹¹ (1835-1911) and Major Sergeant Jordán Wysocki¹² (1830-1883).

⁵ Mesa de Ingenieros.

⁶ Juan Czet was a Hungarian soldier that, after his wedding in Spain with the niece of Juan Manuel de Rosas, settled in Argentina in 1859 (Cutolo, 1968).

⁷ Inspección y Comandancia General de Armas

⁸ One of the norms inherited from the colonial period is the continuance of “Spain’s military Regulations for the service of the Army and the Navy”, enforced by Carlos III in 1769 concerning military justice (Fazio, 2005a: 1).

⁹ Campaña al Desierto

¹⁰ Oficina Topográfica Militar

¹¹ Manuel Olascoaga was born in 1835 in Mendoza Province. He was a military man, topographer and politician. He graduated from Alberto Larroque school. After participating in the Campaign to the Desert, he

The rest of the staff¹³ of the Military Topographic Office would be designated by Olascoaga and had to be military men. Olascoaga's faculty of choosing his staff was important because he was allowed to select technicians that, according to his criterion, were more qualified for solving and facing the goals proposed by the office.

The Military Topographic Office had the objective of carrying out trigonometric works, gathering and ordering geographic, topographic and cartographic works that had been developed until then in the Army. It also had to make topographic profiles, research the natural history of the territories where the military commissions advanced, and take notes for the general diary and the accountability books of the Commissions.

Many authors point out that it is not by chance that this Office had been created the same year the Campaign to the Desert was carried out (Zusman, 1996; Lois, 2004). In fact, the goals of the Office were framed in the needs of the process of territorial formation, this is, as Zusman (1996) points out, from a material point of view, the process of territorial formation required: 1) the reconnaissance of the space to be controlled (explorations); 2) the compilation of all the information relative to physical conditions and economic potentialities, and 3) the systematization of the knowledge obtained in previous activities with the purpose of economic valuation, but also for the construction of those arguments that were of use for the defense of territorial pretensions (cartography, trip stories).

The Military Topographic Office run until January 2nd 1884; in that moment, the "General Army Staff" was created (eliminating the former Inspection and General Command of Arms). According to Fazio (2005b), the creation of the Staff was one of the most important decisions made by the National State aiming at the reform of the Army. From the perspective we are following in this paper, it is important to set out that the General Army Staff, took over the functions of the Military Topographic Office and, as we will see, it incorporated new ones.

Indeed, one year after the creation of the General Army Staff¹⁴, the *IV Section of Military Engineers, Topography and Cartography* was founded. Its manager was Colonel Juan Czetz and its secretary Colonel Benjamín García Aparicio¹⁵.

published "Estudio Topográfico de la Provincia de La Pampa" and diverse topographic and cartographic treatises. He was the governor of the National Territory of Neuquén and founder of Chos Malal city, the first capital of the province. He died in 1911 in his home province (Cutolo, 1968).

¹² Major Sergeant Jordán Wysocki studied in the Superior Technical School of Polonia. He arrived to Buenos Aires in 1867, he worked under the orders of Czetz in the province of Santa Fe. He carried out the topographic survey of La Pampa and the plans of the new frontier lines in Puán, Southeast of Buenos Aires province, and the layout of new small forts in the National Territory of Chaco (Mazzitelli Masticchio, 2008: 24).

¹³ The Military Topographic Office was made up of a colonel lieutenant, a major sergeant and two draftsmen with the salary of a captain.

¹⁴ In 1886 the General Staff was chaired by Division General Joaquín Viejobueno and was divided into seven sections; namely: I Section Direction of the Staff and General Command of the Army; II Section Inspection of Arms; III Section Military History of the Republic. Sheets of the Army's Service. Library; IV Section Military Engineers, Topography and Cartography; V Section General Direction of the Military Park, Workshops and Deposits; VI Section General War Commission; and VII Section: Military Health (IGM, 1951: 20).

¹⁵ Benjamín García Aparicio was born in Buenos Aires Province. He entered the Military School in 1880 and in that year he took part of topographic surveying and exploitation works in the southern Andean region, under the command of Colonel Olascoaga. He participated in the Commission of Limits with Brazil (1886), where he carried out topographic studies in the frontier of Corrientes and Misiones. In 1910 he was designated as Director of the Military Geographic Institute, where he was in charge until 1916. He represented Argentina in many international congresses, such as: London International Conference (1909), the Scientific Congress of Rome (1911) and of Paris (1913). He was a delegate in the II International Conference –where he presented three sheets of the World Map to Millionth that were compiled, drawn and printed during his term of office- and in the Pan-American Congress of Washington. He also directed the publication of the first three volumes of the Yearbook of the Military Geographic Institute, which spread the works of the Institute, both in the country and abroad. He was an honorary member of the Royal

The IV Section –which was divided in 5 offices- maintained the title of the former Military Topographic Office for the first of its subdivisions. Thus, the first Subdivision was called “**Military Topographic Office**”¹⁶. The second Subdivision was called “**Office of Military Fortifications**”¹⁷, the Third subdivision was called “**Office of Military Constructions**”¹⁸. The Fourth Subdivision was the “**Office of Bridges, Railroads and Military Telegrapher**”¹⁹. Finally, the Fifth Subdivision was the “**Secretary and Archives**”²⁰. As it can be deduced from the labels of the Subdivisions of this military office, the IV Section was an institution aimed at infrastructure. Indeed, it is not difficult to imagine with which purpose the Argentine State wanted a military office with tasks focused on the country’s infrastructure: when the IV Section was inaugurated, Argentina was going through a period of economic expansion. More specifically, between 1880 and 1914 Argentina was moving away from its relatively marginal position in the world’s economy and integrating to the international system achieving important economic advances (Saborido and de Privitello, 2006: 110). On the other hand, the economic growth implied an increase in the exports of primary goods, which were mostly concentrated in Buenos Aires’ port. In order to organize this flow of goods, the expansion, organization and planning of the country’s communications and transport infrastructure became necessary. In fact, the development of most rail infrastructure took part in that period: the rail net in 1870 had an extension of 732km; in 1890 it had 9.432km and it reached 27.994km in 1910 (Floria and García Belsunce, 2003: 712). This made evident the need of creating an office that assumed such tasks of territorial planning.

In 1895, General Alberto Capdevilla²¹ (1856-1905) took charge of the Army Staff. One of his first measures was the updating of the organization chart of the Army: he divided the Staff in three divisions: 1° Technical Division, 2° Instruction Division and the 3° Inspection Division. This new organization, although it closed definitely the IV Section, continued having a work agenda directed to infrastructure.

In this new organization chart, the new office in charge of topographic tasks was the 1° Technical Division, which had been left in hands of Major Engineer Luis Dellepiane (1865-1941).

The 1° Technical Division was made up of four subdivisions. The 1° Subdivision was called “**Railways, roads and highways, river and sea routes inside the Republic and in the neighbor states**”²² and it was dedicated to infrastructure. Its function was the construction of railways and roads, the organization and direction of the personnel of military transport, the service of carrier pigeons and telegraphers. The 2° Subdivision was denominated “**Military statistics of the Republic and foreign nations, and transport**”²³. The 3° Subdivision was called “**Construction, study and direction of**

Geographic Societies of England, Spain, Italy and Germany, as well as of the similar French institution. He died in October 12th 1916 (Cutolo, 1968: tomo III, 237-238; IGM, 1979: 268).

¹⁶ It was made up of a chief that had the rank of lieutenant colonel, a captain, a lieutenant 1° and four draftsmen.

¹⁷ The staff was composed of a chief with the rank of Major Sergeant, a Captain and a First Lieutenant.

¹⁸ This subsection counted with a chief, Major Sergeant, one Captain, one First Lieutenant and a draftsman.

¹⁹ It was composed of a Major Sergeant, a Captain, one First Lieutenant and two Second Lieutenants.

²⁰ It was made up of a chief, who was a Lieutenant, one Colonel, one Lieutenant Colonel, three Major Sergeants, four Captains, four First Lieutenants, two Second Lieutenants, one porter and two orderlies.

²¹ In 1873, General Alberto Capdevilla graduated from the Nation’s Military School, of which he got to be Director in 1893. Before being in charge of the Army Staff, Capdevilla served in different regions of the country.

²² Its staff was composed of a chief (engineer) with the position of major, three captains, one first lieutenant and one second lieutenant.

²³ Its personnel were a chief (engineer), one captain and two lieutenants.

permanent and provisional fortifications"²⁴, and its goal was to organize the construction of military buildings.

Evidently, the 1° subdivision was focused on infrastructure matters, while the 2° and 3° subdivisions dedicated to military related questions.

Lastly, the 4° subdivision, named "**Topographic, Geographic and Cartographic Survey**" had the goal of developing the military chart of the Republic and constructing plans for the Army. In comparison with the other subdivisions, the personnel²⁵ of the 4° subdivision had more technicians and draftsmen in charge of topographic and cartographic tasks.

With the shift of the century and in the context of a new institutional reorganization, the 1° Technical Division became the 3° *Division*. In the Decree that enforces this modification appears, for the first time, the name *Military Geographic Institute*²⁶ (IGM). According to the Military Bulletin N° 4 of the same year, the Military Geographic Institute or 3° Division was divided into three sections: 1) **Geodesy**; 2) **Topography**; and 3) **Cartography**. In this way, the tasks aimed at infrastructure works were abandoned, and the division focused only in matters related to making maps.

The professional profile of the institute's staff was much more technical than it had been in the other military offices²⁷ and it included assistants and helpers for the professionals that were in charge of topography. It also had a "worker topographic brigade"²⁸, which was promoted to company in 1906. This shows how topographic tasks began to receive more attention and to be more important. In 1909, another section called "Graphic workshops" was created. It included the areas of "**Lithology**" and "**Photogrammetry**", both of which had, until then, depended on the "Cartographic Section".

The outstanding characteristic of the 3° Division or Military Geographic Institute was the progressive technical, professional and institutional specialization. This specialization was mainly expressed in three levels. First with the creation of the 3° Division or IGM, significant modifications were introduced in the personnel. On the one hand, there was a marked increase in the number of people employed, while the employees working in the IV Section were 37 and 23 in the 1° Division, in the IGM the number grew to 67 employees (not counting the worker brigade). On the other hand there was an increase in the number of qualified technicians and professionals in the tasks of geodesy, cartography and topography: while in the former offices the only professionals hired were engineers or draftsmen, with the creation of the IGM, the professional spectrum became wider and other specialists began to be required (such as mechanics, photographers, machine operators, etc.).

Secondly, a gradual consolidation of a more specific knowledge could be noted. This knowledge was related to the methods used for carrying out cartographic and topographic tasks, which leant on the specificity of the topographic work. In fact, the

²⁴ It was composed of one chief (engineer) with the position of major; one captain; one architect and one engineer.

²⁵ Made up of one chief, also an engineer with the position of major, one engineer captain, two engineers and five draftsmen (IGM, 1951: 34).

²⁶ *Instituto Geográfico Militar*

²⁷ The personnel were composed of a chief, colonel or lieutenant colonel; two section chiefs that were lieutenant colonels or majors; twenty nine assistants among chiefs and officials; one helper of the division; two clerks; one civil engineer, chief of the geodesy section; three civil engineers; two cartographers; one precision mechanics; two lithographers; four topographers; two calligrapher draftsmen; two photographers; two computers; two printers; one machine operator; four helpers; two photographer helpers; two apprentice draftsmen; one apprentice mechanic and two office boys.

²⁸ In the military scale, the lower level of a group is the Body Command, followed by the Brigade, then the Battalion and finally the Company.

labels of Geodesy, Topography and Cartography sections are names of types of knowledge that were already very developed for that period and that referred to scientific practices that were specific and exclusive of the cartographic work.

Last, the Military Geographic Institute suffered several subsequent reorganizations that stressed its technical and specialized profile. For instance, in 1917 the staff was modified, including for the first time geodimeters within the personnel of the institute. Nevertheless, the Geodesy Section was reformulated and became the Trigonometric Section, while the Cartography and Topography sections maintained their names.

Evidently, the Military Geographic Institute was progressively acquiring a more and more specific nature. Finally, in 1918 the 3° Division became independent from the General Army Staff and began to be part of one of the Big Departments of the War Ministry. With this new organization, the “main goal was the realization of the chart and geodesic works for them to be a support in the military and civil spheres” (IGM, 1979: 19). This institutional independence suggests the importance that the State was giving to cartographic tasks.

II. The topographic campaigns: new cartographic methodologies

Although with the creation of the Military Geographic Institute strictly military works continued being developed (and in fact they continue being predominant), during the first decade of the XXth Century maps to a scale 1:50.000 and 1:100.000 of the provinces of Buenos Aires, Corrientes, Salta, Entre Ríos and Santa Fe began to be carried out. In the provinces of Buenos Aires²⁹ and Mendoza³⁰, during these first years, topographic works to a scale 1:25.000 were also developed. Even if these first works did not follow a clear and previously defined cartographic plan and neither did they correspond with a more general cartographic program, it is possible to identify a common characteristic among all these surveys: the spaces surveyed were areas located close to cities. In this way, a gradual giving up of the zones that had been of fundamental cartographic interest during the XIX Century occurred –as it was the case of the areas of military interest that were charted in order to being incorporated symbolically and materially to the National State (as it is the case of Chaco and Patagonia). But taking into account that the purpose was not charting territories of military operations, what kind of methodology was used for surveying these zones?

A campaign implied the deployment of an organization of professionals that designed in the office the procedures that were to be developed in field. In that way, topographic campaigns began to articulate different work stages. First, there was a set of deskwork to be carried out before going to the field, such as: verification of the state of the equipment with which the measurements would be conducted; the recompilation of all the cartography of the region to be surveyed that could help the location of the topographers in the field and the fulfilling of a triangulation preliminary project.

Afterwards, they proceeded to the field campaign, which first of all consisted in the rapid reconnaissance of the working zone developing stations in hills, towers or any tall building with the aim of making a study of the horizon and the visibility of future trigonometric points. Once the reconnaissance was made, the surveying of the terrain

²⁹ The planchets of Buenos Aires Province were the following: Capital-Avellaneda, Lomas, Martínez and Otamendi (1907); Capital-Palermo, Burzaco, Campo de Mayo, Capital-Flores, Capital Puerto, Merlo and San Miguel (1908); Estancia Alvarez, Florencio Varela, General Pacheco; Monte Grande, Morón, Pereyra, San Fernando, San Justo, San Martín, San Benito, Bahía Blanca, Grünbein and Cuatrerros (1909); Libertad, Monte Casero, Pujol, Vedoya, Rincón Bonete, Rincón San Pedro, Banfield, Escobar, Lomas Oeste, Matheu, Quilmes, Toro sur, Wilde and Paraná (1910) (IGM, 1912: 20).

³⁰ Between 1904 and 1906 the planchets of Mendoza, Garín and Toro were surveyed (IGM, 1912: 22).

and the settlement of the coordinates of the points took place. The coordinates were calculated with goniometers and the data obtained were transferred to a chart that facilitated the execution of the calculations necessary for obtaining the definitive coordinate for the point. The density and distribution of the places chosen for measuring the coordinates (trigonometric points) were defined depending on the characteristics of the zone (although it was previously agreed as part of the deskwork). The assistants of the topographers had to make physical and material marks (signs) that made the stations visible and were taken as a reference point when the triangulation was calculated.

Another task developed in field was the realization of monographs of the landmarks [mojones] and of the landscape. These monographs were fundamental for subsequent topographic works (both for fieldwork and for deskwork), and if they were not made, the topographer had the obligation of indicating the reason. The monographs had to include the data collected at the moment that the point was measured and they had to have a name (which had to be as short as possible and refer to the place where it was located). The access to the points from a town or from the closer railroad station also had to be indicated clearly, and that route had to be indicated with the words “left” and “right” in order to show the direction of the itinerary.

When the points were situated in places that were not near details of infrastructure for using them as a reference (routes, roads, railroads, etc.), they resorted to other planimetric elements or to the hydrography of the area. In addition, the monograph had to include a sketch with the geographic characteristics that surrounded the point. The sketch had to include as many details as possible, and the altimetric reference had to appear although it was not in keeping with the scale with which the sketch had been made. The geographic description was completed with a short text accompanying the sketch that described the geography of the region. The visual and textual description of the landscape surrounding the point was essential for completing the fieldwork.

Although the Military Geographic Institute took the military offices that worked during the XIXth century as an antecedent for building its own past, appropriating the topographic and cartographic experience and legitimizing in that way its later cartographic development (Lois, 2004: 3), we may think that with the arising of the IGM, a new way of carrying out topographic tasks began: a stage in which the development of the map continues to be a task of military men begins, but it becomes an issue independent from the military needs. Although the traditional perspective tends to join the civil and military cartography, it can be said that the campaigns are not longer military, but *topographic campaigns* carried out by military men.

This new methodology implied specialized work in which technicians of different profiles took part, and that resulted in a division of the topographic work. In other words, the tasks implied in the process of realization of a map involved more and more professionals with different specializations: geodimeters, topographers, draftsmen and engravers among others. At the same time, this way of making cartography was regulated by an administrative regulation that depended entirely of the National State (Nadal and Urteaga, 1990). This way of making cartography is very different from the work developed by the military offices of the XIX Century and required as well, the training of technicians with skills for facing new challenges.

III. A new profession: the cartographers of the State

Although the military professional academies go back many years and we can date them in the time of the breaking-off of the colonial bonds³¹, it was just with the creation of

³¹ Some academies were: the Military Mathematics Academy (1810-1812); the Mathematics School of Tucumán Province (1814) and the Military Academy of Buenos Aires Consulate (1816-1821).

the Military School (1870), the School of Engineers (1885) and the Superior War School (1900) that the professional stage began in the Argentine Army. This stage is characterized by a growing interest in training the personnel responsible for the cartographic tasks³².

Most cartographer technicians and military engineers that took part in the realization of maps and plans and in the education of new technicians, were foreigners that had received their education in their country of origin. This situation –that had been considered positive initially since the incorporation of those scholars for overcoming the lack of national production provided certain prestige- began to be regarded as a problem towards the end of XIX Century. This was mainly because the participation of foreigners began to be considered counterproductive and unfavorable for the interests of the nation, homologating in that way the very act of producing cartography and “serving the country” (Lois, 2000b: 38).

In this context of nationalization of technicians, the Nation’s Military School was created. Although its syllabus was considered as very complete³³, students had to complement their studies in the Faculty of Engineering of the University of Buenos Aires in order to obtain the degree of engineer. This complement of civil education in the military training was taken by Juan Czetz for arguing that the graduates from the Military School entered the Faculty of Civil Engineering and when they graduated, some years later, asked for the discharge from the army. In this way, those professionals that had been trained in the Military School were lost. For that reason, and while he was in charge of the IV Section in 1885, Czetz submitted a bill to the chief of the Army that gave rise to the Decree by which the School of Military Engineers³⁴ was created. The School had two main characteristics that differentiated it from previous institutional attempts. First, it was the first academic institution aimed exclusively at the scientific education of one kind of arm, the engineers one (previous academies were focused on the training of military officers no matter the kind of arm or the body to which they belonged). In second place, classes were given in a military office that was exclusive for topographic tasks (the 1° Subdivision of the IV Section) (Mazzitelli Mastricchio, 2006: 5). The course lasted four years and the attendants had to be graduated from the Nation’s Military School.

In 1893 the Military School modified its syllabus and added a specific superior course for Military Engineers. This modification allowed it to give the degree of Military Engineer to the officers that had studied in the Faculty and that had graduated as civil engineers. The school also gave the qualifying degree to those that had been educated in a superior European institution. In this way, the School of the IV Section gradually began to lose its functions and to be replaced by the new courses of the Military School.

³² For more information about Argentine military engineers, see Martí, de Paula, Gutiérrez, 1946; Mazzitelli Mastricchio, 2006 and Lois, 2007. An analogous situation to the Argentine case is the training of military engineers in Spain and Mexico. See respectively Capel, 1982, 2003a, 2003b; and Moncada Maya, 1984; Mendoza Vargas, 2001.

³³ In 1882 an Examiner Commission said that although the School's syllabus fulfilled the required subjects (mathematics, language, history, geography, cosmography, tactic regulations of the three forces, planimetry, drawing, English, French and shot and fencing exercises) it was important to include the subject Military Constructions in superior courses in order to complete even more the training (Scena, 1980: 50).

³⁴ The academic education of the applicants for Engineer Officials was based on knowledge of civil and military engineering, and in the command of mathematics. The courses given included Superior Algebra, Rectilinear and Spherical Trigonometry, Linear and Topographic Drawing, Roads and Railroads, Analytical Geometry, Geodesy I, Drawing, Bridges, Temporary Fortification, Differential and Integral Calculation, Permanent Fortification, Geodesy II and Astronomy. In addition, in a complementary way, they had to attend to the following subjects in the Faculty: Descriptive Geometry I, Descriptive Geometry II and Mechanics and Architecture.

In 1900 the Superior School of War (ESG) was created. Its syllabus first lasted two years³⁵. In 1904 one further year was added, as required by the War Academy of Berlin³⁶.

This was the way in which a big group of military engineers educated in these national institutions that began to replace their own teachers, meaning the foreign technicians that had been in charge of directing the national cartographic production until then.

Most people responsible for the topographic offices had, indeed, studied in their countries of origin, as it was the case of Juan Czetz and the German Military Geographer Engineer Francisco Host (1822-1894), among others, and they had a wide and well known working career in Argentina. But since the 1° Technical Division came into being, most people responsible for the sections and subsections were Argentine military men that had studied in the School run by Czetz or, once it was closed down, in the Nation's Military School. Two people taken as example of this kind of career are Dellepiane and Moret.

The Chief of the 1° Division, Luis Dellepiane, as well as his Secretary Carlos Moret were born in Argentina, and besides having studied in national institutions they have also studied in European schools. The chiefs of the subsections of the 1° Division were also Argentine and had studied in national schools. For instance, Andrés Rodríguez (1865-1928) and Salvador Velasco Lugones (1864-1922) that had been in charge of two of the subsections of the 1° Technical Division, had studied in the Nation's Military School, the University of Buenos Aires and the School of Engineers run by Czetz. Velasco Lugones would be the first president of the Military Geographic Institute between 1904 and 1905. Although hierarchical positions and the positions of decision making gradually began to be in hands of Argentine people, it did not mean that all the foreign personnel had been excluded. Engineer Julio Lederer, for example, who was Hungarian, took part of the IV Section in 1890 carrying out topographic activities, afterwards he worked in the 1° Technical Division under the orders of Enrique Schröder for developing surveys in the Andean region and carrying out astronomic and geodesic works. Later on he was in charge of the Geodesy Section of the IGM until 1912.

The movement of foreign technicians to positions of lower hierarchy seems to have been part of a systematic policy the flipside of which was that hierarchical positions were reserved for Argentine officers (Lois, 2006). But these less hierarchical positions also implied a daily contact with technical personnel that were in charge of the fulfillment of topographic tasks, therefore, these foreign personages continued training professionals and technicians. In fact, since 1904 the presidency of the Military Geographic Institute was always in charge of military men that had received their military and topographic training in national military institutions, although some of them completed their education in European institutions.

³⁵ The following were the compulsory subjects: Tactic Regulations, Military History, Artillery (including description of the material), Fortification, Topography, General Geography, General History, International Law, French, Horse Riding. Facultative subjects were: Superior Mathematics, Natural Science (Chemistry and Physics) and German. During the 2° year, the following subjects were compulsory: Applied Tactics, War History, Staff Service, Artillery, Fortification, General Geography, Military History, French and Horse Riding. And optional: Geodesy and German (Picciuolo, 2000: 68).

³⁶ The course of this academy lasted three years. The following subjects were given during the first year: Tactics, War History in Ancient Times, Study of War Weapons, Fortification, History, General Geography, Mathematics, Physical Geography, French, Russian. During the second year the subjects were as follows: Tactics, History of War, Communications and Transport, Realization of Plans, Military Penal Law, Military Hygiene, Military Geography, History, Mathematics, Physics, French and Russian. In the third year they added Staff Service, Attack and Defense, Notions of Administration and Law and Geodesy. The six hours of Mathematics and Physical Geography could be replaced by French or Russian (Picciuolo, 2000: 39).

On the other hand, new schools aimed at the training of military technicians oriented to the cartographic and topographic knowledge came up. Their syllabus continued leaning strongly on mathematics and drawing. For instance, the School of Application of Engineer's Artillery in charge of General Pablo Riccheri (1904) gave courses of Constructions, Infinitesimal Calculations, Chemistry, Physics, Drawing, Topography and Geodesy.

When in 1912 the IGM presented the Chart Plan –the first integral cartographic project of the State that had as a goal the developing of the topographic chart of the Argentine Republic to different scales-, institutions and courses focused on training auxiliary personnel for cartographers and topographers came up. The School of Lithographer Typographer Draftsman (1912) and the School of Topographer Apprentices (1916) are good examples of this. In 1917, in face of the closure of these schools, theoretical-practical improvement courses began to be given to the topographers that wanted to deepen their knowledge of topography, photography and drawing; its graduates received the degree of *Planchetistas* (IGM, 1979). The School of Topographers was created in 1937. It gave two-year courses and granted the Topographer degree. This institution that educated topography technicians, assistants to geodesy professionals, *calculistas* and cartographic draftsmen, had the entrance requirement of having approved the 3^o year of secondary school, being *native Argentine* and older than 18 years old. The school did not depend on the Ministry of Education, and that is why it had to close down in 1941 with the sanction of the Chart Law (which established that the technical personnel that carried out fieldwork or deskwork had to be Argentine and to have a qualifying degree given by the National University or by schools that depended on the Ministry of Education).

In this way, while the IGM was consolidating as a highly specialized actor for developing the cartographic tasks in the country, different work areas inside the Military Geographic Institute began to arise with the objective of educating auxiliary technicians and apprentices. These schools gave short and specialized courses, which were aimed at educating specialized technicians in only one of all the activities implied by topographic work (*planchetistas*, draftsmen, specialists in photogrammetry, etc.). This made the division of works became more and more marked.

In turn, this helps us to assume that there was certain urgency for counting with a staff of technicians, numerous enough and with the necessary capacity of solving the problems that the realization of cartographic and topographic works implied. In this context, these courses satisfied this demand and allowed replacing university education (which implied much more time and dedication).

VI. Conclusion

The first military topographic offices charted zones where military interest and tasks of military skills were developed. But when the objectives of the offices found their way, their work agenda was oriented to the material infrastructure needs that articulated the Argentine territory at the moment of its insertion to the international economy. On the other hand, their personnel were just a few technicians (most of them engineers) and draftsmen.

With the organization of the IGM, a growing specialization of cartographic and topographic tasks took place, and it was expressed at different levels: 1) A qualitative and quantitative growth of the personnel hired for carrying out topographic tasks was produced, and 2) the organization chart of the IGM was constituted around specific types of knowledge that were already very developed for that period, such as geodesy,

cartography and topography. Therefore, an independence of cartography from military activities occurred, what led to changes in the working methods: there was a shift from military campaigns to topographic campaigns carried out by military men. In addition, this specialization led to the modernization of the methods for topographic surveying, what made necessary the training of technicians and professionals devoted to more and more specific tasks. In this context, institutions that aimed at educating professionals and auxiliaries for the topographic surveying of the country were created.

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