



Production of Nautical Literature in Spain, in the Nineteenth Century

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ARTICLE INFO

Article history:

Received 21 December 2012;
in revised form 07 January 2013;
accepted 09 February 2013

Keywords:

Nautical literature, Spain, 19th
Century, Bibliographical catalogues

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ABSTRACT

Navigation was not immune to the difficult circumstances that Spanish science experienced during the nineteenth century. Since in scientific and technological disciplines the transfer of knowledge occurs primarily through specialized publications, their study can provide significant information about the development of a specific field at a given place and time. Taking as a basis an existent bibliographical index that includes 260 nineteenth-century Spanish nautical works, the chances for the evolution of navigation shall be discussed in this paper, in the light of the vicissitudes of the nautical literature edition in Spain in the Nineteenth century.

1. Introduction

In Spain, the advancement of science and technology in the nineteenth century was hindered by political instability within the country. Very little domestic scientific production took place, and even less was done to keep abreast of the advances taking place abroad¹.

In scientific and technological disciplines, the transfer of information occurs primarily through specialized publications. Their study has proved an effective means of tracking the spread of new ideas², hence their importance to the history of science and the unquestionable interest of historical researchers in examining catalogues of these printed sources. The analysis of these indexes can also provide an insight into the evolution of a particular discipline at the place and period considered.

In order to see if the devastating cultural framework of nineteenth-century Spain proved true in the nautical field, an analysis of the Spanish specialized literature production has been conducted. The results shall be discussed in this paper.

2. Methodology

In order to perform the analysis of literature production that comes next³, an index of Spanish nineteenth-century nautical works has been prepared firstly, taking as starting point the bibliographical index compiled by Llabrés Bernal (1959). Other bibliographical indexes have been consulted, including Fernández de Navarrete (1851) and Palau Claveras and Ponce de León (1943). In the first approach, 260 works on the discipline 'Cosmography and Navigation' were compiled, 21 of which were not listed by the mentioned authors but were found in libraries or archives⁴. Key aspects supporting the preparation of this index are:

- Works (published and manuscripts) on Cosmography and Navigation have been listed, including those of a historical character.

¹ The cultural scenario of the nineteenth-century Spain has been outlined, *inter alia*, by Vernet (1975), López Piñero (1992) and Sánchez Ron (1999).

² See, e.g.: Ibáñez, Llombart and Iglesias (2004).

³ It is also worth mentioning that our intention was not to perform a complete bibliometric study, although some ideas have been taken from: Price (1973); López Piñero, Terrada and Portela (1984); and Capel, Solé and Urteaga (1988).

⁴ Some texts have not even been found but their existence has been somehow corroborated. For instance, reference to the unpublished manuscript: José B. de Goldaracena (1851) *Tratado de navegación*. Bilbao, has been found in the record of the author kept at the archive located in Alcalá de Henares: Archivo General de la Administración. Sección Educación y Ciencia. Legajo 5725.

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- Works related to other nautical disciplines such as ‘Ship handling’ or ‘Naval architecture’, have not been gathered.
- New editions and reprints have been included.
- Translations into Spanish of foreign texts related to navigation have been included.
- Articles published in journals have not been listed, except those who had offprint.

The histograms and tables included in this paper have been prepared based on this inventory. The total number of works has finally been reduced to 233. The criteria followed for the preparation of the data are:

- Works have been arranged according to their edition year.
- Some works that have been excluded are:
 - Historical texts
 - Manuscripts
 - Booklets that are less than 10 pages in length
 - Periodical works like almanacs and yearbooks

Among them, we find 146 works strictly related to navigation. Those are the works that remain from the previous index, after picking off the texts on hydrography and even the cosmographies and other works on astronomy. For works that comprise more than one volume, it has only been taken into account the volume covering the subject navigation.

These data support the interpretation of the vicissitudes of the nautical literature production, in the light of the troubled political unrest which hindered the progress of science and technology in nineteenth-century Spain. To put it in context, the background to the issue shall be provided in the first place.

3. Background

The venture of the discovery, conquest and exploitation of America, were the circumstances that led to the fact that one of the areas of scientific activity more developed in sixteenth-century Spain was the art of navigation, and closely associated to it the naval architecture and the nautical cartography⁵. The numerous losses that occurred, not only due to the imperfection of the art but also because of sailors’ ignorance, led the Government to control the mariners’ training, through the *Casa de Contratación* of Seville⁶, and to protect those who disseminated nautical knowledge, which favored the emergence of more or less notable writers who compiled the rules and precepts of the profession, in order to facilitate their understanding to mariners (Márquez y Roco, 1875).

Books just compiling nautical rules such as *Suma de Geographia* (Sevilla, 1519) by Martín Fernández de Enciso and *Tratado del esphera y del arte de marear* (Sevilla, 1531), by Francisco Faleiro, were followed by more complex texts called *Artes de navegar* and *Regimientos de navegación*⁷. The supremacy of Spanish treatises is widely recognized and reached its algid point with the famous *Arte de navegar* (Valladolid, 1545) by Pedro de Medina and *Breve compendio de la sphaera y de la arte de navegar* (Cádiz, 1551) by Martín Cortés, texts

that widely surpassed the level of their predecessors, and were spread in Europe in successive editions⁸. With these works, nevertheless, the brief period of Spanish teaching in the nautical field finished, not being observed recovery signs until the end of the seventeenth century, with the presence of authors like Francisco Seijas Llobera⁹ -*Teatro naval hidrográfico* (Madrid, 1688)- and Antonio de Gaztañeta¹⁰ -*Norte de la navegación hallado por el quadrante de reducción* (Sevilla, 1692)¹¹.

The modernization of scientific and technical disciplines began in Spain with the *novator* movement over the last third of the seventeenth century. During the eighteenth century, modernization was sponsored by the governments of the new Bourbon dynasty that were inspired by the Enlightenment, reaching its peak during the reign of Carlos III (1759-1788). The country became permeable to the European scientific development, making possible the gradual incorporation of Spain to the modern science and technology, which had a direct repercussion, among others, in the nautical field.

In fact, the production of nautical works continued in Spain during the eighteenth century, whose level has been described by Vernet (1975, p. 170) as acceptable and optimal. Nevertheless, as shown by Capel (1982, pp. 204-5), it did not have a uniform distribution throughout the century, which confirms, in addition, that the cultivation of science and its governmental promotion were not necessarily contemporary. The common denominator of the large majority of works published in these years was their educational destiny and their essentially practical character. There were some exceptions with a greater mathematical content, indispensable for the improvement of the nautical studies, like: *Compendio del arte de la navegación* (Sevilla, 1717) by Pedro M. Cedillo; *Tratado de navegación teórica y práctica* (Sevilla, 1749) by Juan Sánchez Reciente¹²; *Lecciones náuticas* (Bilbao, 1756) by Miguel Archer; *Compendio de navegación* (Cádiz, 1757) by Jorge Juan¹³; or *Lecciones de navegación* (Isla de León, 1790) by José de Mazarredo¹⁴.

Completely different from these is the treatise that Fernandez de Navarrete (1846, p.415) considers the most skillful and complete work ever written in Spanish language on this matter, the *Tratado de navegación* (Madrid, 1787) by J. Mendoza y Ríos, author who put the perfect end to the century with the

⁵ See, e.g.: López Piñero, 1979, pp. 44-46 or Martín-Merás, 1999, p. 11.

⁶ See, e.g.: Arroyo, 1989, p. 9, or Pulido Rubio, 1923, p. 9 and pp. 219-222.

⁷ The most prominent *Artes* were those by Medina (Valladolid, 1545) and by Cortés (Cádiz, 1551). Among the *Regimientos*, the one written by Medina (Sevilla, 1552), which was published again in 1563, outstands. The latter were treatises less complicated than the former and, therefore, more accessible to the sailors they were addressed to. See: Guillén, 1964, pp. 5-6.

⁸ See: Guillén, 1943. On the English translations of these works, in particular, see: Basterrechea, 1997.

⁹ On Seijas’ works, see: Fernández de Navarrete, 1846, pp. 400-402.

¹⁰ On Gaztañeta’s work, see, e.g.: Fernández de Navarrete, 1851, vol. 1, pp. 134-135; Fernández Duro, 1879, pp. 41, 46; and Apestegui, 1992, pp. 44-45.

¹¹ The Spanish nautical texts of the Renaissance have been analyzed by Carriazo in an interesting work that combines both, the historical and the linguistic approaches. See: Carriazo, 2003.

¹² Cedillo and Sánchez Reciente taught mathematics and navigation at the Royal School of San Telmo in Seville. See, e.g.: Tikoff, 2008; and García Galarón, 2009.

¹³ Work that has been considered a representative text of the transit from the ‘art of navigation’ to the ‘science of navigation’. See: González de Posada, 2008.

¹⁴ On Spanish nautical textbooks of the eighteenth century, see: Iglesias, 2000.

publication in 1800 of his *Colección de Tablas para varios usos de la navegación*¹⁵.

Thus, Spain occupied an excellent position at the beginning of the nineteenth century, but the encouragement of scientific activity would soon be interrupted. As a consequence, the country remained out of the process of emergence of contemporary science that would shortly take place in Western Europe¹⁶.

4. Politics-shaped science in nineteenth-century Spain

During the nineteenth century, the development of scientific and technical activities in Spain, reflected the political instability that characterized the period. According to Vernet (1975, p. 231), the Spanish War of Succession (1808-1814) caused the collapse of the feverish development of science, which López Piñero (1992, p. 14) extends up until 1833, qualifying the interval between 1808 and 1833 as a catastrophic period. In spite of the brief liberal interlude (1820-1823), the absolutism that presided over the reign of Fernando VII (1814-1820 and 1823-1833) meant persecution or exile for leading scientists, the re-establishment of the Inquisition, and censorship of the press, López Piñero (1992, p. 15) claims that the few uniquely Spanish scientific contributions were made by exiles in contact with the latest European tendencies.

However, the fact that there was no active, organized, scientific community in Spain, during the first third of the nineteenth century, hardly implies that there were no isolated researchers within the different scientific branches. For instance, certain Spanish naval officers studied advanced navigational techniques with the support of the Navy and enjoyed worldwide recognition as scientists, although their contribution to the progress of mathematics or physics was scarce as they were expected to commit themselves to teaching and maritime activities (Peset *et al.*, 1978, pp. 39-40). Among those found towards the end of the eighteenth and the start of the nineteenth century, we may mention Jorge Juan (1713-1773), José Mendoza y Ríos (1763-1816), Gabriel Ciscar (1760-1829), and José Sánchez Cerquero (1784-1850)¹⁷.

Broadly speaking, in spite of the above, as Menéndez y Pelayo (1888, p. 130) said, the nineteenth century did not actually start until 1834 for Spanish literature and science. Indeed, the cultural scene only improved during the reign of Isabel II (1833-1868) as a consequence of the end of absolutism. Although this period had its political ups and downs and in consequence its discontinuities in scientific policy, recovery was possible, to a great extent, thanks to fewer controls over the edition and circulation of scientific publications. It should also be mentioned that important educative reforms were undertaken in this period and some scientific institutions were established; factors that undoubtedly helped to smooth the way¹⁸.

Despite the difficult circumstances that Spanish science experienced during the nineteenth century, as from 1833, different scientific and technical disciplines began once again to

flourish, but at unequal rates, although they all matured during the second half of the century (Vernet, 1975). The efforts made along the mid-nineteenth century and the period known as *Sexenio Revolucionario* (1868-1874) laid the foundations for the recovery that scientific activity knew in the Restoration, as from 1874. Although, as Tuñón de Lara (1982) points out, the cultural renaissance that occurred with the Bourbon Restoration was not exactly promoted, but rather consented, by the official policy.

5. Spanish works on navigation in the nineteenth century

Following the methodology set out above, this section will chart progress in the production of nautical works in nineteenth-century Spain. As formerly mentioned, the prepared index comprises a total of 233 works, which include 146 texts strictly related to navigation.

In Figure 1 the influence of the national political situation in the production of these works can be observed. In fact, the negative impact of some war periods as the War of Independence (1808-1814) is confirmed, whereas a clear upward trend in the number of works can be seen as from the reign of Isabel II (1833), taking into account, as already indicated, that cause and effect are not necessarily contemporary. Broadly speaking, the same general trend is observed if the only works considered are those on navigation. In this case, there is a notable production increase in the second half of the century, which accounted for 72.6% of the total.

In the following sections, we shall continue with the analysis of the production of the 146 selected works on navigation as they constitute a suitable representative for the nautical literature production along the nineteenth century.

¹⁵ This work, which gained great prestige, was improved and translated into English and French. Mendoza himself prepared the first English edition (London, 1805), published again in 1809, and, in 1842, appeared a French edition prepared by Richard. In Spain, the second edition was published in 1850 and in several occasions thereafter so that its use was generalized among navigators.

¹⁶ See, e.g.: López Piñero, 1992, p. 13; and Sánchez Ron, 1999, p. 36.

¹⁷ Jorge Juan together with Antonio de Ulloa (1716-1795) were the only Spaniards taking part in the expedition to Peru (1734-1743) organized by the French Académie of Sciences, in order to resolve the question of the Earth's real shape. On this subject see, e.g.: Lafuente and Mazuecos, 1987. The main focus of the literary works by José Mendoza was on navigation. His masterpiece was the celebrated *A complete collection of tables for navigation and nautical astronomy* (London, 1805), first edited in Spain in 1800 (see Note 15). But Mendoza's contribution may be partially considered as originating in exile, since he eventually settled in London, where he was commissioned in 1789 by the Spanish government. See, e.g.: Fernández de Navarrete, 1851, vol. 2, pp. 91-96. The unquestionable excellence of the professional career of Gabriel Ciscar has been stated by his numerous biographers. The most recent and complete biography is by La Parra, 1995. Ciscar developed multifarious activities, one of which outstands because of its international projection: his geodesic and gravimetric research carried out in connection with the International Congress for the unification of weights and measures (Paris, 1798). Finally, a recent work by Ausejo and Medrano (2012) focuses on Ciscar's role as mathematician. José Sánchez Cerquero was the Director of the San Fernando Observatory since 1825 and made important contributions in the fields of mathematics, astronomy and navigation. See, e.g.: Pavía, 1874, vol. 3, pp. 455-459. The works published abroad by these Spanish scientists are listed in Valera, 2006.

¹⁸ On the educational reform process that took place during the first half of the nineteenth century, see: Gil de Zárate, 1855. On the foundation of some scientific institutions, see, e.g.: Gomis, *et al.*, 1986.

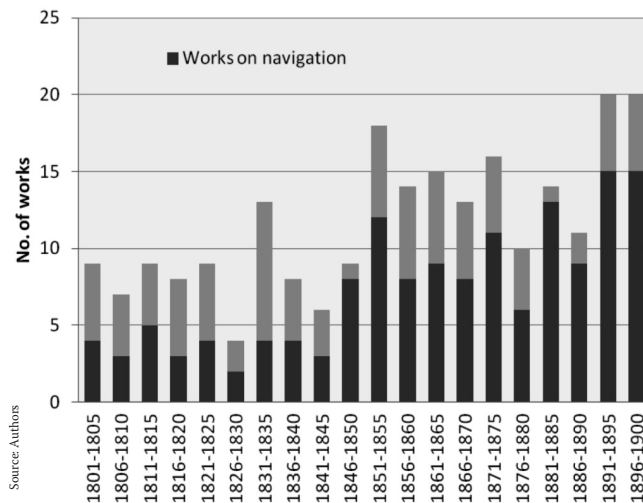


Figure 1: Spanish nautical works, 1801-1900.

5.1. The first decades of the century: the consequences of the War of Independence and the absolutism

At the turn of the century, two fundamental works derived from the Winthuysen syllabus¹⁹ were edited: *Lecciones de navegación* (Madrid, 1801) by Dionisio Macarte and *Curso de estudios elementales de marina* (Madrid, 1803) by Gabriel Ciscar. The new instruction was passed in 1790 but, in principle, no text existed that complied with the established programme.

Table 1: Spanish works on navigation, by subject and edition typology, 1808-1833.

Subject	First Edition	Reprint	Translation	Translation Reprint	Total
General (*)	1	—	—	—	1
Treatise	1	4	—	—	5
Monograph	Positioning	1	—	—	1
	Instruments	1	—	—	1
	Other	1	—	—	1
Tables	4	1	2	—	7
TOTAL	9	5	2	—	16

(*) It refers to works of a more general character that include a part on navigation. Source: Authors.

The War of Independence and the reign of Fernando VII negatively influenced the production of works, which decreased not only quantitatively but also qualitatively. As shown in Table 1, in 26 years only 16 works were edited, mostly tables and treatises, with only a first edition of the latter: *Elementos de astronomía náutica ...* (Barcelona, 1816-17) by Agustín Canellas. It is also worth mentioning the *Reflexiones sobre el método de hallar la latitud en la mar por medio de dos alturas de sol observadas fuera del meridiano* (Cádiz, 1823) by J. Sánchez Cerquero, as it is one of the scarce Spanish contributions to the advancement of navigation in this century.

An interesting fact is that most of the works published during the war (reprints of the treatises by Macarte and Ciscar, and the Tables by Faquineto²⁰) were printed in 1813, in Palma de Mallorca, location geographically distant from the armed conflict²¹. The scarce number of translations also outstands,

which reflects the cultural isolation that Spain suffered during this period.

The establishment of absolutism in 1814, after the War of Independence, and in 1823, after the liberal triennium, meant, as mentioned, persecution for some scientist and exile for others. In the nautical field, among those affected, Martín Fernández de Navarrete and Gabriel Ciscar outstand, but the less known case of Pedro José Rodríguez (1803-1838) has to be added²².

Rodríguez fled in 1823 and ended up joining the US Navy in 1827 with the appointment of Acting Sailing Master, bound for the Norfolk Naval School, where he participated in the training of midshipmen as professor of navigation, mathematics and languages²³. Among his works, *Elements of spherical trigonometry, designed as an introduction to the study of nautical astronomy* (New York, 1829), *On the observations of Comets* (*American J. of Sci. and Arts*, 1829) and *Tablas para calcular la latitud por medio de la estrella polar* (N. York, 1830), are to be numbered (Valera, 2006, pp. 182-183). Additionally, Rodríguez left some unpublished manuscripts, among which there is a treatise on nautical astronomy²⁴.

¹⁹ During the second half of the 18th century, numerous Nautical Schools were founded along the Spanish coast with the exclusive purpose of training Merchant Navy officers. Their shortage was in evidence as the traffic with America was deregulated, a process that culminated in 1778 when the *Reglamento de Libre Comercio con los Puertos Americanos* was promulgated. The increase in the number of these Schools together with the progress in the navigation techniques, raised awareness on the need to modernize and homogenize the nautical studies. As a consequence, the so-called *Instrucción Winthuysen* was passed in 1790. See, e.g.: Ibáñez, Llombart and Louzán, 2002.

²⁰ Faquineto, F. (1813) *Colección de tablas auxiliares a la navegación para uso de los alumnos de náutica de la Escuela de Náutica del Consulado de Mallorca*. Palma de Mallorca: Imprenta de Miguel Domingo.

²¹ The Napoleonic invasion favored the commercial and maritime prosperity of the island of Mallorca and, as a side effect, the enrollment at the Nautical School of Palma increased significantly. The *Consulado* of the city even founded a second Nautical School in 1811. To facilitate the study of students who followed the career of seamanship various teaching facilities were acquired and several reprints were ordered: Nautical treatises and astronomical tables. See: Llabrés Bernal, 1925, pp. 18-25.

²² About the case of M. Fernández de Navarrete, see: Guillén, 1944, p. 912. On Ciscar's case, see, e.g.: La Parra, 1995, p. 4. Vernet (1975, p. 221), mentions that Rodríguez was another escapee after the liberal triennium.

²³ According to information received from Jim Cheevers (U.S. Naval Academy Museum): "The published annual registers of U.S. Navy and Marine Corps Officers for the period 1828 to 1838 list a P. J. Rodriguez who entered the service on 4 August 1827, was given a commission as an Acting Sailing Master, and was assigned to the naval school at Norfolk, Virginia. By the mid-1830s the Navy began listing Rodriguez and others as "Teachers at Naval Schools" and calling them professors of mathematics and languages, but, from 1836 to 1838, he is only a Professor of Mathematics [...]. Although there is no reference to the job of P. J. Rodriguez as professor of navigation, a piece of evidence has been found in the memoirs of Admiral Charles Steedman, as quoted by Burr (1939, p. 180): "At last the dreaded day for me to appear before the Board arrived [...]. After the commodore had asked a few questions, he turned me over to Captain Bolton, who put me through my seamanship and then handed me over to professor Rodriguez, to be examined in mathematics and navigation. This was the branch I dreaded, but I got through quite creditably and received my certificate of having passed (Jan. 14, 1834), and was shaken by the hand and congratulated by the members of the board".

²⁴ According to Llabrés (1955, p. 71), at his death, Rodríguez bequeathed some professional manuscripts to the Philosophical Society of Philadelphia, including a treatise on nautical astronomy. It is the unique reference found about this text. We requested information from the *American Philosophical Society of Philadelphia*, but, this manuscript does not seem to be in their documentary collection.

5.2. Signs of recovery, which strengthened in the second half of the century

The reign of Isabel II created a more favorable environment for the dissemination of scientific knowledge. Book publishing was made easy, mainly translations of foreign texts, and also specialized scientific journals emerged (Ten and Aragón, 1996).

Table 2: Spanish works on navigation, by subject and edition typology, 1834-1850.

Subject	First Edition	Reprint	Translation	Translation Reprint	Total
General (*)	—	1	—	—	1
Treatise	1	3	—	—	4
Monograph	Positioning	—	—	—	—
	Instruments	2	—	1	3
Tables	5	1	2	2	10
TOTAL	8	5	3	2	18

(*) It refers to works of a more general character that include a part on navigation. Source: Authors.

As for the production of works on navigation, Table 2 depicts their distribution in the initial phase of this progressive period. It shows not only a clear trend of quantitative growth, but also an increase in the number of translations, signs of the new, more permissive order. The highlights of these works are the *Apuntes de pilotaje de altura* (Santander, 1834) by José M. Montalvo, teacher at the Nautical School of Santander, and, among the tables used to help with the navigation calculations, the already mentioned *Colección completa* (Madrid, 1850) by José Mendoza.

Nautical journals were also encouraged in the reign of Isabel II (Llabrés, 1930), and the reorganization of civil nautical studies took place in 1850, the syllabus for which remained in force until the second decade of the twentieth century²⁵.

As shown in Table 3, the growth trend was consolidated in the second half of the century, despite some fluctuations, as the decrease experienced over the final years of the reign of Isabel II, before the Revolution of 1868 (see Fig. 1).

Table 3: Spanish works on navigation, by subject and edition typology, 1851-1900.

Subject	First Edition	Reprint	Translation	Translation Reprint	Total
General (*)	8	—	—	—	8
Treatise	6	11	1	—	18
Monograph	Positioning	16	—	2	19
	Instruments	21	4	1	26
Tables	10	16	5	4	35
TOTAL	61	31	9	5	106

(*) It refers to works of a more general character that include a part on navigation. Source: Authors.

In this second half of the century, the attempt to modernize the nautical instruction stands out, by means of the publication of treatises and manuals that completed or replaced that one by Gabriel Ciscar, which still knew five reprints. In fact, Ciscar's treatise on navigation was added, in 1864, by Francisco Fernández Fontecha, who decided to publish his most complete *Curso de astronomía náutica y navegación* in 1875. The first edition of the *Manual del navegante* by Antonio Terry

was edited in 1873; although its main character was practical, it was also used as textbook in some Nautical Schools. Likewise, the *Compendio de navegación astronómica* (1883) by Miguel González Aveño and the *Lecciones de navegación* (1885) by Ramón Estrada were employed in the nautical instruction (Ibáñez *et al.*, 2004).

Other remarkable works in this period are the monographs on the so-called 'new celestial navigation', the emergence of which is marked by the line of position discovered in 1837, and published in Boston in 1843, by the Captain of the U.S. Merchant Navy, Thomas H. Sumner (1807-1876). These works helped to spread and discuss the new positioning techniques that were developed as from 1843 and made it possible to obtain the ship's coordinates simultaneously. Among them, it is worth mentioning the *Nuevo método de situarse en la mar del capitán de la marina mercante de los Estados Unidos Thomas H. Sumner* (Madrid, 1864 and San Fernando, 1864) by José S. Montojo; the *Reflexiones sobre la memoria del teniente de navío don José Montojo* (San Fernando, 1865) by Cecilio Pujazón; the *Problemas sobre la nueva navegación astronómica* (Barcelona, 1883) by Salvador Millet Pagés; the *Nueva navegación astronómica en los buques rápidos* (Barcelona, 1895) by José Ricart and the *Nuevos procedimientos de navegación astronómica* (El Ferrol, 1897) by José A. Barreda.

Another striking aspect is the number of works on instruments that are devoted to the magnetic compass: 17 out of the referenced 26. This is explained, first, by the numerous studies conducted during this century for the determination of deviations in magnetic needles produced by the presence of steel in their vicinity, material whose use had increased in shipbuilding since the advent of steam ships. In addition, other event that favored the publication of these works was the installation in Spanish vessels of the magnetic compass designed by William Thomson (1824-1907)²⁶.

6. Conclusions

During the nineteenth century, the development of navigation in Spain, like the rest of scientific and technical activities, reflected the political instability that characterized the period. This becomes clear from the analysis of the production of nautical literature presented above, which shows how the overall cultural scenario described by López Piñero or Vernet, among others, is also visible in this field.

Focusing on the general trends throughout the century, the negative impact of some war periods is noticeable, as well as the upward trend in the number of works as from 1833. In fact, after this year there was a quantitative increase in the production of nautical works, as well as in the number of translations,

²⁵ Adopted by Royal Decree of 20 Sept 1850, this syllabus came to substitute the one in force since 1790. See, e.g.: Arroyo Ruiz-Zorrilla, 1989, pp. 128-31.

²⁶ This instrument presented numerous advantages over ordinary compasses. Thomson developed a binnacle that incorporated an improved mechanism for compensating the deviation caused by the presence of steel in the vicinity of the magnetic compass. First patented in the United Kingdom, this binnacle received U.S. patent protection in 1878 and was adopted by most maritime nations in the late nineteenth century. See, for instance, Martínez-Hidalgo, 1946, ch. 16.

which reflected a new, more permissive regime. Despite its fluctuations, this tendency was maintained and consolidated during the second half of the century.

Within this context, unlike in previous centuries, the Spanish contribution to navigational science was limited. In addition, the diffusion of the new methods of navigation that had evolved abroad was very slow to take place. As a consequence, the initial question about the local innovation on this matter has been overcome with the challenge to inquire into the quality of the instruction delivered to Spanish Merchant Navy officers along that century.

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