2. Sixteenth-Century Nautical Treatises: The Definition of a New Genre of Technical Literature

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Abstract: In the sixteenth century, Iberian crews undertook an increasing number of long-distance maritime voyages, leading to a need to preserve and disseminate navigational knowledge. Written texts became essential for codifying this information, birthing a new genre of maritime literature: nautical treatises. Early works like the Munich and Évora Nautical Guides (ca. 1509–1519) integrated practical navigation with cosmographic knowledge, establishing a foundation for future manuals. Their widespread circulation and translation promoted the sharing of Iberian navigational expertise across Europe, influencing navigation manuals in France, England, and the Netherlands. This chapter examines the emergence of nautical treatises and their significant impact on maritime knowledge and their role in transforming navigation into a disciplined science.

Keywords: nautical treatises and guides, cosmography, the art of navigation, oceanic navigation, Iberian Peninsula, Francisco Faleiro.

Introduction

In 1606, over a century after oceanic navigation began, the well-known Spanish cosmographer Andrés García de Céspedes (1560–1611) published his *Regimiento de navegación*. In this book, he compares a ship guided by an uninformed pilot to a blind person using a cane. They might find their way sometimes, but they are just as likely to run into things, like the backside of a horse. Similarly, a poorly navigated ship without the right instruments can

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easily run aground or crash into rocks. With that in mind, Céspedes warns against settling for "a substandard level of knowledge or equipment"—both human lives, and valuable cargo, are at stake.[1]

The well-being of people, material goods, and the empire itself depended on proper navigation.[2] Sailing was no mere adventure, and reaching a destination safely demanded discipline, use of the right techniques, and an eye for precision. Unlike navigating the Mediterranean or coastal waters, the inability to accurately determine a ship's position while sailing across the open ocean for long stretches could be deadly.

At the beginning of the sixteenth century in the Iberian Peninsula, the increasing number of voyages and individuals engaged in navigation created an urgent need to share the practical knowledge thus far acquired about oceanic navigation, in order to train new pilots and sailors in the complex procedures required for these voyages. To this end, new institutions were established to regulate, organize, and disseminate such information, such as the Casa da Índia in Lisbon and the Casa de la Contratación in Seville. Additionally, new roles like *piloto mayor* and *cosmógrafo-mor* were introduced, along with innovative methods for organizing information, including the *padrón real* (master chart). Alongside these efforts, various initiatives emerged to formalize navigation practices, which naturally led to the development of new genres of technical literature.[3] Indeed, Pedro de Medina (1493–1567), an influential cosmographer serving the Casa de la Contratación, begins his *Arte de navegar* (1545)—one of the most important works of the first half of the sixteenth century—by attributing

1 "las cosas poco mas o menos, porque en este negocio no va menos que las vidas, y mucha hazienda." Andrés Garcia de Céspedes, *Regimiento de navegacion q*[*ue*] *mando haser El Rei nuestro Señor por orden de su Conseio Real de las Indias a Andres Garcia de Cespedes su cosmografo maior siendo Presidente en el dicho Consejo el conde de Lemos* (Madrid: Juan de la Cuesta, 1606), "Al Lector."

2 The concern for human lives on board and for the products being transported was a constant at this time, given the risks involved in oceanic navigation. Alonso de Chaves echoes such sentiments when explaining the practice of sounding: "En la mar este instrumento es de muy gran provecho porque nos descubre las celadas y engaños encubiertos, que muchas veces nos roban las haciendas y las vidas, porque están encubiertos debajo del agua, no los vemos hasta estar caídos en los lazos que nos están puestos para nuestra perdición […]." (At sea, this instrument is of great use because it reveals to us the hidden traps and deceits that often rob us of our possessions and our lives. Because they are concealed beneath the water, we do not see them until we have fallen into the snares that are set for our ruin […]) Alonso de Chaves, "Quatri partitu en cosmographia pratica y por otro nombre llamado espejo de navegantes" (1528), f. 22r–22v.

3 Henrique Leitão and Antonio Sánchez, "Zilsel's Thesis, Maritime Culture, and Iberian Science in Early Modern Europe," *Journal of the History of Ideas* 78, no. 2 (2017): 191–210.

the incompetence of "those who sail" to a deficit of proper instruction and a lack of books providing the relevant education.[4]

The teaching and examination of pilots in Spain were the responsibility of the *piloto mayor* since the position was first created in 1508. Initially, the *piloto mayor* taught the theoretical fundamentals of oceanic navigation in his own home. However, in 1552, with the creation of the chair of cosmography at the Casa de la Contratación, the responsibility for training pilots shifted to the individual holding that position. A royal decree issued in 1527 to *Piloto Mayor* Sebastián Caboto (1476–1557) highlights the rigorous demands placed on pilots aspiring to navigate the routes to the Spanish Indies:

> Anyone aspiring to become a pilot must demonstrate, with witness testimony, that they have navigated for six years in the Indies, having traveled to Tierra Firme, New Spain, Española, and Cuba. They must possess a chart and be capable of marking the ship's position, detailing headings, lands, and the most dangerous ports and shallows. Additionally, they should be able to outline the precautions that must be taken and identify locations where essential supplies like water, wood, and other necessities can be obtained. They are also required to have an astrolabe to measure the sun's altitude and a quadrant for locating the North Star, as well as the knowledge to effectively use both instruments. Furthermore, they should understand how to determine and apply the sun's declination, along with the rising and setting of stars, and be able to tell the time during both day and night.[5]

4 "The second thing, Most Serene Lord, that has moved me to this was that I have often remembered how many times I have considered how many people sail, and that not only the known parts, but the very remote and distant that there is no news of, they try to sail, seeking and knowing; and seeing how long and dangerous sea routes are sailed and that few of those who sail know what is required for navigation. The reason is because there are no teachers to teach it, nor books where they can read it." ("Lo segundo, Sereníssimo Señor, que a esto me há movido fue que yo muchas vezes he puesto memoria en considerar quán gran número de gentes navegan, y que no solamente las partes notas y sabidas, mas las muy remotas y apartadas y que d'ellas no ay noticia, se procuran navegando buscar y saber; y viendo quán largos y peligrosos caminos por la mar se hazen y que pocos de los que navegan saben lo que a la navegación se requiere. La causa es porque ni ay maestros que lo enseñen, ni libros en que lo lean.") Pedro de Medina, *Arte de navegar en que se contienen todas las reglas, declaraciones, secretos, y avisos, que a la buena navegaciõ son necessarios, y se deven saber, hecha por el Maestro Pedro de Medina* (Valladolid: Francisco Fernandez de Cordova, 1545), Prologue, f. 2r–2v.

5 "Cualquiera que quisiese ser piloto probase por testigos, si había navegado seis años a las Indias, si había estado en Tierra Firme, y Nueva España, y la Española, y Cuba, y que tuviese su carta de marear y supiese echar punto en ella, y dar razón de los rumbos, y tierras, y de los puertos, y bajos mas peligrosos, y de los resguardos que se deben dar, y de los lugares donde se

In Portugal, the formal establishment of nautical education came later, although there had been informal practices beforehand. In 1547, the position of chief cosmographer was established and awarded to the cosmographer and mathematician Pedro Nunes (1502–1578). This role was associated with the Armazéns da Guiné e Índias, the Portuguese institution responsible for navigational matters.[6] In 1592, King Philip II issued directives in the Regiment of the Chief Cosmographer, mandating that lessons be provided for aspiring officers and members of the nobility serving on royal ships.[7]

This document clearly outlines the curriculum for mathematical instruction, which the chief cosmographer was expected to deliver for one hour each day. Subjects included the sphere and its circles; the movements of the sun, moon, and major celestial bodies; principles of lunar and tidal knowledge; techniques for creating and utilizing nautical charts; the use of the nautical astrolabe for solar observation and determining latitude at noon; the application of the quadrant and cross-staff for finding latitude using the North Star, along with methods for determining latitude by that star; and finally, the determination of magnetic variation and the use of sundials.[8]

Given the structure of pilots' education in the Iberian Peninsula during this period, Medina's complaint, quoted above, is understandable, as

podían abastecer de agua, leña, y de las otras cosas, en tales viajes necesarias. Que tuviese un astrolabio, para tomar la altura del sol, y cuadrante, para el norte, y supiese el uso de entrambas cosas, así en el tomar altura como en el añadir, o quitar la declinación del Sol, y lo que la estrella alza, y baja, juntamente con el conocimiento de las horas que son en cualquier tiempo del día, y de la noche." AGI, Patronato, 251, R.22. Cited in Antonio Sánchez Martínez, "Los artífices del Plus Ultra: pilotos, cartógrafos y cosmógrafos en la Casa de la Contratación de Sevilla durante el siglo XVI," *Hispania* 70, no. 236 (December 30, 2010): 629–630; and in Antonio Sánchez Martínez, *La espada, la cruz y el Padrón: Soberanía, fe y representación cartográfica en el mundo ibérico bajo la Monarquía Hispánica, 1503–1598* (Madrid: Consejo Superior de Investigaciones Cientificas, 2013), 126–127.

6 Avelino Teixeira da Mota, "Some Notes on the Organization of Hydrographical Services in Portugal before the Beginning of the Nineteenth Century," *Imago Mundi* 28 (1976): 51–60.

7 Codex in Ajuda National Library, shelf mark 44/XIII/56, pp. 188 to 196v. This regiment dates from 1592, although there is evidence that it is an update of an earlier version, from 1559. For a more detailed analysis of this document and its contents, see Avelino Teixeira da Mota, *Os regimentos do Cosmógrafo-Mor de 1559 e 1592 e as origens do ensino náutico em Portugal* (Lisboa: Junta de Investigações do Ultramar, 1969).

8 It is noteworthy that, despite the fact that the mathematical instruction covered a substantial amount of material that is also present in nautical treatises, there is a certain disconnect between what was taught to the pilots and the topics on which they were examined. In the lessons provided by the chief cosmographer, emphasis was placed on topics more associated with cosmography and astronomical navigation, while the pilots' examinations focused more on practical matters. Teixeira da Mota, "Os regimentos do Cosmógrafo-Mor," 43.

the training of most pilots serving the empire relied heavily on a single individual.

Medina's second protest is that there were no navigation books available to pilots, positioning his work as the first in this category. While it is true that *Arte de navegar* had undeniable importance in nautical literature, it is not accurate to say there were no resources available for training pilots in oceanic navigation at the time. In fact, both Portugal and Spain had already produced works aimed at this purpose, marking the start of a new genre of technical literature in the Iberian Peninsula—nautical treatises.

It is crucial to note that most nautical literature from this period existed in manuscript form. Many of these works, often loose documents with navigational directions and notes, have unfortunately been lost. Some, however, were compiled into "books of seamanship" or other collections and have survived. Notable examples include João de Lisboa's *Livro de marinharia*, which includes his well-known *Tratado da agulha de marear* ("Treatise on the Sea Needle"), and Alonso de Chaves's *Quatri partitu*.[9] Printed books were almost an exception to the norms of information transmission, yet they had the advantage of reaching a larger number of people.

Several nautical treatises were printed during the sixteenth century. They were mostly written by cosmographers and codified existing knowledge on oceanic navigation. They aimed, according to their authors, to help pilots and sailors acquire a basis for oceanic navigation, acquainting them with cosmography and astronomy (topics with which these practical men generally had little contact).

9 About the *Livro de marinharia* de João de Lisboa, see the edition coordinated by Jacinto Brito Rebello: João de Lisboa, *Livro de marinharia, Tratado da agulha de marear de João de Lisboa. Roteiros, sondas e outros conhecimentos relativos à Navegação*, ed. Jacinto Ignacio Brito Rebello (Lisban: Imprenss Libanio da Silva, 1903). See also João de Lisboa, "O 'Tratado da agulha de marear' de João de Lisboa. Reconstituição do seu texto, seguida de uma versão francesa com anotações," ed. by Luís de Albuquerque, *Junta de Investigações Científicas do Ultramar* (1982): 129–162. On the *Quatri partitu* of Alonso de Chaves see Ursula Lamb, "The *Quatri partitu en cosmographia* by Alonso de Chaves: An Interpretation," in , *Cosmographers and Pilots of the Spanish Maritime Empire* (Aldershot: Variorum, 1995), II; Maravillas Aguiar, "*Quatri partitu en cosmographia pratica i por otro nombre llamado Espejo de navegantes* by Alonso de Chaves: A Navigation Manual for the Instruction of Spanish Pilots in the Sixteenth Century," in *Ships, Saints and Sealore: Cultural Heritage and Ethnography of the Mediterranean and the Red Sea*, ed. Dionisius A. Agius and Timmy Gambin (Oxford: Archeopress Archaeology, 2014), 41–60; Sánchez Martínez, *La espada, la cruz y el Padrón*, 216–222; and also Alonso de Chaves, *Quatri partitu en cosmografia practica y por otro nombre espejo de navegantes*, ed. Paulino Castañeda Delgado, Mariano Cuesta Domingo, and Pilar Hernández Aparicio (Madrid: Instituto de Historia y Cultura Naval, 1983), 15–65.

The purpose of this chapter is to explore the emergence and development of this new type of literature, showing its relevance and impact on the sixteenth-century European technical literary framework.

2.1. The Nautical Guides of Munich and Évora: Beginnings

Around 1509, a sixty-four-page unnumbered leaflet was published in Portugal with the title *Regimento do estrolabio e do quadrante pera saber ha declinação e ho logar do soll em cada um dia e asy pera saber ha estrella do norte* ("The Regiment of the Astrolabe and the Quadrant to Determine the Declination and Position of the Sun on Any Given Day and to Identify the North Star").[10] The publisher was Hermão de Campos, one of the most reputable printers in Lisbon at that time. However, no information exists regarding the author or compiler of this work.[11] Only two known copies of the publication survive today—one in the Bavarian State Library[12] and the other in the Vatican Apostolic Library.[13]

The book is divided into two parts. The previously mentioned title corresponds to the first part of the work, which contains regiments and instructions for navigators. The second part is entitled *Tractado da spera do mundo tyrada de latin em liguoagem com ha carta que um gramde doutor aleman mandou ao rey de purtugall dom Joham el segundo* ("Treatise on the Sphere of the World Taken from Latin into the Vernacular, with the Letter That a Great German Scholar Sent to the King of Portugal, Dom João II"). This second part is likely the first vernacular version of Sacrobosco's *Treatise on the Sphere* known in Europe.

10 A "regiment" (*regimento*) is a set of rules or instructions that must be followed to accomplish a certain action.

11 Hermão de Campos, a German, arrived in Lisbon in 1509 and there are known works printed by him until ca. 1518. Besides the Munich Guide, he printed other scientific works such as the *Reportório dos tempos*; *Consideracion astronomica de la maxima conjuncion*; *Arte menor de arismetica, y modo de formar campos*; *Examen de ingenios para las sciencias*; *Tractatus cessante causa cessant effectus*; some medicine titles. He also published editions of laws and regulations of Portugal.

12 *Regimento do estrolabio y do quadrante pera haber ha declinaçam y logar do soll em cada huum dia* (ca. 1510), Bayerische Staatsbibliothek [BS], Rar. 204 (B3Kat-ID: BV001474468). A digitization of Bensaúde's facsimile edition is available from the Internet Archive at this link: https://archive.org/details/regimentodoestrooobens. Recent searchable edition: Zenodo, 2023. https://doi.org/10.5281/zenodo.8379665

13 *Regiment of the estrolabio* [*et*] *of the quadrant* … (ca. 1500–1510?), Vatican Apostolic Library [BAV], Stamp.Ross.653.

Approximately ten years later, around 1519, a very similar work was published by Germão Galharde's printing house in Lisbon.[14] The title on the frontispiece reads *Tractado da Spera do mundo tirada de latim em lingoagem portugues com huma carta que um grande doutor Aleman mandou a el Rey de Portugal dom Joam ho segundo* ("Treatise on the Sphere of the World Translated from Latin into Portuguese with the Letter that a Great German Scholar Sent to the King of Portugal, Dom João II"). This work, spanning seventy-two unnumbered pages, is also divided into two parts, with the title of the second part being *Segue-se ho regimento da declinaçam do sol pera per ella saber ho mareante em qual parte está, a saber, aquem ou alem da linea equinocial. Com ho regimento da estrela do norte* ("Following is the Regiment of the Declination of the Sun, so that the Sailor Can Determine His Position, Namely, on This Side or beyond the Equinoctial Line, with the Regiment of the North Star"). The author or compiler of this work remains unknown, and only one copy is known to exist today, preserved in the Public Library of Évora.[15]

These two small publications from the early sixteenth century are considered to be the first printed works intended to assist pilots in oceanic navigation and are the oldest known Portuguese nautical guides.[16] The

14 Germão Galharde (or German Gaillard) was a French printer who settled in Lisbon in 1519 and also worked in Coimbra. He used the printing materials that had belonged to Valentim Fernandes (? –1519), a German printer who had established himself in Lisbon and became a key figure in the Portuguese printing industry. Besides many editions of laws and regulations of Portugal and religious works, he also printed scientific works such as *Reportório dos tempos*, Pedro Nunes's *Tratado da esfera*, Gaspar Nicolás's *Tratado da prática d'arismética*, Ruy Mendez's *Prática darismetica*, Dionísio Areopagita's *Dialogus circa quasdam questiones in medicina*, a commentary on Pliny by Martinho de Figueiredo, João de Barros's *Décadas da Ásia*, and some chronicles.

15 *Tratado da esfera* (ca. 1516–1524?), Évora Public Library [BPE], BPE-RES Res. 0404. Digitized work available as PDF at this link: https://purl.pt/27101/1/index.html. Recent searchable edition: Zenodo, 2023. https://doi.org/10.5281/zenodo.8367561.

16 The Portuguese historian of maritime expansion, Luís de Albuquerque, published a modern edition of these works and studied them in detail, naming them according to their locations: Guia náutico de Munique (Munich Guide) for the 1509 publication and Guia náutico de Évora (Évora Guide) for the 1519 edition. This terminology will be used throughout this chapter. The discussion of the dating of the two leaflets is present in Albuquerque's work: ca. 1509 for the Munich Guide and ca. 1516 for the Évora Guide. No firm consensus on their date of composition exists, however; Jorge Semedo de Matos, for example, considers the Évora Guide to have been written between 1520 and 1524, see Jorge Semedo de Matos, "Tábuas solares na náutica portuguesa dos séculos XV e XVI," in *D'Aquém, d'Além e d'Ultramar: Homenagem a António Dias Farinha*. eds. Francisco Contente Domingues, José da SiIva Horta, and Paulo David Vicente (Lisboa: Centro de História da Faculdade de Letras da Universidade de Lisboa, 2015), II:1235–1250. In fact, the printer of the Évora Guide, Germão Galharde, only settled in Lisbon in 1519, which means it is

simplicity and compact format of the publications, the use of the vernacular language, and the translation of *The Sphere* suggest that these works were aimed at individuals with limited formal education, such as pilots, and were possibly intended to be brought on board. According to Eva Taylor, these publications established the standard for nautical manuals in Portugal.[17]

From the titles, one can discern the two fundamental components present in both the Munich and Évora Guides: one part dedicated to regiments and practical instructions for navigation, and another focused on the sphere, or the fundamentals of cosmography. The titles also reveal similarities between the two publications, which, at first glance, appear to be two editions of the same work, with the order of the contents reversed in the second edition.[18] In fact, the section on the sphere is identical in both cases. However, this is not true for the other section—the navigation regiments—which differs substantially. Therefore, despite certain striking similarities, it is not evident that the two leaflets are simply two versions of the same text.

The two works likewise share features in their visual presentation, starting with the frontispieces. In the Munich Guide, both the regiments and the section on the sphere are preceded by a folio featuring an armillary sphere. In the Évora Guide, there are slight variations: while the frontispiece of the section on the sphere also displays a large armillary sphere, two human figures, one on each side, have been added. One figure holds a crown and scepter (likely representing Afonso X), while on the other side, a man holds a book and points to a circular diagram within it (probably a depiction of Ptolemy).

The frontispiece of the second section (focused on the regiments) is decorated with an elaborate frame that contains a human figure holding a book, set against a background of a star and a sphere. To his right is an armillary sphere, and at the bottom of the frame, the publisher's mark of Germão Galharde is visible. In both Guides, there are thirty-two identical diagrams in the section on the sphere, one additional diagram in the regiments section, and a set of tables concluding this section.

impossible that the work is from 1516. In any case, it seems likely that both works were written and printed in the early decades of the sixteenth century. For the purposes of this chapter, ca. 1509 will be adopted for the Munich Guide and ca. 1519 for the Évora Guide.

17 Roger Barlow, *A Brief Summe of Geographie*, ed. E. G. R. Taylor, Works Issued by the Hakluyt Society, Ser. 2,69 (London: Hakluyt Society, 1932; repr., Farnham: Ashgate, 2010), xv.

18 This is the opinion of Luís de Albuquerque, who argues that the two leaflets are distinct editions of the same work, the Évora Guide constituting an improved version of the Munich Guide: Luís de Albuquerque, ed., *Os guias náuticos de Munique e Évora* (Lisboa: Junta de Investigaçoes do Ultramar, 1965), 7–8.

Figure 2.1. Frontispiece of the Munich Nautical Guide, Lisboa, 1509

Figure 2.2. Frontispiece of Évora Nautical Guide, Lisboa, 1519

These publications are innovative for several reasons. First, they mark the first time that navigation regiments for pilots were printed and made publicly available. The appearance of such texts in print reflects not only the new demands of oceanic navigation but also the specific knowledge that pilots needed to navigate the ocean without any references. These regiments provided basic procedures for performing the astronomical operations essential to this new form of sailing, such as calculating the altitude and declination of the sun, measuring the altitude of the North Star, and understanding the relationship between degrees and leagues, among other skills.

These computations and measurements served a fundamental purpose in long-distance navigation: determining the ship's position by calculating both course and latitude. Latitude could be determined by measuring the altitude of the North Star using instruments like the astrolabe, quadrant, or cross-staff, or by measuring the sun's altitude. For calculations based on the sun's position, it was necessary to consider the sun's declination on that specific day, information provided by solar declination tables prepared before a voyage.[19]

The regiments are written in succinct and straightforward language, devoid of complex definitions or explanations of phenomena. They consist of clear, practical, and objective steps to be taken (much like those found in a recipe book), and instructions are delivered in the form of direct commands, as if the author is giving orders. This reinforces the practical nature of the work, which was obviously not intended to remain on a shelf for scholarly study. The absence of any paratextual elements further emphasizes such a role. To illustrate this, let us examine the beginning of the sun regiment in the Munich Guide:

> If you want to know, wherever you are, how much you are away from the equinoctial line, and whether you are below or beyond or under, by the height of the sun; know that it is necessary that you first take the height of the sun with an astrolabe or quadrant, and this at noon, when the sun is at its steepest. Once you know the height, keep it. And enter in this table the height of that month and day; and you will find on that day in what degree the sun is and how much declination it has then.[20]

19 The presence of astronomical tables, namely of solar declination, is indicative of the practical purpose of the work.

20 "Se tu quiseres saber, em qualquer parte em que estiveres, quanto é aquilo que estás afastado da linha equinocial, e se estás aquém ou além ou debaixo, pela altura do Sol; sabe que é necessário

To carry out the calculations described, solar declination tables were necessary, and in both guides, these are placed after the regiments, using Arabic numerals. In the Munich Guide, there are twelve tables, corresponding to the twelve months of the year. For each day of the month, the tables include a column for the saint assigned to that day, another for the sun's position, and two more columns for the sun's declination (in degrees and minutes).

The tables in the Évora Guide show some differences that indicate they were improved to better serve the practical purposes of the work. While the Munich Guide tables are calculated for just one year, the Évora Guide contains the first known printed quadrennial tables. One-year tables were calculated using rough approximations, and could often be used for more than one year with only minimal adjustments. The variations would not be very significant, usually affecting only the minutes. However, the results would not be as accurate as those obtained from quadrennial tables, which had to be renewed after each cycle.[21]

In the Évora Guide, the table layout for the first year is similar to that of the Munich tables, but from the second year onwards, the columns for the saint of the day and the sun's position are removed. The improvements evident in the Évora Guide are clear both at a technical and typographical level, reflecting a more advanced stage in the evolution of nautical knowledge.[22]

Regarding the content of the regiment section in the Munich Guide, first comes the regiment of the sun (that is, the rules for knowing the height of the sun, its declination, and from that calculating the latitude, followed by the regiment of the Pole Star (or regiment of the north, with the rules for calculating the height of the North Star and thus the latitude). Next, the Munich Guide provides a list of the heights of the equinoctial. At the end, before the tables, there is a small section containing the regiment of the leagues (the equivalence between degrees and leagues). The regiment section in Évora Guide is more complete. Besides the regiments of the sun, Pole Star and leagues, it is supplemented with instructions for determining

que tomes primeiro a altura do Sol com astrolábio ou quadrante, e isto ao meio-dia, quando o Sol está mais empinado. A qual altura sabida, guarda-a. E entra em esta tabuada em direito daquele mês e daquele dia; e acharás em aquele dia em que grau está o Sol e quanto tem então de declinação." Joaquim Bensaúde, *Opera omnia*, vol. IV (Lisboa: Academia Portuguesa da História, 1995), 48. (Bensaúde's work is cited here as it contains a facsimile edition of the original edition of *Guias náuticos*, and the advantage is that in Bensaúde's work they are numbered, which is not the case in the original copies.)

21 Albuquerque, *Os guias náuticos de Munique e Évora*, 75.

22 Albuquerque, *Os guias náuticos de Munique e Évora*, 76.

the hour of night by means of the Pole Star. The list of altitudes is also more complete, and a new rule for the tides was added at the end.

As for the cosmographical section (which appears second in the Munich Guide and first in the Évora Guide), the version of the *Treatise on the Sphere* printed in both is quite faithful to Sacrobosco's text. It maintains the original order and includes the diagrams that were common in versions of the *Sphere* circulating at the time. The text is divided into four chapters, but unlike other versions, such as those by Francisco Faleiro or Pedro Nunes, it lacks the subdivision of each chapter into various sections with titles. This absence makes it more difficult to identify the different subjects within the continuous text.

There are also some omissions and minor alterations to Sacrobosco's text, mostly in sections that were not essential for sailors. Additionally, there are certain inconsistencies between the section on the sphere and the other texts (regiments) in the Guides. These inconsistencies led Luís de Albuquerque to suggest that the various parts of the work were likely written separately.[23]

The excerpt presented above, from the regiment of the sun in the Munich Guide, addresses concepts such as "equinoctial line" and "height of the Sun." It is not immediately apparent that these concepts, which were common in fields like astronomy and cosmography, were fully understood by pilots and navigators in the early days of oceanic navigation. The authors or compilers of the nautical guides recognized this issue early on: to properly understand the regiments, a certain precision in the definition of the concepts used was necessary.[24] The vernacular translation of Sacrobosco's *Sphere* in the nautical guides, therefore, represents a completely innovative (and perhaps unexpected) element in the nautical literature of the time, seeking to address this challenge.

Sacrobosco's *Treatise on the Sphere* was written and circulated for the first time in the thirteenth century and was widely disseminated throughout Europe during the medieval period, serving as the reference work for teaching the basics of cosmography.[25] For almost three centuries, this work was

23 Albuquerque, *Os guias náuticos de Munique e Évora*, 85–86.

24 It is interesting to note that the order of the contents in the Évora Guide was reversed: the first part refers to the sphere and the second to the regiments and tables. If one had to be familiar with the concepts appearing in the regiments to understand them well, then it was better for the cosmography part to appear first, providing the basis for understanding.

25 Owen Gingerich, "Sacrobosco as a Textbook," *Journal for the History of Astronomy* 19, no. 4 (November 1988): 269–273; Matteo Valleriani, ed., De sphaera *of Johannes de Sacrobosco in the Early Modern Period: The Authors of the Commentaries* (Cham: Springer Open, 2020); Matteo

read exclusively in Latin. Since its target audience was primarily university intellectuals, no translation was necessary.

The fact that the Munich Guide contains the earliest vernacular edition of Sacrobosco's *Sphere* published in Europe suggests that, most likely, this was the first time the work was used outside the university context, specifically in the field of navigation. This highlights a new need among a specific social group (pilots and seamen) in a specific country (Portugal) for the content of a cosmographical text that had previously been inaccessible to them. As part of a broader set of disciplines cultivated and developed among the literate, cosmography required training that this group had lacked.

In medieval nautical literature, it was uncommon to find content like that found in the Nautical Guides. Since medieval navigation was primarily coastal, the information in nautical texts focused more on tides, seabeds, currents, routes, and directions to ports.[26] However, with the onset of long-distance voyages, sailing techniques began to evolve, incorporating astronomical methods to calculate the ship's position on the high seas. Technical literature had to adapt to these changes, furnishing pilots with the necessary instructions to carry out astronomical observations and measurements—skills not required in coastal navigation.

Cosmography, therefore, provided pilots and sailors with the foundational knowledge needed to make these measurements and calculate latitude on the open ocean. But cosmography had a broader role. The shift to global navigation made it more difficult for sailors to control their spatial orientation, as the vast ocean offered no physical points of reference, unlike the Mediterranean. Thus, cosmography came to offer a new mental framework, transmitting the theoretical references that helped pilots navigate and understand the immense spaces they were crossing.

Furthermore, cosmography addressed the growing need for a common language, which had previously been absent in oceanic navigation. It probably facilitated communication both aboard ships, between pilots and

Valleriani, "The Tracts on the Sphere: Knowledge Restructured Over a Network," in *The Structures of Practical Knowledge*, ed. Matteo Valleriani (Cham: Springer International Publishing, 2017), 421–473.3; Kathleen Crowther et al., "The Book Everybody Read: Vernacular Translations of Sacrobosco's Sphere in the Sixteenth Century," *Journal for the History of Astronomy* 46, no. 1 (February 2015): 4–28; Richard J. Oosterhoff, "A Book, a Pen, and the Sphere: Reading Sacrobosco in the Renaissance," in *History of Universities*, ed. Mordechai Feingold (Oxford: Oxford University Press, 2015), XXVIII/2:1–54.

26 See Luís de Albuquerque, *Introdução à História dos Descobrimentos Portugueses*, 3rd ed. (Mem Martins: Publicações Europa-América, 1986) and E. G. R. Taylor, *The Haven-Finding Art: A History of Navigation from Odysseus to Captain Cook*, new augmented ed. (London: Hollis and Carter for the Institute of Navigation, 1971).

sailors, and on land, between pilots and cosmographers, as well as between sailors, merchants, administrative officials, and military personnel. With the increasing need for cooperation between these different social groups, cosmography played a crucial role in creating a shared vocabulary. If pilots, with their practical knowledge, became familiar with the basic concepts of cosmography, the exchange of information between these groups would be much easier. The effort to bridge this gap is evident in the nautical guides, where an attempt was made to adapt theoretical content to the practical needs of sailors, ensuring the transmission of knowledge and the development of a common linguistic code.

There was certainly a wide circulation of these publications, although only three copies are known to have survived to the present day.[27] For instance, we know that the solar declination tables from the Munich Guide were reproduced in a manuscript attributed to the *Book of Francisco Rodrigues* (1511–1515). This indicates that the nautical guides reached at least as far as India and the Far East, playing an important role in the training of qualified pilots like Francisco Rodrigues.[28]

One consequence of the broad circulation of the Munich and Évora nautical guides was their significant impact on European technical and nautical literature, influencing several major subsequent works in the field, including Enciso's *Suma de geographia* in Spain, Roger Barlow's *A Brief Summe of Geographie* in England, and Fontaneau's *La Cosmographie, avec l'esphère et le règne du Soleil et du Nord* in France. It is to these works, in which the impact of the nautical guides is unmistakable, that we now turn.

Martín Fernández de Enciso's *Suma de geographia* (1519) was published in Seville by Jacobo Cromberger.[29] As indicated by the title, Enciso dedicates

27 It is known that small books are more susceptible to loss and destruction than large books. Probably, in addition to the nautical guides, other books and pamphlets with similar content circulated among pilots, in manuscript, which have not reached us.

28 Semedo de Matos, "Tábuas solares na náutica portuguesa dos séculos XV e XVI," 14. Francisco Rodrigues was a Portuguese pilot and the main cartographer to accompany Afonso de Albuquerque. He was likely chief pilot of the fleet that explored the seas of Indonesia between 1511 and 1512, led by Antonio de Abreu and ordered by Afonso de Albuquerque, with the aim of reaching the Moluccas. Rodrigues also passed through places like India and Ethiopia and he prepared records and rutters of his various voyages that are compiled in the *Book of Francisco Rodrigues*. For more information about this work see *O livro de Francisco Rodrigues: O primeiro Atlas do Mundo Moderno*, ed. José Manuel Garcia, 1st ed. (Porto: Editora da Universidade do Porto, 2008).

29 Full title: *Suma de geographia que trata de todas las partidas e provincias del mundo: en especial de las indias. E trata largamente del arte del marear: junto con la espera en romãce: con el regimiento del sol e del norte: nuevamente hecha* ("A Sum of Geography that Treats of All the Parts and Provinces of the World: Especially of the Indies. And Deals Largely with the Art of

most of his work to the geographical description of the world (about a hundred folios). The *Suma* begins with a section on the sphere, followed by tables of solar declination, the regiment of the North Star, and the regiments for the astrolabe and quadrant. This entire first part occupies only around forty folios of the 150 that make up the work, which is not divided into chapters.

Enciso's cosmographic section is brief and does not present major innovations—unlike the geographical part, where he offers, for the first time, a description of the New World. This description enjoyed widespread credibility throughout the century as it was based on the author's own experience.[30] While the *Suma* was the first manual of its kind in Spain to combine the sphere with the art of navigation, it should be noted that this is not the most significant aspect of the work. The structure of the cosmographic section was already present in the nautical guides of Munich and Évora.

The regiment of leagues in Enciso's *Suma de geographia* largely reproduces the numbers from the Évora Guide, and the values in the regiment of the Pole Star also correspond to those found in the nautical guides, although abbreviated. The regiment on the sun's declination is similarly a direct copy from the Munich Guide, albeit with some variations. The parts of Enciso's work that are identical to those in the nautical guides suggest that Enciso used them as a source for his *Suma de geographia*.[31] However, the divergent values in the solar declination tables indicate that he also availed himself of other reference materials.

In 1540/41, Roger Barlow wrote *A Brief Summe of Geographie*, which was not published until 1932 (by Eva Taylor).[32] The basic structure of this book included some nautical rules and routes, but the author later expanded it by adding a section on the sphere. The influence of Enciso's work is plain; however, Barlow must have also consulted the nautical guides, since the values of the regiment of leagues and the regiment of the North Star match

Navigation: Together with the Sphere in Romance: with the Regiment of the Sun and the North Star: Newly Made).

30 Antonio Sánchez Martínez, "Cartografia en lengua romance: Las cartas de marear en los regimientos y manuales españoles sobre el arte y la ciencia de navegar," *Boletín de La R.S.G* CXLVI (2010): 169. According to Eva Taylor, the cosmographic part of Enciso's work was translated from André Pires's *Livro de marinharia* (Barlow, *A Brief Summe of Geographie*, xv). Luís de Albuquerque does not share this opinion, as he claims that the compilation of the *Livro de marinharia* by André Pires was made after the publication of the first edition of Enciso's *Suma de geographia.* He concludes that both Enciso and André Pires were based on the same sources. Albuquerque, *Os guias náuticos de Munique e Évora*, 116 (note 60).

31 See some examples in Albuquerque, *Os guias náuticos de Munique e Évora*, 117–118.

32 Barlow, *A Brief Summe of Geographie*.

those of the guides, and the rules for the sun's declination are those found in the Évora Guide, rather than in the *Suma de geographia*.[33] Furthermore, the sun's declination tables in Barlow's work correspond to the quadrennial tables of the Évora Guide.

In the first major French work on seamanship, *La Cosmographie, avec l;esphère et le règime du Soleil et du Nord* (1544/45), by Jean Fontaneau (the Portuguese João Afonso), the influence of the nautical guides is evident as well, particularly in the tables of solar declination. It is also clear that João de Lisboa's work impacted Fontaneau, especially regarding magnetic declination.[34]

These three works are just a few illustrations of the importance of the Munich and Évora Nautical Guides for early sixteenth-century technical literature—their impact, however, extends well beyond these examples. Such is the case for Francisco Faleiro's *Tratado del esphera*, which will now be analyzed in greater depth.

2.2. Francisco Faleiro's *Tratado del esphera*: Setting the Pattern

In 1535 Francisco Faleiro published the *Tratado del esphera y del arte del marear* in Seville.[35] Ten years later, Pedro de Medina complained (in his work *Arte de navegar*) that, despite the large number of people involved in navigation, "there are neither masters who teach this art, nor anyone who has written about how to navigate."[36] It is difficult to accept that Medina was unaware of Faleiro's work, especially since they collaborated at the Casa de la Contratación. Therefore, Medina's statement should be interpreted as a rhetorical device—a common tactic in texts of that period—meant to promote his own work. Faleiro's treatise in fact precedes Medina's and did not receive the attention it deserved, either in its time or in subsequent historiography.

Francisco Faleiro was a Portuguese cosmographer who, after assisting in the preparation of Ferdinand Magellan's expedition to the Moluccas, remained in Seville in the service of the Spanish monarch, building a long career as a cosmographer at the Casa de la Contratación.

33 Albuquerque, *Os guias náuticos de Munique e Évora*, 119.

34 Albuquerque, *Os guias náuticos de Munique e Évora*, 124.

35 Francisco Faleiro, *Tratado del esphera y del arte del marear* (Sevilla: Juan Cromberger, 1535).

36 "ni hay maestros que esta arte enseñen, ni de ninguno hay notícia que hasta ahora haya escrito modo de navegar." Medina, *Arte de navegar*, Prologo, f. 2v.

In addition to collaborating on various projects, including the reform of the *padrón real* (the royal navigation chart), Francisco's expertise was frequently sought by the community of cosmographers and pilots on technical and scientific matters. His influence in this field was significant, and his opinions were highly regarded in matters of navigation and cosmography.

Faleiro's most prominent contribution to the field of nautical studies was his *Tratado del esphera y del arte del marear, con el regimiento de las alturas, con algunos reglas nuevamente escritas y muy necessarias* ("Treatise of the Sphere and the Art of Seafaring, with the Regiment of the Heights, with Some Newly Written and Very Necessary Rules"). This 104-page work was published by one of the best printing houses in Spain at that time, belonging to the Cromberger family, with royal privilege, and it had no other edition besides the first.[37] The title of the work already gives a glimpse of its content, which combines two worlds: cosmography and the art of navigation. A more detailed analysis of this work's content will help us understand the central role it played in shaping the literary genre of nautical treatises.

The first part of the text, comprising twenty-two chapters, focuses on cosmography. As in the nautical guides, Faleiro includes a version of Sacrobosco's *Sphere*. However, it is not a direct translation, as Faleiro adds his own material and critical comments, distinguishing himself from the role of a mere translator. This is evident in his unique way of explaining concepts, as well as the deliberate additions and omissions he makes to suit the purpose of his work.

In the first three chapters of Faleiro's work, the alignment with Sacrobosco's text is apparent—the two are very similar. However, in other sections, Faleiro takes a distinctive approach to certain topics, such as the properties of the elements, the humors, and the influence of the stars on human life. Additionally, Faleiro does not follow the exact order of subjects presented in Sacrobosco's text. He also expands upon certain topics, such as the division of the earth into five zones, further developing these themes by supplementing Sacrobosco's information with recent data obtained through the discoveries, which contradicted some ancient ideas. Furthermore, the discussion of the timing and revolutions of the spheres—the last chapter in Faleiro's first part—constituted an entirely new section that did not exist in Sacrobosco's work. Faleiro leaves out parts of the *Sphere* he considered extraneous to the aims of his treatise—in chapter 10, on the colures, he states, "As these circles do not serve the purpose of this work, they will

37 On the Crombergers and their work see Clive Griffin, *The Crombergers of Seville: The History of a Printing and Merchant Dynasty* (Oxford: Clarendon Press, 1988).

Figure 2.3. Frontispiece of Francisco Faleiro, Tratado del esphera, Sevilla, 1535

not be further discussed."[38] In Faleiro's text the discourse is presented in a simple and instructional manner, using diagrams and practical examples to clarify the concepts being discussed.

The second part of Faleiro's *Tratado del esphera* is dedicated to the art of navigation, consisting of nine chapters and a tenth section on numerals. At

38 Faleiro, *Tratado del esphera y del arte del marear*, chap. X.

the beginning of this section, Faleiro offers three chapters on the horizon, a fundamental concept for oceanic navigation. He then provides a chapter entitled, "Very Useful Instruction for Beginners in the Art of Navigation," with guidance for pilots. Finally, he includes regiments already found in the nautical guides, such as those for determining the altitude of the Pole Star, the height of the sun, and converting degrees to leagues.

The eighth chapter of the second part of Faleiro's *Tratado del esphera* is notable for its innovative content, drawing the attention of historians, as it marks the first time that the issue of magnetic declination was addressed in a printed work. Although this phenomenon was already known and circulated in manuscript form, as seen in João de Lisboa's *Tratado da agulha de marear*, its significance for navigation and cartographic representation only became evident with the expansion of oceanic navigation and the concomitant increase in travel scale and distances.[39] In this chapter, Faleiro presents four methods to determine and correct the compass needle's error, together with a shadow instrument designed for this purpose.[40]

In the final chapter of the second part, Faleiro explains the use of the quadrennial tables of solar declination, which are given at the end of the book. The inclusion of these tables is not unique to Faleiro's *Tratado*, as they had already appeared in earlier works like the nautical guides and *Suma de geographia*. Faleiro adopts the values proposed by Abraham Zacuto (1452–1515) for the tables, with a maximum declination of 23°33." However, he omits information on the sun's position and religious holidays, details unnecessary for navigation, providing instead only the day of the month and the sun's declination in degrees and minutes for each day. Faleiro's tables were fully reproduced in the second edition of *Suma de geographia* (1530) and in Pedro de Medina's *Arte de navegar* (1545).

In the final section of the *Tratado*, Faleiro includes a brief section titled "Rules for Quickly Learning How to Count with Numbers," where he explains the use of Arabic numerals. Notably, Portuguese navigation tables, such as the nautical guides and *Reportório dos tempos*, more frequently employed Arabic numerals than Roman numerals, while Spanish authors adopted Arabic numerals more gradually. In Enciso's *Summa*, Roman numerals appear in both editions, whereas Medina's *Arte de navegar* uses both types, with

39 Luís de Albuquerque, "Contribuição das navegações do séc. XVI para o conhecimento do magnetismo terrestre," *Revista da Universidade de Coimbra* XXIV (1970): 5–22; Lisboa, "O 'Tratado da agulha de marear' de João de Lisboa."

40 For an analysis of these four processes and a brief description of the shadow instrument proposed by Faleiro in this chapter see Luís de Albuquerque, *Instrumentos de navegação* (Lisboa: Comissão Nacional para as Comemorações dos Descobrimentos Portugueses, 1988), 73–79.

a preference for Roman. However, in later works, such as Martín Cortés's *Breve compendio de la sphera* (1551) and Medina's *Regimiento de navegación* (1563), Arabic numerals are more prevalent. Although Faleiro published in Spain, he opted for Arabic numerals, possibly influenced by his Portuguese background, as Roman numerals appear to have remained in use longer in Spain.[41]

Faleiro expanded on the structure found in the nautical guides of Munich and Évora, enhancing it and incorporating elements he considered essential for assisting navigators. While the nautical guides already contained cosmography, navigation regiments, and solar declination tables, Faleiro introduced a crucial element: navigation instruments.

Interestingly, although one section of the nautical guides is designated *Regimento do estrolabio e do quadrante* ("Regiment of the Astrolabe and Quadrant"), the astrolabe and quadrant are seldom mentioned explicitly. The instructions focus more on the calculations involved, suggesting that familiarity with these key navigation instruments may have been tacitly assumed to be acquired knowledge among navigators. Faleiro references the astrolabe and quadrant more frequently than the nautical guides but does not provide detailed usage instructions. He places particular emphasis on the compass in chapter 8, where he explains the phenomenon of magnetic declination.

Alongside standard instruments like the astrolabe, cross-staff, and quadrant, Faleiro touches upon new instruments in his work. In chapter 6 of the second part, for example, he proposes a novel "shadow instrument" for measuring the sun's altitude even when it is not exactly noon, addressing the issue of the sun's occasional invisibility. In chapter 8, he describes another

41 For an analysis of the appearance and the diffusion of the Arabic numerals in Portugal see Joaquim Barradas de Carvalho, *Sur l'introduction et la diffusion des chiffres arabes au Portugal* (Lisboa: Livraria Bertrand, 1958). According to this author, the introduction of Arabic numerals in Portugal happened through authors or foreign origin or formation (such as Valentim Fernandes, Martim Behaim, and Hans Mayr), who established themselves in Portugal, attracted by commerce and the navigation underway. Thus, the first Portuguese texts in which the percentage of Arabic numerals is considerably higher than that of Luso-Roman numerals are works by authors involved in navigation and commercial life. The first author born and educated in Portugal to apply a larger amount of Arabic numerals in a text was Duarte Pacheco Pereira (1460–1533), in the *Esmeraldo de situ orbis* (ca. 1505–1508). It is therefore not unreasonable to assume that it was through the influence of Portuguese nautical texts that Arabic numerals were also introduced and spread in the Spanish nautical literature. However, it is known that Arabic numerals appeared at different times depending on the discipline. The use of Arabic numerals in astronomical tables dating back to the fourteenth and fifteenth centuries indicates that astronomy was probably the first to adopt them.

shadow instrument, this time for determining magnetic declination. Faleiro furnishes instructions for constructing and using these instruments and provides an illustration of the instrument for magnetic declination. He then underscores the importance of reliable instruments on board ships.

Compared to the brief and schematic pamphlets format of the nautical guides, Faleiro's text features a much more developed narrative style. He engages with the reader by explaining essential navigation concepts, such as the sun's altitude, shadow, and declination, as well as latitude and longitude, route, course, meridian, parallel, and more. He supplements this material with diagrams and practical examples, and expresses himself in clear, accessible language.[42]

The use of the vernacular is a key element in this type of literature, as it was aimed at an unschooled audience, as Faleiro notes in the introduction to his *Tratado*. The author explicitly states the purpose of his work, addressing the practical needs of navigation:

> And because the main purpose of all this and of the heights is to ensure in this art that the sailors know what they are sailing by their routes and how much navigation they have according to the voyage that each one hopes to make, and that by the height they know the degrees in which are the ports, rivers, capes, cities, berries, bays, straits and the parallel or height in which the ships are every day. And they should know the routes that should be followed to navigate from one to the other and the distances between them, both from the equinoctial and from one to the other.[43]

42 "[…] I wanted to write this simple treatise in our Castilian language with my rough pen and humble thought, submitting myself to the emendation and correction of better wit, in this crude style, so that those who, like me, do not reach the polished Latinity, to this lack may not fail to know something by natural reason of the admirable works and wonders of God […]." "[…] quise escrevir com mi ruda péñola y humilde pensamiento, sometiéndome a la emienda y corrección de mejor ingenio, este simple tratado en nuestra lengua castellana por este tan tosco estilo, para que los que como yo no alcanen la polida latinidad a esta falta no dexen de saber algo por natural razón de las admirables obras y maravillas de Dios[…]." Faleiro, *Tratado del esphera y del arte del marear*, f. iir–iiv.

43 "E porque el fin principal de todo esto y de las alturas es endereçado en esta arte a que los mareantes sepan lo que por sus derrotas navegan e quánto tienen de navegación según el viaje que cada uno espera hazer, y que por el altura se sepan los grados en que están los puertos, ríos, cabos, ciudades, bayas, baxos, estrechos y el paralelo o altura en que las naos se hallan cada día. E sabido, sepan las derrotas que conviene seguir para navegar de los unos a los otros e las distancias d'ellos, assí de la equinocial como de los unos a los otros." Faleiro, *Tratado del esphera y del arte del marear*, f. 28v.

It is worth considering why a work of such significance, authored by someone as well-regarded and respected as Faleiro, did not achieve greater impact and distribution. One possible explanation is that shortly after its publication, similar works emerged in Spain that surpassed Faleiro's in various aspects.

2.3. Crossing Boundaries: From the Iberian Peninsula to Europe

In 1545 Pedro de Medina published his *Arte de navegar en que se contienen todas las reglas, declaraciones, secretos, y avisos, que a la buena navegaciõ son necessarios, y se deven saber, hecha por el maestro Pedro de Medina* ("The Art of Navigation in Which Are Contained All the Rules, Declarations, Secrets, and Warnings, Which Are Necessary for Good Navigation, and Which Should Be Known, Made by the Master Pedro de Medina"). The title suggests a broader ambition than that of the nautical guides or Faleiro's *Tratado*. In the nautical guides, the title refers to the treatise on the sphere and the regiments for the sun and the North Star. Faleiro's title, in turn, includes the treatise on the sphere, the regiment of heights, and adds "some rules newly written." Medina, however, aims to present all the rules necessary for effective navigation. Medina's work is thus more extensive than Faleiro's, spanning roughly twice as many folios. It addresses most of the topics covered by Faleiro in greater depth and treats additional subjects as well.

The *Arte de navegar* is divided into eight books. The first book covers the sphere, drawing on Sacrobosco's work, though Medina, like Faleiro, does not reproduce Sacrobosco's text *ipsis verbis*. The second book discusses the sea, its movements, and the origins of navigation, while the third addresses the winds. The fourth and fifth books detail the regiments for determining the altitude of the sun and the Pole Star, respectively; the sixth covers the sea compass and magnetic declination; the seventh discusses the phases of the moon; and the eighth and final book examines the days of the year. Throughout, Medina connects each topic to navigation, in lucid vernacular language.

As has been stated, Medina's work includes topics that Faleiro does not address in his *Tratado*, such as the sea and wind, the moon's phases, and the calendar. Interestingly, while Medina incorporates elements from Faleiro's *Tratado*, such as the solar declination tables, he also diverges from it, particularly on magnetic declination in book 6. Here, Medina introduces the compass as the most essential tool for a navigator, likening it to sight among the human senses. He then outlines six reasons why compasses

might fail to point north (whereas Faleiro identifies only one) and proposes solutions for each of these issues.

Next, Medina clarifies what constitutes east and west and their relationship to the equinoctial line, along with the directions in which the sun rises and sets—valuable information for navigation. In the third chapter of book 6, Medina shares his view on compass variation, which differs from Faleiro's. He states, "In this matter, I have sought some authority, reasoning, or foundation, and I must say that regarding this variation ascribed to the needle, I have found no writings, reasons, or reliable experience to confirm it."[44] He then outlines the reasons for rejecting the existence of magnetic declination.

In book 6, Medina also introduces a shadow instrument that allows one to check if the compass needle is accurate. This suggests that Medina acknowledges variations in the needle but does not attribute them to magnetic declination. Instead, he considers these variations to be due to imperfections in the needles themselves.

In his work, Medina embraced the well-known idea that a picture is worth a thousand words. From Book III onward, the *Arte de navegar* is richly illustrated, featuring approximately eighty diagrams—sixty-seven of them circular—and a nautical chart. Medina set a new standard for visual content in nautical manuals, far surpassing the number of illustrations in preceding works. The nautical guides of Munich and Évora, for instance, contain only thirty-two diagrams in the section on the sphere and one additional diagram in the section on regiments. Enciso's *Suma* includes no illustrations or diagrams in the sphere section and only two in the regiments section. Faleiro's *Tratado* has ten diagrams in the sphere section, six in the navigation section, and an instrument illustration.

There is a clear progression in the number of illustrations in works published in Spain: illustrations are scarce in Enciso (two), more numerous in Faleiro (around seventeenth), and increase significantly in Medina (around eighty).

Visually, the *Arte de navegar* stands out among these works, as seen from its frontispiece. Both nautical guides feature armillary spheres on their covers, and the *Suma de geographia* by Enciso also has a frontispiece depicting a large armillary sphere held by an arm within an ornate frame, with the title below in both editions. Similarly, Faleiro's *Tratado* has a large

44 "Sobre esto yo he procurado buscar alguna auctoridad o razón o alguna cosa en que esto tenga fundamento y digo que d'esta variación que del aguja se dize no hallo cosa escripta, ni razón, ni experiencia que cierta sea." Medina, *Arte de navegar*, f. 82r.

Figure 2.4. Frontispiece of Pedro de Medina, Arte de navegar, Valladolid, 1545

armillary sphere with a simple frame as its frontispiece. Medina, however, breaks with this tradition, displaying instead the coat of arms of Emperor Charles V, reflecting the imperial patronage his work received.

Beyond its visual aspects, the *Arte de navegar* is notable for the large number of editions and translations it garnered across the Iberian Peninsula

and throughout Europe, establishing it as a model for sixteenth-century navigation manuals. Within a century of its publication, it was republished in fifteen French editions, five in Dutch, three in Italian, and two in English.[45]

Despite its undeniable importance and influence on subsequent works of this kind, Medina's contribution builds upon established foundations, such as the nautical guides and Faleiro's *Tratado*, fitting within the nascent literary genre of nautical treatises dedicated to oceanic navigation. As David Waters notes:

> Sixteen years later a great Portuguese scholar, Francisco Faleiro, writing in Castilian, published at Seville (in 1535) *Tratado del Esphera*. It was a notable work for many reasons, but particularly because it set the framework for subsequent manuals of navigation. [...] With its brilliant diagrams, clear tables and lucid text Medina's *Arte* was a masterpiece of exposition as it was of printing; nevertheless, its pattern was set by Faleiro.[46]

Nonetheless, Pedro de Medina's *Arte de navegar* marks a clear turning point in this genre due to its widespread dissemination, which brought nautical subjects previously confined to the Iberian Peninsula into the literature of several other European countries.

A work that rivals Medina's in terms of impact is the *Breve compendio de la sphera y de la arte de navegar, con nuevos instrumentos y reglas, ejemplarizado con muy sutiles demostraciones* ("Brief Compendium of the Sphere and the Art of Navigation, with New Instruments and Rules, Exemplified with Very Subtle Demonstrations," 1551), by Martín Cortés, Spanish cosmographer. Though published in Seville, it was composed in Cádiz.[47] This work contains approximately 200 pages, where the investment in typography is evident through the inclusion of diagrams, decorative capitals, and marginal notes.

At the beginning of the book, there is a letter dedicating the work to Charles V. In this letter, Cortés praises the emperor, comparing him to the

45 Francisco José González, *Astronomía y navegación en España. Siglos XVI–XVIII* (Madrid: MAPFRE, 1992), 72.

46 David Waters, *The Iberian Bases of the English Art of Navigation in the Sixteenth Century* (Coimbra: [Separtata da *Revista da Universidade de Coimbra* 24], 1970), 14.

47 This is an important information to understand some differences in the works of Medina and Cortés, because the authors were inserted in different traditions: Medina in the Casa de la Contratación, in Seville, and Cortés in Cadiz. José Ramón Carriazo Ruiz, *Tratados náuticos del Renacimiento: Literatura y lengua*, Estudios de Historia de la Ciencia y de la Técnica 24 (Valladolid [Salamanca]: Junta de Castilla y León, Consejería de Educación y Cultura; Universidad de Salamanca, 2003), 39.

gods of the Latin and Egyptian traditions. He also asserts that he is the first to condense all aspects of navigation into a brief compendium, intended to promote the highest achievements in navigation during the reign of Charles V, and to be "useful and profitable for those on land and indispensable for those at sea."[48]

Cortés offers the second dedication of his work to Don Álvaro de Bazán, the captain general of His Majesty's fleet. He lists the many benefits of navigation and emphasizes one of its main dangers: the ignorance of pilots, who neither know nor wish to know more. Cortés assures readers that this compendium will greatly benefit all, providing the means to achieve the vital goal of "arriving safely and securely at port." He claims to have made a greater effort than others to bring forth knowledge that many have kept concealed. In concluding the prologue, Cortés reveals that his motivation for writing this work was "the common benefit it could bring to those who wish to learn from home and to sailors, who are rarely able to be at home."[49]

In the frontispiece, beneath the title, we see the coat of arms of Charles V, flanked by two columns. Below, Latin inscriptions exalt the emperor. On the following page, there is an engraving of a man pointing toward the sky, likely representing an astronomer, astrologer, or mathematician. He gestures toward a star positioned in front of the sun, surrounded by clouds. On the ground are various objects, including a compass, a quill, a book, and an armillary sphere.

The *Breve compendio* is organized into three sections. The first section covers cosmography, a topic present since the nautical guides, and introduces basic navigational concepts such as the sphere, lines, angles, and the zenith. In the second section, Cortés describes the movements of the sun and moon, various instruments, divisions of time and tides, and storm patterns. The third section provides information on winds, nautical charts, the compass and magnetic declination, as well as guidance on the regiments of the sun, the north, and leagues. This section also covers instruments like the astrolabe and cross-staff, along with other tools for timekeeping. Throughout the text, illustrations and engravings are included to aid the reader's comprehension.

The full title of this work reveals several intriguing aspects. At first glance, the reader recognizes a structure similar to that of the nautical guides,

48 "[…] com este breve compendio de navegación, a los de la tierra útil e provechoso, y a los de la mar tan necessario." Martín Cortés, *Breue compendio de la sphera y de la arte de nauegar* (Sevilha: Anton Alvarez, 1551), Carta al Cesar.

49 "[…] el provecho común que podía resultar a personas que desean en su casa saber y a marineros que jamás saben en ella parar." Cortés, *Breue compendio de la sphera*, Prologo.

Faleiro's *Tratado*, and Medina's *Arte de navegar*, indicated by the inclusion of the terms "sphere" and "the art of navigation." However, Cortés's ambition goes further: he aims to introduce new instruments and rules, accompanied by subtle demonstrations.

Indeed, Cortés's treatment of nautical instruments distinguishes his work from its predecessors. While some instruments are mentioned in the nautical guides, there is no explanation of their construction or use. In Faleiro's *Tratado*, instructions for the manufacture and employment of instruments appear, but are limited to the new shadow instruments he proposes. In contrast, Cortés places significant emphasis on instruments, as noted in the title. Nearly the entire third section of the book is devoted to a detailed description of these instruments, with guidance on their fabrication and application. This is no longer a brief collection of rules, like the nautical guides, where cosmography is summarized and only the essentials of navigational tables and regiments are condensed. Cortés's work is far more developed, with a richer and more complex narrative.

Reading the works of Medina and Cortés reveals that their intended audience likely differs from that of earlier texts. The nautical guides and Faleiro's *Tratado* were clearly designed to assist minimally literate pilots with practical navigation: they are small, straightforward books that focus solely on essential navigation topics, including examples, illustrations, vernacular language, and other accessible features. By contrast, Medina's and Cortés's works are more substantial in size, with a complex and advanced narrative targeting the empire's elite.

In the *Breve compendio*, as with Medina's work, imperial sponsorship is apparent through the dedication and the inclusion of Charles V's coat of arms. The frequent use of Latin phrases (as seen on the frontispiece), along with references to classical and biblical authorities and numerous marginal notes, indicates a scholarly dimension absent in earlier works. Unlike in the nautical guides, which contain no such references, and Faleiro's *Tratado*, which gives only a few minor citations, the references in Medina's work are more prominent—and in Cortés's text, they reach a level of prominence that surpasses all others. Additionally, the objects depicted in the engraving at the beginning of *Breve compendio* suggest that this work is more theoretical than practical.

In the prologue and dedication, Cortés explicitly identifies his intended audience as both theorists who remain on land and practitioners who sail. However, the characteristics of the work (its length, format, and scholarly language) seem better suited to those on land or for instructional use in the teaching of pilots. It is unlikely that the book would have been practical

Figure 2.5. Frontispiece of Martín Cortés, Breve compendio de la sphera, Sevilla, 1551

for consultation during navigation, or well-received by sailors and pilots, who typically had limited education and were unfamiliar with Latin and the frequent allusion to classical authorities.

Cortés's *Breve compendio* became one of the most widely disseminated Iberian works of its time. While Medina's work gained particular popularity

in France, with around twenty editions, Cortés's work found favor in England, with at least six editions published throughout the sixteenth century.[50]

As other nations began to navigate the ocean, similar nautical texts appeared outside the Iberian Peninsula. One of particular significance was *Spieghel der Zeevaerdt* by Lucas Waghenaer, published in 1584.[51] Shortly thereafter, in 1588, it was translated into English by Antony Ashley under the title *The Mariners Mirrour*.[52]

The frontispiece of the work, a colorful illustration, is remarkable, and its elements are quite revealing. At the top, six men are depicted leaning over a globe. Framing this globe are two smaller spheres: the one on the right represents the earth, while the one on the left symbolizes the sky. On both sides, a series of interconnected instruments is illustrated, including a quadrant, an astrolabe, a cross-staff, and a sounding lead. Below, two men, one on each side, hold sounding leads. The bottom of the page centers a ship, flanked by two compasses. The title of the work is prominently displayed in the center, bordered by two columns.

Spieghel der Zeevaerdt, a work of approximately one hundred pages, is divided into two parts, with the second part published a year after the first. The author begins the book by providing instructions for those learning the art of navigation. He advises them to mark and sketch all visible landmarks (such as buildings, castles, churches, towers, and other significant features) while on board, and to record the distances using a compass. He also suggests they take note of the depth of sandbanks. Furthermore, he recommends that they compare the information on their charts with the actual locations they observe. To achieve this, the author encourages apprentices to seek guidance from the ship's master and other experienced sailors, and to make

50 María M. Portuondo, *Secret Science: Spanish Cosmography and the New World* (Chicago: University of Chicago Press, 2009), 52–53. It is important to note that one of the English translations of Cortés's work was completed by the famous English translator Richard Eden, in 1561.

51 An online scan of this work can be found at https://dspace.library.uu.nl/handle/1874/210220.

52 Full title of English translation: *The Mariners Mirrour Wherin may playnly be seen the courses, heights, distances, depths, soundings, flouds and ebs, risings of lands, rocks, sands and shoalds, with the marks for th'entrings of the Harbouroughs, Havens and Ports of the greatest part of Europe: their several traficks and commodities: Together with the Rules and instruments of Navigation*. The translation is fairly faithful to the original, apart from a few instances where Ashley changes the place names from Dutch to English and corrects the positions of some towns. He also makes some changes to the chart of the Thames estuary. The textual differences between the English version and the Dutch original are not relevant. G. R. Crone, "'The Mariners Mirrour' 1588," *The Geographical Journal* 119, no. 4 (1953): 457.

Figure 2.6. Frontispiece of Lucas Waghenaer, Spieghel der Zeevaerdt, Leyden, 1584

use of the cross-staff and astrolabe, which, along with the compass, are essential instruments for safe and effective navigation.[53]

After these recommendations, there is a set of tables related to the calendar and the moon, followed by quadrennial tables of solar declination. Compared to those found in the nautical guides, these tables are more compact, presenting only the date of the month along with the declination values in degrees and minutes. They occupy just two pages, whereas the corresponding tables in the Munich Guide, for instance, take up twelve pages.

The following section provides instructions for determining the phases and age of the moon, explaining how fixed stars are utilized in navigation. It includes a catalog of the main fixed stars (from 1588), which displays their longitude, declination, and right ascension values. Additionally, a table with the right ascension values of the sun is provided, along with instructions for calculating the height of the pole using stars located within the tropics that decline from the equator.

The text then continues with a section on instruments, beginning with a description and illustration of a movable star compass. This is followed by instructions for constructing and using a cross-staff, accompanied by an engraving. Finally, the text explains how to draw and use a true and accurate sea chart.

Next, the author provides bearings for all the coasts of Holland, Zealand, France, and Spain, along with a list of important latitudes for western and eastern navigation. This section also includes a regiment of leagues, as well as descriptions of currents, tides, and seabeds in various parts of Europe.

Continuing in the first part of the work, a section titled "A Description and Portrait of the Greatest Part of the Seacoasts of Europe" begins with a map of western Europe, followed by twenty-two charts of "Western Navigation," which cover the coasts from Texel to Cádiz. The second part of the work contains twenty-three charts of "Eastern Navigation," detailing the waters east of the Zuiderzee, extending to Norway and Finland.[54]

Waghenaer's work was highly successful in Holland and throughout Europe, resulting in multiple editions and translations. Its impact was so significant that it even gave rise to a new literary genre known as "Waggoners" in England.

53 Anthony Ashley, *The Mariners Mirrour* (London, 1588), "An Author's Admonition to the Reader."

54 Günter Schilder, "A Dutch Manuscript Rutter: A Unique Portrait of the European Coasts in the Late Sixteenth Century," *Imago Mundi* 43 (1991), 61.

Despite its importance, the *Spieghel* differs from other works, such as the nautical guides and Faleiro's *Tratado*, not only in terms of the chronological distance of their publication but also in content. Early Iberian treatises primarily focused on oceanic navigation and methods for determining a ship's position at sea, while the *Spieghel* mainly addresses coastal navigation, complete with descriptions and illustrations of Europe's coasts. The work's emphasis on coastal profiles, seabed topography, and soundings highlights a continued focus on coastal navigation, setting it apart from other Iberian manuals less concerned with such matters. It is worth noting that the Dutch only began to systematically explore oceanic navigation in the early seventeenth century, underscoring both the transformation of the genre, and the geographical conditions that shaped it.

An interesting aspect that sets the *Spieghel* apart is its lack of the cosmographic element of the sphere found in earlier works. A possible reason for this absence is that, as educational systems and institutions evolved, it became unnecessary for pilots. By that time, pilots and sailors would have already acquired this knowledge, rendering its inclusion in manuals redundant. However, later works such as Céspedes's *Regimiento de navegación* and John Davis's *The Seaman's Secrets* reincorporate the cosmographic section, suggesting that *Spieghel*'s primary focus is on coastal navigation, despite having some information on oceanic navigation. Moreover, the numerous maps included in the work represent a unique and novel feature, absent in the previously mentioned treatises, and further pointing to coastal navigation as the central concern of the *Spieghel*.[55]

Another milestone of the emergence of nautical treatises in Europe is John Davis's *The Seaman's Secrets*, published in England in 1594 by Thomas Dawson.[56] This hundred-page book is dedicated to Lord Charles Howard, captain general of the Royal Navy. Unlike the authors of the works discussed so far, who were primarily cosmographers, Davis was a sailor himself. He writes with the authority of someone who has experienced the challenges of the sea, emphasizing this in his dedication: "[…] to present unto your most honourable favour this small treatise of Navigation, being a breefe

55 Pedro de Medina's *Arte de navegar* contains only one nautical chart, as does Cortés, who reproduces the same nautical chart as Medina.

56 Full title: *The Seaman's Secrets. Divided into 2 parts, wherein is taught the three kinds of sailing, horizontal, paradoxal and sailing upon a great circle: also an horizontal tide table for the easy finding of the ebbing and flowing of the tides, with a regiment newly calculated for the finding of the declination of the Sun and many other most necessary rules and instruments, not therefore set forth by any.* Thomas Dawson was a well-known printer in London, highly productive between 1568 and 1620, publishing mostly religious works and scientific treatises.

collection of such practises as in my severall voyages I have from experience collected."[57] The purpose of the book is also clearly stated in the dedication:

> To manifest the necessary conclusions of Navigation in breefe and shorte termes is my only intent, and therefore I omit to declare the causes of tearmes and diffinition of artificiall wordes, as matter superfluous to my purpose, neither have I laid downe the cunning conclusions apt for Schollars to practise upon the shore, but onely those things that are needfully required in a sufficient Seaman.[58]

Davis presents his work as a practical guide to navigation, containing only the essential information needed for this purpose. Consequently, his text shares more similarities with earlier Iberian treatises, such as the nautical guides and Faleiro's *Tratado*, than with the more theoretical works of Medina and Cortés. The structure of the text adheres to the typical format of navigational treatises, divided into two parts: one focusing on the practical aspects of navigation and the other addressing cosmography.[59] Each section's title takes the form of a question, subsequently answered by the author.[60]

The first part of the work addresses a range of topics, including an introduction to navigation, navigation courses, necessary instruments, the movement and age of the moon and its impact on tides, and the regiments of leagues, the pole, and the sun, as well as the sun's declination. Davis then explains basic concepts such as the zenith and provides an overview of nautical charts and their uses. Finally, he offers a brief summary of the topics covered.

The second part of *The Seaman's Secrets* is entitled "Wherein is Taught the Nature and Most Necessary Use of the Globe, with the Circles, Zones,

57 John Davis, *The Voyages and Works of John Davis the Navigator*, ed. Albert Hastings Markham, Works Issued by the Hakluyt Society, Ser. 1,59 (London: Hakluyt Society, 1880; repr., Farnham: Ashgate, 2010), 231.

58 Davis, *The Voyages and Works of John Davis the Navigator*, 238.

59 Davis highlights the importance of cosmography to navigation at the end of the first book: "to the purpose of navigation, we must understand Cosmography to be the universall description of the terrestriall Globe, distinguished by all such circles, by which the distinction of the celestiall Sphere is understoode to be given, with every Country, Coast, Sea, Harborow, or other place, seated in their one longitude, latitude, Zone and Clyme." Davis, *The Voyages and Works of John Davis*, 285.

60 The first question that appears in the book is, "What is Navigation?" and the answer, "Navigation is that excellent art which demonstrated by infallible conclusion how a sufficient ship may be conducted the shortest good way from place to place by corse and traverses." Davis, *The Voyages and Works of John Davis the Navigator*, 239.

Climates, and Other Distinctions for the Perfect Use of Sailing." This section explains concepts related to cosmography and the sphere, including the equator, equinoctial, ecliptic, zodiac, colures, tropics, poles, meridian, and horizon. It also presents the division of the world into zones and climates, discusses paradoxical navigation, describes methods for determining the height of the poles, and outlines ways to locate the sun on the ecliptic, as well as how to tell time at night using fixed stars.[61]

The text concludes with an exploration of three instruments. First, Davis discusses the cross-staff, beginning with an explanation of the conventional cross-staff before introducing a variation of his own design, in which the user stands with the sun at their back and observes its shadow. He provides a detailed explication of the construction and use of this instrument, emphasizing the excellence of his discovery.[62] He then briefly mentions the quadrant and astrolabe, accompanied by illustrations.

Davis's work closely follows the structure of Iberian navigation treatises, with a slight variation in the sequence of subjects—it places the section on the art of navigation before cosmography. Another notable difference is the absence of tables for solar declination, which had been a consistent feature since the nautical guides. This omission is intriguing, as the author presents the book as practical yet excludes these tables.

As we have seen, the genre of nautical treatises inaugurated by the nautical guides of Munich and Évora extended well beyond the Iberian Peninsula. As other countries developed their navigation methods and began sailing far from the coast, they also needed to codify information on oceanic navigation; however, they had the advantage of established models to build upon. The widespread dissemination of Pedro de Medina's *Arte de navegar* and Martín Cortés's *Breve compendio* among Europe's major maritime powers led to the creation of works with similar structures and content in these countries, such as *Spieghel* and *The Seaman's Secrets*, among others.

61 Regarding the division of the world into five zones, it is noteworthy that the author disputes the ancient notion by using his personal experiences: "[…] but in these our dayes we find by experience that the auncient Geographers had not the due consideration of the nature of these zones, for three times I have been within the Artick frozen zone, where I found the ayre very temperate." Davis, *The Voyages and Works of John Davis*, 306. This refutation, supported by recent discoveries, is also present in cosmographers' works, but is rarely presented in a first-person perspective.

62 "[…] and therefore no instrument may compare with the excellencie of this crosse staffe for the Seamans use." Davis, *The Voyages and Works of John Davis*, 337. This instrument became known as backstaff or Davis quadrant.

Analyzing these works enables us to establish connections between them, revealing their mutual influences and their impact on the development of this literary genre. By examining both the similarities and distinctions within these treatises, it is possible to better understand the technical challenges navigation faced during this period of great change and how these nautical texts sought to address them.

Conclusion

The sixteenth century in the Iberian Peninsula was marked by significant technical and scientific advances in oceanic navigation, accompanied by developments in nautical literature. The nautical guides represent the first effort to codify and compile the essential knowledge required for navigation into a printed text. Their style and content suggest that they were intended for practical individuals without scholarly backgrounds, such as sailors and pilots, who needed to adapt to the new demands of oceanic navigation, and to acquire a basic understanding of cosmography.

These small works, written in a simple language, aim to establish the body of knowledge necessary for the practice of astronomical navigation. As a result, for the first time in a nautical work, two key components are brought together: cosmographic content (the Sphere, in its first vernacular version) and navigational instructions (the regiments). This core structure would be replicated in subsequent works of this type, with a gradual effort to enhance and expand the information included in such texts over time.

This is evident in various titles where authors aim to provide the reader with "newly written rules" (Francisco Faleiro), "rules, declarations, secrets, and notices" (Pedro de Medina), or "new instruments and rules" (Martín Cortés). The expansion and refinement of these texts is likely linked to the emergence of oceanic pilots as a new professional group, needing the theoretical tools required for astronomical navigation. Faleiro's work closely follows the structure of the guides, developing and supplementing it while maintaining its goal of being straightforward and easily accessible for a less educated audience. The royal privilege granted to the work and its dedication further illustrates the growing interest of the empire and its court in this type of publication.

Through Faleiro's work, a standard of content was established that would later spread beyond the Iberian Peninsula. The works of Medina and Cortés, being larger and more complex, deviate slightly from the practical focus of earlier treatises. Nonetheless, these works achieved significant dissemination

outside the Iberian Peninsula and influenced the creation of other texts in the same genre, such as the *Spieghel* and *The Seaman's Secrets*. Although they generally follow a similar structure, their content varies. For example, the *Spieghel* omits the cosmographic section and includes nautical charts, auguring a distinct shift in this literary tradition. Subsequently, another genre would materialize within this tradition: nautical rutters, which can already be seen in Céspedes's *Regimiento de navegación*.

It is noteworthy that the authorship of these works, initially undefined (as seen in the nautical guides) becomes increasingly salient over time. The authors, primarily cosmographers, assert their authority and establish their distinct voices, as evidenced by the paratexts of their works, such as dedications. This movement toward cosmographer empowerment arises from a context in which two distinct groups—pilots and cosmographers—were attempting to reconcile their differing approaches to navigation.[63]

The treatises frequently highlight the ignorance of pilots and emphasize the need to educate them in astronomical navigation, which the authors claim is the primary purpose of their works. Meanwhile, pilots resist the theoretical and mathematical demands imposed by cosmographers, favoring simpler, traditional methods that, while not mathematically precise, proved effective in practice.[64] This new literary genre, established during the sixteenth century, reflects the tension between the disciplined approach to navigation advocated by cosmographers and the practical needs of pilots.

Nautical treatises did not exist prior to the early sixteenth century; they were born out of necessity and consolidated over time. Rather than constituting a rigid genre, such works constantly adapted to the influence of various external factors, such as the state of navigation technology at the time of writing, the cultural and political context of each country, and the prevailing systems for pilot education. A correlation can be observed between the power of contemporary empires and the development of this literary genre, as nearly all these works were published with royal privilege or support from court-related figures and were printed by the most reputable printing houses.

63 This discussion between pilots and cosmographers is well studied and documented in Alison Sandman, "Cosmographers vs. Pilots: Navigation, Cosmography, and the State in Early Modern Spain" (PhD diss., University of Wisconsin, 2001).

64 It was also in this context that Céspedes wrote his work, albeit adopting a different position than most cosmographers of his time. Being an important cosmographer of the Casa de la Contratación, he supported the pilots' point of view regarding several matters. See Alison Sandman, "An Apology for the Pilots' Charts: Politics, Projections and Pilots' Reports in Early Modern Spain," *Imago Mundi* 56, no. 1 (2004): 7–22.

This chapter has aimed to contribute to the understanding of the emergence of this new genre of technical literature dedicated to oceanic navigation, examining the aforementioned works collectively and contextualizing them within this developmental trajectory.

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