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General considerations of Spanish military geographical thought applied to the study of borders and modern transport (1859-1936)

Abstract

The Industrial Revolution was not only taking place in the factories of Europe´s growing cities, but also a military revolution was taking place which was adapting the new inventions to its own purposes. In the same way, industry and science al produced new weapons which gave the military of all countries new means of actions.

Railways were the ultimate key to the progress of the great powers in the economic, political and military modernisation of the 19th and 20th centuries. The great motorised ships since the 19th century and the incredible aeronautical development since the 20th century have also been part of these keys to economic, political and military power for the great powers.

Keywords

Technology, Evolution, Frontiers, Military geography, States.

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1. Introduction

The invention of the wheel for land transport and the construction of floating vessels on water were inventions that —many millennia ago— changed the face of humanity wherever they reached. Those inventions appeared countless centuries ago and their exact origin is not the subject of debate in this article, but are taken as axioms. Our study begins in 1859 when Colonel José Gómez de Arteche published his *Geografía Histórico-Militar de España y Portugal* [Historical-military geography of Spain and Portugal], and it ends in 1936, the year Commander of the General Staff José Díaz de Villegas had published his *Geografía militar de España, países y mares limítrofes* [Military geography of Spain – bordering countries and seas]. This study uses primary sources that are in the Spanish language. These years cover a crucial period that saw a series of astonishing inventions in many fields,that changed life in the world forever. These years were therfore a major turning point, perhaps the most important period in world history for countless centuries.

So what happened then in those years that could be rated with such high importance? General Staff commanders José Irureta-Goyena and Secundino Serrano put it this way: "In metallurgical advances, we hit the apogee in the construction of rifles and machine guns, field guns and huge siege and naval guns, torpedoes, submarines, locomotives, automobiles, aeroplanes, spotlights, and the development of telegraphy and radiotelegraphy" (1925: 14). From this list of inventions, we should first highlight those that revolutionised transport. On land we have railways and automobiles; at sea we have steamships and submarines; in the skies we have aeroplanes and airships. These inventions were based on industrial production powered by coal, oil or electricity. In the field of armaments, it is worth mentioning the automatic weapons, with allowed a very high number of shots to be fired per soldier; the invention of large cannons with kilometre-long ranges and explosive ammunition, whose accuracy, range and lethality were unprecedented; and the invention of the "armoured cavalry", i.e. tanks armed with cannons and machine guns.

Military-geographical thinking changed as inventions entered the political and economic life of modern states, their societies and, of course, their armed forces. In this sense, what had been described once as distant territories, separated by major geographical features, became closer and closer in this period due to the high speeds and transport capacities of the new inventions. Mountains, rivers, seas, or deserts, geographical features that once separated countries or regions, were suddenly crossable due to a human ingenuity that blunted them or deprived them of their qualities. This advance march of technology affected plans for border defence and attack , both on land and at sea, as armies had to adapt their military plans to the new weapons and their new, hitherto unknown capabilities. They would even have to deal with the new border dimension of airspace. The one thing that did not change, according to Commander Epifanio Gascueña, was the object of war: "break the will and psychological strength of the enemy. All objectives leading to this will be good strategic objectives; their importance and their preference depend on each case and circumstance" (1922:13).

2. Defining military geography

Military geography in Spain had its period of greatest development between 1859 and 1936. Due to the fact that the concept of "military geography" and its field of study is very often misunderstood or unknown, I consider it necessary to make an initial review of its subject of study through the most important definitions by Spanish military men at that time, as it is crucial to precisely understand their way of thinking about this field. Later on, we will define the concept of borders and their dimensions on the basis of Spanish geographic-military texts.

As we noted in the introduction, Colonel Arteche's work was published in 1859. It was not only a fundamental work, but also a foundational one, since other Spanish military authors based their work on it in depth or criticised it. In his first paragraph, Arteche justified the need for his work on the basis of an existing shortage: "The lack of a treatise on Geography has been felt for a long time. After giving a clear idea of the varied configuration of the land that constitutes our Peninsula, under a reasoned and philosophical system, the treatise would offer the reader the most appropriate applications to the military art, according to the most authoritative theories and mainly, according to the experience of undeniable events, capable of serving as a guide for the future". And he goes on to point out that he himself is "convinced of the need for such interesting study and useful knowledge for the exercise of my military profession", because in his words, Spain lacked the precise knowledge necessary for the military to carry out their profession, which was to guarantee national defence and sovereignty (1859; V-IX).

Elaborating on the purpose of his work, he indicated that he had subjected his studies "to a general system in accordance with the standards of the art in the operations of armies" where he tried to "point out the influential points and lines in them" as well as "the communication facilitated between the most important centres of population to whose command or sustenance the war may be directed". Accordingly, the content of his work begins "with a general description of the Iberian Peninsula and a historical summary of its territorial division and of the invasions to which it has been subjected from the earliest times, indicating its irregular or methodical military progress, in order to point out with justification the most important general lines to cover in the defence of the country". He divided the country into "large hydrographic regions", from which he deduced "from their physical conditions, defensive state and the resources they can provide, the military properties corresponding to them, corroborated with the reasoned history of the most instructive campaigns that occurred there". And his work ends "with an analysis of our military state and the needs it is called upon to meet" (Gómez de Arteche, 1859; V to IX).

With the preface of this 1859 work we already have a first definition of military geography (knowledge useful for the exercise of the military profession), its objective (national defence) and its sources (physical and political geography and military history).

Later, in 1884, Commander of the General Staff, Leopoldo Barrios y Carrión, in his book *Geografía Militar de España. Comprendiendo sus islas adyacentes y posesiones de ultramar* [Military geography of Spain. Including its adjacent islands and overseas possessions] stated that military geography "is the science that studies the conformation of land surfaces in order to apply its knowledge to major military operations" (Barrios, 1884: 8-9). A few years later, in 1887, in the anonymous book entitled *Geografía militar de Europa. La geografía es la base en que se funda todo problema estratégico* [Military geography of Europe. Geography as the foundation for all strategic problems], we find a very similar definition, since it shows that "military or strategic geography [...] is the science that studies the configuration of the surfaces of our globe in order to be able to apply its knowledge to major military operations" (Anonymous, 1887).

At the same time, an Italian military man had a great influence in Spain thanks to the Spanish translation of his work in 1885. Lieutenant General Giovanni Sironi pointed out in his work *"Ensayo de Geografía Estratégica* [Essay on strategic geography] (1885: 9):

> "Military geography is a particular branch of geographical studies which has its origin in the special way in which the military man considers the different regions of the earth. He examines and studies them as spaces in which armies settle the conflicts of nations by force of arms, and discusses the importance and influence of the accidents of the terrain, either in isolation or as a whole, on the great operations of war".

This definition, in fact, had a very noticeable repercussion in other Spanish military men years later, such as the Engineer Captain Valeriano Casanueva y Novak, who in his book *Nociones de Geografía militar* [Concepts of military geography] offered this similar definition (1902: 3-4):

> "Military geography is that part of geographical studies in which the different regions of the earth are considered only as spaces in which the nations, by means of their armies, decide the success of the questions they have pending between them; it considers the accidents of the terrain, either in isolation or as a whole, only from the point of view of their importance and influence on the operations of war".

Geographical knowledge and its military application are the fundamental core of military geography. However, it was not until 1889 that definitions were found which, in my opinion, better express what military geography is the study of, since they manage to indicate in two words what is to be known and what is to be analysed. In this sense, Captain Manuel Castaños y Montijano, in his book entitled *Geografía militar de la Península Ibérica* [Military geography of the Iberian Peninsula] explained that military geography (1889: 144):

> "(…) is the science that studies the structure of the earth's surface, with application to warfare. It should, therefore, be divided into two parts: a descriptive part, outlining the natural and artificial features and pointing out the regions over which armies must move in order to achieve the

> aims of a campaign; and a strategic part (which might better be called geostrategy) which discusses the value of the same features in the general and particular concept of military operations".

From here it is very important to highlight the *descriptive* and *strategic* parts, which summarise in two words the tasks that military geography must know and analyse.

Entering the 20th century, we find a book by Lieutenant Colonel Leandro Mariscal, entitled *Compendio de Geografía militar de España y Portugal* [Military geography compendium of Spain and Portugal] (1907), in which he defined military geography in this way: "It is the science that describes the earth's surface and studying what advantages can be obtained from the main accidents that cover it at a time of war" (Mariscal, 1907: 9). Furthermore, we find that military geography has two aspects in his view, 1) *Description*, and 2) *Discussion* (1907: 9) which keeps us on the aforementioned path of Captain Castaños' book (1889). Military geography must therefore describe the territory, and discuss its usefulness in war. Of course, the need for "interest in the matter is easy to demonstrate" (1907: 9), as one must know the country where one is going to fight (mountains, rivers, population, fortresses, roads, etc.) as well as the elements with which one can fight. And with this knowledge, the situation map is formed, where the objectives and the ways to achieve them are set.

In the 1920s, we find the definition developed by Lieutenant Colonel of the General Staff,[1] Luis Villanueva López-Moreno, whose work *Bases para el estudio de la Geografía Militar* [Foundations for studies in military geography] is, for me, the most precise and precious work of all these years because it offers, in addition to a definition of military geography, a methodology to analyse the multiple dimensions that every military geographer should study.

He stated succinctly that military geography "is the science that studies the influence and use of geographical factors in warfare" (1925: 27). However, military geography is a science derived from general geography whose field "is vast and [...] is not limited to the study of physical accidents, but encompasses the most complex questions of the human factor, and, above all, the relationship between man and his environment takes on a preponderant role" [...]. Thus, it turns out that (1925: 28):

> "All these elements in turn make up the concept of military geography in relation to the operations of war, the relativity of obstacles, the character of the inhabitants, their political ideals, their warlike aptitude, their resources, their defences, etc., and it is impossible to understand the successful use of the many elements available to the country or even the government of its inhabitants when these relationships and their foundations are unknown".

Finally, in 1936, we have the work of the Commander of the General Staff, José Díaz de Villegas (1936) whose prologue speaks of the object of military geography,

1 Lieutenant Colonel of the General Staff, former Professor of Military Geography and Geology and Professor of General Tactics and General Staff Service at the War College; full member of the National Geographical Society.

which will definitely never be a narrow and anachronistic field, but a living, useful and current discipline:

> "The field of military geography has no limits, it embraces everything; the physical branch, with its geological, orographic, hydrographic and meteorological studies; politics, with its human societies, ethnic, political, religious and social groupings, the basis and origin of the struggle between men; everything is of interest to military geography and to those in charge of directing and executing war".

In short, military geography is the study of physical and political geography and of military history for the planning and conduct of warfare. We could even express it as a mathematical formula:

Military geography= (physical + political) geography + military history

In order to facilitate war planning, whose ultimate objective is national defence, Lieutenant Colonel Villanueva's book contains a methodology of analysis in the form of an index (1925: 32): "By which geographical studies can be ordered, taking care to adapt it to the circumstances and suitably modifying, in place and proportion, its various elements, depending on whether we are dealing with a nation, a region, a small territory, a theatre of war, etc."

1. General study of the territory.
    a) Physical factors.
        i. Geographical position.
        ii. Geological, orographic and hydrographic features.
        iii. General landforms and their composition.
        iv. Climatology-Vegetation-Water.
        v. Natural productions.
    f) Human factors.
        i. Historical situation.
        ii. Population.
        iii. Communications.
        iv. Agriculture, industry, trade.
        v. Psychology, culture, fine arts.
        vi. Political, social and economic issues.
    c) Military factors.
        i. Potentiality, Military use of activities and resources.

ii. Strategic centres; objectives.

iii. Offensive and defensive, military and naval organisation.

iv. Theatres of operations (natural and circumstantial).

v. Military survey of coasts and borders.

2. Military considerations on the territory as a whole and historical confirmations.

This index is a key element in understanding the practical purpose of military geography, not only in the historical period from 1859 to 1936, but also in providing us with a contemporary analytical methodology. It this way, it shows that there is content, among Spanish military authors, that is useful for the present generation. With this methodology we can get an overall picture of the existing elements of a given territory, and from this we can draw conclusions regarding the borders in particular and other parts of a territory. It should always be remembered that the basis is general geography and the endpoint is military-geography.

With this index, we can have a precise idea of the characteristics of a country or region, but it will change when a novelty appears in one of its elements, such as new ideas or new inventions; such novelties may bring changes in other aspects that may be more or less important. In the case of borders, it was the motor-driven means of transport that were most noticeable, as they were able to cover greater distances in less time, and this consequently affected the way people lived and of course affected the way military operations were organised and conducted. In other words, the distance that used to separate the great centres of power became shorter and shorter as a result of greater speed and the mass use of transport. It is for all these reasons that we will then approach the study of borders from the perspective of military geography.

Inspired by the index of elements that Lieutenant Colonel Villanueva bequeathed to all the readers of his work in 1925, I have developed a classification that I will present here in seven variables (with their internal indicators), which will assist in understanding and evaluating the most important inventions and resources that arose between 1859 and 1936. The fundamental basis lies in understanding that there are inventions in one field that have an impact in other fields and thus promote a certain development path or action.

So, let us therefore look at the variables and their indicators, first schematicly, and then briefly. I would like to stress once again that this outline is based on Spain as a modern European state in the period from 1859 to 1936. The indicators will necessarily change with changes to the space and time of the country or location under analysis:

1. Armament (A): Infantry, Cavalry/Armoured, Artillery, Trains*, Vehicles*, Vessels*, Submarines*, Aircraft* and Airships*. Ammunition, creation of the cartridge and howitzer, explosive ammunition.

2. Fortification (F): Permanent (castles, bastions, and bunkers), and Field (trenches and trench lines, casemates).

3. Ideas (I): Philosophical, cultural, sociological, , political, economic, etc. perspectives as the basis for the formation and global expansion of modern states.[2]

4. Demographics (D): Population growth or decline (rising or falling birth and death rates).

5. Science (S): Scientific advances in the fields of industry, medicine, chemistry, physics, cartography, transport, etc.

6. Natural resources (R): Energy type (coal and oil), mineral type (needed for products), and agri-food type (food).

7. Communication channels (C): Roads, railways, canals, bridges, tunnels, cable* or radio communication*.

Several elements are marked with an asterisk (*) in this classification, this is to emphasise that in those years we find on one hand a series of civilian inventions that ended up in military hands, while on the other hand there is a series of specifically military inventions. In the first case we have railways[3] and automobiles on land; steamships and submarines at sea; aircraft, hot air balloons and airships in the air; as well as cable and radio communications. In the second case we have the purely military use of everything mentioned just before added to armoured trains and armoured vehicles; armoured steamships, war submarines, aircraft for reconnaissance, fighting and bombing, and airships and hot-air balloons for surveillance and even attack; in armament we find automatic weapons,[4] rifled guns,[5] explosive ammunition,[6] and toxic gases.

Of all the above, there is undoubtedly one invention that stands out above the rest in the works of the Spanish military and their war planning and execution: the railway. This mass transport on land was a crucial turning point in world history as it was the first land transport capable of moving immense masses of troops and supplies in war, but also serving for the intensive trade of goods and transport of people in peacetime. The railway brought an unprecedented shortening of distances, which meant for military actions that the period of mobilisation and concentration of ground troops went from being counted in weeks to being counted in days. Arriving a day late to complete the concentration of its own army to defend its threatened border could mean a serious defeat. It could even lead to a national debacle were it overwhelmed

2 Also noteworthy are international border treaties (delimitation or regulation), international cross-border organisations, creation of border security and internal police forces (carabineros and civil guards).

3 With its tramway and underground metro variant for passenger transport in the ever-expanding industrial cities.

4 For example, machine guns, which greatly multiplied the number of shots a pair of soldiers could fire.

5 Such guns greatly increased accuracy and range, both for infantry, artillery and ship-based weapons.

6 Used to cause devastation in areas, resulting in the need to hide troops in trenches or curtains, even later in underground bunkers out of sight and range of enemy weapons.

and crushed, or having to abandon some strategic territory of high demographic and economic value due to defensive incapacity. The 20th century saw the emergence of automobiles, a flexible companion to the railway. Both played an important role for military transport in the First World War.

Also noteworthy on the naval side was the creation of large, armoured vessels, both for war and transport. Air weapons, a brand new invention of the 20th century that had been constantly evolving since its appearance, offered new capabilities for military action. This will also be discussed below, albeit more briefly than rail and car land transport. Common to all these inventions was their speed and portability and their ability to overcome geographical features that had once been considered of great defensive value. These inventions had a direct impact on military planning of States, which raised a particular question: how could a country now defend its borders?

3. Defining borders in military geography

To define the concept of borders as expressed by the Spanish military, we first have the work of Infantry Commander Manuel Romerales Quintero and his *Estudio geográfico, militar y naval de España* [Geographical, military and naval survey of Spain]. Borders are "the dividing lines that separate different states". Internally, "borders are divided into natural, artificial and mixed". Regarding each type, the commander notes the following (1915: 145):

1. Natural borders "are those formed by a natural feature, which establishes a separation between the inhabitants of the regions on either side of it. Such boundaries include all those formed by a mountain range, a mighty river or the sea".
2. Artificial borders, "also called conventional borders, are those which, as a result of an agreement between the countries they separate, follow an agreed course, without natural obstacles determining them".
3. Mixed borders "are those derived from the two types of borders mentioned above".

A few years later, we find a similar definition in the work of Infantry Captain Lucas de Torre (1921: 19):

> "Borders are the lines or areas of land that mark the limit of a people's or nation's land area. Geographically, they are considered to be divided into two classes: natural and artificial. The former are those which rest on geographical features of sufficient importance to constitute by themselves an obstacle to the march of armies, and the latter are those which, drawn at random in the midst of regions which nature sees as one, follow a conventional direction, fixed in advance by international treaties".

So far, the definition of borders is seen as natural, artificial or mixed lines or zones of separation. However, when we return to the work of Lieutenant Colonel Villanueva, we see a different vision of borders, which "may be considered as zones, from the geographical and political point of view, and although these aspects are inseparable from the military, in the tactical and strategic order, it is necessary to consider them as lines with all the consequences that their very conception entails, an artifice of men at odds with geographical realities" (1925: 155).

This allows us to understand that borders are both zones and lines at the same time (the difference is in the approach, whether it is geographical or military). In fact, he denies the existence of natural borders because for him, all borders are created by human hands, and therefore, "there is no scientific rigour today that allows it to be accepted as a starting point for the rational study of borders" (1925: 154). He goes on to point out that the origin of the idea of borders as natural or artificial comes from the false association of mountain ranges and rivers as walls and moats of the country. Borders are, therefore, an artifice which requires the greatest care and the most meticulous foresight [...] and by which the first clashes of a war, which, as is well known, tend to be the most momentous, must be presided over" (1925: 155)

Indeed, earlier works by important Spanish military officers maintained the idea that natural boders were based on some important geographical feature, while artificial borders were drawn over open country. As a result, natural borders were synonymous with military borders for the defence of the country. The underlying idea was that the existence of a significant geographical feature (especially mountains and rivers) meant that with a few military works and small garrisons a realistic defence could be maintained, in other words, with the lowest budget. Whereas, on an artificial border, i.e. in the open, much more must be spent on military works and establishing larger garrisons (in short, higher expenditure). Let us look at two examples:

– Natural [borders] are also called military borders, because of the defensive value of the accident that determines them, and on the other hand, a nation whose confines are artificial is said to lack borders (García Alonso, 1901: 13).

– Natural borders are also called military borders because the accidents that form them are, when necessary, defensive lines; on the other hand, a nation is called a borderless nation if it has only artificial ones (Mariscal, 1907: 32).

Finally, on the typology of boundaries, Villanueva points out the existence of two types not mentioned in previous works (1925: 156-157):

1. Buffers: A strong State establishes neutralised States around it. The example of this would be Belgium as a neutral country.

2. Strategic boundary: One State seeks to control a border sector of a rival State. The example here would be France vis-à-vis the west of Germany after 1919.

As we can see, the Spanish military studied borders, especially land borders, because the great wars were fought over land, and therefore the great movement of armies took

place over land (although the naval factor was never neglected). Consequently, the defence plans to be drawn up had to be constantly updated, taking into account those human inventions that transformed geography so that its features no longer had:

> "[…] the value they used to have in war. So that the geographic-military problem relating to borders will consist of the correct evaluation of these features, adapting them to the circumstances of the present and knowing how to make the best possible use of the conditions of the land" (Villanueva, 1925: 155-156).

4. The land revolution: railways and automobiles

As noted above, the railway stands out from other technological advances in this period. It had two possible uses: in peacetime it was the fastest, mass transit system for raw materials, goods and people; and in wartime it was equally fast and large-scale for transporting soldiers, weapons and supplies to defend one's own borders or, conversely, to cross one's own borders into neighbouring states. At that time, the Spanish military understood that the railway was crucial for the economic and social progress of Spain, apart from being the main tool for (defensive and offensive) war operations. In this sense, the Spanish military's understanding of the use of railways evolved in parallel with the evolution of events, both in relation to the economic development of the great European colonial empires and in relation to the results of some of the wars that marked a turning point in history, for example, the Franco-Prussian War (1870-71) and the First World War (1914-18). It was precisely these wars which were test of blood and fire, that showed how important it was understanding railways and knowing how to use them for military purposes, especially for transporting troops to one's own borders or frontlines during war operations.

4.1. Railways and national prosperity

Among the Spanish military of this period, Epifanio Gascueña Gascón, commander of the General Staff Corps, and his work *Los ferrocarriles españoles y la defensa nacional (Spanish Railways and National Defence)*[7] stands out. This work is absolutely key for everything it deals with, as it establishes an intimate and total connection between railway activity in peacetime (for trade and communication) and actions in wartime, which we will address. Afterwards, we will see the outline of the history of the military use of the railway by Commander Gascueña, where he highlighted the most important wars and the role played by the railways in them.

7 According to the title page, it won first prize for the General Staff theme in the 1920 official competition for military themes.

In analysing this valuable work, I will start with the chapter on "Importancia social de los medios de comunicación y de transporte y de los ferrocarriles en particular" [Social importance of means of communication and transport, and of railways in particular].[8] In this respect, Commander Gascueña stated that, "the new discoveries that have facilitated the speed of communications and transport and eliminated the greatest distances, constitute the essential factors in the interweaving of the economic structure of contemporary society" (1922: 17). From among all these factors:

> "The railways stand out as the first among peers. Without them, large-scale industry could not have blossomed and developed. In addition to the commercial and industrial advantages, railways are of great national interest from the moral and political point of view: they eliminate distances and ensure national unity, because the more connections and journeys, the greater the community of interests; with the greater the contact, prejudices disappear".

In short, for Commander Gascueña: "Railways are, therefore, instruments of civilisation and progress. Of all human works, it is the one that has produced the greatest economic and social revolution and the one that indicates most surely and best the degree of civilisation, progress, power and well-being of a nation" (1922: 17).

Commander Gascueña also addressed the purely military issue of railways, i.e. strategic railways.[9] He strongly emphasised the relationship between the wealth of the country developed in times of peace and the military use of the railways since, "the interests of national defence are the same as those of the normal life of the country" (1922: 31). This, in his words, is justified as follows: "The railway that develops the wealth of a region contributes to the defence, moreover, [...] the general wealth of the country is the first element that must be counted on for the preparation of war" (1922: 32). From what has been seen so far, it is clear that the "intimate link between the general interests of the country and those of national defence make it necessary to study the strategic railways in their double character as military and commercial lines, as elements of strength and wealth" (1922: 83).

The work of Lieutenant Colonel Villanueva, for its part, is also very relevant for an overall, deep vision of the use of railways in the civilian and military spheres, that is, in peace and wartime. In his work he pointed out that (1925: 164):

> "All peoples have endeavoured to improve their railway networks, to structure them appropriately for the use of such a decisive element of war [...], and to ensure, at the same time as a prosperous economic development, an effective intervention of the State [...] which, [...], will always keep them ready to exercise their high mission in the defence of the country".

8 Chapter II of the book (Gascueña, 1922: 17).

9 Strategic railways are those built solely for military purposes, without any commercial justification.

In addition, Lieutenant Colonel Villanueva also highlighted the economic value of the railway in his work, since (1925: 141):

> "One of the main sources of wealth consists in the development of industries [...], requiring the establishment of communication and traffic routes to meet growing needs [...]. When the regions in this case are close to borders, all circumstances introducing modifications must be the object of special attention on the part of the governments responsible for the security of the country, since the works carried out, and especially the roads and railways, may alter the defensive conditions of that sector and contribute more easily, by falling into the hands of the enemy, to the attainment of one of its most coveted goals".

Thus, we can clearly understand that the vision of the most important military men of the time was that industry was on one hand the source of wealth and progress of the country, and on the other hand, a basic military target to be especially careful about when located near a border. In this sense, armies will defend in war what is prosperous in peace, for therein lie the objectives of every enemy: conquer what would increase its economy and, conversely, dispossess its rival of the sources of wealth and production.

4.2. Railways as a weapon of war

Having pointed out their great importance of the railways in terms of trade, wealth and progress, let us look specifically at its military importance in history, as this is the most important value with regard to military geography. Commander Gascueña made a short and precise historical summary in which he chronologically presented the development of the railway in the wars (1922: 20-22) from its origins in the mid-19th century until 1918, the end of the Great War:

> "The military use of railways began with the trial in England of transporting a regiment from Liverpool to Manchester (50 kilometres) in two hours back in 1832. The Danish campaign (1849-51) already provided an example of a major troop transport, with 75,000 infantrymen, 8,000 horses and 1,800 carriages being driven from Vienna and some Hungarian towns to Brunn and Olmutz in twenty-six days by six or seven trains a day. But it was not until the war of 1859 that the railways really played an important military role. In that war, some 604,000 men and 130,000 horses were transported from the French squares to the theatre of operations in Lombardy; in ten days, the 35,000 men and 4,500 horses of the Imperial Guard were moved from Paris to the Sardinian border. In addition, the railways were also used with the greatest success to transport reserve troops to the battlefield.
>
> The American Civil War (1861-1865) was even more conclusive, [...].

> That war fully demonstrated the possibility of undertaking operations at considerable distances from supply centres thanks to railways. It showed the need for special organisation to re-establish lines destroyed by the enemy, and highlighted the difficulties involved in combining the military and technical elements in the management and operation of railways. In short, it was the first in which railways were used systematically and skilfully for military-technical purposes.
>
> Moltke in Germany realised early on the role railways could play in war and the measures he took as Prussian Chief of Staff had a favourable impact in 1866[10] and much more decisively in 1870.[11] All military writers have recognised that one of the most important causes of German success in the last of the above-mentioned wars was the speed with which the forces were mobilised and transported thanks to the railways and the excellent organisation and smooth operation of the military railway apparatus.
>
> The Franco-Prussian war finally convinced the whole world, and obliged states to take a series of resolute measures based on the principle that railways were one of the most important and effective elements of modern warfare, not only strategically, but also logistically and even tactically, if all the necessary precautions had been taken in terms of the organisation and military preparation of the railways during peacetime.
>
> The wars following the Franco-Prussian war brought nothing new to the means of transport other than corroboration of what has already been said. In the Boer War[12] and in the Russo-Japanese War[13] it became clear that the iron road was the only supply route for troops. In the latter war, the railway was like an umbilical cord for the Russians and they had to take care of it above everything else. Thus, the main operations and battles were fought in the vicinity of this track".

Finally, on the military history of the railways, Commander Gascueña dealt separately with the role of the railways in World War I (1922: 22). This war was significant not only because of the improvement of railway use, but also because it included a newer means of land transport, the automobile (which we will discuss later). But, to return to the First World War, the railways "gave a formidable performance their use; from a strategic point of view, above all, they surpassed the limits attributed to their potential" (1922: 24). In this regard, Commander Gascueña highlighted the actions of mobilisation and concentration, as the main European powers competed to

10 1866 refers to the Austro-Prussian war.

11 1870 refers to the Franco-Prussian war.

12 There were two Boer wars, the first in 1880-81, and the second between 1899 and 1902. I believe that the author is referring only to the second, as it was the longest and involved the largest number of troops.

13 The Russo-Japanese war took place in 1904-05.

carry out these preparatory actions in the shortest possible time, given that: "A single day's advance in concentration represents a considerable advantage over the adversary, because a fully prepared army can throw itself upon an army that is not yet prepared" (1922: 24). Finally, on concentration, Commander Gascueña also remarked "that the speed of concentration depends on the length of the line in conjunction with the proper functioning and strength of the transport" (1922: 24).

Commander Gascueña also explained the use of the railways for military concentration, saying that from all this mass, rapid use of the railways creates the inherent need to supply the huge military masses with huge quantities of supplies at all times, as an army cannot sustain itself in action without all the necessary supplies. In short, "supply and evacuation transports are, therefore, another necessity of strategy" (1922: 19). In addition to the factor of constant supply, he also pointed to speed as a crucial factor in warfare; speed is key to surprise attacks or counter-attacks with reserve forces. "In both cases, it must be ensured by the above-mentioned transports that the mass is a warrior mass" (1922: 19).

4.3. Railways and automobiles

As previously mentioned, technological advances in the First World War were not limited to the intensive and planned use of railways, but also to the mass use of automobiles. In this regard, Commander Gascueña mentioned that since World War I, the automobile and the railway had been the best mechanical means of land transport, and consequently the military strategy required the use of both means of transport. It was explained by the military man in this way (1922: 19-20):

> "Without the railroad and the automobile, the troops required by the armed nation would be impossible, because the local resources could not feed them and the necessary supplies would have to be brought from the rear; nor could concentrations of dozens of divisions be made for a battle without taking a long time [...]; it would also not be feasible to bring from the factories, scattered throughout the national territory, the ammunition required for rapid-fire equipment, and the considerable work in the intensive use of fortifications would not be achieved for lack of material and machines".

Later, in 1934, for the commander of the General Staff, José Clar, automobiles and railways were already two inseparable and necessary elements in war. He pointed out that roads and railways were "the arteries through which the life of that monstrous Mars, a nation at arms, circulates" (1934: 64).

In fact, such was the importance of railways and automobiles in the military field that Commander Gascueña stated that because of them the war "has degenerated into a war of transport as much as a war of matériel" (1922: 20), and all manoeuvres, both strategic and tactical, would be conducted by rail and road transport. In this

regard, mention should also be made of the importance he attached to double-track lines, as opposed to single track, since a double-track route could establish an outward and a return direction, which would greatly increase the speed and effectiveness of deployment, as well as the withdrawal of material and the return of casualties.

On the question of which transport was faster (train or car), Commander Gascueña did not prefer one over the other, but rather described the optimal scope of action of each transport resource, so that they could be understood and used in the most efficient way (all exemplified by the historical cases of the First World War). Accordingly, in the words of the commander (1922: 29):

> "The car is less bound than the railways to rigid routes, is more flexible and less influenced by the destruction wrought by aviation; but it is naturally subject to the number and condition of the roads, and is greatly affected by the inevitable congestion which always exists in areas where military operations are carried out".

As for Commander Clar, the rail network needed to be complemented by the road network in order to establish, through the flexibility of roads, a large number of points of contact between troops, as well as to have alternative ways to move in case one of them was destroyed by the enemy, among other reasons (1934: 64). He also stressed the importance of cars during the First World War in providing the troops with all the supplies they needed to continue fighting. Lieutenant Colonel Villanueva noted "the 4,000 taxis that took 70,000 men from Paris to Meaux in 6 hours contributed to the victory at Marne" (1925: 162), and also mentioned in his work the massive use of trucks that supplied Verdun (1916) through the *voie sacrée* and served to sustain its defence.

As for the capacity of each transport, Commander Gascueña explained that the capacity of 150 lorries is equivalent to that of a single train, making the automobile a good complement to the railway, but not a substitute (at least with the technological advances of the time). In this sense, "the car has its special value as a distributing agent and for stage service" (Villanueva, 1925: 162). In fact, in 1925 the commanders Irureta-Goyena and Serrano also pointed out that the automobile was very useful for rapid concentration, but at the same time it was costly and fragile, requiring a lot of material and human resources (Irureta and Serrano, 1925: 173). What these Spanish military personnel had in common was the appeal to the speed of action provided by war transportation (in the mobilisation, concentration and military operations that took place in the wars of those years).

Going a little deeper into the matter, Commander Gascueña pointed out that (1922: 30):

> "The motorcar industry has been more involved than anything else in strategic operations on the battlefield where railways were absent or insufficient, or no advantage could be gained by using the railways because the distance to be travelled was not long enough. With surprise being a function of swiftness and swiftness being a function of transport speed, all

> the means at one's disposal to form concentrations in the theatre of war capable of bringing about a decisive and important victory will always be too little and insufficient".

Finnaly, as it is the latest work, Commander Clar also made recommendations similar to those of the aforementioned military men. For example, he recommended the use of the car for short distances (less than 100 kilometres) and for more than 100 kilometres he recommended the railway because "it is enough to remember that one train is equivalent to 170 lorries" (1934: 75-76). He went on to point out that the disadvantages of cars include breakdowns on long journeys as well as wear and tear on the roads.[14] Commander Clar concluded that, up to that time (1934), railways were unrivalled in moving large quantities between distant points. Furthermore, railways, with a smaller staff, could move more material with less expenditure of fuel, at greater speed and taking up less space, and railways suffered little wear and tear compared to cars (1934: 76).

5. New weapons and new scenarios: the seas and skies

General Lamarque stated: "It is quite possible that steam will one day bring about as complete a revolution in the means of warfare as the invention of gunpowder" (1885: 232). And indeed it was, as we have already seen in the case of land transport and will now see in much greater detail with regard to naval and air transport. Motorised transport was not only used on land —trains and cars— but also at sea and in the hitherto unknown field of air transport. This was stated by Lieutenant Colonel Villanueva: "the achievements of aviation bring a third dimension to the notion of borders" (1925: 157), i.e. in addition to land and sea borders, there were now air borders. But we will start at the historical and technical level. Infantry Captain Benito Martín, in his scientific-military studies, described the situation (1909: 112-113):

> "Three elements surround us on the globe, namely land, water and air, on which man has tried to march in the best conditions of speed and safety. The first thing he thought of was to perfect the natural faculties of moving on the ground, making use of animal tractors, applying wheels to vehicles, taking advantage of the propulsive force of steam, oil, electricity, etc. The almost intuitive ability to support oneself and move, using water as a support, has been progressively improved by mankind, inventing boats with oars, sails, steam, and nowadays reaching the point of submerging and moving in the depths of the liquid with submarines, built in almost all nations. The same efforts have been made by man to become master of the air, and yet many centuries have passed without any result".

14 In addition, both cars and roads require a large number of staff and a large amount of material for repairs.

5.1. Naval forces

The Infantry Commander, Francisco Villamartín, who was a highly renowned military officer from the 19th century (and revered to this day in the 21st century), expounded in his military thinking a remarkable quality of steamships, which is that they can sail in any direction no matter which way the wind blows. In his words, this has a very important military consequence, since (1883: 590):

> "A squadron of steamers can rendezvous and assemble on the same day, and perhaps at the same hour, at a point on the high seas, with the confidence that few or none of the steamers will miss the rendezvous, whereas a sailing squadron cannot because of the danger that the ships may not be able to arrive at the proper time. Moreover, it is sometimes forced to disperse against its will, because its departures, movements and manoeuvres depend on the wind and the sea".

With these possibilities for action by naval forces, it is worth noting the words of Lieutenant Colonel Villanueva, where he pointed out that in a historical perspective (1925: 37):

> "At one time, the peoples surrounded by the sea were, in a certain sense, distanced from the life of relationships for which that element was an obstacle due to the scarce development of maritime navigation, [...] it was easy to isolate themselves politically at will, [...]; the seas were real moats that defended them from possible enemy attacks".

But since the 19th century, new motorised ships had also reduced the time it took to travel what once had been large distances. However, it was not all advantage. Just as modern land-based armies require constant mass resupplies, so too do navies to be constantly resupplied in order to continue their military movements and actions. This need was covered by the creation and defence of naval bases that were always adapted to the military conditions of the maritime and land forces in the 19th century, with air bases being added in the 20th century (Gascueña, 1922: 144-157).

Regarding the steamships and the large cannons installed on land and on ships, Lieutenant Colonel Villanueva indicated that the "artillery on a coast may keep an enemy at bay, but [...] it never represents control of the sea, rather a guarantee that the maritime borders will not be breached" (1925: 150). Another element to be taken into account were the steam transport ships, whose use was crucial for any landing in enemy territory, "but they can also be powerful auxiliaries of the land-based concentration when there is maritime superiority and there is no great danger that the convoys could be surprised by the enemy" (1925: 187).

Finally, of all the most innovative naval inventions of the period, the submarine stands out for its ability to navigate and attack under the sea. Commanders Irureta-Goyena and Serrano pointed out that during the First World War (1925: 16):

> "The submarine was used for the first time, and in the midst of wartime operations a great step was taken in the development of underwater navigation, from the first small-tonnage, short-range submersibles to larger ones, and it was even the case that in this great conflict the *Deutschland*, a merchant submarine, was launched, which reached the United States and returned to Germany, without being hunted by its adversaries".

5.2. Air forces

As we have already seen, engines on land and at sea had revolutionary applications, increasing the capacity and speed of transport in times of peace and war to unprecedented levels. But the flying machines also opened up the skies, creating a new point of contact or conflict for humanity. A new place for trade or war over land and sea Commanders Irureta-Goyena and Serrano again pointed out something similar to the submarines, in the sense that it was during the First World War "when aerial navigation acquired enormous development and it can be said that at the end of this conflagration of races and continents, it is known more for military applications than others" (1925: 467). We are going to focus on the military applications of these mechanical birds, because in the opinion of those commanders, planes "will cease to be, as they were at the beginning of the 1914 war, just 'the eyes of the army' and will become a very important factor in victory" (1925: 468). And indeed, time has shown the ever-increasing importance of aviation to military operations in all subsequent wars.

The development of aviation was already such at the time of Commanders Irureta-Goyena and Serrano that they described in their work the basic organisation of aeronautics as follows (1925: 468):

> "It includes aviation, aerostation and air defence.
>
> *Aviation* uses heavier-than-air aircraft, organised in squadrons; it observes by means of its reconnaissance units, for the benefit of the various weapons; it bombs and fights with its bombers (day and night) and fighters.
>
> *Aerostation* uses lighter-than-air aircraft and is given the same general surveillance, firing and liaison missions as reconnaissance aviation, with which it coordinates its action.
>
> *Air defence* has ground-based protection assets; artillery groups, machine gun units, searchlight personnel, tethered balloon personnel, concealment personnel, pursuit and transmission service".

Although aeronautics had been developed in the 19th century with airships[15] and these proved very useful for gaininga high view of unknown terrain for photography and mapping, as well as for bombing, they were quickly superseded and replaced by the development of aviation during the First World War. Commander Gascueña indicated that for the defensive organisation of borders, it was not only necessary to have railways and roads, but also: "Numerous airfields will form the bases of the aircraft which are to carry out and assist reconnaissance or to prevent those of the enemy, with which they will have to fight in order to become masters of the skies" (1922: 10). On this last point, Commanders Irureta-Goyena and Serrano explained that the planes would need a flat, clear field on which to take off and land as well as facilities for storing, repairing and refuelling the planes, and a command post for these air weapons (Irureta and Serrano, 1925: 471).

But how much military utility do aircraft have in warfare? Commanders Irureta-Goyena and Serrano also described the missions that these flying weapons could perform. 1) *Information*: Distant reconnaissance and aerial photography to ascertain enemy positions and strength; close reconnaissance to ascertain the destruction carried out (1925: 472). 2) *Artillery*: Support to artillery units in their destructive work (1925: 472). 3) *Link*: Connection between different army units when the communications network is destroyed in an offensive (1925: 473). 4) *Combat*: "These missions involve: aerial combat, in order to gain control of the air; the prohibition of enemy aircraft from certain regions; the protection of certain aerial reconnaissance; combat against troops" (1925): 473. 5) *Bombing*: Attacks "on the rearguard, cantonments, cavalry mustering, batteries, livestock staging posts, stations, ammunition and materiel depots, bridges, headquarters, etc." (1925: 475). In addition, these bombings would also attack "large industrial centres, naval and air bases, and other similar ones of real military importance, because of the direct influence they have on operations, and they also compromise mobilisation and concentration" (1925: 475). 6) *Special*: Troop supply and offloading (1925: 476).

The result was a new means of attack, whose destruction from the air could reach both the front line and the vital centres in the interior of the country. The creation of anti-aircraft weapons was therefore logical and necessary. This would be the air defence mentioned earlier by Commanders Irureta-Goyena and Serrano, but Commander Clar went into more detail (1934: 145-146):

> "Air defence, or anti-aircraft defence, has a variety of means, some active and some passive. Among the former, we can cite aviation, artillery, machine guns, searchlights and sound locators; among the latter, we can name barrage balloons, shelters, camouflage, various rescue services, etc.; and as a complement to each other, there must also be information, pursuit and transmission networks".

15 For more information on this interesting topic, see the historical overview and military action capabilities of airships from the second half of the 19th century, both for reconnaissance and bombardments (Martin, 1909: 112-131).

6. Conclusions

In the light of history, technological advances forced the Spanish military to adapt the planning and execution of its military operations. It focused in particular on international war events, where other militaries would use the new devices as part of their national arsenals and where the fate of countries and peoples would be decided.

In the field of military geography, technology opened up a new space to add to land and maritime borders - airspace, a third dimension of borders. The possibilities offered by aviation to attack further afield and with greater ease also meant that special measures had to be taken to defend against such aerial onslaughts. And in the face of so much progress, other old weapons became obsolete to the point that historical weapons such as cavalry were called into question in the face of the incipient *armoured cavalry*. Cable and radio communications brought people, countries and armies into rapid connection. The industrial-military revolution of those years changed the face of the world by action or reaction, starting with the modern states that competed with each other for the whole world. Their expansive pretensions drove them, and their technologies opened up new possibilities.

Territories that were once difficult to cross, and seas that were once so vast to navigate, began an irreversible process of shrinking in the face of the roaring engines that propelled merchants and armies of different states around the world. Where it previously required months to mobilise and concentrate an army, it was now a matter of weeks or even days as the use of railways intensified and the mass use of automobiles took off. Where previously there had been a clear border separation, the new large-calibre guns with kilometre-long ranges brought them easily within attack. Where there was previously no economic value, suddenly, the discovery of some energy or mineral resource made the area crucial to the possessor's growth in peacetime and sustenance in wartime.

Ultimately, technological changes necessarily implied military changes in each country. They had to adapt the technological innovation for offensive use or defensive preparation, as could be seen from the incremental additions by creators to put theory into practice. This was as true then as it is now, and will continue to be true in the future. General geography, as we have seen, is not a field limited to its physical part, but encompasses all fields as is well reflected in Lieutenant Colonel Villanueva's index. We must always take into account the changes in physical factors, political factors and military factors to produce the most up-to-date assessments of geography applied to military requirements. Or even use the 7-variable methodology with internal indicators that I developed from Villanueva's essential reading.

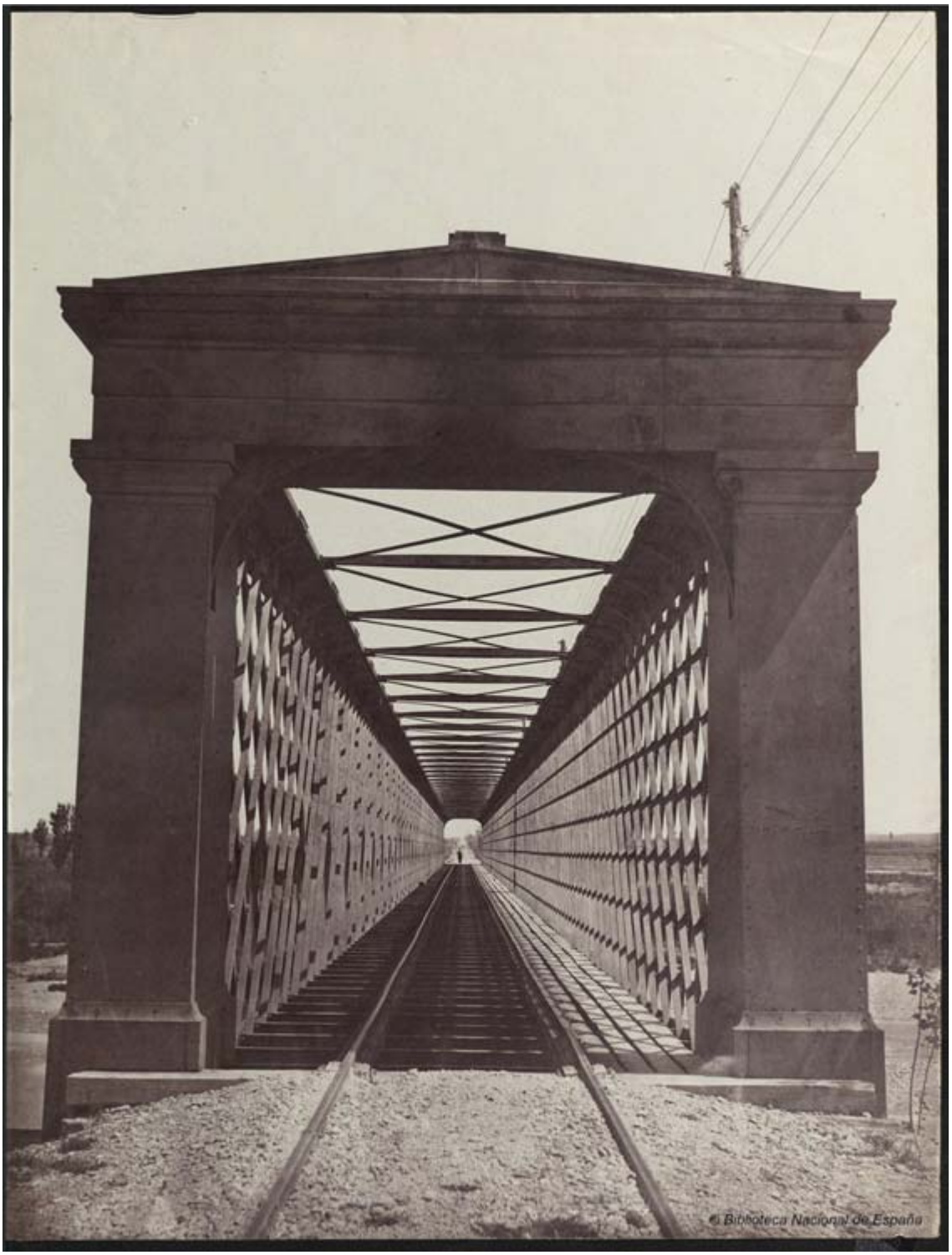

Fig.1. A photograph from 1867 showing three technological symbols of this modern period just analysed: railway tracks across an iron bridge, with telegraph poles for communication[16].

16 M. Sánchez. "Iron bridge". (1867). [Accessed: 01/10/2022]. Available at: http://bdh-rd.bne.es/viewer.vm?id=0000018644.

Bibliography

Anonymous (1887*). Geografía militar de Europa. La geografía es la base en la que se funda todo problema estratégico* [Military geography of Europe. Geography as the foundation for all strategic problems]. *Preliminary, on reel ML-306-A (SA/M27).*

Barrios y Carrión, L. (1884). *Geografía militar de España* [Military geography of Spain], Barcelona.

Casanueva y Novak, V. (1902). *Nociones de geografía militar* [Concepts of military geography]. Valladolid.

Castaños y Montijano, M. (1889). *Geografía militar de la Península Ibérica* [Military geography of the Iberian Peninsula]. Toledo.

Clar, J. (1934). *Un fragmento de la Moderna Geografía Militar de España* [A fragment of Spain's modern military geography],. Toledo.

Díaz de Villegas, J. (1936). *Geografía militar de España, países y mares limítrofes* [Military geography of Spain, bordering countries and seas]. Printing works and workshops of the Ministry of War. Madrid.

García Alonso, C. (1901). *Compendio de Geografía militar escrito para oficiales de la Reserva* [Compendium of military geography for reserve officers]. Madrid.

Gascueña Gascón, E. (1922). *Los ferrocarriles españoles y la defensa nacional* [Spanish railways and national defence]. Madrid.

Gómez de Arteche, J. (1859). *Geografía histórico-militar de España y Portugal* [Historical-military geography of Spain and Portugal/. Madrid.

Henry, R. (1885). *Ensayo de un compendio de la filosofía de la guerra ó Colección de máximas militares* [Compendium of war philosophy or a collection of military maxims]. Barcelona.

Irureta-Goyena, J. and Serrano S. (1925). *Nociones de Arte Militar* [Concepts of military art]. Madrid.

Mariscal, L. (1907). *Compendio de geografía militar de España y Portugal* [Military geography compendium of Spain and Portugal]. Valladolid. [Accessed: 14/02/2022 [online]. Available at:http://bdh-rd.bne.es/viewer.vm?id=0000201394&page=1.

Martín, B. (1909). Estudios científico-militares: Telegrafía y telefonía, proyectores y explosores, automovilismo y navegación aérea [Scientific and military studies: telegraphy and telephony, spotlights and blasting machines, motoring and flying]. Toledo.

Romerales Quintero, M. (1915). Estudio Geográfico, Militar y Naval de España [Geographical, Military and Naval Survey of Spain.]. Madrid.

Sironi, G. (1885). *Ensayo de geografía estratégica* [Essay on strategic geography], Madrid.

de Torre, L. (1921). Geografía militar de Europa [Military geography of Europe.]. Toledo.

Villamartín, F. (1883). *Obras selectas de Don Francisco Villamartín* [Selected works of Francisco Villamartín]. Madrid.

Villanueva López-Moreno, L. (1925). *Bases para el estudio de la geografía militar [Foundations for the study of military geography]*. Madrid.

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