40 • Spanish Nautical Cartography in the Renaissance

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The history of Spanish nautical cartography is well known, at least in outline. The major surviving charts have been discussed with great erudition, as have the basic institutional structure and the voyages of exploration that provided geographic information for the charts. In this chapter, I have made no attempt to duplicate the work of Ricardo Cerezo Martínez or María Luisa Martín-Merás in recent years, though I of course rely heavily on their studies.[1] Unfortunately, beyond the general introductions to nautical cartography, much less is available for those who cannot read Spanish.[2] What I hope to do is provide a contextual introduction to Spanish sea charts, discussing the charts in light of the institutions surrounding them and the various groups interested in their construction and use. In this chapter, I pay particular attention to the history of navigation (for pilots used the charts), of cosmography (for cosmographers made them), and of territorial disputes and other diplomatic imperatives.[3] Fortunately the bureaucracies in Spain surrounding navigation and exploration kept copious records that have often survived better than the charts they discuss; these bureaucratic discussions of charts form a major source for all discussions of Spanish nautical cartography.

The construction of sea charts in Spain certainly did not begin in the sixteenth century, or even with Christopher Columbus, but followed a long medieval tradition, which produced such important works as the Catalan Atlas.[4] The Columbian voyages, however, catalyzed important changes. The increased state interest and the bureaucratic apparatus that grew up around the administration of the new territories combined with the new navigational needs of the increasingly routine oceanic voyages to change the ways that charts were regulated, sold, and used. With new places to portray, new clients to please, and new regulations to follow, the Spanish chart trade entered a new era. For that reason, I begin with the sixteenth century.

The manuscript chart tradition poses difficult problems of documentation. Most of the charts known to have been made have not survived, most mentions of charts in the archival records cannot be matched to any particular surviving chart, and most of the extant charts seem to have been made for presentation rather than use. The charts used by the pilots were supposed to be destroyed when they were no longer sufficiently current to be useful, as were old versions of the *padrón real,* the central exemplar kept as a pattern for chartmakers to copy. Cerezo Martínez has compiled an invaluable list of known nautical charts, including some still extant, some destroyed in modern times, and some known only from brief sixteenth-century mentions.[5] Because of this poor survival rate, many of the most important charts are known only from textual records. For this reason, I have organized this chapter around the different uses of sea charts and the institutions and people serving them rather than around the individual surviving charts. In the introduction, I give a brief overview of the charts themselves, their major characteristics, and the difficulties in deciding how to obtain information for revising them. In the first part, I discuss the institutional background of nautical cartography in

Abbreviations used in this chapter include: *Cosmographers and Pilots* for Ursula Lamb, *Cosmographers and Pilots of the Spanish Maritime Empire* (Aldershot: Variorum, 1995); *El Tratado* for *El Tratado de Tordesillas y su época (Congreso Internacional de Historia),* 3 vols. ([Tordesillas]: Sociedad V Centenario del Tratado de Tordesillas, 1995); and AGI for Archivo General de Indias, Seville.

1. Ricardo Cerezo Martínez, *La cartografía náutica española en los siglos XIV, XV, y XVI* (Madrid: C.S.I.C., 1994). Of the many fine works by María Luisa Martín-Merás, see especially her *Cartografía marítima hispana: La imagen de América* (Barcelona: Lunwerg, 1993). See also Belén Rivera Novo and María Luisa Martín-Merás, *Cuatro siglos de cartografía en América* (Madrid: Editorial MAPFRE, 1992), 65–102; María Luisa Martín-Merás, "La cartografía de los descubrimientos en la época de Carlos V," in *Carlos V: La náutica y la navegación,* exhibition catalog (Barcelona: Lunwerg, 2000), 75–94; and idem, "La cartografía marítima: Siglos XVI–XIX," in *La cartografia iberoamericana,* by María Luisa Martín-Merás et al. (Barcelona: Institut Cartogràfic de Catalunya, 2000), 19–83, esp. 19–38.

2. Michel Mollat du Jourdin and Monique de La Roncière, *Sea Charts of the Early Explorers: 13th to 17th Century,* trans. L. le R. Dethan (New York: Thames and Hudson, 1984), provides a good introduction, but the section on Spain is very brief and not always reliable.

3. For overviews of cosmography and navigation in the period, see chapters 3 and 20 in this volume.

4. On the earlier traditions, see Cerezo Martínez, *Cartografía náutica,* 25–88, and Martín-Merás, *Cartografía marítima hispana,* 25–42. On Mallorcan and Catalan cartography, see Julio Rey Pastor and Ernesto García Camarero, *La cartografía mallorquina* (Madrid: Departamento de Historia y losofía de la Ciencia, "Instituto Luis Vives," Consejo Superior de Investigaciones Científicas, 1960).

5. Cerezo Martínez, *Cartografía náutica,* 253–81.

Spain, outlining the different groups concerned with the charts' construction and use and the roles the charts played in certain ongoing conflicts. In the second part, I concentrate on the *padrón real,* or central pattern chart, particularly the attempts to revise it, keep it up to date, and ensure that all other charts were copied from it. Finally, in the third part I focus on the sale of charts to the pilots and on the construction of charts as tools for use at sea.

Introduction: Nautical Cartography in the Sixteenth Century

Sea charts were regulated by the Casa de la Contratación (House of Trade), founded in 1503 in Seville, which was given jurisdiction over everything related to the Indies, whether trade, travel, or colonization.[6] Despite Seville's somewhat inconvenient distance from the sea, it remained the administrative center for travel to the Indies, though subsidiary offices were set up in Sanlúcar de Barrameda and Cádiz. Navigation was considered part of this enterprise, though a relatively minor part in terms of expense or energy, so sea charts fell under the auspices of the Casa. The Casa, in turn, was subject to oversight from the royal court, and the entire enterprise was put under the authority of the Council of the Indies after its formation in 1523.[7]

Most sea charts used in sixteenth-century Spain (as in the rest of Europe) were essentially portolan charts of the Mediterranean that had been expanded to include the New World.[8] The early ones included just the Atlantic coast (of both the old and new worlds), though later ones expanded to include as much of the known world as was considered necessary for the voyage being considered. While the charts differed widely in detail and ornamentation, depending on both the maker and the intended audience, the basic features remained the same, forming a coherent tradition. This was almost entirely a manuscript tradition, though a few charts were printed for use in navigation textbooks and books on cosmography.[9]

The most notable feature of the charts was the set of overlapping rhumb lines completely covering the chart. These lines emanate from a circle (or double circle) of thirty-two-point compass roses spaced around the chart and color coded, with the eight primary directions black, the eight between them green, and the remaining sixteen red. These rhumb lines formed a base for specifying the compass bearings between any two places and, when combined with distances read off the scales placed on the charts, were crucial to using the charts at sea. The charts almost always contained at least one latitude scale, forming almost a secondary grid, and usually had the equator and the tropics marked. Many had a longitude scale as well. The charts were also characterized by lists of placenames, perpendicular to the coast and almost completely filling it. A few had other features potentially useful for pilots, such as the annotated central compass rose on Diego Gutiérrez's Atlantic chart (fig. 40.1).[10]

Another striking feature of the charts is their size. The surviving charts are generally very large, often one to two meters in length. Though these particular charts were probably not intended to be taken to sea, in 1606 Andrés García de Céspedes indicated a similar size for the

6. José Cervera Pery, *La Casa de Contratación y el Consejo de Indias (Las razones de un superministerio)* (Madrid: Ministerio de Defensa, 1997), 51–63 for the foundation of the Casa and its antecedents, 67–72 for its functions. See also [María del] Carmen Galbis Díez, "The Casa de la Contratación," in *Discovering the Americas: The Archive of the Indies,* ed. Pedro González García (New York: Vendome Press, 1997), 91–128. On the cartographic functions of the Casa, see José Pulido Rubio, *El piloto mayor de la Casa de la Contratación de Sevilla: Pilotos mayores, catedraticos de cosmografía y cosmógrafos* (Seville, 1950), 255–457. In contemporary documents, the Casa was referred to variously as the Casa de Contratación and the Casa de la Contratación; for the sake of consistency, I use only the latter.

7. On the Council of the Indies, see Ernst Schäfer, *El Consejo Real y Supremo de las Indias: Su historia, organización y labor administrativa hasta la terminación de la Casa de Austria,* 2 vols., trans. Ernst Schäfer (1935–47; reprinted Nendeln, Liechtenstein: Kraus Reprint, 1975), vol. 1, and the essays in Demetrio Ramos Pérez et al., *El Consejo de las Indias en el siglo XVI* ([Valladolid]: Universidad de Valladolid, Secretariado de Publicaciones, 1970).

8. For a general survey of portolan charts, see Tony Campbell, "Portolan Charts from the Late Thirteenth Century to 1500," in *HC* 1:371–463.

9. Pedro de Medina and Martín Cortés both included schematic charts in their textbooks. Half a century later, Andrés García de Céspedes also included a chart, closely tied to the geometrical arguments in the text. For a partial list of maps and charts included in such books, see Martín-Merás, *Cartografía marítima hispana,* 121–35. On the printing history of Medina's chart, see Barbara B. McCorkle, *New England in Early Printed Maps, 1513 to 1800: An Illustrated Carto-Bibliography* (Providence, R.I.: John Carter Brown Library, 2001), 7. For charts in textbooks, see Pedro de Medina, *Regimie[n]to de nauegacio[n]: Contiene las cosas que los pilotos ha[n] e saber para bien nauegar . . .* (Seville: Simon Carpintero, 1563), fols. [vii verso]–viii recto, and the facsimile edition and transcription, *Regimiento de navegación (1563)* (Madrid, 1964); Martín Cortés, *Breue compendio de la sphera y de la arte de nauegar con nueuos instrumentos y reglas . . .* (Seville: Anton Aluarez, 1551), fol. lxvii recto, and the facsimile edition, *Breve compendio de la esfera y del arte de navegar* (Madrid: Editorial Naval, Museo Naval, 1990), 225; and Andrés García de Céspedes, *Regimiento de navegacion mando haser el rei nvestro señor por orden de sv Conseio Real de las Indias,* 2 pts. (Madrid: I. de la Cuesta, 1606), pt. 2, *Segvnda parte, en qve se pone vna hydrografia que mando hazer Su Magestad* (hereafter referred to as *Hydrografía*), after fol. 126.

10. The numbers Gutiérrez gave are very close to those given by Rodrigo Zamorano as the "old figures" (the ones used before he recalculated the table); he explains the use of such numbers in Rodrigo Zamorano, *Compendio de la arte de navegar,* facsimile edition (Valencia: Librerías "Paris-Valencia," 1995), fols. 44v–46r. Such tables were a standard feature in navigation textbooks. Domenico Vigliarolo (Domingo Villaroel) included a similar compass rose in the fourth chart of his manuscript atlas, reproduced in Sandra Sider, *Maps, Charts, Globes: Five Centuries of Exploration. A New Edition of E. L. Stevenson's* Portolan Charts *and Catalogue of the 1992 Exhibition,* exhibition catalog (New York: Hispanic Society of America, 1992), 35.

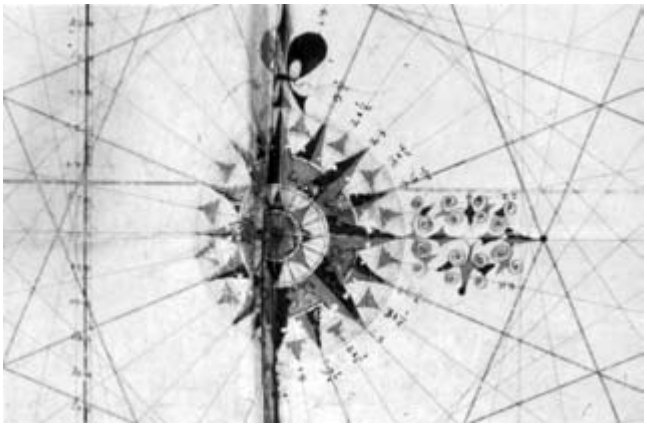


FIG. 40.1. COMPASS ROSE FROM DIEGO GUTIÉRREZ'S ATLANTIC CHART, 1550. The numbers around the compass rose indicate the distance in leagues a pilot would need to travel along each rhumb in order to change position by one degree of latitude. This information was commonly included in navigation textbooks but is only rarely seen on extant charts. Photograph courtesy of the BNF (S H Arch N2).

"padrón ordinario" of the West Indies trade.[11] This size must have made these charts unwieldy at sea, and indeed makes them difficult to reproduce. Even the largest images in modern books are usually less than half the original size, giving the unavoidable (though false) impression that the charts were cramped and hard to read. Certainly, pilots throughout the century complained about latitude errors in the charts of half a degree or less, errors that would be invisible in smaller charts.

Other features of the charts varied according to the intended purchaser. The charts carried by the pilots aboard ships were relatively cheap and probably had little decoration. Because they were not supposed to last long, they were drawn on paper. Though the reality always fell short of the theory, pilots were supposed to replace their charts from time to time with more up-to-date ones. Pilots' charts also were often limited to the part of the world relevant to the voyage the pilot was planning to undertake. These charts were frequently mentioned in administrative and legal records, but no examples are known to have survived.[12]

The charts sold to the pilots were all supposed to match a central exemplar called the *padrón real,* literally the royal standard or pattern. The *padrón* (as it was consistently called in the records) took different forms over the course of the century, but it was generally drawn on parchment for ease of correction. It was supplemented by a book containing statements gathered from pilots; as late as 1590, this book was kept alongside the pattern chart in a locked box at the Casa de la Contratación.[13] Though nominally showing the entire world, in practice the *padrón* focused on the voyage to the West Indies, the voyage most commonly undertaken from Seville. At the end of the century, this single chart was replaced by a set of six, each showing a different voyage, though most attention was paid to the chart showing the voyage to the West Indies. No chart unambiguously identified as one of the pattern charts has survived, though many extant charts are thought to be copies.

Most of the extant charts are ornate and were probably intended as gifts, though they are generally believed to contain the same geographic information as the pilots' charts and the *padrón,* in essentially the same format. These are the charts most often reproduced, and often include pictures, coats of arms, and detailed captions. These decorations often supported particular programs or territorial claims; Giovanni (Juan) Vespucci's 1526 chart, for example, uses flags to claim the Spice Islands and the Rio de la Plata for Spain while ceding Brazil and India to Portugal, all without showing any boundary line; supporting this de facto division of the world, ships in the South Atlantic and Indian Oceans bear Portuguese flags, while those in the Pacific and North Atlantic bear Spanish ones (fig. 40.2).[14] Diogo Ribeiro (Diego Ribero) tended to include illustrations of cosmographical instruments such as astrolabes and quadrants on his charts, probably to indicate the growing importance of measuring latitude, which could be found with such instruments (fig. 40.3).[15]

These more ornate charts had many different purposes. Some were commissioned to present to dignitaries on special occasions, such as royal weddings.[16] Others may have been presented by their makers to a potential or actual patron.[17] A third type of chart was used by would-be explorers, most notably Columbus and Magellan, to illustrate the feasibility of their plans. Though we do not

11. García de Céspedes, *Regimiento de navegacion,* fol. 104r. In his discussion of the need for different distance scales for different latitudes, he drew a line that he said represented six degrees "according to the degree of the ordinary pattern [chart] of the indies route." The line in the printed book is 6.7 centimeters long, which would have made a chart covering the area from Spain to the Caribbean about a meter long.

12. The Atlantic chart made by Diego Gutiérrez is a possible exception. Even if (as seems likely) the surviving chart is typical of those carried by pilots, it is still of a type officially forbidden; see later discussion.

13. AGI, Patronato, 251, R. 77, block 2, images 38–39, 28 August 1590 petition from Domenico Vigliarolo to have Rodrigo Zamorano return the chart and book.

14. For a brief discussion and a color reproduction of the full world map, see Sider, *Maps, Charts, Globes,* 13–16.

15. Such illustrations are also found on the Weimar world map (1529), Vatican world map (1529), Weimar world map (1527), and Castiglione world map (1525); for these and all other pre-1530 manuscript maps showing the old and new worlds, see appendix 30.1. Ribeiro, along with Fernando (Hernando) Colón and Alonso de Chaves, tended to support increased education for the pilots, and a corresponding increase in their reliance on celestial navigation.

16. See, for example, the Salviati (figs. 30.26, 40.13, and 40.14) and Castiglione (figs. 30.25 and 40.12) charts.

17. Giovanni Vespucci's 1526 world map, for example, bears the coat of arms of the Habsburgs.

FIG. 40.2. DETAIL OF SOUTH AMERICA FROM GIOVANNI VESPUCCI'S WORLD MAP, MADE IN SEVILLE, 1526. The checkered flags represent Castile, while the dotted ones represent the House of Avis of Portugal. Vespucci used the flags to indicate ownership of land and usual sea routes not only in South America but also in Africa and Asia. The complete world map is shown in figure 30.27.
Size of the entire original: 85 × 262 cm; size of the detail: ca. 48 × 38 cm. Photograph courtesy of the Hispanic Society of America, New York (MS. K. 42).

FIG. 40.3. DETAIL FROM THE WORLD MAP OF DIOGO RIBEIRO, 1529. This detail shows a quadrant and circular figure for finding solar declination, both with accompanying instructions. The text in the boxes explains how to read solar declination off of the figure and the accompanying latitude scale (given the date), how to use the quadrant, and how to calculate latitude given the solar declination and the sun's height at noon. Similar illustrations and explanations appear on several of Ribeiro's other world maps. The complete world map is shown in figure 30.29.
Size of the original: 80 × 204.5 cm; size of the detail: ca. 57 × 64 cm. Photograph © Biblioteca Apostolica Vaticana, Vatican City (Borgiano III).

know the exact form these visual aids took (surviving accounts make vague references to maps and globes and charts), some of them were probably nautical charts.[18] Finally, there were charts that were part of diplomatic agreements. The 1529 Treaty of Saragossa, for example, specified that a joint committee was to draw a chart showing the new Line of Demarcation between Spanish and Portuguese territories in the East Indies, and that the line as drawn on the chart was to constitute the new legal boundary.[19]

Sea charts were not the only type of navigational aid available to the pilots. There were also views of headlands and plans of islands showing ports and major features, which were frequently accompanied by sailing directions. Together these formed an alternate way of specifying the routes to be followed, relying less on latitude and more on compass bearing and recognition of the signs (or notable features) of the lands and waters. The "Luz de nauegantes," by Baltasar Vellerino de Villalobos, is an example of this genre, combining a detailed rutter with the signs (*señas*) of the lands, to use the phrase most common at the time.[20] A brief inspection of an island view indicates the huge difference between the two genres (fig. 40.4). Such island views were elaborated versions of the more common detailed descriptions of routes, and they may have been based on sketches and notes kept by the pilots themselves. In this particular case, the lack of similarity between some islands and their depictions in the book makes the practical utility of the illustrations questionable; the pilots themselves were more prone to refer to signs than to drawings of islands.[21] A mixed form of book can be seen in the "Islario general de todas las islas del mundo," written by Alonso de Santa Cruz. This book, unpublished in his lifetime, contained careful descriptions of the locations, fea-

18. See, for example, the chart most commonly known as Kunstmann IV (figs. 30.22 and 40.9).

19. Unfortunately, if this chart was drawn, it did not survive.

20. For a facsimile edition, see Baltasar Vellerino de Villalobos, *Luz de navegantes, donde se hallarán las derrotas y señas de las partes marítimas de las Indias, Islas y Tierra Firme del mar océano* (Madrid: Museo Naval de Madrid, Universidad de Salamanca, 1984).

21. See, for example, Martin Fernández de Enciso, *Suma de geographía,* ed. Mariano Cuesta Domingo (Madrid: Museo Naval, 1987);

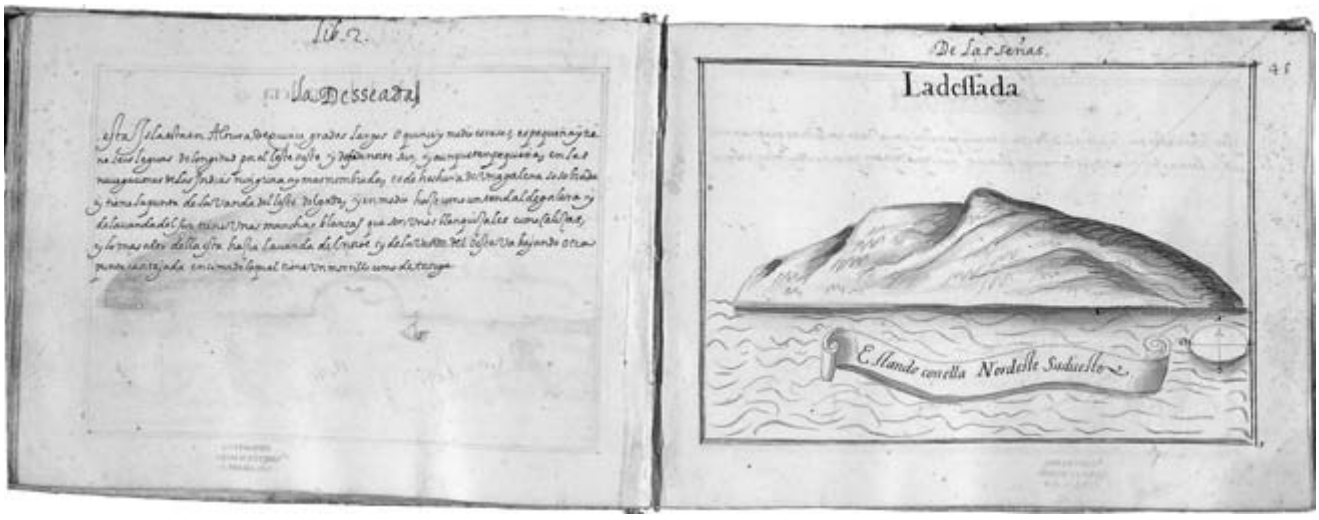


FIG. 40.4. VIEW OF DÉSIRADE FROM VELLERINO DE VILLALOBOS'S "LUZ DE NAUEGANTES." The manuscript book consists largely of facing pages of images and text. In this case, the text describes the latitude and size of the island, along with its most outstanding features. So named because it was a welcome sight after crossing the Atlantic, the island begins the book's treatment of the West Indies.
From Baltasar Vellerino de Villalobos, "Luz de nauegantes, donde se hallaran las derrotas y señas de las partes maritimas de las Indias, islas y tierra firme del mar occeano," 1592. Photograph courtesy of the Biblioteca General Universitaria, Salamanca (MS. 291, fols. 44v–45r).

tures, and resources of the islands, detailed depictions of each island, and an atlas.[22]

Though some of these books were made by the same people who made sea charts, they do not form a part of the same tradition. Even manuscript atlases, which became increasingly common over the course of the sixteenth century, seem never to have been intended for pilots or seamen.[23] The books of views and descriptions were not only visually distinct from the charts, but as books they were probably aimed at a richer and more educated audience than the often illiterate pilots. In this chapter, I focus instead on the manuscript tradition of the sea charts.

CONSTRUCTING A CHART

Though firsthand accounts of the process of making charts tended to be quite brief, commenting more on the ease and skill displayed and the quality of the finished product than on the steps in drawing the chart, the process was often discussed in navigation textbooks of the period.[24] Because these accounts agree on the major points, they indicate the consensus on how charts ought to have been made, if not always the procedure followed. The texts make clear that there were two different ways of making a chart: from a pattern or from a report. Copying an existing chart was much easier and more common; because all charts sold to pilots were supposed to be exact copies of the pattern chart, being able to copy that chart, varying the scale when necessary, was sufficient for most purposes. A comment from the end of the sixteenth century confirmed this practice. Praising one particular mapmaker for his ability to make charts from reports, the astronomer and doctor Simón de Tovar said that "from whatever account that they give him he makes charts matching it, as if he were copying it from a pattern," and that "there are few cosmographers who know how to do that."[25]

Alonso de Chaves, *Quatri partitu en cosmografía práctica, 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), 249–422; and Juan de Escalante de Mendoza, *Itinerario de navegación de los mares y tierras occidentales, 1575* (Madrid: Museo Naval, 1985). Vellerino de Villalobos was accused of plagiarizing his text from the *Itinerario;* see the introductory study by María Luisa Martín-Merás in Vellerino de Villalobos, *Luz de navegantes,* xx–xxi.

22. Mariano Cuesta Domingo, *Alonso de Santa Cruz y su obra cosmográfica,* 2 vols. (Madrid: Consejo Superior de Investigaciones Científicas, Instituto "Gonzalo Fernández de Oviedo," 1983–84). While not a facsimile edition, the work includes an introductory study, a transcription of the "Islario," and many reproductions.

23. These atlases were more often associated with the Mallorcan cosmographers (such as Joan Martines and the Olives and Oliva families) than with the Sevillian ones; see Rey Pastor and García Camarero, *Cartografía mallorquina,* 101–48.

24. For accounts in textbooks, see Chaves, *Espejo de navegantes,* 110–14; Cortés, *Breve compendio,* 214–25; and Diego García de Palacio, *Instrucción náutica,* ed. Mariano Cuesta Domingo (Madrid: Editorial Naval, Museo Naval, 1993), 236–39.

25. AGI, Patronato, 261, R. 8, 16 October 1592 testimony of Simón de Tovar on the merits of Jerónimo Martín (in the records named variously as Jerónimo Martín, Jerónimo Martínez, and Jerónimo Martínez de Pradillo). When Martín applied to be a cosmographer, several people were detailed to watch him make a sea chart; see p. 1136.

Only when making a new *padrón* would the cosmographers be forced to go beyond the available charts and find a way to incorporate and reconcile reports from various pilots. Many cosmographers, however, did incorporate corrections from pilots' reports even when copying from a pattern, saying that this made their charts easier to sell.[26] Compiling a new *padrón* was sufficiently difficult and time-consuming that it was usually entrusted either to a known expert (frequently the pilot major, the official in charge of licensing the pilots and inspecting their charts and instruments) or to a committee of such experts.[27] Despite reiterations of the rule that cosmographers meet regularly to correct errors in the pattern chart, these revisions were rare and usually separate from day-to-day mapmaking activities.

Whether the chart being made was adapted from an existing chart, drawn from reports, or a mixture of the two, much of the procedure was the same. The cosmographer Alonso de Chaves provided a detailed description of the process in his unpublished navigation textbook, leading the reader step by step through the construction of a chart. First he defined his aim, explaining that while globes were the best representation of the world, he was going to discuss only the sea chart, "since it is the instrument most used in navigation, and about which the Spanish seafarers have most knowledge."[28] Chaves went on to discuss the construction of the web of rhumb lines underlying the chart, followed by the addition of a grid of latitude and longitude, with the equator, tropics, and Arctic and Antarctic circles (if necessary) drawn in and visually distinguished from the other lines.

In the next section of Chaves's textbook, he described how to depict the earth on such a prepared blank. He specified that the most important thing was detailed and accurate information, whether "a picture, having another chart to copy, or writing, such as Ptolemy or another who treats the topic, or a report from sight and experience."[29] Then one should pick a very well-known place, such as a promontory or cape or river, find its latitude, and draw it in the appropriate latitude on the chart. Then, picking another well-known place close by, one should put the two in the correct relation to one another, checking the latitude first, then the distance and compass bearing between them, and finally drawing the second feature. The last step in the process was to draw in the coastline between the two points with all its particularities. These steps should be followed for every possible well-known feature until the coastline was complete. Interestingly, the main text to disagree with this procedure was written by a Valencian jurist, Pedro de Siria, with no known ties to chartmakers or navigation as practiced in the Atlantic. He insisted that charts, rather than using distances or rhumbs, instead be based on latitude and longitude, with the features placed according to values found in tables in learned books.[30] There is no evidence, however, that his opinion had any impact on practices in Seville.

The next step was to label the chart with the names of the capes, rivers, ports, and anything else useful, perhaps with the most important names in larger letters or in red. Then the chart could be decorated: features drawn on the land, and the small islands colored to be readily visible. Chaves added that it was customary to mark sandbanks with many small, thick points, and underwater dangers with crosses. Finally, one should draw compass roses on the thirty-two points (and a larger one at the center), indicate north on each one, and label the seas with their names. The entire account specifies the conventions normally used in making the charts, indicating a high degree of standardization in colors and overall appearance.

Martín Cortés (Cortés de Albacar) gave an account in many ways similar, though focused on different details.[31] In particular, instead of discussing the construction of a new chart from reports or writings, he provided detailed instructions for how to trace a preexisting chart, using thin paper soaked in linseed oil to trace the coastline, and paper smoked on one side to transfer the design onto a paper already prepared with rhumb lines. The next step was to add the names of ports and similar features, decorations, colors, and finally the scale of leagues, all copied from the original. Only then did he say one should add the lines of latitude, copied from the original, calculated from the league scale at a chosen conversion rate of either 17½ or 16⅔, or inferred from known latitudes. Finally he discussed how to change the scale of a chart, increasing or decreasing the size. For convenience he provided a simplified version of such a chart for ready reference (fig. 40.5).

The audience for such descriptions is unclear, especially given the odd mixture of methods and explanations. Both accounts of how to make a chart were included as part of navigation textbooks, though Chaves's was never published and Cortés's became better known

26. Diego Gutiérrez and Domenico Vigliarolo both used this as a defense against charges that their charts did not match the *padrón;* see later discussion.

27. On the office of pilot major, see Pulido Rubio, *Piloto mayor,* 9–53.

28. On the construction of a chart, see Chaves, *Espejo de navegantes,* 110–12, esp. 111. For a detailed analysis of the process actually used, see pp. 185–89.

29. On depicting the earth on a chart, see Chaves, *Espejo de navegantes,* 113–14, esp. 113.

30. Pedro de Siria, *Arte de la verdadera navegacion: En que se trata de la machina del mu[n]do, es a saber, cielos, y elementos* (Valencia: I. C. Garriz, 1602), 67; reproduced in José Ignacio González-Aller Hierro, comp., *Obras clásicas de náutica y navegación,* CD-ROM (Madrid: Fundación Histórica Tavera, Digibis, 1998).

31. Cortés, *Breve compendio,* 214–25. For a facsimile of a sixteenth-century English translation, see idem, *Arte of Navigation (1561),* intro. David Watkin Waters (Delmar, N.Y.: Scholars' Facsimiles and Reprints, 1992), fols. lvi recto–lxi verso.

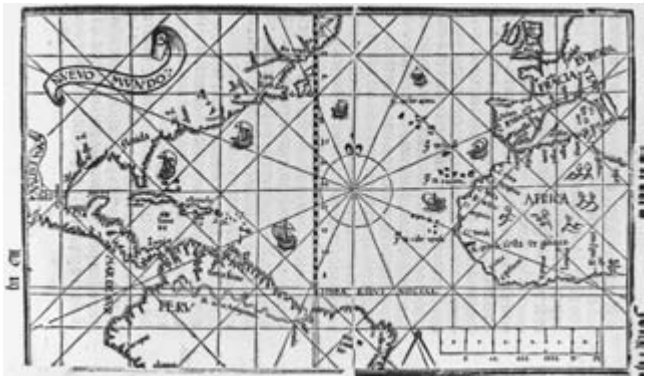


FIG. 40.5. PRINTED CHART INCLUDED IN MARTÍN CORTÉS'S *BREUE COMPENDIO,* 1551. This was not meant to give geographical detail or be useful at sea, but simply to provide an illustration of the major features of a chart. Similar images were included in the textbooks by Pedro de Medina.
Size of the original: ca. 15.4 × 25.7 cm. From Martín Cortés, *Breue compendio de la sphera y de la arte de nauegar, con nueuos instrumentos y reglas* . . . (Seville: Anton Aluarez, 1551), fol. lxvii recto. Photograph courtesy of the BL (C.54.k.4).

in England than in Spain. Though Cortés, especially, did give step-by-step instructions, it seems unlikely that anyone actually learned how to make charts solely through such descriptions.[32] However, because both men were closely involved with the sailors plying the Indies route, and Chaves was also in close touch with the cosmographers who sold the pilots their charts, it seems likely that their accounts bear some resemblance to actual practices, if only in idealized form.[33]

SOURCES OF INFORMATION

All of the information included on charts came ultimately from voyages. The pilots on voyages of exploration kept logs, made and annotated charts, and eventually reported back to officials at the Casa de la Contratación and to cosmographers in Seville. The information from explorers was supplemented by reports from pilots aboard the merchant and armada ships, compiled in the hope that repeated voyages to the same places would help determine their exact locations. In the long term, this approach was successful, and charts in general had fewer errors as the century went on. However, the use of information from pilots was not as straightforward as people would have liked, especially when the available reports contradicted one another, and in the short term it gave rise to many controversies. As the sixteenth century progressed, cosmographers and royal officials found various solutions to these problems; they both revised their procedures for gathering information from pilots and found ways to supplement it, first with special-purpose surveying expeditions and later with detailed questionnaires and astronomical observations.

Reports from Pilots

Despite controversies about the reliability of reports from pilots and repeated attempts to find substitute sources of information, such reports remained the most important source of information on locations. In 1527, the king ordered pilots to keep detailed records in order to help revise the pattern chart and improve nautical cartography in general. Pilots were to keep a daily written record of the entire voyage, keeping track of "the path which they followed every day and on which rhumbs, and which lands or islands or bays they reached, and how far away they were, and how the coasts ran, and what ports or rivers or capes there were in these places, and in what distance and latitude they lay."[34] All was to be turned in upon arrival in Seville or in Santo Domingo, signed by the pilot and the ship master and accompanied by an oath that they had not stopped anywhere else, which may have allowed the records to serve a secondary function of deterring smuggling. Though this rule was never fully enforced, it was reiterated later in the century, and the pilots' reports formed the basis of all future arguments about charts. The pilots' statements were gathered by cosmographers working at the Casa de la Contratación in Seville, though it is not always clear who had responsibility for receiving the reports.

This information was difficult to use, however, and spawned several conflicts.[35] Despite general agreement that the reports of the pilots were indispensable, many of the cosmographers did not trust them. As an anonymous

32. It seems likely, however, that these careful instructions were the reason the book was adopted by the English.

33. For the little known about Cortés, see the study by Mariano Cuesta Domingo in Cortés, *Breve compendio,* 33–34. On his book's use in England, see Cortés, *Arte of Navigation (1561),* 7–22. For brief biographies of Chaves, see Chaves, *Espejo de navegantes,* 15–35, and Pulido Rubio, *Piloto mayor,* 607–37. On navigation textbooks in general, see Pablo Emilio Pérez-Mallaína Bueno, "Los libros de náutica Españoles del siglo XVI y su influencia en el descubrimiento y conquista de los océanos," in *Ciencia, vida y espacio en Iberoamérica,* 3 vols., ed. José Luis Peset Reig (Madrid: Consejo Superior de Investigaciones Científicas, 1989), 3:457–84, and María Luisa Martín-Merás, "Los regimientos de navegación de la Casa de la Contratación," in *Obras españolas de náutica relacionadas con la Casa de la Contratación de Sevilla* (Madrid: Museo Naval, 1992–93), 13–29.

34. AGI, Indiferente, 421, L. 12, fol. 40rv, 16 March 1527. A transcription of the relevant sections of the king's order is available in Pulido Rubio, *Piloto mayor,* 261–64 n. 225, esp. 262–63.

35. For a more detailed examination of one such controversy in the 1530s and 1540s, see Alison Sandman, "Mirroring the World: Sea Charts, Navigation, and Territorial Claims in Sixteenth-Century Spain," in *Merchants & Marvels: Commerce, Science, and Art in Early Modern Europe,* ed. Paula Findlen and Pamela H. Smith (New York: Routledge, 2001), 83–108, esp. 88–91.

pamphleteer pointed out, if three pilots on the same ship could disagree by one hundred leagues in their calculations of position, their observations could not be considered reliable.[36] The reliability (or lack thereof) of pilots' reports was one key issue in the vicious debates that shook the Casa de la Contratación in the 1540s, and despite much discussion, it was never satisfactorily resolved.

Francisco Faleiro (Falero), who had gone to Spain with Ferdinand Magellan and remained active for the next several decades, gave a detailed account of the problem of relying on pilots for information.[37] He saw the problem as twofold—pilots used compass bearings where they should have used latitudes, and they failed to correct their compasses for magnetic declination, either ignoring the systematic error or compounding the problem in their attempts to correct for it. As a result, the compass bearings most pilots reported could not be trusted, and their latitude measurements were few and unlikely to be accurate. For Faleiro, the issue was each individual pilot's ability to make reliable observations, so the solution was more training, careful monitoring, and a new survey.

Alonso de Santa Cruz disagreed, charging that the problem was not so much the pilots, but the biases of the cosmographers.[38] Writing in the context of another attempt to revise the pattern chart, he suggested that they should first get a copy of the sea chart most popular with the active pilots, which was likely to be the best. Then the pilots should be taken one by one into a room, with no mapmakers present, and asked under oath to point out the flaws in the chart. He assumed that such close and independent questioning would eliminate bias and so produce a workable consensus.

Unfortunately, it is not clear which, if either, of these proposals was implemented. It seems likely that the pilots' reports continued to be sought, used, and complained about. In 1575, the cosmographer major Juan López de Velasco asked that the pilots be required to supply detailed written reports of their journeys.[39] The summary of his request specified that he was merely asking them to follow rules that had been on the books for some fifty years, but there is no record of its being more successful than the previous attempts. Eventually, the Council of the Indies decided to try a new approach to information gathering. Their solution was twofold: to send out trained people to gather information, and to use specific questionnaires to guide untrained people in providing information. Nonetheless, a 1606 book discussing the revision of the pattern chart still relied heavily on pilots' reports, though warning of the inevitable errors of such an approach.[40]

Eclipse Measurements and Jaime Juan's Survey

One solution tried by the Council of the Indies, and in particular by Juan López de Velasco, was to write detailed questionnaires in the hope of controlling the information gathered.[41] The questionnaires, called the *relaciones geográficas,* involved all sorts of information potentially useful in administering far-away lands; only a small part of this information involved location. Unfortunately, the responses to the questionnaires were disappointing. Few of the people responding knew how to find latitude at all, and most ignored the relevant question.

In a related attempt, López de Velasco tried to get overseas observers to send back observations of lunar eclipses, which could then be used to determine longitude.[42] He printed careful instructions and sent them to all of the Spanish possessions in the New World, asking the officials there to make sure the observations were made. The attempt lasted over a decade, for he requested observations for eclipses in 1577, 1578, 1581, 1582, 1584, and 1588; the final instructions specified that the responses would provide the information needed to make the whole project worthwhile.[43] Despite these efforts, however, he

36. Sandman, "Mirroring the World," 88.

37. See Sandman, "Mirroring the World," 88–89, citing AGI, Justicia, 1146, N. 3, R. 2, block 1, images 15–17, 5 May 1545 statement. On Faleiro, see the study by Ricardo Arroyo Ruiz-Zorrilla in the transcription and facsimile edition of Francisco Faleiro, *Tratado del esphera y del arte del marear: Con el regimie[n]to de las alturas* (Madrid: Ministerio de Defensa, Ministerio de Agricultura Pesca y Alimentación, 1989), 9–40.

38. See Sandman, "Mirroring the World," 89, quoting AGI, Justicia, 945, fol. 169rv, 6 September 1549 letter from Santa Cruz to Hernán Pérez de la Fuente.

39. AGI, Indiferente, 1956, L. 1, fol. 266rv, 14 March 1575. The pilots were to give the information to the cosmography professor, Diego Ruiz.

40. García de Céspedes, *Hydrografía.* This book has been reproduced in González-Aller Hierro, *Obras clásicas.*

41. For a detailed examination of the questions about locations and their responses, see Clinton R. Edwards, "Mapping by Questionnaire: An Early Spanish Attempt to Determine New World Geographical Positions," *Imago Mundi* 23 (1969): 17–28. On the maps prompted by the questionnaires, see Barbara E. Mundy, *The Mapping of New Spain: Indigenous Cartography and the Maps of the Relaciones Geográficas* (Chicago: University of Chicago Press, 1996).

42. For a facsimile and transcription of the observations of the 17 November 1584 eclipse, see María Luisa Rodríguez-Sala, ed., *El eclipse de luna: Misión científica de Felipe II en Nueva España* (Huelva: Universidad de Huelva, 1998). See also Edwards, "Mapping by Questionnaire," 18–22, which includes an English translation of one set of instructions, and García de Céspedes, *Hydrografía,* fols. 161v–69v, for a near-contemporary critique of López de Velasco's methods. Despite the problems, however, García de Céspedes considered lunar eclipse observations the most reliable way of finding longitude. The theory was not new; what was innovative was the attempt to gain information from large numbers of untrained observers. On the general importance of long-distance information networks, see Steven J. Harris, "Long-Distance Corporations, Big Sciences, and the Geography of Knowledge," *Configurations* 6 (1998): 269–304.

43. AGI, Indiferente, 427, L. 30, fols. 374v–75v, 1 June 1587 *cedula* with a list of twenty-seven recipients. For the results, see AGI, Mapas y Planos, Mexico, 34A–F; reproduced in Rodríguez-Sala, *Eclipse de luna,* 103–62.

received very few replies, almost all from expert cosmographers. As a way of mobilizing New World agents, the questionnaires were a failure.

Because the reports from both the pilots and the officials in the New World proved inadequate to supply detailed information on the locations of places, the king decided to try a third measure. In 1583, the Council of the Indies agreed to send a Valencian cosmographer, Jaime Juan, on a surveying expedition to New Spain and the Philippines.[44] The plans were made by Juan de Herrera (who was also associated with the Academia de Matemáticas) and López de Velasco, with only lukewarm support from the council. Jaime Juan was instructed to keep detailed records, especially of latitudes and compass declination, and carry with him several types of observing instruments; his assistants included a painter. Additionally, he was expected to teach the pilots on his ship how to use the instruments and to observe and critique their practices at sea. The point of the expedition was to take Juan, a cosmographer, to all of the places where cosmographers had been dependent on inexpert observers. Unfortunately little came of the attempt, because Juan died along the way and his papers were lost, though one of the few surviving eclipse observations dates from his expedition.

Responses to Questions Asked of Pilots

After the failure of the eclipse observations and the expedition of Jaime Juan, attention returned once again to the pilots. When Pedro Ambrosio de Ondériz was sent to revise the charts used at the Casa in the 1580s, he made it clear that some better method of obtaining information was necessary. Though he suggested another special-purpose expedition, the Casa officials rejected the proposal on grounds of expense and instead suggested another set of detailed instructions for the pilots.[45] The council agreed, and the pilots were duly sent out with large astrolabes to facilitate observations and a checklist of the information required. The instructions reveal the continuing lack of trust in the pilots' expertise, for they were explicitly enjoined not to do the calculations necessary to find latitude from their observations, but simply to report the raw numbers.[46] Even with these precautions, however, the results were disappointing, and in 1595 Ondériz again pushed for a special expedition, specifying that it would require few resources (only two small ships) and using Jaime Juan's survey as a precedent. This time the king and the council agreed, but Ondériz fell ill and died before it could be put into effect.[47]

In the end, the revision had to be accomplished using reports from the pilots, though those responsible did circulate questionnaires asking for a list of errors in the charts, rather than relying solely on voyage accounts. Andrés García de Céspedes, who took over after Ondériz, not only admitted that he relied on accounts from pilots, but even specified which pilots provided the information for each section of the revised chart. Aside from general remarks about the greater reliability of independent reports that came to the same conclusions, he provided no method for determining which accounts to believe, though he did provide a detailed analysis of the major sources of error in each part of the world.[48] After almost a century of experimentation, the cosmographers at the Casa de la Contratación and the royal court were forced to admit that special-purpose expeditions were too costly, and that, despite all their faults, the pilots were the best observers available. Though the relationship between voyages and knowledge of the territories explored was never as straightforward as the cosmographers might have wished, the pilots remained a necessary source of information.

Sea Charts as Part of the Nautical Bureaucracy

From the founding of the Casa de la Contratación in 1503, Seville served as the regulatory center for navigation. As such, it became a magnet for both navigators and those who supported them, including makers of charts and nautical instruments. Many of the key people—both explorers and cartographers—came from abroad, lured to Spain by the chance for riches and glory or by the hope of finding royal support for a pet project. Others migrated from other parts of the Spanish kingdoms or were simply attracted to a growing field. All competed both for a share in the growing market for charts and for official attention with the resulting opportunities for patronage. Their disputes about what charts could be used, who was allowed to sell them, and what prices could be charged were referred first to the Casa, and then, if appealed, to the council, while the monarch intervened at will. Thus, while sea

44. On this expedition, see M. I. Vicente Maroto and Mariano Esteban Piñeiro, *Aspectos de la ciencia aplicada en la España del Siglo de Oro* ([Spain]: Junta de Castilla y León, Consejería de Cultura y Bienestar Social, 1991), 403–6, and María Luisa Rodríguez-Sala, "La misión científica de Jaime Juan en la Nueva España y las Islas Filipinas," in *El eclipse de luna: Misión científica de Felipe II en Nueva España,* ed. María Luisa Rodríguez-Sala (Huelva: Universidad de Heulva, 1998), 43–66. Many of the relevant records are in AGI, Indiferente, 740, N. 103, and Filipinas, 339, L. 1, fols. 225r–36v.

45. Vicente Maroto and Esteban Piñeiro, *Ciencia aplicada,* 416.

46. AGI, Indiferente, 742, no. 151c–4, 15 December 1593 printed instruction to pilots.

47. Vicente Maroto and Esteban Piñeiro, *Ciencia aplicada,* 420–21; on Ondériz's revised proposal, see AGI, Indiferente, 426, L. 28, fols. 220v–21v, 16 September 1595.

48. García de Céspedes, *Hydrografía,* chap. 13. Because part of the aim of the book was to prove the unreliability of Portuguese reports, thus moving much of the East Indies into the Spanish domain, the disinterestedness of his methods is open to dispute.

charts had many uses besides serving as tools for pilots, and some uses arguably more important, this function was crucial for defining their place in the bureaucracy.

USES OF SEA CHARTS

While sea charts were used for many different purposes in Spain, among others as tools, status symbols, decorations, visual aids, commodities to be sold, and legal evidence, most of these uses had little effect on the laws regulating them. These laws were shaped by two main factors: the intended use of the charts by pilots at sea (and so also their potential use by foreign pilots) and the political sensitivity of charts in light of territorial disputes between Spain and Portugal. In addition, their profit potential for individual producers, many of whom wanted legal monopolies, tempted new people into the field. As understanding these uses is essential to understanding the rules surrounding the production and use of the charts, I briefly discuss each in turn.

Sea charts were widely acknowledged as crucial tools for any pilot wishing to cross the ocean. The importance that the cosmographers attached to the charts can be seen in the navigation textbooks they wrote, for they described in great detail the proper way to use a sea chart.[49] Scattered testimony from pilots affirms the value they placed on charts and indicates that they did indeed use them at sea, as well as discussing the relative merits of some charts over others.[50] One pilot explicitly blamed a shipwreck on errors in charts, describing a pilot who, "directing himself according to the path on the chart made according to the pattern chart, had mistaken the way and been lost."[51]

Royal officials thought the charts sufficiently important to safe navigation that they attempted to restrict their availability to foreigners. Because the Spanish government wished to keep other countries from trading with or settling in the Spanish territories, the charts, and accompanying descriptive information in any form, were considered state secrets, to be centrally controlled and not divulged without permission.[52] As part of the licensing process, pilots swore not to give, sell, or lend their charts to foreigners.[53] Nonetheless, because charts could not be used without being widely distributed, no one expected them to remain completely secret, which of course enhanced their political sensitivity.

As well as trying to keep geographic information more or less secret, the Council of the Indies also tried to make sure that all of the information conveyed in the charts supported Spanish interests. Since the Treaty of Tordesillas in 1494, the boundary between Spanish and Portuguese territory (as far as those two countries were concerned) had been a line of longitude.[54] Because claims to lands were dependent on their location relative to this line, errors in reporting or representing the locations of places were not simply a potential hazard to navigation but could also form the basis for renewed territorial disputes. This was particularly important during periods when the Spanish or Portuguese were considering renegotiating their respective claims.

The amount of official concern was reflected in the questions asked about problematic charts. In testimony in the 1540s, the young cosmographer Sancho Gutiérrez objected to certain sea charts made by his father, Diego, saying that they could easily be misunderstood and used to misrepresent Spanish territorial claims.[55] While expert opinion was divided on whether the charts in question did indeed misrepresent the Line of Demarcation, no one denied the importance of the issue. The placement of the demarcation line on charts remained important for the next several decades. A royal letter to the Spanish ambassador in Portugal about 1575, for example, asked him to investigate whether the Portuguese were falsifying their own charts to keep certain islands on their side of the line.[56] These issues had sufficient impact on the charts produced by the two countries that one of the stated aims of a reform project in the 1590s, more than ten years after the union

49. See, for example, Chaves, *Espejo de navegantes,* 114–16, and Pedro de Medina, *Arte de nauegar en que se contienen todas las reglas, declaraciones, secretos, y auisos, q[ue] a la buena nauegacio[n] son necessarios, y se deue[n] saber* (Valladolid: Francisco Fernandez de Cordoua, 1545), bk. 3, chaps. 7–14.

50. See, for example, AGI, Justicia, 1146, N. 3, R. 2, images 347–57 and 371–72 and the general testimony of pilots following image 157, all dating from 1544 and 1545; and see also Patronato, 262, R. 2, pilots' responses to questionnaires in 1593 and 1596 that asked about errors in the pattern chart.

51. AGI, Justicia, 1146, N. 3, R. 2, block 3, image 216, undated testimony (ca. November 1544) of Diego Sanchez Colchero testifying about the causes of shipwrecks.

52. As early as 1510, it was forbidden to divulge information about the West Indies without express permission; see Pulido Rubio, *Piloto mayor,* 382.

53. This order appears in the official record of each licensing exam; many exams for the period following 1568 are preserved in AGI, Contratación, 54A and B. The earliest example I have found is AGI, Justicia, 836, N. 6, image 795, 22 June 1551 *carta de examen* of Benito Sanchez.

54. For an overview of the treaty of Tordesillas and ensuing disputes, see Antonio Rumeu de Armas, *El Tratado de Tordesillas* (Madrid: Editorial MAPFRE, 1992); see also the articles in A. Teixeira da Mota, ed., *A viagem de Fernão de Magalhães e a questão das Molucas: Actas do II Colóquio Luso-Espanhol de História Ultramarina* (Lisbon: Junta de Investigações Científicas do Ultramar, 1975), and *El Tratado*. On the French and English reactions to Iberian claims, see Paul E. Hoffman, "Diplomacy and the Papal Donation, 1493–1585," *Americas* 30 (1973): 151–83.

55. AGI, Justicia, 1146, N. 3, R. 2, block 3, image 359, undated spring 1545 statement of Sancho Gutiérrez, transcribed in Pulido Rubio, *Piloto mayor,* 512–13.

56. AGI, Indiferente, 427, L. 29, fol. 110r, undated instruction from the Council of the Indies to the ambassador to Portugal; see David C. Goodman, *Power and Penury: Government, Technology and Science in Philip II's Spain* (Cambridge: Cambridge University Press, 1988), 53–61.

of the two countries under Philip II of Spain, was to bring Spanish and Portuguese charts into agreement.[57]

Not all charts used for diplomatic purposes were sea charts. The pilots themselves commented that the charts they used at sea were different from those commonly made by the cosmographers and argued that for the location of the Line of Demarcation one should look at "charts of the entire universe" instead of "the charts with which we navigate, which are no more than to go from here to the Indies, made according to our courses and corrected by our own selves."[58] The officials, however, were concerned that no chart should exist that could be used to further Portuguese claims, regardless of its intended use.

Because diplomatic and navigational considerations impelled the Casa and the council to regulate the chart trade, officials were drawn into all aspects of nautical cartography. They were forced to concern themselves not only with the adequacy of individual charts, but also with their price and general availability, especially because some makers used their licenses to gain monopolies. This left the officials weighing claims that monopolies were necessary for the economic survival of the makers against other claims that sea charts were too important to be left in the hands of any one person. The intensive regulation of the charts meant that purely economic disputes between rival chartmakers were often fought in the courts of the Casa or the council, giving an additional advantage to those makers with connections beyond Seville, and incidentally preserving many records about such disputes.

INSPECTIONS AND LICENSES

The connection between the pattern chart, kept at the Casa de la Contratación and brought out on special occasions, and the charts sold to pilots and carried by them at sea was always problematic.[59] According to the laws, all charts needed to be exact copies of the pattern chart, but the pattern chart was updated infrequently and always amid controversy, which meant that it was usually out of date. There were many strategies for dealing with this problem. Some pilots paid to have their charts corrected in light of recent discoveries.[60] They may then have carried two charts, one for inspection and one for use, or simply hoped that the revised charts would pass inspection. Others petitioned to be able to use charts they had made themselves.[61] Probably many complained to the cosmographers licensed to make charts in Seville, encouraging them to push for a formal revision of the pattern chart, or simply to illegally sell revised charts.[62] In the reform attempts at the end of the century, pilots had to be specifically enjoined to report errors using charts matching the pattern chart, for otherwise their comments could not be properly incorporated.[63] Unfortunately, despite these many indications that the pilots' charts differed from those officially approved, the official charts and the bureaucracy surrounding them remain our best sources on the charts used at sea.

In an attempt to control abuses, the council instituted two parallel systems, one for licensing the people making charts and the other for inspecting the charts they made. At first there was no clear system for licensing chartmakers, so all licenses were ad hoc, granting permission (usually exclusive) to make charts for sale to pilots (see appendix 40.1). The justification for limiting the number of chartmakers was protection of trade; fines assessed on unlicensed sales were to go to the licensed chartmaker, presumably as reimbursement for loss of custom.[64] In this period, the chart concession was granted as a privilege to several of the available makers rather than being an office in its own right.

In 1519, the Council of the Indies created the office of royal chartmaker (*maestro de hacer cartas de navegar*).[65] Four years later, the council created the office of royal cosmographer, who was supposed to make both charts and other navigation instruments and was responsible in addition for helping revise the pattern chart and attending

57. Vicente Maroto and Esteban Piñeiro, *Ciencia aplicada,* 410–12. The Spanish described the project as correcting the distortions in the Portuguese charts.

58. AGI, Justicia, 1146, N. 3, R. 2, block 3, images 356–57, undated petition from six pilots circa 1544; transcribed in Pulido Rubio, *Piloto mayor,* 510–12.

59. The best overall account of this system is in Pulido Rubio, *Piloto mayor,* 255–90.

60. AGI, Patronato, 261, R. 8, fol. 5v, 6 October 1592 testimony of pilot Juan de Anaya on a chart revised by Jerónimo Martín.

61. AGI, Indiferente, 1963, L. 7, fols. 83v–84v, 17 February 1540 *cedula* granting Antonio Lopez de Aguiare the right to use his own charts provided that on his return he gave an account of the errors he found.

62. The revision completed in 1543–44 under the auspices of Gregorio López was inspired by complaints from the pilots to Sebastian Cabot and Diego Gutiérrez. Forty years later, Domenico Vigliarolo cited complaints from pilots in urging a new revision. Despite support from the pilots, both Gutiérrez and Vigliarolo were investigated on charges of selling charts that did not match the pattern chart.

63. AGI, Indiferente, 742, no. 151c, 15 December 1593 printed instruction to pilots.

64. For a transcription of this 24 July 1512 *cedula,* see Pulido Rubio, *Piloto major,* 467–70. The chartmaker in question was Giovanni Vespucci. Another *cedula* of the same date granted both Vespucci and Andrés de San Martín the right to sell charts to pilots; see José Toribio Medina, *El veneciano Sebastián Caboto, al servicio de España y especialmente de su proyectado viaje á las Molucas por el Estrecho de Magallanes y al reconocimiento de la costa del continente hasta la gobernación de Pedrarias Dávila,* 2 vols. (Santiago, Chile: Imprenta y Encuadernación Universitaria, 1908), 1:324–25 n. 13.

65. Manuel de la Puente y Olea, *Estudios españoles: Los trabajos geográficos de la Casa de Contratación* (Seville: Escuela Tipográfica y Librería Salesianas, 1900), 285–86, and Pulido Rubio, *Piloto mayor,* 293–95. For a list of the cosmographers and chartmakers licensed at the Casa with a discussion of their surviving works, see Martín-Merás, *Cartografía marítima hispana,* 70–72, 80–121.

the licensing exams required of all pilots. Because new people were appointed to these positions faster than the old ones left, the number of people licensed as either chartmakers or cosmographers increased steadily during the first half of the century, though by the 1590s the trend had reversed sufficiently that there were complaints that charts were expensive and hard to find.[66] In the interim, however, competition was often fierce and the granting of licenses contentious.

A license, moreover, was not sufficient; each individual chart and instrument had to be approved as well. The economic importance of the chart trade to individual cosmographers meant that the inspection of charts was always controversial, especially the makeup of the inspection committee. Because opinions differed on whether the rules applied to all charts *sold* to pilots, or to all charts *used* by them, there was also considerable controversy about the appropriate timing of the inspections and whether they were the responsibility of the buyer or the seller.

At first, inspections were done by the pilot major (for a list of the pilots major at the Casa de la Contratación during the sixteenth century and the early seventeenth, see appendix 40.2).[67] At this time, the onus seems to have been on the pilots to buy good charts, for there is no mention of inspecting the charts before sale. At some point in the 1530s, the pilot major was joined in the inspections by cosmographers. In 1539, the pilot major was told to meet twice a month with the cosmographers in the audience hall of the Casa, to "look at the sea charts and other instruments which are there, and discuss them and other things related to your offices."[68] These same people were sometimes asked to examine the charts and instruments made by a cosmographer seeking a license or to inspect a given maker's charts.[69]

After an extended debate in the 1540s on the adequacy of the charts being sold, these regulations were tightened significantly, and two of the main chartmakers were personally ordered not to make any sales without prior approval. They objected vigorously to this rule, detailing the safeguards already in place. Not only did the pilot major inspect charts at the pilots' licensing exams and before each voyage, but an inspector at the port checked for evidence of these inspections before allowing a ship to leave.[70] Nonetheless, the rules were changed so that a committee of the pilot major and cosmographers would inspect charts before they could be sold, though this did not necessarily halt the other inspections.[71] In 1566, the rules were changed again after charges of conflict of interest from the Universidad de Mareantes, the newly formed guild representing pilots, ship masters, and shipowners. The pilot major and cosmographers were joined in the inspections by two experienced pilots (not coincidentally, both guild leaders), while the cosmographer who had made the charts was prohibited from inspecting them.[72]

Regardless of the constitution of the inspection committee, the procedures followed seem to have been fairly static. Throughout the century, charts that failed inspection were returned to their makers for correction, or destroyed if they were judged uncorrectable, while those that passed were given an official stamp. However, the codification of procedures did not stop complaints that the pilot major refused to inspect or approve certain charts.[73] They also did not prevent cheating. Rodrigo Zamorano, for example, was accused of breaking one of the locks on the box holding the official stamps, stealing the stamps, and approving blank sheets of paper, which he then took home for an assistant to use in making charts.[74] As imperfect as the system was, however, it provided the pilots some protection.

Cosmographical Offices, Sea Charts, and Navigation

Though most of the people who made sea charts in the sixteenth century were cosmographers, the reverse was certainly not true. The cosmographers working at the Casa de la Contratación were an atypical part of a much larger field; there were also cosmographers at the universities and at the royal court, in increasing numbers over the course of the century. To understand the actions of the

66. AGI, Patronato, 261, R. 8, images 7–19, 1592 testimony of various pilots in support of appointing a new cosmographer.

67. AGI, Indiferente, General, 1207, no. 61, piece 2, 1546 copy of 2 August 1527 rule on inspecting charts and instruments.

68. AGI, Indiferente, 1963, L. 7, fol. 13r, 19 September 1539.

69. See AGI, Indiferente, 1961, L. 3, fol. 284r, 16 June 1535 request to examine the work of Gaspar Rebelo; Indiferente, 1962, L. 4, fols. 5v–6v, 13 November 1535 request to examine the work of Alonso de Santa Cruz; Indiferente, 1962, L. 6, fol. 156rv, 20 December 1538 license for Pedro de Medina; and Indiferente, 1963, L. 7, fols. 19v–20r, 19 November 1539 order to reexamine Medina's charts and instruments following reports that they were erroneous.

70. All of the information and petitions are in AGI, Indiferente, 1207, no. 61. The original rule was dated 9 March 1545, and the rest of the material dates from the spring of 1546.

71. *Ordenanzas reales para la Casa de la Contratacion de Sevilla, y para otras cosas de las Indias, y de la navegacion y contratacion de ellas* (Seville: for F. de Lyra, 1647), 1552 laws, law no. 141; see also Francisco Morales Padrón, *Teoría y leyes de la conquista* (Madrid: Ediciones Cultura Hispánica del Centro Iberoamericano de Cooperación, 1979), 252–58.

72. For the complaint, see AGI, Indiferente, 1966, L. 15, fol. 193r, 21 October 1564 *cedula* summarizing the petition. A counterproposal suggested that two cosmographers be called to the meetings and paid for their time; see AGI, Indiferente, 2005, 14 October 1566 petition. On the guild, see Cervera Pery, *Casa de Contratación,* 91–108, and Luis Navarro García, "Pilotos, maestres y señores de naos en la carrera de las Indias," *Archivo Hispalense* 46–47 (1967): 241–95, esp. 279–92.

73. Pedro de Medina accused Sebastian Cabot of not wanting competition, while Domenico Vigliarolo made similar complaints about Alonso de Chaves, and then about Rodrigo Zamorano; see later discussion.

74. AGI, Contratación, 5554, 5 September 1592 accusation from Domenico Vigliarolo.

cosmographers in Seville, it is essential to understand this wider intellectual and institutional context.

As an intellectual endeavor, cosmography was part of a university tradition, based fundamentally on Ptolemy (both his astronomical and geographical works) but also on Aristotle, Johannes de Sacrobosco, and Pomponius Mela.[75] It included aspects of geography, hydrography, geometry, astronomy, cosmology, and natural history, and throughout the sixteenth century cosmographers in Spain were closely involved not only in astronomy and mathematics, but also in medicine and as official historians and chroniclers.[76]

Despite the university connection, most jobs in cosmography were related to the Indies, and the great majority of these posts involved navigation or cartography.[77] The Casa de la Contratación was the first major cosmographic center in Spain; because its primary purpose was regulating travel to and commerce with the New World, cosmographers there tended to focus their attention on navigation.[78] Cosmographers employed at the Casa were routinely involved in revising the pattern chart, giving classes to pilots, attending pilots' licensing exams, and inspecting charts and instruments. They were also called together for meetings about the locations of disputed territories and asked to comment on new instruments, books, policies, or people asking for jobs. In essence, they served as support personnel for the enterprise of the Indies.

Later in the century, as more cosmographical jobs became available elsewhere, the connection between the Casa and the royal court weakened. Because the cosmographers at the Casa were busy with matters related to navigation, and furthermore were several days' travel from the court, the king began to gather cosmographical expertise closer at hand.[79] This trend began with Alonso de Santa Cruz, who even in the 1540s had positions both at the Casa and at the royal court. In 1571, the Council of the Indies was reorganized, creating the position of chronicler and cosmographer major attached to the council.[80] This job entailed not only writing the history of the Indies, but also providing a description, complete with maps and charts. In 1582, the creation of the Academia de Matemáticas provided a center for teaching and translation and a new home for the cosmographer major.[81] These court cosmographers were not responsible for matters in Seville and did not have direct authority over the cosmographers there. Nonetheless, the cosmographer major was the obvious person for the council to send to oversee technical matters at the Casa and so became a key intermediary between the Casa and the council on matters related to charts.[82]

The rise of these intermediaries underscored the continuing attempts of cosmographers to assert their authority over navigation. In the first half of the century, many Casa cosmographers used their positions (and especially their control over charts) to try to reform navigation, though a few with particularly close ties to the pilots rejected these attempts. After about 1580, however, the reforming impulse came from the court rather than from cosmographers based in Seville. In both cases, and throughout the century, reformers focused their attention on control of the pattern chart.

The *Padrón Real*

The royal pattern chart, or *padrón real,* was intended as a centralized repository of geographic information. By pooling all information into one centralized chart and up-

75. On the place of cosmography in the university, see Cirilo Flórez Miguel, Pablo García Castillo, and Roberto Albares Albares, *El humanismo científico* (Salamanca: Caja de Ahorros y Monte de Piedad de Salamanca, 1988), 39–47.

76. For an overview of the various meanings of cosmography in sixteenth-century Spain, see Víctor Navarro Brotóns, "La cosmografía en la época de los descubrimientos," in *Las relaciones entre Portugal y Castilla en la época de los descubrimientos y la expansión colonial,* ed. Ana María Carabias Torres (Salamanca: Ediciones Universidad de Salamanca, Sociedad V Centenario del Tratado de Tordesillas, 1994), 195–205, and idem, "Cartografía y cosmografía en la época del descubrimiento," in *Mundialización de la ciencia y cultura nacional: Actas del Congreso Internacional "Ciencia, descubrimientos y mundo colonial,"* ed. Antonio Lafuente, Alberto Elena, and M. L. Ortega (Madrid: Doce Calles, 1993), 67–73. The work of Portuondo on cartography and cosmography, which I have been unable to integrate into this chapter, is of particular interest; see Maria Portuondo, "Secret Science: Spanish Cosmography and the New World, 1570–1611" (Ph.D. diss., Johns Hopkins University, 2005). On the role of cosmographers in astronomy and mathematics, see also Mariano Esteban Piñeiro, "Cosmografía y matemáticas en la España de 1530 a 1630," *Hispania* 51 (1991): 329–37; Vicente Maroto and Esteban Piñeiro, *Ciencia aplicada;* Víctor Navarro Brotóns, "Astronomía y cosmología en la España del siglo XVI," and Mariano Esteban Piñeiro, "Los oficios matemáticos en la España del siglo XVI," both in *Actes de les II Trobades d'Història de la Ciència i de la Tècnica (Peníscola, 5–8 desembre 1992)* (Barcelona: Societat Catalana d'Historia de la Ciència i de la Tècnica, 1993), 39–52 and 239–51; and Víctor Navarro Brotóns and Enrique Rodríguez Galdeano, *Matemáticas, cosmología y humanismo en la España del siglo XVI: Los* Comentarios al segundo libro de la Historia Natural de Plinio *de Jerónimo Muñoz* (Valencia: Instituto de Estudios Documentales e Históricos sobre la Ciencia, Universitat de València–C.S.I.C., 1998), 181–88.

77. For an extensive list of mathematical posts, see Esteban Piñeiro, "Oficios matemáticos." Almost all of these (the main exception was naval artillery) were filled by cosmographers.

78. The standard reference on cosmographical work at the Casa remains Pulido Rubio, *Piloto mayor;* see also Puente y Olea, *Trabajos geográficos,* and Cervera Pery, *Casa de Contratación,* 108–37. On the Casa as a cartographic center, see Martín-Merás, *Cartografía marítima hispana,* 69–158. On the roles cosmographers played in disputes at the Casa, see the articles collected in Ursula Lamb, *Cosmographers and Pilots.*

79. Esteban Piñeiro, "Oficios matemáticos," 244–49, and Vicente Maroto and Esteban Piñeiro, *Ciencia aplicada,* 76–109 and 399–406.

80. Vicente Maroto and Esteban Piñeiro, *Ciencia aplicada,* 99–100 and 400–403.

81. Vicente Maroto and Esteban Piñeiro, *Ciencia aplicada,* 74–86.

82. This was especially true in the attempts to reform navigation at the end of the century; see Vicente Maroto and Esteban Piñeiro, *Ciencia aplicada,* 407–31.

dating it regularly, officials meant to create a resource they could call on at need. Furthermore, by making sure there was only one such reference chart, they provided a standard by which to measure all other charts in use. For all the flaws in the implementation of this plan, it was essentially a success. The Council of the Indies asked the Casa de la Contratación to provide copies of the pattern chart for such occasions as cosmographical meetings, and copies were duly sent. Pilots were regularly asked to provide information about their voyages, and their statements were kept at the Casa. While the chart was not always kept up to date, revisions were made from time to time, using the data collected from the pilots. Finally, while not all charts used by the pilots matched the pattern chart, the existence of the rule provided leverage for reformers, prompting changes both in the charts used by the pilots and in the pattern chart itself. Though always to a lesser degree than the king and the council desired, the existence of the chart helped increase centralization and standardization.[83]

The existence of the pattern chart, and the necessity for frequent revision, meant that maintaining it became one of the most important functions of cosmographers in Seville. In their revisions, they always had to keep in mind the twofold purpose of the chart—to provide a pattern for charts used by pilots and to provide a reference for the ruler and later for the Council of the Indies. Thus, charts were never simply tools, but also claims about the locations of places, and so were politically sensitive. Furthermore, while arguments about the individual sea charts sold to pilots were frequently reduced to the simple question of whether they matched the pattern chart, all attempts to revise the pattern charts necessarily considered their potential utility to both navigation and diplomacy.

To suit this double purpose, there were multiple copies of the pattern chart—one in Seville, kept in a locked case at the Casa de la Contratación, and a second with the Council of the Indies at the royal court. The pattern chart was also kept in several forms, thus indicating the existence of several different pattern charts, though they were usually discussed as if singular. Several of the orders to revise the pattern chart specified that the cosmographers should produce both a world map and a sea chart, sometimes specifying that at least one should show the interior of continents.

The version of the pattern chart kept in Seville was subject to revisions by the resident cosmographers, both frequent small corrections and occasional complete overhauls produced at formal meetings. These meetings were often contentious, and the resulting documents provide most of the extant information on how sea charts were made and used, though, given the absence of the charts themselves, less contentious revisions may not have left documentary evidence. For a list of the major revisions, see appendix 40.3. While the details of the revisions tend to reflect local politics in Seville and the relations among the cosmographers there, the motivation behind each revision reflects the more general diplomatic context and the concerns of the Council of the Indies. The decisions regarding the pattern chart cannot be understood outside of this diplomatic context, so I begin with an introductory section on the Treaty of Tordesillas and the attempts of Spain and Portugal to divide the world between them.

DIPLOMACY AND BUREAUCRACY

The Treaty of Tordesillas

The history of the Treaty of Tordesillas is well known, but its importance for Iberian cartography can scarcely be overstated. Spain and Portugal signed the treaty in 1494, agreeing to abide by a line drawn in the Atlantic 370 leagues west of an unspecified point in the Cape Verde Islands, with the Spanish getting the lands on the western side of the line and the Portuguese those on the eastern.[84] Though this started as a simple convenience, to divide up the developing spheres of influence and thus limit conflicts between the two powers, the details of the agreement were to have far-reaching consequences. The negotiators set as a boundary a line no one could trace in a location that could be determined only by experts, if indeed by anyone at all. This ensured that the location of the boundary line would continue to be controversial, and that cosmographers, as the relevant experts, would have a role in navigation and cartography.[85]

83. On the pattern chart system as a form of standardization and control, see David Turnbull, "Cartography and Science in Early Modern Europe: Mapping the Construction of Knowledge Spaces," *Imago Mundi* 48 (1996): 5–24, esp. 7–14, and Harris, "Long-Distance Corporations," 279–85.

84. For a good overview of the treaty and the subsequent Line of Demarcation, see Rumeu de Armas, *Tratado de Tordesillas;* for a brief overview in English, see Joseph F. O'Callaghan, "Line of Demarcation," in *The Christopher Columbus Encyclopedia,* 2 vols., ed. Silvio A. Bedini (New York: Simon and Schuster, 1992), 2:423–26. On the papal bulls leading up to the treaty, see Marta Milagros del Vas Mingo, "Las bulas alejandrinas y la fijación de los límites a la navegación en el Atlántico," in *El Tratado,* 2:1071–89.

85. On difficulties ascertaining the location of the line, see Luís de Albuquerque, "O Tratado de Tordesilhas e as dificultades tecnicas da sua aplicação rigorosa," in *El Tratado de Tordesillas y su proyeccion,* 2 vols. (Valladolid: Seminario de Historia de America, Universidad de Valladolid, 1973), 1:119–36; Ricardo Cerezo Martínez, "El meridiano y el antimeridiano de Tordesillas en la geografía, la náutica y la cartografía," *Revista de Indias* 54 (1994): 509–42; and António Estácio dos Reis, "O problema da determinação da longitude no Tratado de Tordesilhas," *Mare Liberum* 8 (1994): 19–32. On the implications for cosmography and navigation, see Alison Sandman, "Cosmographers vs. Pilots: Navigation, Cosmography, and the State in Early Modern Spain" (Ph.D. diss., University of Wisconsin–Madison, 2001), 26–91.

The treaty stated that the exact location of the Line of Demarcation was to be settled by a joint Spanish-Portuguese commission, but because the commission never met, the exact location of the line remained ambiguous.[86] Though many charts did indeed indicate the line, there was little consistency in the positions chosen.[87] There was ample scope for principled disagreement; aside from the studied ambiguity of the treaty itself, the Spanish and the Portuguese used different standards for converting between degrees and leagues, complicating any attempt to determine the location of the line astronomically. Additionally, there was no consensus about the locations of the newly discovered lands, especially their longitudes. Thus, it is impossible to know which charts (if any) got the line in the right place.[88]

In practice, there was a clear tendency for Spanish and Portuguese charts to diverge in their portrayals, presumably in part for political reasons.[89] One of the earliest known charts to depict the Line of Demarcation, for example, was the Cantino chart, copied from a Portuguese original and smuggled out of the country. This chart clearly indicates Portuguese ownership not only of a large section of South America, but also of Newfoundland.[90] The Spanish tended to claim that the boundary was considerably farther to the east, even to the point of denying the Portuguese any territory in the New World. The Line of Demarcation was sometimes drawn in directly, as in the Cantino chart; other times chartmakers chose to indicate possession with flags rather than depicting a line per se.[91] Diogo Ribeiro combined the two, positioning flags to indicate a boundary line without, however, drawing in the line itself (fig. 40.6).

In the early years of the sixteenth century, neither side paid much attention to the Line of Demarcation. Even after the discovery of Brazil and the subsequent Portuguese claims to territory in the New World, the two countries continued to focus their efforts in different geographic areas, though there were occasional diplomatic skirmishes.[92] It was not until the Spanish used Magellan's voyage to stake a claim in the East Indies that the exact location of the Line of Demarcation became important. In the meantime, however, the bureaucratic apparatus surrounding sea charts had time to develop.

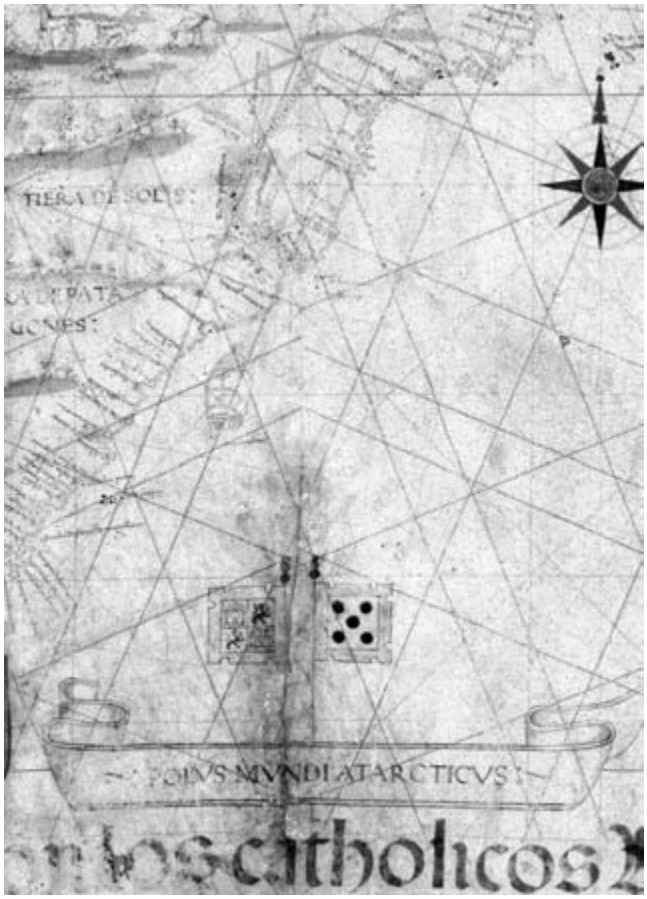


FIG. 40.6. DETAIL FROM THE WORLD MAP OF DIOGO RIBEIRO, 1529. The two flags form a de facto dividing line, with each flag facing toward its country's territory. Ribeiro did the same in the East (for by that time the Line of Demarcation was seen as two lines 180 degrees apart), but left more space between the flags, perhaps as an indication of the prevailing uncertainty. The complete world map is shown in figure 30.29. Size of the entire original: 85 × 204.5 cm; size of the detail: ca. 49 × 29 cm. Photograph © Biblioteca Apostolica Vaticana, Vatican City (Borgiano III).

Creating the System of Pattern Charts

From the foundation of the Casa de la Contratación, the regulation of charts was closely linked to both crown sponsorship of exploration and the needs of trade and navigation. The first pilot major, the Florentine Amerigo Vespucci, was one of a group of experienced explorers advising Ferdinand the Catholic; he was given the position as recompense for staying behind to oversee matters in Spain and was put in charge of teaching and licensing pi-

86. Rumeu de Armas, *Tratado de Tordesillas,* 148–50.

87. For a survey of the locations chosen, see Cerezo Martínez, "Meridiano y el antimeridiano," 529–32.

88. For a strong statement of this point, see Rolando A. Laguarda Trías, *El predescubrimiento del Río de la Plata por la expedición Portuguesa de 1511–1512* (Lisbon: Junta de Investigações do Ultramar, 1973), 55–57.

89. Cerezo Martínez, "Meridiano y el antimeridiano," 530–31.

90. On the Cantino chart, see Ernesto Milano, *La Carta del Cantino e la rappresentazione della terra nei codici e nei libri a stampa della Biblioteca estense e universitaria* (Modena: Il Bulino, 1991).

91. See, for example, the detail of Giovanni Vespucci's 1526 world map (fig. 40.2). Flags were also used by Juan de la Cosa, Diogo Ribeiro, and Nuño García Toreno.

92. Most notable was the arrest of eleven Portuguese sailors accused of being on the Spanish side of the Line of Demarcation; see Laguarda Trías, *Predescubrimiento,* 91–113. The Portuguese also objected to Spanish attempts to send voyages to the east; see Ramón Ezquerra

lots and regulating their charts and nautical instruments.[93] One of his first tasks was to make a new chart "of all the lands and islands of the Indies that up to now have been discovered belonging to our kingdoms and realms" to serve as a general exemplar for others to copy; this was the first pattern chart.[94]

Vespucci's orders clearly stated the problem this pattern chart was designed to solve: the multiplicity of charts in use, differing both in the location of places (*asiento*) and the compass bearings (*derrota*) between them. This double emphasis on compass bearings and location (usually in terms of latitude) was typical throughout the sixteenth century, and the inevitable discrepancies between the two fed into many of the major cartographic disputes. To overcome this multiplicity, the pilot major, in consultation with experienced pilots, was ordered to make a new and better chart of the Indies. The reform thus had the twofold goal of improving the charts (i.e., making them more certain) and standardizing them. Though these goals were never fully achieved, the attempt called for an unprecedented amount of centralized control.

It was clear, however, that even the best charts would need to be continually corrected and updated, so the instructions also provided for regular reports from returning pilots: "Also, we order all the pilots of our realms . . . that finding new lands or islands or bays or new ports or any other thing which is fit to be put in the said pattern chart, that on returning to Castile they go to give their report to you, the said our pilot major, and to the officials of the House of Trade of Seville, so that everything be put in its place in the said pattern chart."[95] It is clear from later accounts that the pilots were also supposed to report any errors they found in the charts they used.

Aside from this detailed mandate, however, little is known about either the first pattern charts or the variety of charts in common use in 1508. They may have born some resemblance to surviving charts from the era, such as the Juan de la Cosa chart of 1500 (fig. 40.7),[96] or the anonymous chart from about 1505–8 conserved in the Biblioteca e Musei Oliveriana in Pesaro (fig. 40.8).[97] These show the changing ideas about the shape of the New World, and so give some indication of the geographical information becoming available, but the huge differences between the two in both geography and style can do no more than indicate the range that might have been available. Furthermore, though there is evidence that Amerigo Vespucci did create a pattern chart, the chart itself has not survived. Traces do remain; the New World sections may have been similar to those in the atlas called Egerton 2803 (plate 39),[98] and probably formed the base for the printed chart published in 1511 in the *Décadas del nuevo mundo,* by Peter Martyr (Pietro Martire d'Anghiera).[99] In 1510, Vespucci was working in his house on making a pattern chart, with the help of the illuminator Nuño García (de) Toreno, who would later be appointed as the first royal chartmaker.[100] In 1511, the Casa officials ruled that the chart should be kept in a box locked with three keys. Vespucci died in early 1512.

A few months later, Juan Díaz de Solís, the new pilot major and another member of the circle of explorers advising Ferdinand, was asked to revise the pattern chart.[101] In revising the pattern chart, he was to have help from Giovanni Vespucci (Amerigo's nephew), who was also licensed to sell copies of the pattern chart.[102] Unfortunately, none of the charts they made at that time have survived,

Abadía, "Las Juntas de Toro y de Burgos," in *El Tratado de Tordesillas y su proyeccion,* 2 vols. (Valladolid: Seminario de Historia de America, Universidad de Valladolid, 1973), 1:149–70, esp. 168–69.

93. The 6 August 1508 *cedula* creating the job of pilot major has been transcribed in most major collections of documents; see, for example, Pulido Rubio, *Piloto mayor,* 461–64, and Martín Fernández de Navarrete, *Colección de los viages y descubrimientos que hicieron por mar los españoles desde fines del siglo XV,* 5 vols. (Buenos Aires: Editorial Guarania, 1945–46), 3:299–302. For the meeting at Burgos (and an earlier one at Toro) to plan future explorations, see Cerezo Martínez, *Cartografía náutica,* 133–34, and Ezquerra Abadía, "Juntas de Toro y de Burgos."

94. AGI, Indiferente, 1961, L. 1, fols. 65v–67r, 6 August 1508 instructions for Amerigo Vespucci as pilot major. This section of the *cedula* is quoted in Pulido Rubio, *Piloto mayor,* 258; the *cedula* as a whole is transcribed on pp. 462–63.

95. Pulido Rubio, *Piloto mayor,* 463 (transcription).

96. This chart has been much studied from a variety of viewpoints. For a detailed account of the chart and the historiography surrounding it, see Cerezo Martínez, *Cartografía náutica,* 89–118, and also Ricardo Cerezo Martínez's series of three articles: "La carta de Juan de la Cosa," *Revista de Historia Naval* 10, no. 39 (1992): 31–48; 11, no. 42 (1993): 21–44; and 12, no. 44 (1994): 21–37. For a different perspective, see Fernando Silió Cervera, *La carta de Juan de la Cosa: Análisis cartográfico* (Santander: Instituto de Historia y Cultura Naval, Fundación Marcelino Botín, [1995]). On the chart and the Line of Demarcation, see Hugo O'Donnell y Duque de Estrada, "La carta de Juan de la Cosa, primera representación cartográfica del Tratado de Tordesillas," in *El Tratado,* 2:1231–44. For biographical information on Juan de la Cosa, see Antonio Ballesteros Beretta, *La marina cántabra y Juan de la Cosa* (Santander: Diputación Provincial, 1954), 129–402.

97. Cerezo Martínez, *Cartografía náutica,* 124–26; and Frederick Julius Pohl, "The Pesaro Map, 1505," *Imago Mundi* 7 (1950): 82–83. Cerezo Martínez argued that this chart is probably a copy of one by Nuño García Toreno.

98. Cerezo Martínez, *Cartografía náutica,* 257, and Arthur Davies, "The Egerton MS. 2803 Map and the Padrón Real of Spain in 1510," *Imago Mundi* 11 (1954): 47–52. For a facsimile edition of this atlas, see [Vesconte Maggiolo], *Atlas of Portolan Charts: Facsimile of Manuscript in British Museum,* ed. Edward Luther Stevenson (New York: Hispanic Society of America, 1911).

99. Reproductions of this chart are readily available; see, for example, Martín-Merás, *Cartografía marítima hispana,* 123.

100. Cerezo Martínez, *Cartografía náutica,* 148–49.

101. Cerezo Martínez, *Cartografía náutica,* 148–50; the order has been transcribed in José Toribio Medina, *Juan Diaz de Solís: Estudio histórico,* 2 vols. (Santiago, Chile: Impresso en Casa del Autor, 1897), 2:78–85. The first volume is a biography of Solís, while the second transcribes many of the associated documents. For a briefer account, based primarily on Medina, see Pulido Rubio, *Piloto mayor,* 567–89.

102. On Giovanni Vespucci, see Consuelo Varela, *Colón y los Florentinos* (Madrid: Alianza Editorial, 1988), 78–81.

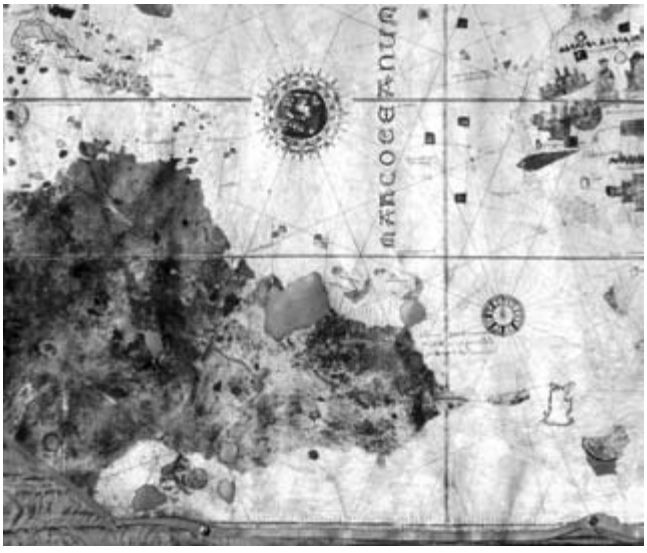


FIG. 40.7. DETAIL FROM THE JUAN DE LA COSA CHART, 1500. The detail shows a section of the coastline of South America, including the equator, with the flags indicating Castilian dominion. The meridian line shown goes through the Azores and could not have been intended as the Line of Demarcation. It probably represents a line of zero magnetic declination (at the time assumed to be a fixed meridian), perhaps as Cosa observed it during his voyages. The complete world map is shown in figure 30.9.
Size of the entire original: 95.5 × 177 cm; size of the detail: ca. 54 × 67.5 cm. Photograph courtesy of the Museo Naval, Madrid (inv. 257).

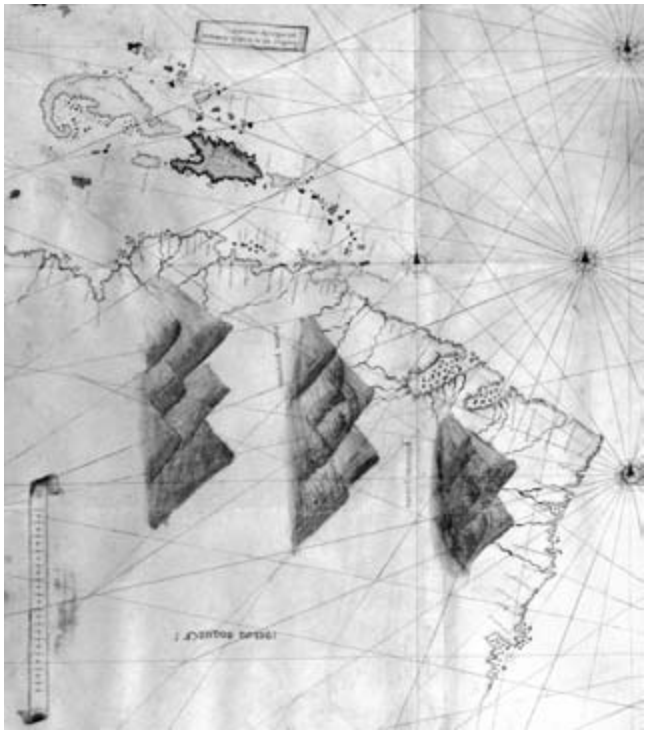


FIG. 40.8. DETAIL FROM AN ANONYMOUS CHART, CA. 1505–8. The detail shows part of the Caribbean and South America, labeled "Mundus novus." This is probably a copy of one of the charts available at the Casa de la Contratación before the creation of the first pattern chart. The complete world map is shown in figure 30.15.
Size of the original: 122 × 206 cm; size of the detail: ca. 69 × 60 cm. Photograph courtesy of the Biblioteca e Musei Oliveriana, Pesaro.

and in 1515 Solís left on a voyage from which he never returned. In 1518, a new revision was entrusted to Fernando Colón (Ferdinand Columbus), the younger son of Christopher Columbus. A chart of South America and the Antilles showing Balboa's discovery of the Pacific may date from this revision.[103]

By this time, the pattern chart had been incorporated into the institutional workings of the Casa, for testimony from several pilots taken in 1513 mentioned adding information to it.[104] In 1515, when a group of pilots and cosmographers were gathered together to give evidence on the location of the Cape of San Agustín, at the easternmost tip of what is now Brazil, they were using a new pattern chart, this one constructed by Andrés de Morales.[105] Thus, by 1515 there had already been several revisions of the pattern chart, and it was accepted, at least in theory, as a central repository of geographic information, to be corrected with information brought back from voyages.

Magellan and the Portuguese Connection

Little attention was paid to nautical cartography for the next few years, probably due to the lack of a pilot major combined with the instability surrounding Charles V's accession to the throne. By early 1518, however, Charles was in residence, and at the end of March he approved the voyage proposed by Ferdinand Magellan to prove that the Spice Islands fell on the Spanish side of the Line of Demarcation, by that time seen as two lines 180 degrees apart.[106] Magellan's proposal promised to strengthen Spain's legal claim to the islands, catalyzing important changes in Spanish cartography.

The most important change was probably in personnel, for Magellan enticed several Portuguese cosmographers to join him in Spain. Rui (Ruy, Rodrigo) Faleiro (Falero) was a partner with him in planning the voyage, indicating the importance placed on cosmography and cartography

103. Martín-Merás convincingly argues this in her study of the chart; see "Cartografía de los descubrimientos," 75–82.

104. Cerezo Martínez, *Cartografía náutica,* 148.

105. The pattern chart was approved in a *cedula* of 15 November 1515; Cerezo Martínez, *Cartografía náutica,* 151. On the meeting, see Laguarda Trías, *Predescubrimiento,* 96 and 190–93, and on Morales, see "Morales, Andrés," in *Diccionario histórico de la ciencia moderna en España,* 2 vols., ed. José María López Piñero et al. (Barcelona: Península, 1983), 2:82–83.

106. For a history of the idea of an antimeridian, see Ramón Ezquerra Abadía, "La idea del antimeridiano," in *A viagem de Fernão de Magalhães e a questão das Molucas: Actas do II Colóquio Luso-Espanhol de História Ultramarina,* ed. A. Teixeira da Mota (Lisbon: Junta de Investigações Científicas do Ultramar, 1975), 1–26.

FIG. 40.9. DETAIL FROM THE REDRAWING OF AN ANONYMOUS CHART ATTRIBUTED TO JORGE REINEL, CA. 1519. Formerly in the Staatsbibliothek, Munich, and lost since 1945, this chart survives in a 1935 photograph and this color redrawing of about 1843 by Otto Progel. The many explanatory legends in Latin and the placement of the Moluccas on the far left have led to the speculation that this was one of the charts used by Magellan to convince the Spanish king to support his voyage. The detail shows Brazil, complete with explanatory text and flags allocating territory. The section where Magellan would be sailing was left blank, except for pictures of ships. The complete redrawing of the world map is shown in figure 30.22.
Size of the entire original: ca. 65 × 124 cm; size of the detail: ca. 18.2 × 25.6 cm. Photograph courtesy of the BNF (Rès. Ge AA 564).

from the beginning of the project. In addition to writing a handbook on finding longitude at sea (necessary if the voyage was to prove Spanish ownership), he made several charts for the voyage.[107] His brother, Francisco Faleiro, was less well known initially, but remained in Spanish service for the next fifty years, participating in several revisions of the pattern chart. Diogo Ribeiro and Pedro and Jorge Reinel also went to Spain to join the project.[108] Though the Reinels soon returned to Portuguese service, Ribeiro spent the rest of his life working for Spain. The participation of so many Portuguese provided both geographical information and skilled craftsmen. There was ample scope for employment in the preparations for the voyage; the accounts of the expedition include payments for more than thirty charts for five ships.[109]

Magellan also took maps and charts with him from Portugal to Spain, including a globe and a world map that he used to convince the Spanish king that his project was feasible. The amount of information contained in these charts is not totally clear: according to one account, the area of the chart that would contain the strait in South America through which he planned to sail was purposely left blank.[110] The charts were probably not ordinary sea

107. On Faleiro, see A. Teixeira da Mota, *O regimento da altura de leste-oeste de Rui Faleiro: Subsídios para o estudo náutico e geográfico da viagem de Fernão de Magalhães* (Lisbon: Edições Culturais da Marinha, 1986), esp. 129–41 (the study was originally written in 1943). Faleiro became increasingly erratic in his behavior and spent most of the rest of his life in the care of his brother.

108. L. A. Vigneras, "The Cartographer Diogo Ribeiro," *Imago Mundi* 16 (1962): 76–83, esp. 76, and Joaquim Ferreira do Amaral, *Pedro Reinel me fez: À volta de um mapa dos descobrimentos* (Lisbon: Quetzal Editores, 1995), 39–49. See also the treatment on p. 987 and pp. 992–95 in this volume.

109. Navarrete, *Colección de los viages y descubrimientos,* 4:165.

110. Cerezo Martínez, *Cartografía náutica,* 168. The account of the blank section comes from Bartolomé de Las Casas.

charts but instead more ornate ones containing explanations, such as the anonymous chart known as Kunstmann IV (or as the Munich Planisphere), which seems designed as a visual aid and is often attributed to Jorge Reinel (fig. 40.9).[111] Though a careful examination of the longitudes would put the Moluccas in Portuguese territory, the overall layout of the chart (with the Moluccas at the far left and the Portuguese territories in the East Indies at the far right) implies that they would fall into Spanish territory.

In sum, Magellan's voyage would have been important to Spanish nautical cartography even if it had been completely unsuccessful. However, the return of the *Victoria* under the command of Juan Sebastian del Cano (Delcano, Elcano) was to have even more far-reaching effects. The rich cargo encouraged Spanish hopes of sharing in the riches of the East, reopening the issue of demarcation. Both Spain and Portugal agreed that the obvious solution to the legal question would be to extend the Line of Demarcation, thus literally dividing the world in half. Determining the exact location of this line in the east was a problem, however, because not only did they have no reliable way of determining longitude at sea, but they still could not agree on the location of the line in the Atlantic. In the face of this uncertainty, both cartographers and diplomats were brought in to make the Spanish case.

The cartographic case was clear. Following the example of Kunstmann IV, Spanish charts of this period consistently put the Moluccas on the Spanish side of the Line of Demarcation.[112] The first to explicitly showcase the boundary line in the east was Nuño García Toreno, in a 1522 chart of southern Asia made in Valladolid (where the court was at the time) with information brought back by Cano (fig. 40.10). The Moluccas are clearly on the Spanish side of the Line of Demarcation; in fact, the line goes through the island of Sumatra, even farther west than Magellan had claimed, putting the entrepot of Malacca on the Spanish side as well. Martín-Merás has suggested that this was one of a number of charts created during the next few years as gifts for foreign leaders, intended to showcase the justice of the Spanish claims, and that indeed most charts leaving Spanish hands in the sixteenth century may have served such a purpose.[113]

These claims were made as much by the overall layout of the charts as by explicit boundary lines. The anonymous chart known as the Turin chart did not explicitly depict the Line of Demarcation but implied Spanish dominion over the Moluccas by putting them at the far left of the chart rather than with the rest of Asia, despite the inconvenience of the resulting large empty space between the islands and the Americas (fig. 40.11).[114] As the diplomatic battle intensified, this placement became commonplace in Spain as a way of asserting ownership of the Moluccas. The Castiglione chart (1525), attributed to Diogo Ribeiro,

FIG. 40.10. DETAIL FROM THE CHART BY NUÑO GARCÍA TORENO SHOWING THE ANTIMERIDIAN OF TORDESILLAS, 1522. The detail shows the Line of Demarcation running through Sumatra, with the Moluccas clearly on the Spanish side. The demarcation line is labeled "linea divisionis castellahorvm et portvgallensivm."
Biblioteca Reale, Turin (Coll. O XVI/2). By concession of the Ministero per i Beni e le Attività Culturali.

111. See Ivan Kupčík, *Münchner Portolankarten: "Kunstmann I–XIII" und zehn weitere Portolankarten/Munich Portolan Charts: "Kunstmann I–XIII" and Ten Further Portolan Charts* (Munich: Deutscher Kunstverlag, 2000), 41–48, including a color reproduction of the nineteenth-century redrawing.

112. See Martín-Merás, "Cartografía marítima," 31.

113. Martín-Merás, *Cartografía marítima hispana,* 87; Cerezo Martínez, *Cartografía náutica,* 173–74; and, for a more detailed study, see Alberto Magnaghi, "La prima rappresentazione delle Filippine e delle Molucche dopo il ritorno della spedizione di Magellano, nella carta costruita nel 1522 da Nuño García de Toreno, conservata nella Biblioteca di S. M. il Re in Toreno," in *Atti del X Congresso Geografico Italiano,* 2 vols. (Milan, 1927), 1:293–307.

114. Cerezo Martínez, *Cartografía náutica,* 175–76; Martín-Merás, *Cartografía marítima hispana,* 88–89; and Alberto Magnaghi, *Il planisfero del 1523 della Biblioteca del Re in Torino: La prima carta del mondo costruita dopo il viaggio di Magellano unica copia conosciuta di carta generale ad uso dei piloti dell'epoca delle grandi scoperte* (Florence: Otto Lange-Editore, 1929). In his extensive discussion of the politics of demarcation (pp. 29–49), Magnaghi argued that the mark in the center of the chart does indeed represent the Line of Demarcation.

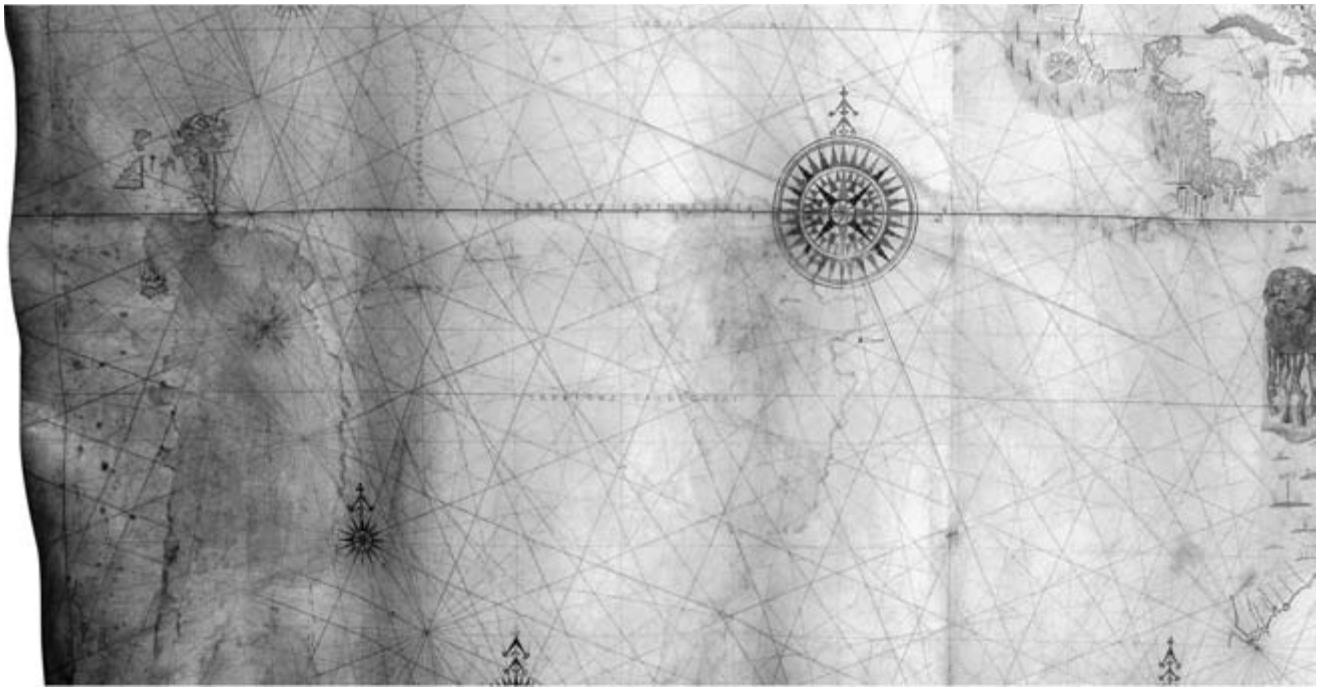


FIG. 40.11. DETAIL FROM THE TURIN WORLD MAP, ANONYMOUS, CA. 1523. Attributed to Giovanni Vespucci or Nuño García Toreno. Note the inclusion of the Strait of Magellan (lower right) and the placement of the Moluccas at the far left. The importance of this placement is clear from the mapmaker's willingness to tolerate the largely blank expanse of the Pacific. The complete world map is shown in figure 30.24. Size of the entire original: 112 × 262 cm; size of the detail: ca. 62 × 118 cm. Biblioteca Reale, Turin (Coll. O.XVI.1). By concession of the Ministero per i Beni e le Attività Culturali.

places the islands on both sides of the chart, together with Spanish flags to indicate possession (fig. 40.12). The Salviati chart of the same year, attributed to Nuño García Toreno, places the islands clearly at the far left of the chart with a large label (fig. 40.13), though a careful examination of the longitude markings would put them in Portuguese territory.[115] Two ships with Spanish flags and banners reading "Hic ratis e qvinq[ue] est totvm qvi circvit orbem" (essentially, "This ship is one of five that circled the earth") nonetheless reaffirm the Spanish claims (fig. 40.14).[116] Because these charts were intended as gifts on the occasion of the wedding of Charles V to Isabella of Portugal, it seems likely that the choice of charts as gifts was intended to publicize the Spanish territorial claims.[117]

The importance of the cartographic and propagandistic side of the Spanish case was increased by the failure of the diplomatic side. In a series of meetings in 1524, delegates from Spain and Portugal tried to agree on the location of the Line of Demarcation.[118] Many cosmographers were involved, either as delegates (Fernando Colón) or as expert advisers (including Sebastian Cabot, Diogo Ribeiro, and Giovanni Vespucci). The Reinels served as advisers to the Portuguese side, despite a Spanish attempt to hire them away.[119] In spite of the broad range of experts involved, the talks ended in a stalemate, though only after extensive debates about which charts were reliable and could be used as evidence. The territorial issues were

115. See *Carlos V: La náutica y la navegación,* exhibition catalog (Barcelona: Lunwerg, 2000), 240–41, and, for a full-size facsimile, see Edward Luther Stevenson, *Maps Illustrating Early Discovery and Exploration in America, 1502–1530, Reproduced by Photography from the Original Manuscripts* (New Brunswick, N.J., 1906), map no. 7. The equator is graduated in unlabeled ten-degree increments—slightly over seventeen on the eastern side of the Line of Demarcation, and almost nineteen on the western. Thus, the visual impression, that the antimeridian ought to lie on the left border, is misleading; it would run through the label "Malucos."

116. On the use of ships on maps as decorations and territorial claims, see Martín-Merás, "Cartografía marítima," 22–24.

117. Cerezo Martínez, *Cartografía náutica,* 184; Martín-Merás, *Cartografía marítima hispana,* 91–93; and Roberto Bini, ed., *Carta del navegare universalissima et diligentissima: Planisfero Castiglioni, 1525* (Modena: Il Bulino, 2001).

118. On the meetings, see Mariano Cuesta Domingo, "La fijación de la *línea*—de Tordesillas—en el Extremo Oriente," in *El Tratado,* 3: 1483–1517, esp. 1499–1505. Most of the Spanish expert opinions can be found in AGI, Patronato 48, R. 12–17, and have been published in Navarrete, *Colección de los viages y descubrimientos,* 4:296–337. For a brief summary from the Portuguese perspective, see Isabel Branquinho, "O Tratado de Tordesilhas e a questão das Molucas," *Mare Liberum* 8 (1994): 9–18, esp. 15–16. In the early seventeenth century, the Spaniard Andrés García de Céspedes reopened the issue during his revision of the pattern chart; see the extensive quotes from the documents in García de Céspedes, *Hydrografía,* chap. 8.

119. See the account in Jerry Brotton, *Trading Territories: Mapping the Early Modern World* (Ithaca, N.Y.: Cornell University Press, 1998), 133–34. This is presumably the origin of the appointment letters later presented by Diego Gutiérrez as proof of a position vacancy; see AGI, Indiferente, 1204, no. 21.

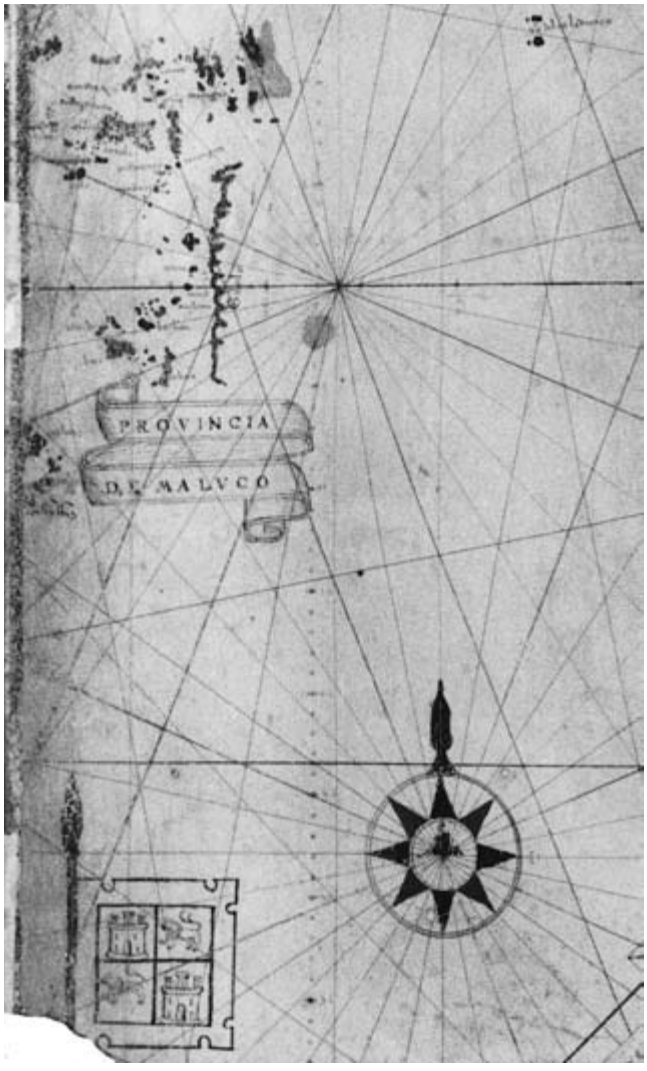


FIG. 40.12. DETAIL OF THE CASTIGLIONE WORLD MAP, ATTRIBUTED TO DIOGO RIBEIRO, 1525. Note the placement of the flag below the Moluccas signaling Spain's claim. In the full world map, shown in fig 30.25, the duplication of the islands at the far right (again with the Spanish flag) clarifies their relation to the Portuguese Indies. Also note the same cosmographical illustrations as on Ribeiro's 1529 world map, though without the explanatory texts.
Size of the entire original: 82 × 208 cm; size of the detail: ca. 30 × 19 cm. Photograph courtesy of the Biblioteca Estense e Universitaria, Modena (C.G.A.12).

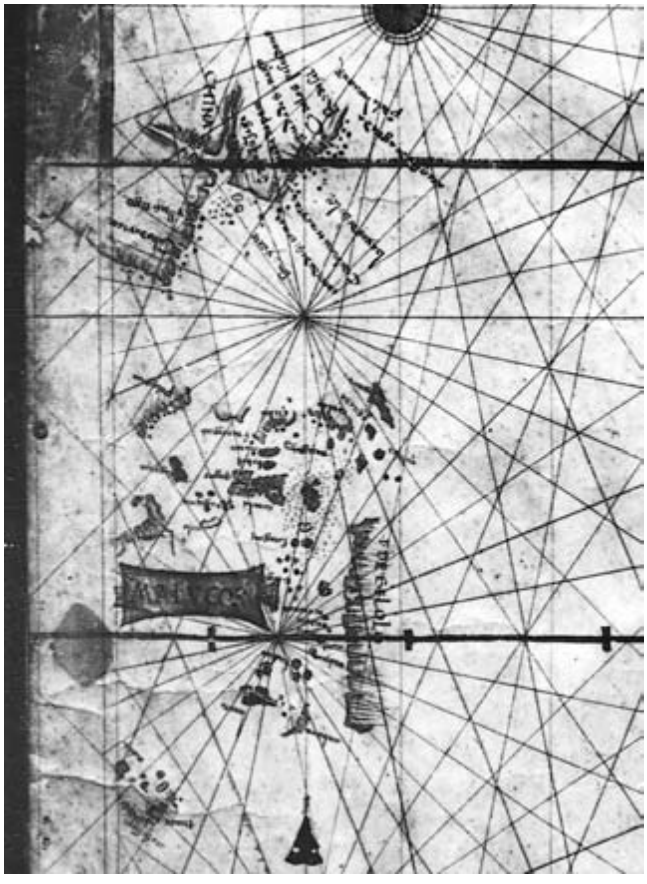


FIG. 40.13. DETAIL OF THE MOLUCCAS FROM THE SALVIATI WORLD MAP, ATTRIBUTED TO NUÑO GARCÍA TORENO, CA. 1525. The Spanish claim to the Moluccas is made by implication by placing them at the far left of the chart rather than the far right with the Portuguese possessions in the East Indies. The size of the label, equivalent to those of the continents, indicates the importance of the islands. The complete world map is shown in figure 30.26.
Size of the entire original: 93 × 204.5 cm; size of the detail: ca. 24.6 × 18.6 cm. Biblioteca Medicea Laurenziana, Florence (Med. Palat. 249). By concession of the Ministero per i Beni e le Attività Culturali.

not settled until 1529, when the Spanish pawned to Portugal any rights they might have to the Spice Islands, but even then the agreement stipulated that the islands fell in Spanish territory.[120]

The failure of the talks between Spain and Portugal underscored the need to revise the pattern chart, both to incorporate the new information gathered during the voyages and to ensure that there was a uniform standard. In light of the use of charts as evidence at the talks, it seems likely that any new pattern chart would also have had to clearly support the Spanish claims. In June of 1526, the Council of the Indies ordered the pilot major to get together with other pilots and make a new pattern chart.[121] In his absence (and that of most of the experienced chartmakers), the task was eventually entrusted to Fernando Colón, who had been one of the delegates and had presided over an earlier revision in 1518.[122] Colón was

120. For an analysis of the treaty negotiations and the diplomatic situation at the time, see Leoncio Cabrero, "El empeño de las Molucas y los tratados de Zaragoza: Cambios, modificaciones y coincidencias entre el no ratificado y el ratificado," in *El Tratado,* 2:1091–1132.

121. Cerezo Martínez, *Cartografía náutica,* 190.

122. AGI, Indiferente, 421, L. 11, fol. 234rv, 6 October 1526. Vespucci did produce a chart in 1526, but there is no evidence that it was intended as a revision of the pattern chart, and he played very little

FIG. 40.14. DETAIL WITH SHIP FROM THE SALVIATI WORLD MAP. The ship, with its Castilian flag and Habsburg eagle, is shown in the middle of the Pacific, on its way back from the Moluccas, thus adding to the iconography claiming the islands for Spain. The Latin text referring to Magellan's voyage cements the reference.
Size of the entire original: 93 × 204.5 cm; size of the detail: ca. 13.9 × 9.3 cm. Biblioteca Medicea Laurenziana, Florence (Med. Palat. 249). By concession of the Ministero per i Beni e le Attività Culturali.

probably assisted by Diogo Ribeiro (after his return from the Casa outpost in La Coruña) and the young cosmographer Alonso de Chaves, who was given an appointment as royal cosmographer on Colón's recommendation.[123] Colón began to gather information from returning pilots, who were ordered to keep daily records for him while at sea.[124] Unfortunately, it is unclear whether he ever made a pattern chart from the information.[125]

Whether or not an official pattern chart had been approved, the cosmographers at the Casa continued to make small changes and to produce their own charts. The chart of 1527 in Weimar, variously attributed to all of the cosmographers then active but likely by Diogo Ribeiro, is probably typical of the charts that grew out of this attempt (see fig. 30.28).[126] It is quite similar to two charts produced by Diogo Ribeiro in 1529, one now in Weimar and the other in Rome (see figs. 30.29 and 30.30). The charts bear identical titles, referring to the Treaty of Tordesillas and claiming that the chart divides the world into two parts according to the treaty.[127] As usual with Ribeiro, the charts are notable for their illustrations of cosmographical instruments, showing an astrolabe and a quadrant, with legends explaining how to use them, and a figure for finding solar declination. The combination of the title and the illustrations indicates the politicized environment in which he made the charts. The other surviving chart from this era dates from between 1533 and 1535 and is probably by Chaves, though it has also been attributed to Ribeiro (fig. 40.15).[128] Though unfinished, it may well have been intended as a draft of a new pattern chart.

Despite the seeming similarity of the surviving charts from the era, there was enough variation in the charts being used by the pilots to appall an inspector from the Council of the Indies, who reported that "the pilots and sailors and masters in sailing to the Indies used charts copied from a variety of patterns, on which there were many things different and contradictory."[129]

REVISIONS UNDER THE AUSPICES OF THE COUNCIL OF THE INDIES

The next several revisions of the pattern chart were done under the auspices of the Council of the Indies. At the

part in affairs in Seville thereafter. See figure 40.2; Martín-Merás, *Cartografía marítima hispana,* 93–95; and Sider, *Maps, Charts, Globes,* 13–16.

123. AGI, Indiferente, 421, L. 13, fol. 82r, 4 April 1528.

124. AGI, Indiferente, 421, L. 12, fol. 40rv, 16 March 1527.

125. Although he sent a number of charts made by Alonso de Chaves to the Council of the Indies in 1528, it is not clear that these were intended as a new pattern chart rather than simply as proof of Chaves's competence. In 1535, he was asked to complete the chart in terms that imply that it remained incomplete. Cerezo Martínez argues that Chaves's chart was accepted as the new pattern chart, and the council was simply unaware of the fact due to confusion and high turnover. See Cerezo Martínez, *Cartografía náutica,* 191–92 and 201–3.

126. For a discussion of the various opinions about the authorship of the chart, concluding that it was by Ribeiro, see Chaves, *Espejo de navegantes,* 16–20.

127. Martín-Merás, *Cartografía marítima hispana,* 96–97, and Cerezo Martínez, *Cartografía náutica,* 191.

128. Cerezo Martínez attributes it to Ribeiro in *Cartografía náutica,* 191 and 199 (detail reproduced); Martín-Merás argued that Chaves was a more likely author in "Cartografía marítima," 19–38, esp. 21 and 23 (details reproduced). For an earlier detailed discussion, see Edward Luther Stevenson, "Early Spanish Cartography of the New World, with Special Reference to the Wolfenbüttel-Spanish Map and the Work of Diego Ribero," *Proceedings of the American Antiquarian Society* 19 (1909): 369–419.

129. Quoted in Cerezo Martínez, *Cartografía náutica,* 202. The text is part of the councilor's report of his actions.

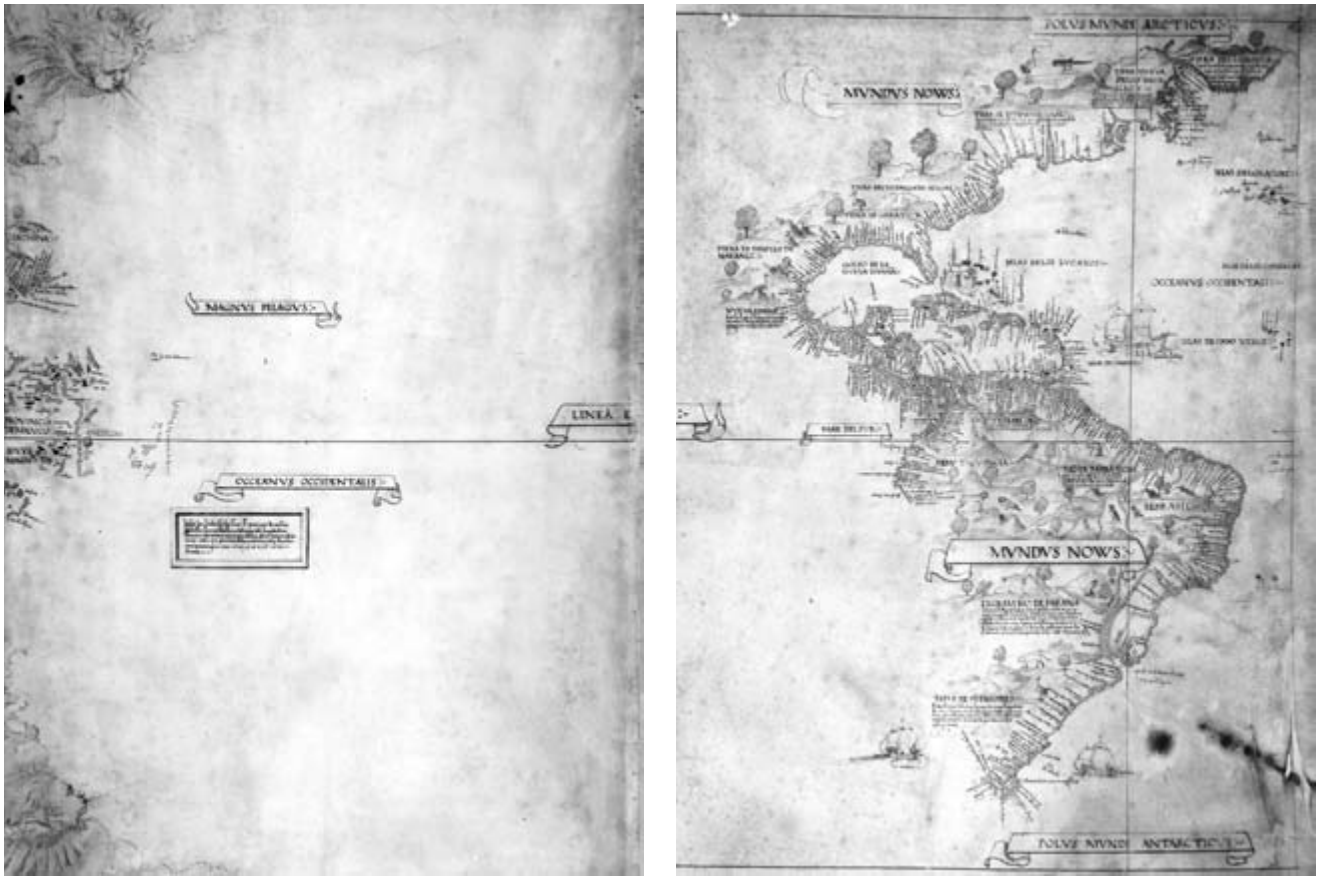


FIG. 40.15. THE WOLFENBÜTTEL CHART, ATTRIBUTED TO ALONSO DE CHAVES, CA. 1533. This unfinished chart is on two sheets showing the Americas and the Philippines, and it may have been part of a large chart covering the entire world. It completely lacks rhumb lines, latitude and longitude markings, and distance scales, though it does contain some decoration on the continents.
Size of the original: 58.3 × 87.8 cm. Photograph courtesy of the Herzog August Bibliothek, Wolfenbüttel (Cod. Guelf. 104A and B Aug.).

time of its founding in 1523, the council had been given jurisdiction over the activities of the Casa de la Contratación. Any oversight, however, necessarily took place from afar, for the Casa remained in Seville and the council followed the royal court. To remedy this problem, the council occasionally sent one of its members to Seville to check up on reported abuses and make any necessary policy changes, much as they did with the overseas territories.[130] Perhaps as part of the general housecleaning, or because the councilors were better known at court than the Casa cosmographers, or perhaps simply for convenience, these inspections frequently became an occasion to revise the pattern chart.

The 1536 Reform under Juan Suárez de Carbajal

The first such revision took place during the inspection of Juan Suárez de Carbajal.[131] In 1535, the Council of the Indies sent a letter to Fernando Colón asking him the status of the pattern chart, ordering him to complete it quickly if it was not yet done, and authorizing the Casa officials to call local pilots and cosmographers to his assistance.[132] Colón was no longer active in cartography, so it was the other local cosmographers who met in the house allocated to Suárez de Carbajal: Sebastian Cabot and Diego Gutiérrez in one faction and a loose alliance of Alonso de Chaves, Francisco Faleiro, Pedro Mexía, and Alonso de Santa Cruz opposing them. The committee spent over a year on the revision, consulting pilots' reports, old charts, and active pilots, and working, according to a later report, with much "agreement, study, and deliberation."[133] In the process, they gathered together a large number of papers,

130. On this process of inspections (called *visitas*), see Schäfer, *Consejo Real,* 1:80–88 and 147–65.

131. For a fuller account of this revision, see Sandman, "Mirroring the World," 85–90.

132. AGI, Indiferente, 1961, L. 3, fol. 276rv, 20 May 1535. It did not further specify who should be called.

133. Suárez de Carbajal, quoted in Cerezo Martínez, *Cartografía náutica,* 202.

which were still in demand 30 years later.[134] Despite all this, they were unable to reach a consensus, and eventually Suárez de Carbajal ordered them to break the deadlock by voting on each point at issue.[135]

One key question for the committee was whose authority should be decisive in revising the chart. Santa Cruz objected to majority rule, because he denied the competence of the other cosmographers, complaining that people who "had never seen a sea chart" or "only knew a little about the sphere and judicial astrology" should not be considered experts.[136] Cabot and Gutiérrez rejected the process on different grounds, complaining instead about the lack of eyewitness experience among the members of the committee. "None of those who were there," Gutiérrez said, "had been in the Indies, nor was a sailor, nor had seen the coasts, islands and bays, except only the pilot major."[137] According to Gutiérrez, this lack of pilot participation initially caused Cabot to refuse to sign the finished chart, though he eventually capitulated.[138]

Santa Cruz thought the procedures so flawed that he left before the pattern chart was finished and went to complain to the Council of the Indies. He later claimed that his intervention was effective in undermining the council's faith in the chart, though they did repeatedly affirm that it was to serve as the official pattern chart.[139] Even so, his protests were fruitful, for Santa Cruz returned to Seville with an appointment as cosmographer, explicit permission to gather the information he thought necessary to revise the *padrón real,* and an order forbidding Cabot to make or inspect charts without him present.[140] Cabot protested this new authority, and after years of fighting Santa Cruz abandoned the field with the promised revision unfinished.[141]

Despite all protests, the chart approved by Suárez de Carbajal became the official pattern chart, though we can only guess at its characteristics. In 1536, Alonso de Chaves made a chart probably based on it, described as a "modern chart," but that has not survived either, unless the Wolfenbüttel chart (see fig. 40.15) dates from that period. Chaves did, however, write a detailed description of the Indies, including the latitudes of the major places and the compass bearings between them. This has survived as part of his unpublished navigation textbook and is probably a good approximation of the type of information included in the book accompanying the pattern chart.[142]

The Revolt of the Pilots, the 1544 Revision, and Two-Scale Charts

Though the pilots did not have a vote in the making of the pattern chart, they did form the main market for the charts and as such had a measure of economic power. According to testimony from the 1540s, the pilots disliked the pattern chart sufficiently that they convinced Diego Gutiérrez to continue selling the old type of charts, though such an action was strictly forbidden. Gutiérrez, in turn, convinced Sebastian Cabot (as pilot major) to approve the charts, allowing them to pass inspection even though they did not match the pattern chart.[143]

The collusion between Cabot and Gutiérrez was threatened by the arrival in Seville of a new cosmographer, Pedro de Medina.[144] Armed with a royal license obtained during a stay at court in 1538, he tried to break into Gutiérrez's monopolies on charts, instruments, and the education of the pilots, amid speculation that his presence was intended as a check on Cabot's power. Whatever the intentions, Cabot was consistently hostile to Medina, even trying to deny him access to the *padrón real.* Thus,

134. In 1569, the Casa tried to arrange the return of the papers that had been in the possession of Fernando Colón; see Pulido Rubio, *Piloto mayor,* 263 n. 225.

135. Several accounts of the debates survive in the legal testimony, for example, AGI, Justicia, 1146, N. 3, R. 2, block 3, image 84, Gutiérrez's account of Suárez de Carbajal's statement. Ursula Lamb has argued that Suárez de Carbajal was trying to determine scientific truth by majority rule; see her "Science by Litigation: A Cosmographic Feud," *Terrae Incognitae* 1 (1969): 40–57, esp. 56, reprinted in *Cosmographers and Pilots,* item III. I think that he was simply trying to find a policy that would enable the committee to reach a decision in the absence of conclusive data, not making any claim about absolute truth.

136. AGI, Justicia, 945, fol. 168rv, 6 September 1549 letter from Alonso de Santa Cruz to Hernán Pérez de la Fuente.

137. AGI, Justicia, 1146, N. 3, R. 2, block 3, images 107–8, 9 September 1544 statement of Diego Gutiérrez. Though this sweeping condemnation discounted Santa Cruz's experience in South America, of which Gutiérrez must have been aware, Santa Cruz had shipped as an agent for the investors and not as a pilot or sailor.

138. AGI, Justicia, 1146, N. 3, R. 2, block 3, image 108, 9 September 1544 statement of Diego Gutiérrez.

139. AGI, Justicia, 945, fol. 168v, 6 September 1549 letter from Santa Cruz to Hernán Pérez de la Fuente.

140. AGI, Contratación, 5784, L. 1, fols. 69v–70r, 7 July 1536, on his appointment; Indiferente, 1962, L. 5, fols. 41v–42v, 20 and 21 November 1536, on gathering information from both pilots and New World governors, and fol. 41v, 20 November 1536, on Santa Cruz's authority over Cabot's making and inspecting charts.

141. For their running battle over authority, see the petitions in AGI, Indiferente, 2005, and Santa Cruz's account in Justicia, 945, fols. 168r–71r, 6 September 1549 letter. For Santa Cruz's movements, see Alonso de Santa Cruz, *Crónica de los Reyes Católicos,* 2 vols., ed. Juan de Mata Carriazo (Seville, 1951), 1:v–viii.

142. Chaves, *Espejo de navegantes,* 249–422, and Cerezo Martínez, *Cartografía náutica,* 204–5.

143. AGI, Justicia, 1146, N. 3, R. 2, block 2, image 33, 28 August 1544 statement of Diego Gutiérrez, and block 3, image 119, 9 September 1544 statement of Sebastian Cabot.

144. Pedro de Medina, *A Navigator's Universe: The Libro de Cosmographía of 1538,* trans. and intro. by Ursula Lamb (Chicago: Published for the Newberry Library by the University of Chicago Press, 1972), 9–18, and Mariano Cuesta Domingo, *La obra cosmográfica y náutica de Pedro de Medina* (Madrid: BCH, 1998), 41–121. On the battles between Medina and Gutiérrez, see Sandman, "Cosmographers vs. Pilots," 160–211, esp. 174–81, and Sandman, "Mirroring the World," 91–97.

when Medina discovered that the charts in common use did not match the *padrón,* he had little incentive to overlook the offense, but instead began legal proceedings that would continue for several years.

In the midst of this controversy, Gregorio López was sent from the Council of the Indies to inspect the Casa de la Contratación.[145] According to later (partisan) accounts, Cabot convinced a group of pilots to take their complaints about errors in the pattern chart to the new inspector.[146] Agreeing that revisions were necessary, López ordered Cabot to take care of them in the presence of the cosmographers, and Cabot duly held meetings with Alonso de Chaves, Pedro Mexía, Diego Gutiérrez, and a number of pilots. According to some of the testimony, the resulting corrections were made by Gutiérrez in his own hand. The changes seem to have been limited to a few specific places, though opinions differed on whether they were to places that represented newly discovered land (where the charts could be expected to need correction) or to older sections of the chart. Nothing else is known about this revision. The details have been obscured by the larger fight surrounding it, which revolved around Gutiérrez's de facto monopoly and the propriety of selling charts that did not match the pattern chart.

Though it was overshadowed by the economic and legal issues, Medina and Gutiérrez also had a more technical dispute, for they disagreed about one of the central problems in cartography of the era—how to reconcile latitudes and longitudes with distances and compass bearings. This is usually seen as a problem of projection, that is, a problem requiring a decision about what to distort when depicting a spherical surface on a flat map. Projection was indeed an issue, but it was not seen as a serious problem until late in the sixteenth century, probably because of the low latitudes at which the Spanish did most of their navigation. In the middle of the century, cartographers were much more concerned about adjusting for compass declination.

The problem arose from the fact that a magnetic compass does not point to geographic north, but instead to a point somewhat to the east or west, depending on the location. In the mid-sixteenth century, the accepted compass bearings between two points—the basis for their placement on the charts and for the routes followed by the pilots—had been observed using compasses that were corrected for the magnetic declination in Seville, but were usually not adjusted along the way. This approach introduced a complicated systematic error into the charts. This error did not pose much of a practical problem so long as the pilots continued to navigate using the same compasses (without correcting them), which most of them did. However, the distortions in the compass bearings became a problem when anyone tried to integrate latitude into the picture. For the journey to the West Indies, the result was that a pilot who thought he was traveling due west would wind up about three degrees farther south than he began. Thus, any attempt to take latitude observations, or to show latitudes on the chart, would indicate that something was wrong.

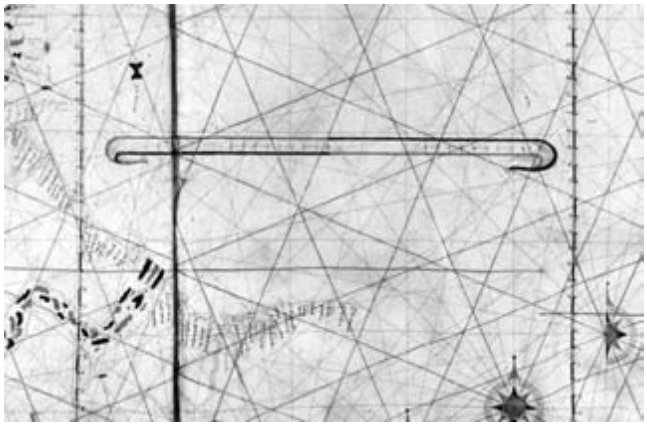


FIG. 40.16. NORTHEAST COAST OF SOUTH AMERICA, FROM DIEGO GUTIÉRREZ'S ATLANTIC CHART, 1550. Each latitude scale shown in the detail has a matching equator, leading to an inevitable discrepancy between the equators and eliciting fierce objections from several cosmographers. Photograph courtesy of the BNF (S H Arch N2).

Gutiérrez solved this problem by adding a second latitude scale, offset from the first by these same three degrees (fig. 40.16). By plotting latitudes in the Old World according to one scale and latitudes in the New World on the other, Gutiérrez could locate places at their correct latitude without changing the compass bearings that the pilots were accustomed to using. On his chart, a pilot could plot a course that simultaneously went due west by the compass and changed latitudes, just as the ships routinely did, without having to figure out how to reconcile the conflicting information from latitudes and compass bearings.[147]

The widespread use of this type of chart is clear from the testimony of a number of pilots, many of whom claimed that they did not know how to use any other type of

145. Schäfer, *Consejo Real,* 1:63–67 and 82–83; the records from the inspection are in AGI, Justicia, 944.

146. This appears from the testimony about whether Gutiérrez's charts match the pattern chart. See AGI, Justicia, 1146, N. 3, R. 2, block 2, images 33–34, 28 August 1544 statement of Diego Gutiérrez; images 37 and 43, 9 September 1544 statements of Alonso de Chaves; block 3, images 84–85, a different 28 August 1544 statement of Diego Gutiérrez; images 109–10, 9 September 1544 statement of Diego Gutiérrez; images 118–19, 9 September 1544 statement of Sebastian Cabot; image 94, 2 September 1544 statement of Pedro Mexía; and the testimony from pilots responding to questionnaires provided by Gutiérrez (Alonso Martin [images 157–62], Alonso Perez [images 168–72], and Juan de Nozedal [images 206–10]) and Cabot (Geronimo Rodriguez [images 320–33]).

147. For a more detailed version of this argument and the reactions of the pilots and cosmographers, see Sandman, "Cosmographers vs. Pilots," 160–211, esp. 190–200.

chart.[148] Even Alonso de Chaves, who in his testimony condemned the charts as false and unusable, referred to them in his navigation textbook as one of the common types of charts in use.[149] Despite this popularity, the charts were rejected by almost all of the cosmographers active in Seville, on the grounds that charts that were not true representations could not conceivably be useful at sea.[150]

While Medina's faction limited themselves to principled objections to the current charts, Gutiérrez and Cabot identified instead specific errors in latitude, compass bearing, distance, and shape. Responding to a request for information on faults in the pattern chart, Cabot and Diego Gutiérrez turned in identical memos, differing only in spelling and the precise layout on the page. Sancho Gutiérrez included the same information in a slightly different form.[151] These memos listed errors in latitude and the compass bearings between places, most extremely detailed, including latitude errors on the order of half a degree. The other responses were disappointingly vague, ignoring the specifics claimed by the Gutiérrez faction and asserting that the chart was well made and contained no notable errors.[152] In essence, they argued that because the *padrón* was carefully made by skilled people using many reports and all under competent authority, and furthermore because it was accepted by all the best cosmographers, it must be a good chart.

This aspect of the debate raised procedural issues. What should a cosmographer do when informed of an error? Was he free to correct his charts on his own, or did every correction require a meeting of all available cosmographers and a formal change to the pattern chart? Though in practice cosmographers often did correct their own charts, Chaves and Medina argued strongly for regular meetings and due process to control the changes. Indeed, the official job description for cosmographers called for meetings every two weeks to discuss changes in the pattern chart, though there is no evidence that such meetings were held.

In the end, the Council of the Indies ignored the reports of specific errors, and came down firmly in Medina's favor.[153] The council forbade pilots to use Gutiérrez's double-scale charts and reiterated the requirement that all charts match the *padrón real.* Gutiérrez was personally forbidden to make any chart that did not match the pattern chart, on pain of loss of his office and forfeiture of all his property.[154] The council made this decision in the face of warnings from the pilots, Cabot, and Gutiérrez, and despite the fact that in their summary Casa officials advised that the suggested changes were potentially dangerous. They did, however, officially give the pilots a year to learn how to use the charts. The actual changeover took a little longer, for the sole surviving double-scale chart by Gutiérrez is dated five years after this decision and in 1551 several pilots testified to having recently bought two-scale charts.[155] Even in the 1560s, standard charts were occasionally specified as single-scale charts.[156]

During much of this period, Alonso de Santa Cruz was working on his "Islario."[157] After leaving Seville following his inconclusive battles with Cabot, he had spent time at court and in Lisbon examining Portuguese charts. Because he retained his access to pilots' reports, his charts probably give a good idea of the information available. While focusing on islands, as indicated in the title, Santa Cruz included a chart of the world in seven sections, done (he said) in the style of a sea chart, so that the reader could readily place the islands in a broader geographical context.[158] Though he divided up the world in much the same way as did the later pattern charts, his charts center on the landmasses themselves rather than on the ocean voyages; he showed New Spain, but not the voyage from New Spain to the Philippines and the Moluccas, as was proposed in the 1580s. Oddly, in his chart of Central America Santa Cruz included a sort of double latitude

148. Their testimony survives in AGI, Justicia, 1146, N. 3, R. 2, block 3; see also Sandman, "Cosmographers vs. Pilots," 197–98.

149. Chaves, *Espejo de navegantes,* 271. Chaves distinguished two types of charts: those using compass directions and those using latitudes. He specified that the latter had a single latitude scale, implying that the other charts were two-scale charts, probably those made by Gutiérrez.

150. See Sandman, "Cosmographers vs. Pilots," 181–90.

151. AGI, Justicia, 1146, N. 3, R. 2, block 3, images 383–85, memo from Sebastian Cabot on errors in the *padrón;* images 389–91, memo from Diego Gutiérrez; and images 393–95, memo from Sancho Gutiérrez. The memos from Cabot and Sancho Gutiérrez are transcribed in Pulido Rubio, *Piloto mayor,* 524–26 and 526–28.

152. AGI, Justicia, 1146, N. 3, R. 2, block 3, images 397–400, 27 January 1545 statement of Alonso de Chaves, transcribed in Pulido Rubio, *Piloto mayor,* 528–31; images 401–2, undated statement of Jerónimo de Chaves; and R. 3, block 3, image 93, January 1545 statement of Pedro Mexía, transcribed in Pulido Rubio, *Piloto mayor,* 518–23.

153. On the politics surrounding the council's decision, see Sandman, "Cosmographers vs. Pilots," 203–9.

154. AGI, Indiferente, 1963, L. 9, fols. 174v–76v, 22 February 1545 letter to the Casa officials, and fol. 176v, 22 February 1545 order to Diego Gutiérrez.

155. See, for example, AGI, Justicia, 836, N. 6, block 3, images 308–9, 1 December 1551 testimony of Diego Munyz discussing his pilot's exam a year and a half earlier; another pilot, Luis Gonzalez, when asked what charts he had bought, testified that he owned a two-scale chart made by Diego Gutiérrez and had just bought (in 1551) a one-scale chart made by Sancho Gutiérrez (image 319).

156. See, for example, the testimony of Gaspar Luis, who was accused of acting as a pilot without being licensed (AGI, Justicia, 852, N. 3).

157. According to Mariano Cuesta Domingo, parts of the "Islario" seem to have been finalized around 1541, but Luisa Martín-Merás argued that some sections dated instead to around 1550; see Cuesta Domingo, *Alonso de Santa Cruz,* 1:115, and Martín-Merás, *Cartografía marítima hispana,* 111.

158. See Martín-Merás, *Cartografía marítima hispana,* 102–11, esp. 102.

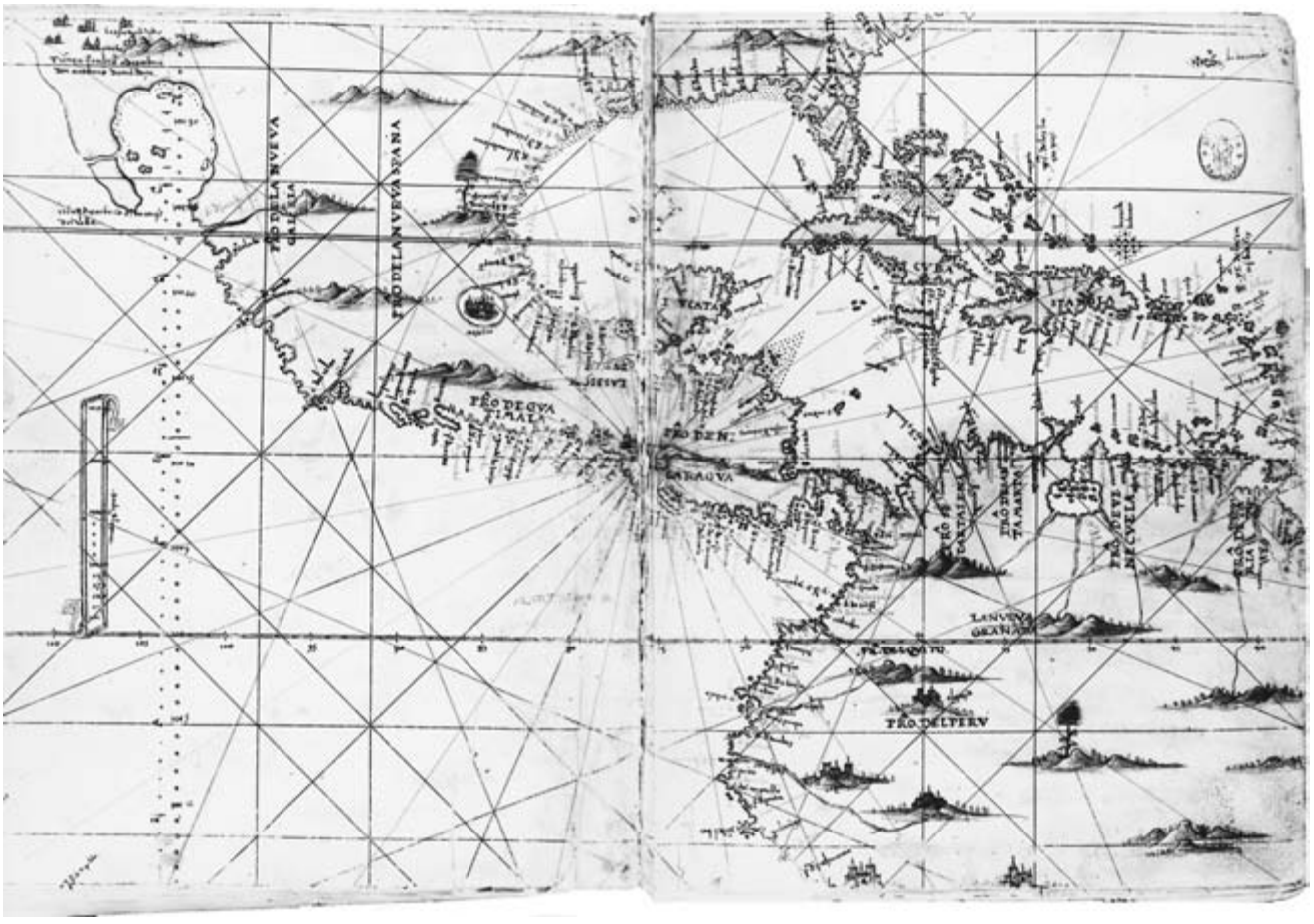


FIG. 40.17. CHART OF CENTRAL AMERICA FROM ALONSO DE SANTA CRUZ'S "ISLARIO." One of seven charts together covering the world. This was intended as a ready reference to help readers place the individual islands covered in the book, but the involvement of Santa Cruz with the pattern chart revisions makes it likely that he was working from essentially the same information as on the pattern charts. Note the double latitude scale with different-sized degrees on the far left. Also note the organization of the chart, focusing on a landmass rather than an ocean voyage.
Size of the original: 285 × 430 cm; Photograph courtesy of Biblioteca Nacional, Madrid (Sección de MS.).

scale, though not the same type as used by Gutiérrez (fig. 40.17). The scale consists of two adjacent latitude scales, each labeled every five degrees, with the degrees slightly larger on the left scale, so that they become progressively more out of phase farther from the equator. The purpose of this device is unclear.[159]

The Revision under Hernán Pérez de la Fuente (1549–1553)

In 1549, another member of the Council of the Indies, Hernán Pérez de la Fuente, was sent to Seville to inspect the Casa de la Contratación and incidentally to revise the pattern chart. A 1549 letter summarizing his progress mentions daily meetings with cosmographers, indicating that they had been asked to add information on population centers and other land features.[160] The letter goes on to describe the version of the pattern chart currently available to the council: "The pattern [charts] are not universal, for they lack more than 30 degrees toward each pole in latitude, because it appeared to those who made them then that the rest never used to be necessary . . . and that the universal ones which are made have nothing in the populated regions, but are like sea charts with only the coasts, and that if it were made anew one could put all of the one and the other very fully and complete in latitude

159. Martín-Merás pointed out both the double latitude scale and the similarity to the division of the pattern chart, though my analysis diverges from hers in a few respects. Her suggestion that the double scale might have been a device to account for magnetic declination seems unlikely given the lack of explanation and the way it differed from all other double latitude scales, but unless the second scale was simply an unerased error or a later addition, I cannot think of any alternative explanation.

160. AGI, Indiferente, 1964, L. 11, fols. 286r–88r, 13 September 1549 letter to Hernán Pérez de la Fuente.

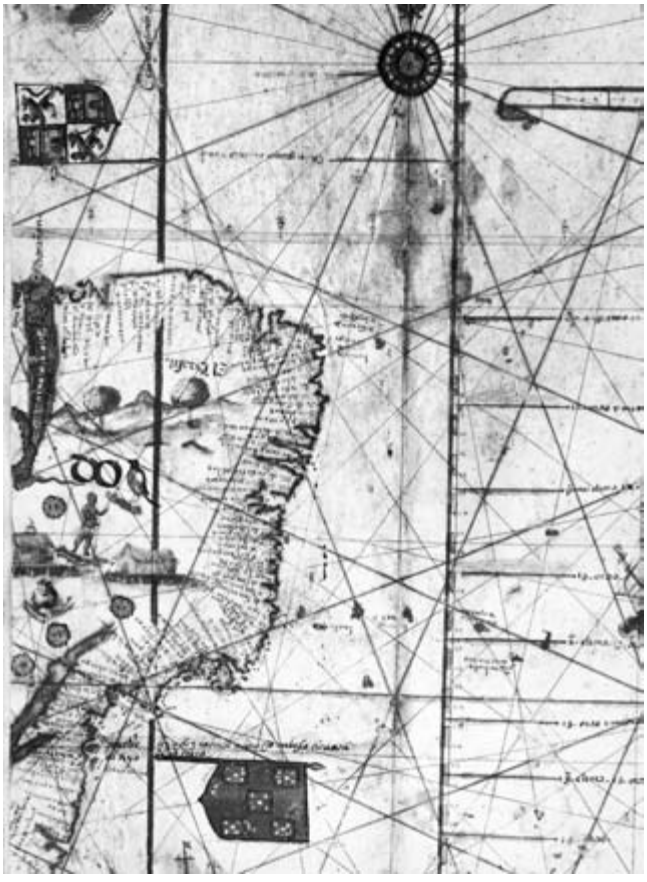


FIG. 40.18. DETAIL FROM THE WORLD CHART OF SANCHO GUTIÉRREZ, 1551. The detail shows ornamentation in the section of South America, and includes the Line of Demarcation and cosmographical inscriptions, including lengths of days.
Size of the entire original: 108 × 336 cm; size of the detail: ca. 37 × 27 cm. Photograph courtesy of the Bildarchiv, Österreichische Nationalbibliothek, Vienna (Map Department: K I 99.416, 4 fol.).

and longitude, which could be done with 40 ducados."[161] Pérez de la Fuente was told to order that such a chart be made but to return to the court in Valladolid without waiting for it to be finished. This is probably the same revision that was discussed in a 1553 letter, but almost nothing else is known about the chart.[162]

Aside from Diego Gutiérrez's double-scale chart and the charts in Santa Cruz's "Islario," few charts survive from this period. One prominent exception is the ornate world map made by Sancho Gutiérrez in 1551, though the extensive descriptions and ornaments make it clear that he did not intend it as simply a copy of the pattern chart (fig. 40.18).[163] Sancho initially followed in his father's footsteps, but at about this time he broke with his family to seek favor with the more theoretically oriented.[164] Despite some initial problems getting his charts approved for sale, he went on to a long career at the Casa, but he never attained the courtly connections of Alonso de Santa Cruz or Pedro de Medina and was described as lacking knowledge of cosmography.[165] Perhaps in response, his world map clearly indicates his cosmographical pretensions. The title block asserts that he was following Ptolemy as well as more modern cosmographers and discoverers, and he included details about climates and lengths of days that were more usual in cosmographies than on charts. Despite Sancho's attempt to break from Cabot and Diego Gutiérrez, many of the blocks of text are identical to the ones on Sebastian Cabot's 1544 world map, as is the general emphasis on textual explanation (figs. 40.19 and 40.20).[166]

THE DECLINE OF SEVILLE AS A CARTOGRAPHIC CENTER

The year 1552 was a time of great upheaval in the Casa de la Contratación, with changes both in personnel and in organization. At the end of a series of investigations that grew out of the 1549 inspection by Hernán Pérez de la Fuente, Diego Gutiérrez and Pedro de Medina were suspended from office.[167] Though Medina was eventually reinstated, he left Seville and participated little in Casa affairs after that point. Gutiérrez died in the midst of his appeal, and one of his sons, also named Diego Gutiérrez, was given his position as chartmaker, while his son Sancho was finally appointed cosmographer after a decade of active service. Though a cosmographer rather than a pilot, Alonso de Chaves was appointed pilot major, and a

161. AGI, Indiferente, 1964, L. 11, fols. 287v–88r, 13 September 1549 letter to Hernán Pérez de la Fuente.

162. On the 20 October 1553 letter, see Pulido Rubio, *Piloto mayor,* 269, and Cerezo Martínez, *Cartografía náutica,* 219. Both date the revision from this letter without mention of the 1549 discussion. Pérez de la Fuente was in Seville twice: first around 1549–51, inspecting the Casa de la Contratación, and again starting in 1553, this time seconded to the city government.

163. For detailed reproductions and an analysis of the text on this chart, see Martín-Merás, *Cartografía marítima hispana,* 112–19; see also Henry Raup Wagner, "A Map of Sancho Gutiérrez of 1551," *Imago Mundi* 8 (1951): 47–49.

164. On the battle within the Gutiérrez family and on Sancho's early career, see Sandman, "Cosmographers vs. Pilots," 212–92, esp. 224–28 and 250–52.

165. Pérez de la Fuente's assessment is in AGI, Indiferente, 1093, no. 98, 22 September 1549 letter. For an analysis of Pérez de la Fuente's inspection and his evaluations of all active cosmographers, see Sandman, "Cosmographers vs. Pilots," 235–42.

166. For a comparison of Gutiérrez's world map with the one printed by Cabot, see Harry Kelsey, "The Planispheres of Sebastian Cabot and Sancho Gutiérrez," *Terrae Incognitae* 19 (1987): 41–58; Martín-Merás, *Cartografía marítima hispana,* 122–31; and Cerezo Martínez, *Cartografía náutica,* 210–12.

167. For the documents from this investigation and the subsequent prosecutions, see AGI, Justicia, 945, and Justicia, 836, N. 4 and N. 6. On the context for these events, see Sandman, "Cosmographers vs. Pilots," 212–92.

new position, professor of cosmography, was created and given to his son, Jerónimo de Chaves.

Thus, by 1554 the licensed cosmographers active in Seville were Francisco Faleiro and Alonso de Santa Cruz (both frequently absent from Seville), Alonso de Chaves (pilot major), Jerónimo de Chaves (cosmography professor), and the brothers Diego Gutiérrez and Sancho Gutiérrez. Most of the institutional power now lay in the hands of the Chaves family, though the Gutiérrez family, helped by a third son (Luis), who was active despite not being licensed, retained most of the custom of the seamen. The relative status of the groups can be seen in attendance at a meeting in September of 1554 at the royal court in Valladolid on unspecified matters relating to cosmography. Alonso de Chaves, Jerónimo de Chaves, and Alonso de Santa Cruz were called to the meeting, along with several university astronomers.[168] The Gutiérrez family was apparently not invited.

Due to the absence of the internecine controversies that had distinguished the previous decades, there is much less information available about the pattern chart. A chart by Diego Gutiérrez (probably the son) engraved by Hieronymus (Girolamo) Cock in 1562 gives some indication of the state of the pattern chart in the 1550s, though the printing of the chart probably owed more to diplomatic considerations than to seafaring ones.[169] A 1562 letter from the Council of the Indies to the Casa officials mentioned that they were gathering the pilots to revise the pattern chart but gave no details.[170] In 1566, the council wrote to the Casa for an updated chart needed for an upcoming cosmographical meeting in Madrid on the status of the Moluccas and the Philippines.[171] Once again, the chart has not survived.

The following years were fairly quiet in Seville. With the creation of the position of cosmographer major of the Council of the Indies in 1571, much of the concern about cartography moved to the royal court. A lot of attention was given to gathering geographic information, both from the pilots and from specific surveying expeditions, but this was separated from the day-to-day affairs at the Casa. While there continued to be a great deal of infighting at the Casa, little of it involved the cartographic activities of the cosmographers. In addition, between deaths and retirements, the number of active cosmographers was declining precipitously (see appendix 40.1).

In 1575, a new cosmographer, Rodrigo Zamorano, came to town, reigniting cosmographical controversies.[172] Zamorano was a new sort of cosmographer, a well-educated expert from out of town who saw the Seville position as a stepping-stone to better things. In a 1582 petition, Zamorano gave details about his activities in the previous seven years, indicating that the bulk of his time had been spent in the preparation of charts and instruments for a voyage to fortify the Strait of Magellan, including the pattern chart revision following Pedro Sarmiento de Gamboa's 1579 voyage.[173] It seems likely that there were many similar attempts to revise the pattern chart for specific expeditions, most of which have vanished with little documentary evidence.

By the 1580s, Seville was no longer the only center for cosmography and had therefore decreased considerably in cartographic importance. Though Zamorano fought his rival Domenico Vigliarolo (Domingo Villaroel) for the next decade for the right to make charts, in the process claiming that Vigliarolo's charts did not match the pattern chart, these claims are reminiscent of Medina's charges against Gutiérrez forty years earlier and probably had much the same motivation. The problems once again were the difficulty of keeping the pattern chart up to date and the propriety of a cosmographer's making changes single-handedly. Because the accusations had more to do with competition for the custom of the pilots than with the pattern chart itself, I discuss the conflict more fully in the final part of this chapter. Despite these bitter arguments, it does not seem that there was any formal attempt to revise the pattern chart. The impetus for change had moved to the royal court.

168. AGI, Indiferente, 425, L. 23, fol. 96rv, 11 August 1554 *cedulas* calling Pedro de Esquivel, Juan Aguilera, and the Abbot of Santjuil to court by 10 September 1554; Indiferente, 1965, L. 12, fols. 188v, 189r, and 192r, 11 August 1554 *cedulas* ordering Alonso de Chaves, Jerónimo de Chaves, and Alonso de Santa Cruz to appear in court by 10 September; and Indiferente, 425, L. 23, fol. 109rv, 19 September 1554 order to pay Esquivel, Aguilera, an unnamed abbot, Jerónimo de Chaves, Alonso de Santa Cruz, Pedro de Medina, and Pero Ruiz de Villegas for their attendance and travel expenses. Medina seems to have attended in place of Alonso de Chaves.

169. John R. Hébert and Richard Pflederer, "Like No Other: The 1562 Gutiérrez Map of America," *Mercator's World* 5, no. 6 (2000): 46–51. Hébert and Pflederer put the map in the context of the Treaty of Cateau-Cambrésis (1559) and the use of the Tropic of Cancer as a line of demarcation. A high-resolution image of the chart is available in the online map collection of the Library of Congress; see John R. Hébert, "The 1562 Map of America by Diego Gutiérrez," <http://memory.loc.gov/ammem/gmdhtml/gutierrz.html>.

170. AGI, Indiferente, 1966, L. 14, fol. 138r, 10 January 1562.

171. On this meeting, see Goodman, *Power and Penury,* 58–61. On cosmographers' being called to the meeting and paid afterward, see AGI, Indiferente, 1967, L. 16, fol. 45rv; Indiferente, 2002, fol. 21rv; Indiferente, 1967, L. 16, fols. 58v–60r; and Indiferente, 425, L. 24, fols. 300v–301r. The results of the meeting and the opinions given are preserved in AGI, Patronato, 49, R. 12.

172. For a brief biography, see Pulido Rubio, *Piloto mayor,* 639–711, and on his mathematical work, see Mariano Esteban Piñeiro and M. I. Vicente Maroto, "Primeras versiones castellanas (1570–1640) de las obras de Euclides: Su finalidad y sus autores," *Asclepio* 41, no. 1 (1989): 203–31, esp. 206–12.

173. AGI, Patronato 262, R. 11 block 1, undated 1582 petition accompanied by 23 May 1582 depositions about his activities; see Cerezo Martínez, *Cartografía náutica,* 226–28. On charts of the Strait of Magellan, see Julio F. Guillén y Tato, *Monumenta chartográfica indiana* (Madrid, 1942–), 1:29–100.

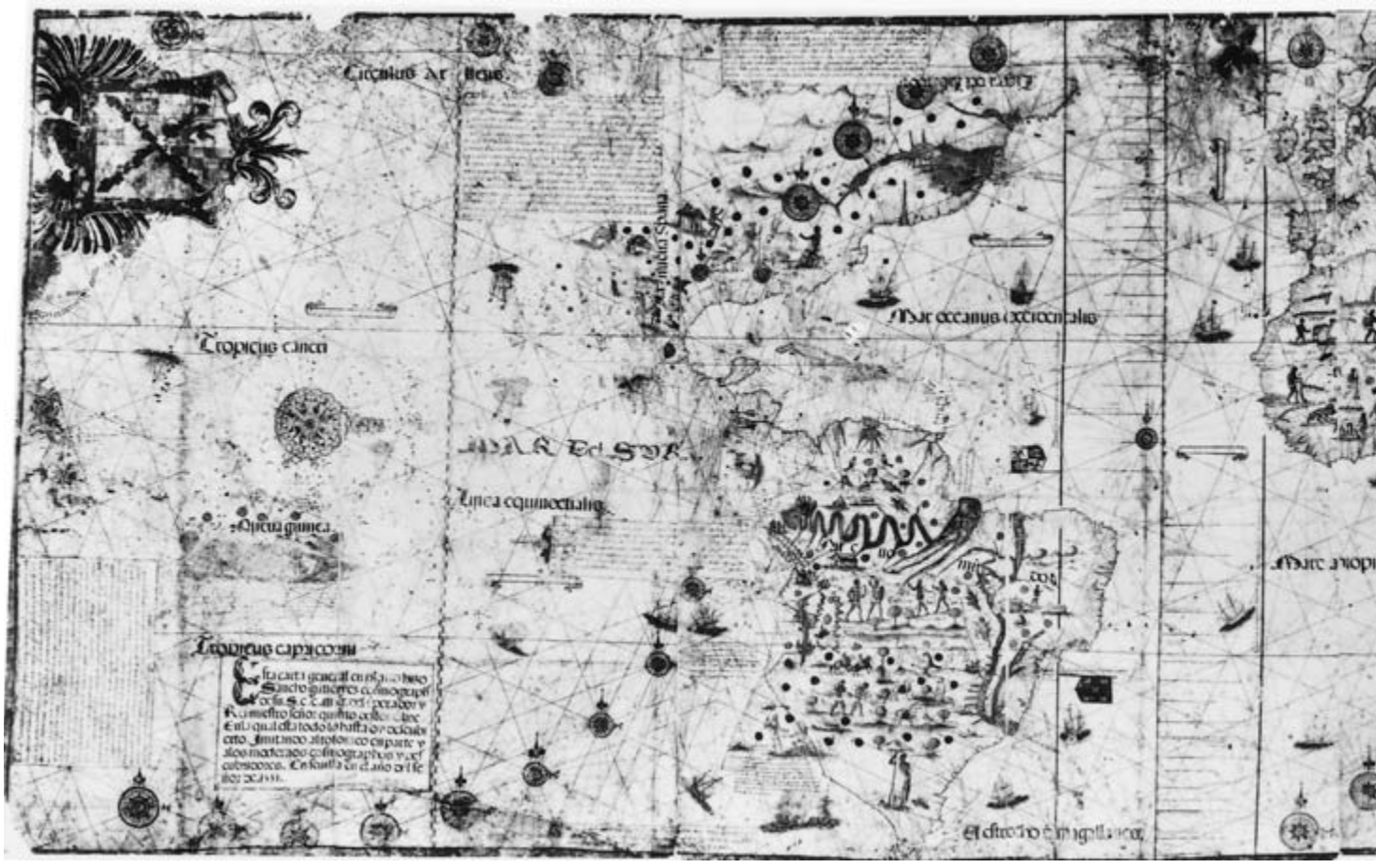


FIG. 40.19. WORLD CHART OF SANCHO GUTIÉRREZ, 1551. The chart contains extensive historical and geographical descriptions. Compare the overall layout and emphasis on text to those in the 1544 world map by Sebastian Cabot (fig. 40.20). Though the projections differ, both men were concerned with emphasizing their cosmographical learning and distancing themselves from the pilots, and both men failed, continuing to be employed as practical men.
Size of the original: 108 × 336 cm, glued on linen. Photograph courtesy of the Bildarchiv, Österreichische Nationalbibliothek, Vienna (Map Department: K I 99.416, 4 fol.)

REVISIONS UNDER THE AUSPICES OF THE COSMOGRAPHER MAJOR

In 1582, on his return from Lisbon, King Philip II created the Academia de Matemáticas at court, another example of the fertile interchange between Spain and Portugal.[174] One of the major functions of the Academia was to teach cosmography, providing a center of study less closely linked to the day-to-day navigational affairs than was the Casa de la Contratación and one more convenient to the royal court. Though run by the architect Juan de Herrera, the Academia was primarily concerned with cosmographical matters: translating mathematical books from Latin into the vernacular, teaching cosmography, and devising nautical instruments, especially instruments for finding longitude at sea. When a new cosmographer major, Pedro Ambrosio de Ondériz, was appointed in 1591, part of his job was specified as correcting the charts and instruments used by the pilots.[175] Obedient to this mandate, Ondériz wrote an extensive memo on the problems with navigation in Seville, and in early 1593 the Council of the Indies gave him permission to travel to Seville to oversee a general reform of navigation.

Because this reform marked the first attempt to examine navigation as a whole since the time of Columbus, and resulted in a redefinition of the pattern chart, it is worth

174. On the formation of the academy and its activities in the sixteenth century, see Vicente Maroto and Esteban Piñeiro, *Ciencia aplicada,* 71–109; see 110–34 for transcriptions of a variety of relevant documents. In this context, the role of João Baptista Lavanha (Juan Bautista Labanna) would particularly repay investigation, for he was involved in reforms in both Spain and Portugal; on his role in Portugal, see A. Teixeira da Mota, *Os regimentos do cosmógrafo-mor de 1559 e 1592 e as origens do ensino náutico em Portugal* (Lisbon: Junta de Investigações do Ultramar, 1969), 12–13.

175. Vicente Maroto and Esteban Piñeiro, *Ciencia aplicada,* 407; on Ondériz's career in general, see 80–108.

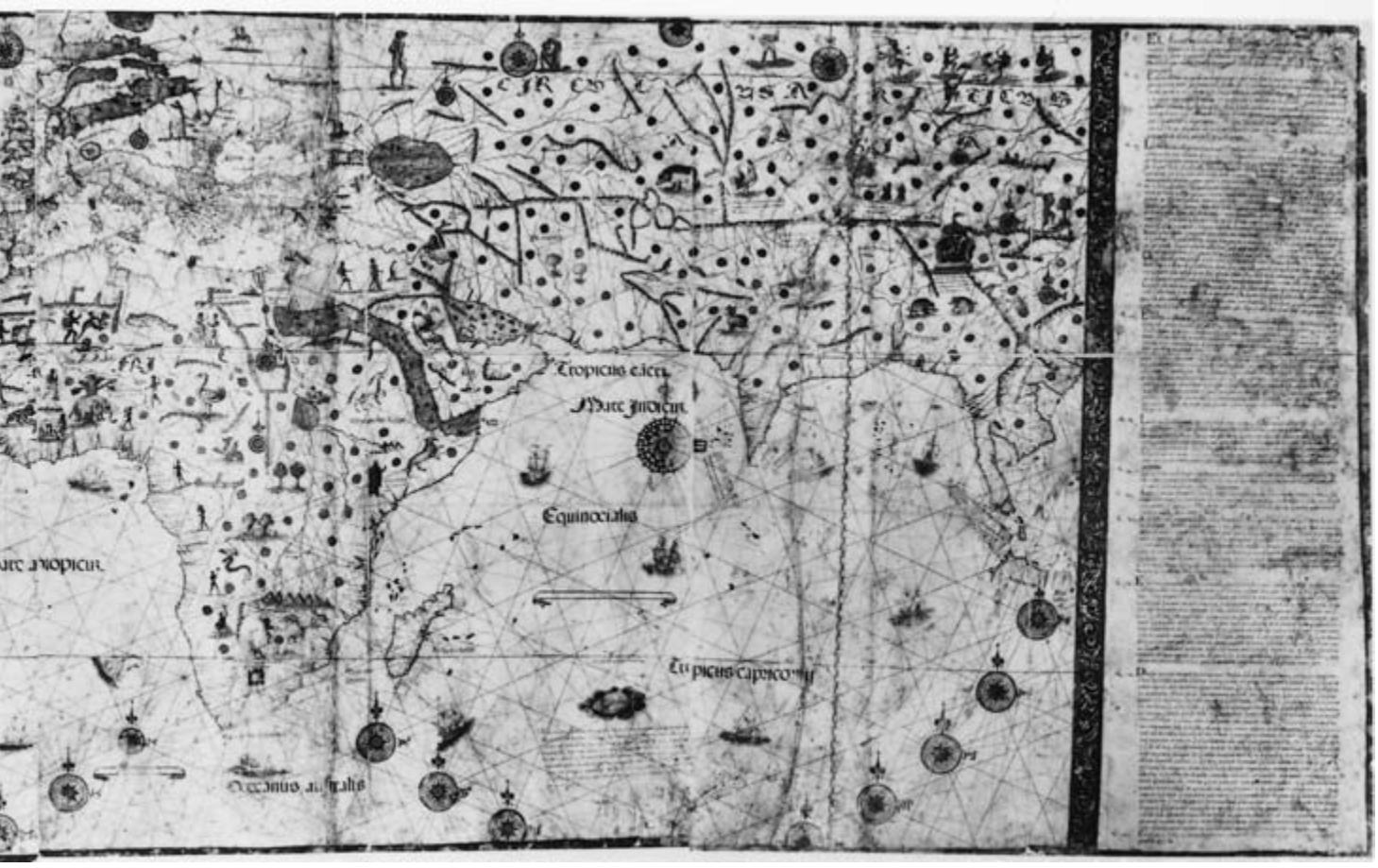


FIG. 40.19. (*continued*)

looking at Ondériz's efforts in some detail. After an extensive discussion of other sources of error, Ondériz turned to the heart of his reforms—the charts used by the pilots—carefully distinguishing systematic errors from particular ones and emphasizing the former.[176] He emphasized the widespread falsification of Portuguese charts, placing the territorial conflicts between the countries in historical context and claiming that the Portuguese were intentionally compressing the lands in their hemisphere to claim the Spice Islands; he added that the recent joining of the two kingdoms provided the perfect opportunity to finally correct this problem. Ondériz then went on to list twenty-four detailed errors in the pattern chart, focusing on the misplacement of shallows, but also listing missing islands, coastlines that needed revision, and a few mistaken latitudes. Adding that there were many more problems that pilots could identify, he called for a general meeting of pilots and cosmographers.

He also called for a redefinition of the concept of the pattern chart, suggesting that the reform committee should make six new charts, divided according to the voyage portrayed, instead of one universal pattern chart. To ensure ready access, he also suggested that one copy of each should be kept at the Casa de la Contratación, with another sent to the Council of the Indies. He specified three charts that it was essential to keep available: one of the voyage from Portugal to the East Indies, one of the voyage to Brazil and the Strait of Magellan, and a third showing the voyage from New Spain to the Philippines and the Moluccas. He also suggested having one of the Mediterranean and another of the northern lands, specified as England, Ireland, and the codfish lands (Newfoundland). These latter two he thought less important, probably because the Casa did not normally send ships there. The final chart was the most important—a pattern chart for the route to the West Indies, by far the most common voyage made from the Casa. This chart, he suggested, should not only be purged of all known errors, but, more important,

176. AGI, Indiferente, 742, no. 83A, 15 January 1593 memo from Pedro Ambrosio de Ondériz accompanying 25 January 1593 *consulta* (consultation) of the Council of the Indies; much of the section relevant to sea charts is quoted in Vicente Maroto and Esteban Piñeiro, *Ciencia aplicada,* 408–14. Additional information on the reasons for the reform and the background of the controversy is included in García de Céspedes, *Regimiento de navegacion* and *Hydrografía.*

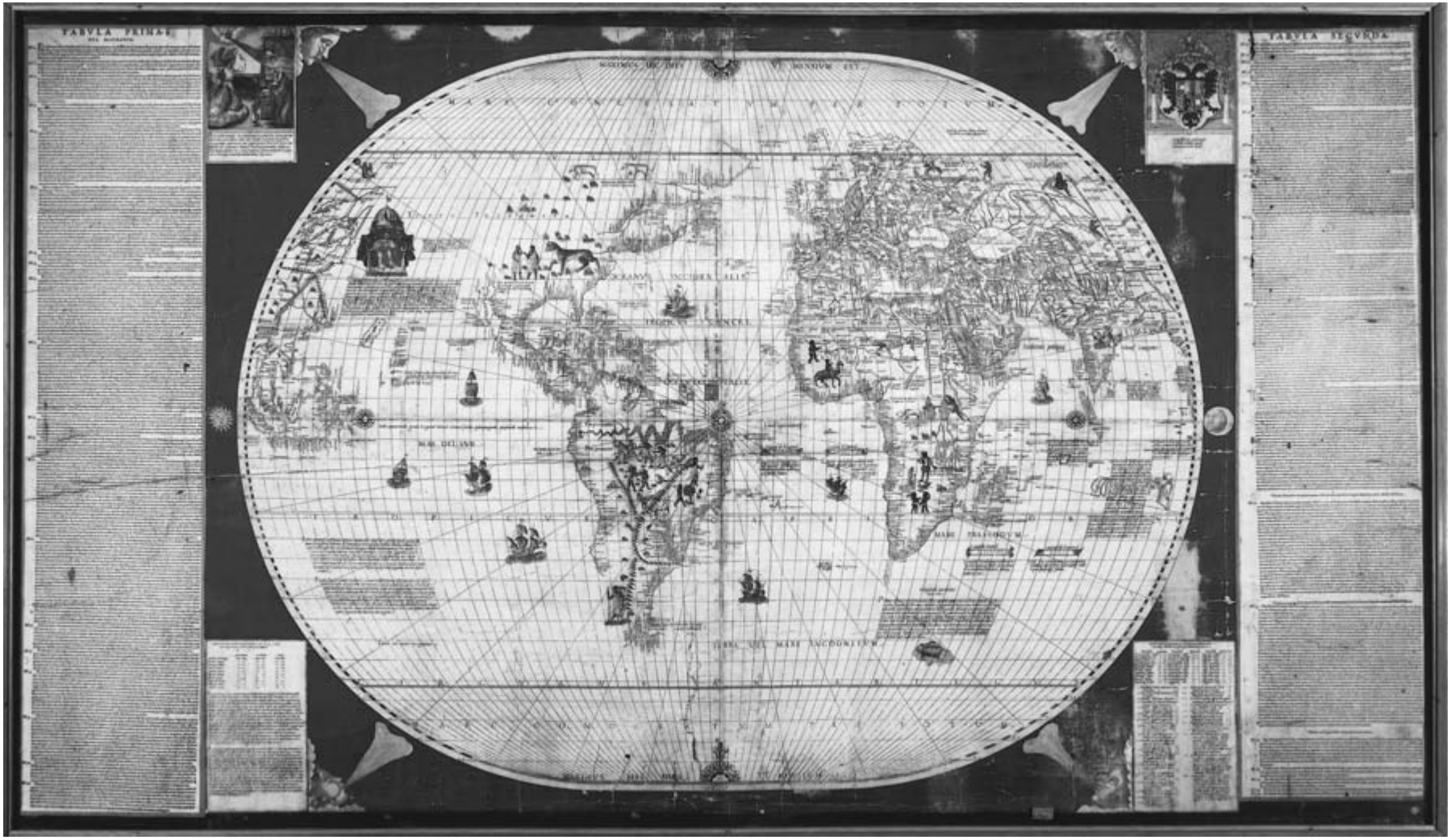


FIG. 40.20. WORLD MAP OF SEBASTIAN CABOT, 1544. This world map seems designed to showcase Cabot's cosmographical knowledge. Aside from historical references (including to his earlier voyages), the texts indicate his familiarity with classical authorities and contemporary cosmographical problems, including a method for finding longitude at sea. The world map may also have functioned as an advertisement, for a few years later he left for England, where another version (now lost) was printed.
Size of the original: 125 × 219 cm. Photograph courtesy of the BNF.

it should be made at least a third larger than the one they currently had so that it could contain more detail.[177] The council agreed with his assessment, and Ondériz was sent to Seville to consult with the pilots, the Universidad de Mareantes, and other experts in Seville.[178]

The recommendations made by this set of experts were telling. The general pattern chart, they said, had not been revised for the previous twenty-six years (since the late 1560s), and so was much in need of correction.[179] Despite the long list of errors provided by the pilots, they still did not feel they had enough reliable information to correct the chart, so they wanted the pilots of the next convoy to gather further data. Once the convoy returned, they would be able to proceed with the revision of the pattern chart for the West Indies, and in the interim they could work on the other five pattern charts. Due to the large amount of work, they suggested that the council not only send Ondériz back to Seville to complete the revision, but also send the Portuguese cosmographer Luís Jorge de Barbuda (Luis Jorge) to help.[180] Ondériz returned to Madrid to report to the council, taking with him a provisional copy of the instructions for the pilots.

These instructions, printed by order of the Casa officials, give a very good idea of the uncertainties in the chart.[181] They consisted of a detailed list of what places were to be surveyed, divided according to the usual destinations of the Indies convoys. The few places not normally covered by the convoys were entrusted to the relevant governors, who were to send ships for the purpose. The instructions specified that the pilots were to record the altitude of the sun at noon in each spot with new larger astrolabes graduated in half degrees, emphasizing the growing importance of latitude measurements.[182] Meanwhile, the council agreed that Ondériz and Luís Jorge de Barbuda should go to Seville once the information from the pilots was available.[183] This information, however, was a long time coming and proved less than satisfactory. In his 1595 report, Ondériz complained that only three pilots had responded, and those without providing good information.[184] He suggested that two special-purpose surveying ships be sent out. The council agreed, but Ondériz died before any arrangements could be made.

The following year, the council appointed Andrés García de Céspedes to replace Ondériz as cosmographer major and so to complete the reform project.[185] García de Céspedes was a university-educated mathematician affiliated with the Academia de Matemáticas at the court, who had recently returned from ten years of service in Portugal. His assignment was to finish the work of Ondériz, completing exemplars of the new pattern charts and all instruments used at sea.

In the wake of the failure of Ondériz's data-gathering measures, one of García de Céspedes's first actions was to put together a new questionnaire for the pilots, asking them to specify any errors in the *padrón real* and to comment on proposed changes in their observing instruments. These questionnaires were printed and distributed to the active pilots; many responses, most from April of 1597, survive in the archives (fig. 40.21).[186] The responses of the pilots indicate their impatience with the whole endeavor; most suggested that the charts and instruments were good enough and should be left alone. Some even specified that any seeming problems with the charts were due instead to unknown currents. A few included details that might be fixed, such as the suggestion that islands be labeled not only with the name of the island but also with the names of any ports.[187]

Using information from the pilots, corrected when possible by longitude information from lunar eclipses, García de Céspedes put together a new set of pattern charts in the spring of 1597, though they were not officially approved until 1599.[188] As the final part of the reform, he published a regiment and a book on hydrography, describing the reforms, explaining how to make and use charts, and incidentally exploring the difference in attitudes and usage between pilots and cosmographers. Though he included a chart in his book, the pattern charts themselves have not survived, and the printed chart seems designed primarily to illustrate the problems of flattening a sphere (fig. 40.22).

177. AGI, Indiferente, 742, no. 83A, fol. 5v.

178. His instructions survive in AGI, Indiferente, 742, no. 151c.

179. On the meetings resulting in these recommendations, see AGI, Indiferente, 742, no. 151c, 22 December 1593 report from the Casa officials, and see Patronato, 262, R. 2 for the pilots' statements.

180. On Barbuda, see Vicente Maroto and Esteban Piñeiro, *Ciencia aplicada,* 83–87, and Goodman, *Power and Penury,* 62.

181. AGI, Indiferente, 742, no. 151c; facsimile in Vicente Maroto and Esteban Piñeiro, *Ciencia aplicada,* 444–47.

182. According to Ondériz's report, as summarized by the Council of the Indies in AGI, Indiferente, 868, 28 July 1595 *consulta.*

183. AGI, Indiferente, 742, no. 151.

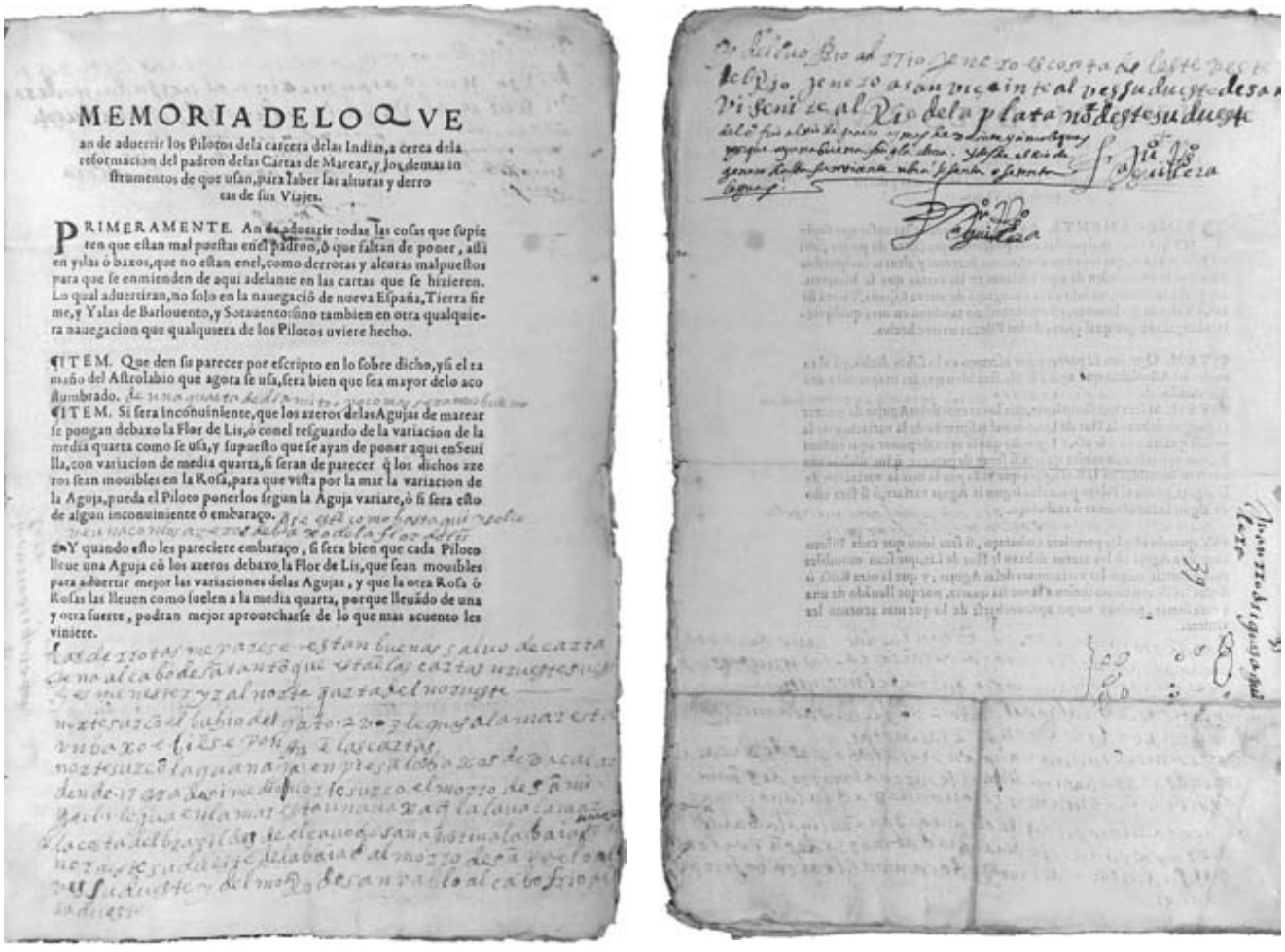
184. AGI, Indiferente, 868, 28 July 1595 *consulta* of the Council of the Indies, and Vicente Maroto and Esteban Piñeiro, *Ciencia aplicada,* 420–22 and 448–50 (transcription).

185. On this phase of the reform, see Vicente Maroto and Esteban Piñeiro, *Ciencia aplicada,* 422–31. Much of the information on the reform activities comes from García de Céspedes's own account in *Regimiento de navegacion* and *Hydrografía.* On García de Céspedes himself, see Vicente Maroto and Esteban Piñeiro, *Ciencia aplicada,* 144–53, and Alison Sandman, "An Apologia for the Pilots' Charts: Politics, Projections and Pilots' Reports in Early Modern Spain," *Imago Mundi* 56 (2004): 7–22.

186. AGI, Patronato, 262, R. 2, fols. 19r–61v.

187. AGI, Patronato, 262, R. 2, fol. 54rv, Jerónimo Martín. Martín was one of the few pilots to give a long list of errors; he was at the time applying (for the second time) for a license as a cosmographer.

188. He included a list of his specific corrections in García de Céspedes, *Hydrografía,* chap. 13.



MEMORIA DELO QVE

an de aduertir los Pilotos dela carrera delas Indias, a cerca dela reformacion del padron delas Cartas de Marear, y los demas instrumentos de que usan, para saber las alturas y derroteros de sus Viajes.

PRIMERAMENTE. An de aduertir todas las cosas que supieren que estan mal puestas enel padron, ó que faltan de poner, assi en yslas ó baxos, que no estan enel, como derrotas y alcuras malpuestos para que se enmienden de aqui adelante en las cartas que se hizieren. Lo qual aduertiran, no solo en la nauegació de nueva España, Tierra firme, y Yslas de Barlouento, y Sotauento: sino tambien en otra qualquiera nauegacion que qualquiera de los Pilotos uviere hecho.

ITEM. Que den su parecer por escripto en lo sobre dicho, yssi el tamaño del Astrolabio que agora se usa, sera bien que sea mayor delo acostumbrado.

ITEM. Si sera inconuiniente, que los azeros delas Agujas de marear se pongan debaxo la Flor de Lis, ó conel resguardo de la variacion de la media quarta como se usa, y supuesto que se ayan de poner aqui en Seuilla, con variacion de media quarta, si seran de parecer q̃ los dichos azeros sean mouibles en la Rosa, para que vista por la mar la variacion de la Aguja, pueda el Piloto ponerlos segun la Aguja variare, ó si sera esto de algun inconuiniente ó embaraço.

Y quando esto les pareciere embaraço, si sera bien que cada Piloto lleue una Aguja cõ los azeros debaxo la Flor de Lis, que sean mouibles para aduertir mejor las variaciones delas Agujas, y que la otra Rosa ó Rosas las lleuen como suelen a la media quarta, porque lleuãdo de una y otra suerte, podran mejor aprouecharse de lo que mas acuerto les viniere.

FIG. 40.21. RESPONSE TO THE 1597 "MEMORIA" ASKING PILOTS ABOUT THEIR CHARTS AND INSTRUMENTS. This response is from Juan Rodrigues Aguilera, a pilot with more than twenty-four years of experience sailing to the Indies, indicating changes he would recommend in the pattern chart. He later wrote a testimonial for García de Céspedes, indicating that he approved of the new pattern chart resulting from the information gathered from the pilots. Photograph courtesy Spain, Ministerio de Cultura, AGI (Patronato, 262, N. 1, R. 2, images 105 and 106).

THE PATTERN CHART AT THE END OF THE CENTURY

The arguments surrounding the acceptance of García de Céspedes's revision of the pattern chart reveal the ideas about sea charts at the end of the century. It is clear that in the eyes of both the pilots and the cosmographers, sea charts were a form unto themselves, with their own unique solutions to the problems inherent in cartography. The problems were twofold—magnetic declination and projection—though in practice they could not be separated so neatly. Projection was an unavoidable problem, for a spherical earth could not be represented on a plane without some distortion. Because the pilots would not tolerate any chart that changed the compass bearings between places from the ones they were accustomed to using, the charts had to distort the distances between places. Though by this time Gerardus Mercator had worked out his solution, and in 1599 Edward Wright published his analysis of the projection, none of the Spanish cosmographers discussed the possibility. Instead, bowing to the necessity of avoiding complicated projections, García de Céspedes attempted to ameliorate the distortions by suggesting that the charts include multiple distance scales, designed to be used at different latitudes.[189]

The other problem was magnetic declination. Because the pilots did not always correct their compasses for declination, the rhumbs they followed were incorrect. Nonetheless, the almost unanimous opinion expressed by the pilots was that the compasses should be left as they were, offset for the declination in Seville. Pedro Muñiz del Salto, for example, explained that all the rhumbs on the charts were placed according to compasses offset for declination, so

189. He explained the problem and justified his solution in García de Céspedes, *Regimiento de navegacion,* chap. 48, and *Hydrografía,* chap. 2.

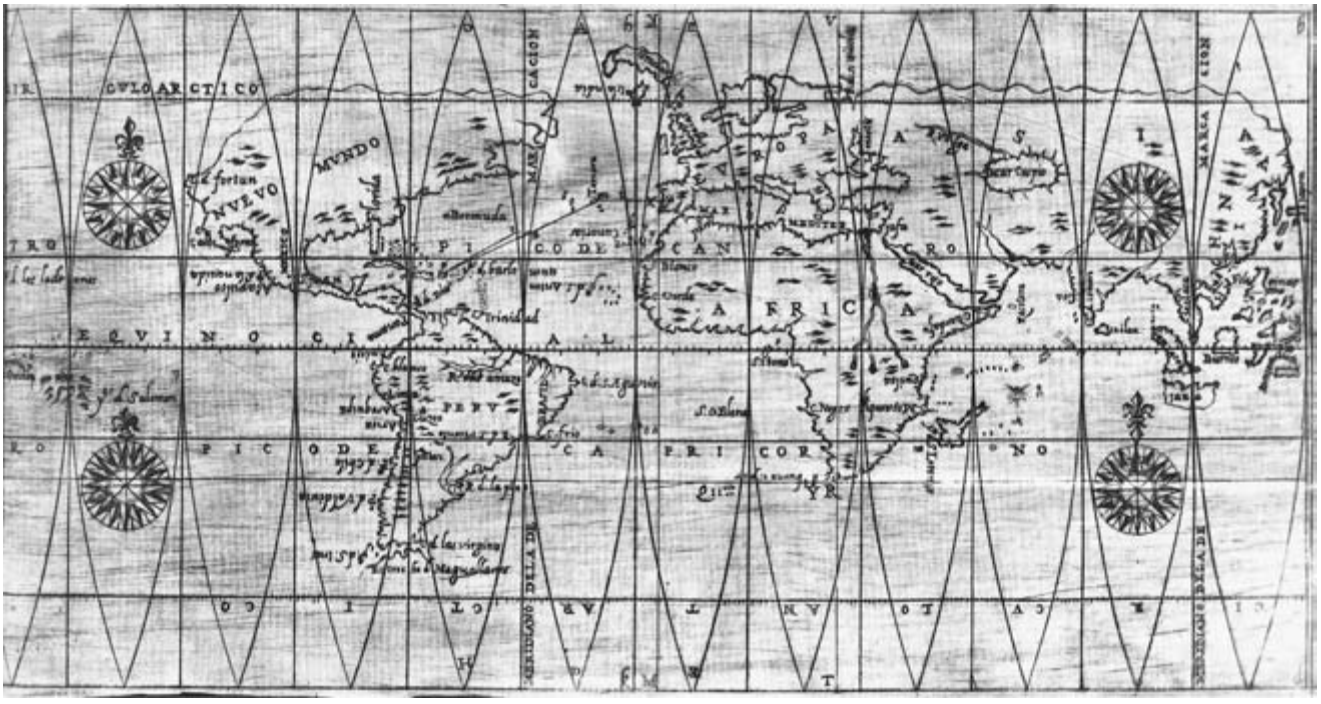


FIG. 40.22. CHART INCLUDED IN ANDRÉS GARCÍA DE CÉSPEDES'S *HYDROGRAFÍA*. García de Céspedes used this figure to help people who did not know enough geometry to follow his earlier discussion understand how sea charts distorted distances at the higher latitudes. The sections of the chart shown inside the curves indicate the actual area of the earth at each latitude; thus, voyagers at higher latitudes thought they had farther to go than they actually did. Andrés García de Céspedes, *Regimiento de navegacion mando haser el rei nvestro señor por orden de sv Conseio Real de las Indias,* 2 pts. (Madrid: I. de la Cuesta, 1606), pt. 2, *Segvnda parte, en qve se pone vna hydrografia que mando hazer Su Magestad,* after fol. 126. Photograph courtesy of the James Ford Bell Library, University of Minnesota, Minneapolis.

changing the compasses would involve changing all the courses people followed, which would be very dangerous without first sending someone to resurvey the routes.[190]

The combination of the two problems meant that the charts preferred by the pilots were technically inaccurate, though the pilots tended to discuss the problem in terms of compass declination while the cosmographers preferred to discuss projection. All agreed, however, that charts needed to be useful to the pilots, even if this involved some compromises or minor inaccuracies. As the Sevillian cosmographer Antonio Moreno explained, it was pointless to expect pilots to be mathematicians.[191] The sea charts were, and should remain, a separate tradition, allowing pilots to travel using their compasses without worrying about the niceties of projection. Thus, at the end of the century Andrés García de Céspedes had managed to find a workable compromise between the needs of the cosmographers and those of the pilots, ending, for a time, the polemics within the Casa that had characterized the middle of the century.

In addition, the reform marked the definitive replacement of a single universal pattern chart with a series of smaller charts, organized by different voyages. This paralleled the increasing popularity of manuscript atlases in the late sixteenth century, though the centers of production differed, as did the principle used to decide which areas belonged together on a single chart.[192] It is probably not coincidental that much of the surviving cartography from the end of the sixteenth century consists of either manuscript or printed atlases; most of the known works of the younger Diego Gutiérrez and Jerónimo de Chaves survive only because they were used by Abraham Ortelius.[193] With the increasing desire for detail, combined

190. AGI, Patronato, 262, R. 2, fol. 20rv.

191. AGI, Patronato, 262, R. 2, fol. 8rv, 16 November 1598 opinion of Antonio Moreno. He was appointed cosmographer in 1603. See also fol. 10r, 15 November 1598 statement of university graduate Diego Pérez de Mesa, and fols. 12r–13r, 23 November 1598 statement of Jerónimo Martín.

192. For a list of manuscript atlases containing nautical charts, see Cerezo Martínez, *Cartografía náutica,* 271–78.

193. For Gutiérrez, a map of America, and for Chaves, maps of South America, Spain, and Florida, see Robert W. Karrow, *Mapmakers of the Sixteenth Century and Their Maps: Bio-Bibliographies of the Cartographers of Abraham Ortelius, 1570* (Chicago: For the Newberry Library by Speculum Orbis Press, 1993), 285–87 (Gutiérrez) and 116–18 (Chaves).

with the division into smaller parts, the sea charts based on the *padrón real* had come around to a new similarity with the *isolarios, itinerarios,* and harbor views.

Finally, the work of Ondériz and García de Céspedes emphasized the continuing importance of diplomatic concerns. Ondériz had characterized distortions due to Portuguese attempts to claim territory as one of the major problems in sixteenth-century cartography. García de Céspedes continued this emphasis; in the permission to print his book on hydrography, written as part of the general reforms, the book is described as "a general hydrography, in which is demonstrated how the Portuguese have perverted maps in order to put the Spice Islands in their demarcation."[194] Thus, while at the end of the sixteenth century the pattern charts looked very different than they had at the beginning, and the bureaucracy surrounding cartography and navigation was much expanded, charts continued to serve the dual purposes of navigation and politics.

Selling Charts to Pilots

Though charts in general had many uses, for pilots they were primarily tools with which to navigate at sea. The pilots were supposed to use only charts that matched the pattern chart, but this was very difficult to enforce. Though the activities were undertaken in the same institution and involved many of the same people, in practice the sale of charts to the pilots was largely separate from efforts to keep the pattern chart up to date. This aspect of nautical cartography has been comparatively neglected, probably due to the paucity of the sources and the lack of prestige accorded the activity. The charts sold to pilots were not supposed to be innovative in any way and were generally made as inexpensively as possible. This meant that while selling charts to the pilots was potentially lucrative, it was unlikely to bring their maker to the attention of rich patrons or to provide opportunity for advancement.

Though all cosmographers in Seville were licensed to sell charts to the pilots, the pilots tended to patronize only a few of the available cosmographers. The people who were successful at selling charts to the pilots were generally the cosmographers with the least education and the lowest salaries, perhaps because they were more willing to respond to requests from pilots. While in the discussions of the pattern chart the pilots were usually outvoted, in the charts they bought for their own use they often managed to get what they wanted regardless of the regulations. Because charts belonging to the pilots were destroyed as they became outdated, their charts (and the activities of the chartmakers who specialized in selling to the pilots) are known exclusively through texts, primarily discussions of charts in corruption investigations and lawsuits about the use of different charts and the licensing of new makers.

Because the charts were seen by both the pilots and the royal officials as tools of navigation, they were usually discussed together with other nautical instruments and in the context of issues related to navigation. Rather than specializing as chartmakers, therefore, the people selling to pilots generally sold all sorts of nautical instruments. In this section, I first discuss the system of nautical outfitters in general, as it functioned throughout the sixteenth century. In the remainder of the section, I give a chronological account of the individual workshops and chartmakers. Rather than focusing on the content of the charts, which for the most part is not known, I look instead at the economic aspects of the trade and the trade-offs between preserving the secrecy of the charts, attracting good chartmakers to Seville, and ensuring a steady supply of charts.

The System of Nautical Outfitters

Sea charts were just one of many tools that a pilot needed, and the same shops tended to sell them all. A cosmographer would handle not only sea charts, but also astrolabes, cross staffs, compasses, quadrants, regiments, and even sandglasses. This does not mean that any one person made all of these objects, for the licensed cosmographers frequently subcontracted some or all of the work and may sometimes have simply approved the objects for sale. A thriving midcentury workshop, that of Diego Gutiérrez, employed two of his three sons (the third was licensed separately) and several anonymous workmen—so many helpers that one enemy claimed that he did none of his own work. Pedro de Medina, who had recently opened an unsuccessful shop, argued mockingly that even if "a silversmith . . . sold him the astrolabes, and a carpenter the cross-staffs, and a book-writer the regiments," Gutiérrez still ought to know enough to make sure they were well made.[195] Though Gutiérrez denied that the instruments were faulty, he made no secret of subcontracting the work.

The practice of subcontracting continued through at least the end of the century.[196] Though most discussions of subcontracting and assistants involved astrolabes and regiments, sea charts were probably also subject to such practices. When Rodrigo Zamorano was accused of having brought home a supply of blank sheets of paper, each

194. Dated 16 June 1603 and printed in García de Céspedes, *Regimiento de navegacion.*

195. AGI, Justicia, 1146, N. 3, R. 2, block 3, images 97–104, 3 September 1544 statement of Pedro de Medina, and block 2, images 33–36, 28 August 1544 statement of Gutiérrez defending the practices.

196. See, for example, AGI, Justicia, 931, N. 6, proceedings begun August 1576 against Manuel Pérez for making astrolabes without a license, and Contratación, 734, no. 1, fol. 6v, 27 October 1593 petition from Pedro Grateo; see also Pulido Rubio, *Piloto mayor,* 690–92.

FIG. 40.23. SEVENTEENTH-CENTURY VIEW OF SEVILLE, AS SEEN FROM TRIANA. Most of the sailors (and so the pilots) lived in Triana, on the opposite side of the river from Seville, next to the pontoon bridge visible at the far left. The Casa de la Contratación was adjacent to the royal palace (Alcázar), next to the cathedral. The sandy area in the foreground outside the wall (the Arenal) was the port. From Triana to the cathedral is now about a fifteen-minute walk, following routes possible in the sixteenth century.
Size of the original: ca. 50 × 230 cm. Photograph courtesy of the BL (Maps K.Top.72.16).

already marked with the seal of approval, part of the accusation was that the charts would actually be made by an assistant. This assistant, at least according to the accusation, had been trained by Zamorano's rival Domenico Vigliarolo, perhaps as part of an informal apprenticeship (for there was no formal apprenticeship system for chartmakers). Vigliarolo complained that not only had Zamorano seduced the assistant into his own service, but he had done so before his training was complete, so the charts made on the preapproved paper were flawed.[197] Thus, it seems clear that people other than the licensed cosmographers made sea charts.

As was common in the period, a cosmographer could either work out of his home (as did the Gutiérrez family) or set up a separate shop (as did Pedro de Medina and later Sancho Gutiérrez). The trade as a whole was centered in the area between the port (just outside the city wall) and the Casa de la Contratación, not far from where most of the sailors lived and in the commercial center of the city (fig. 40.23). Though most official activities (such as inspections of charts and instruments) were supposed to take place within the Casa de la Contratación, the building was too small and had a leaky roof, and despite a few complaints from pilots, it became a sign of status to be able to work from home. The pattern chart itself was kept in a locked box at the Casa, but because any competent cosmographer could make a copy, this would not prevent them from working at home.

It is not clear what percentage of a cosmographers' business was from chart sales, as opposed to the sales of other nautical instruments, but the income to be earned in this way was considerable. Each pilot was required to own a complete set of tools at the time of the licensing exam, and some twenty pilots were licensed each year. Because the pilots' tools were subject to inspection before each voyage, a large percentage of the pilots probably bought new charts from time to time, despite the expense. Most of the pilots questioned in 1545 had bought a chart in the previous year or two, though one insisted that he had not bought a chart in the last twenty years.

For cosmographers such as Gutiérrez, the sale of charts represented a major fraction of their income. Gutiérrez had an annual salary from the Casa de la Contratación of only 16 *ducados,* but earned enough from other sources to set up his son Sancho as a shipowner and provide him with a substantial marriage settlement, including a lodestone later said to provide an annual income of 300 *ducados.*[198] Though Diego Gutiérrez earned some money as a merchant, his main source of income seems to have been payments from pilots for charts and instruments and for tutoring them for the licensing exam, and he could not have prospered without their support. Later in the century, Rodrigo Zamorano (with a considerably larger salary than Gutiérrez's) still testified that the bulk of his income was from the sale of charts and instruments.[199]

197. AGI, Contratación, 5554, 5 September 1592 petition of Domenico Vigliarolo. On the servant, see AGI, Patronato, 251, R. 77, block 2, images 52–55, 26 October 1590 complaint by Domenico Vigliarolo against Rodrigo Zamorano. On the extensive battles between Zamorano and Vigliarolo, see Pulido Rubio, *Piloto mayor,* 665–86.

198. On Diego's salary see AGI, Contratación, 5784, L. 1, fol. 58v. On the 1541 marriage settlement, see AGI, Justicia, 792, N. 4, fols. 42r–45r, 31 August 1563 agreement between Sancho and Luis Gutiérrez. The income the lodestone provided was from fees for using it to retouch compasses. For Sancho Gutiérrez's activities as a shipowner even before his father's death (when the marriage settlement was payable), see AGI, Justicia, 765, N. 1.

199. AGI, Patronato, 251, R. 77, block 2, images 61–62, 15 October 1590 petition presented to the council.

Table 40.1 Prices of Charts and Other Instruments for Various Years, 1519–1592

	1519	1547	1548	1549	1551	Year unspecified	1592
Chart	1023–2250 mrs	3 ds (1125 mrs)	3 ds (1125 mrs)	3½ ds (1312 mrs)	4 ds (1500 mrs)	5–6 ds (1875–2250 mrs)	8 ds–100rs (3000–3400 mrs)
Astrolabe	750 mrs	3 ds (1125 mrs)	24–25 rs (816850 mrs	2½ ds (937 mrs)		2½ ds (937 mrs)	50 rs (1700 mrs)
Cross staff				4 rs (136 mrs)	½ d (187 mrs)		
Regiment				1 d (375 mrs)	15 rs (510 mrs)		
Compass	272–375 mrs	8 rs (272 mrs)			1 d (375 mrs)	14–15 rs (476–500 mrs)	2 ds (750 mrs)

Note: 1 *ducado* (d) equaled 11 *reales* (rs) equaled 375 *maravedís* (mrs), and prices were usually specified in whatever currency was most convenient; the prices in the table are given first in the currency in which they were quoted, then converted to *maravedís* for ease of comparison.

Sources: Prices for 1519 are from Martín Fernández de Navarrete, *Colección de los viages y descubrimientos que hicieron por mar los españoles desde fines del siglo XV,* 5 vols. (Buenos Aires: Editorial Guaranía, 1945–46), 4:165, from the financial accounts of Magellan's voyage. All other prices are from testimony in legal cases: 1547 prices, AGI, Justicia, 945, fol. 125v, 27 July 1549 testimony of Pedro Gonzales, master and pilot; 1548 and 1549 prices, Justicia, 945, fol. 127v, 29 July 1549 testimony of Diego Gutiérrez; 1551 prices, Justicia, 836, N. 6, 1 December 1551 testimony of Diego Muñoz; and unspecified and 1592 prices, Patronato, 261, R. 8, fols. 15r–17r, 8 October 1592 testimony of Juan Gayon, who compared 1592 prices with prices as they used to be. Where accounts list varying prices for the same item, I have given the range.

The charts were also a major expense for the pilots who bought them. At the middle of the sixteenth century (the earliest numbers available), a complete set of tools would have cost at least 8 *ducados* (the chart alone 3), at a time when the salary a pilot could earn on a round-trip voyage was capped at 130 *ducados,* near the bottom of the range of what an artisan in Seville could expect to earn in a year.[200] Because pilots usually started as sailors, who had even lower salaries, the instruments represented a considerable start-up cost, even with the discount Gutiérrez claimed to offer new pilots.[201] Prices continued to rise, and at the end of the century the guild representing the pilots complained that charts were scarce and expensive, causing a considerable hardship to their members. For a summary of the prices of charts and other instruments at various points in the century, see table 40.1. Most of the information comes from the testimony of individual pilots about prices they had paid or paid routinely; these prices seem to have been different from the prices paid to outfit official expeditions.

Shops selling charts and other instruments also served as centers for pilots and sailors to gather and gossip, and probably simply as general meeting places. Much of the pilot testimony about bribery and other corrupt practices involved incidents they had observed while buying instruments or attending cosmography lessons. Toward the end of the century, the pilot major, Rodrigo Zamorano, used the public nature of such shops as an argument against allowing a Frenchman to make astrolabes. Though Zamorano admitted that there was nothing secret about an astrolabe, he argued that because pilots would speak freely in front of the people who made their instruments, such people needed to be worthy of trust and so should never be foreigners.[202] Though this argument almost certainly concealed Zamorano's efforts to extort money from the man in question, it indicates the complicated web of issues surrounding the workshops.

Because the trade was so potentially lucrative, several chartmakers tried to gain a monopoly, using legal or quasi-legal measures to discourage others from entering the market. These attempts caused dilemmas for policy

200. For the cost of instruments, see AGI, Justicia, 945, fol. 125v, 27 July 1549 testimony of Pedro Gonzales on 1547 prices; fol. 127v, 29 July 1549 testimony of Diego Gutiérrez on what he charged for instruments; and fol. 148v, 16 August 1549 testimony of Lazaro Morel on what he paid for his tools. For pilots' and sailors' salaries and their buying power, see Pablo Emilio Pérez-Mallaína Bueno, *Spain's Men of the Sea: Daily Life on the Indies Fleets in the Sixteenth Century,* trans. Carla Rahn Phillips (Baltimore: Johns Hopkins University Press, 1998), 114–24.

201. AGI, Justicia, 945, fol. 641v, questionnaire submitted by Diego Gutiérrez. He defended himself against the accusation of charging too much for charts and instruments by saying that his prices were reasonable recompense for the work involved in making them and that he offered discounts for people just taking the licensing exams who needed the instruments for their job. The prices quoted earlier were paid by newly licensed pilots, and so should reflect this discount.

202. AGI, Contratación, 734, no. 1, 1592–94 dispute between Pedro Grateo and Rodrigo Zamorano about the right to make astrolabes.

makers, who wanted simultaneously to encourage local makers (which meant making sure there was not so much competition that they could not make a living), maintain an adequate supply of charts at low prices (which meant avoiding monopolies), and make sure that charts remained somewhat secret (which meant forbidding foreigners to make charts). These aims were frequently at odds, for chart producers complained that they could not live without a monopoly while pilots complained of expense and scarcity. The chart trade in Seville falls into three main periods; I discuss them in turn.

FAMILIES, WORKSHOPS, AND MONOPOLIES

The Early Period: 1508–1533

In the early years of the century, the chart trade was not closely regulated, and little is known besides the bare facts of who was licensed when. In 1512, Andrés de San Martín and Giovanni Vespucci were given an exclusive license to sell copies of the pattern chart, but they were certainly not the only people making charts in Seville: Andrés de Morales made a chart that was used to revise the pattern chart in 1515, and Nuño García Toreno helped make the first pattern chart and later made many of the charts for Magellan's voyage. Probably as a reward for his work with Magellan, in 1519 Toreno became the first person to be given an official position as chartmaker, but Giovanni Vespucci continued to be active until he was suspended in 1525, perhaps for sending information to the Medici.[203] Thus, in the first quarter of the century, a number of people were making charts, but it is not clear who was selling them to the pilots.

The other important chartmaker of the period was Diogo Ribeiro, one of the Portuguese cosmographers who had gone to Spain to help prepare for Magellan's voyage and who in 1523 became the first person appointed cosmographer at the Casa. He spent the rest of his life working for Spain: the first few years planning expeditions to the Spice Islands from the short-lived Casa de la Especiería in La Coruña, and from 1528 to his death in 1533 at the Casa de la Contratación in Seville.[204] In 1544, a group of pilots was questioned about people who had made charts in Seville in the previous twenty-five years; aside from the Gutiérrez family (who were named in the questioning), Ribeiro was the person most often mentioned.[205] Ribeiro was certainly an active chartmaker during his time in Spain, for several of his world maps are still extant (see figs. 30.25 and 30.28–30.30 and the details in figs. 40.3, 40.6, and 40.12). The convoy intended to install García Jofre de Loaysa as governor of the Spice Islands in 1525 carried charts by both Ribeiro and Toreno; in fact, the charts seem to have been carried aboard the same ship, for one of the pilots noted discrepancies of four leagues between them.[206] It seems likely that Ribeiro also sold charts to individual pilots, but none have survived.

The Gutiérrez Family: 1534–1581

Much more is known about the chart trade in the middle decades of the century, primarily due to documentation collected for lawsuits between cosmographers. In the middle of the sixteenth century, the Gutiérrez family maintained a de facto monopoly on the chart trade. Diego Gutiérrez was licensed as a cosmographer in 1534, though he had been active for several years before that. He owed the position to his friend and ally Sebastian Cabot (the pilot major) and to the support of many pilots.[207] He followed the tradition of the craftsman; with no university education or knowledge of Latin he was one of the least educated of the cosmographers. He trained his three sons—Luis, Sancho, and Diego—from childhood to make charts and instruments, and Sancho in turn trained one of his children, also named Sancho, though the younger Sancho did not continue in the field.[208] Together the family dominated the field from the time the older Diego was licensed to the death of Sancho in 1581.

In the 1530s and 1540s, this monopoly was obtained with the collusion of Sebastian Cabot. As pilot major, Cabot was forbidden to sell charts to the pilots himself, but as chief inspector he could control which charts passed inspection. When Pedro de Medina went to Seville in 1538, he tried unsuccessfully to break into this monopoly. Even after an official ruling in 1540 that there should be no monopoly in the chart trade, Medina's shop

203. Rolando A. Laguarda Trías, *El cosmógrafo sevillano Andrés de San Martín, inventor de las cartas esféricas* (Montevideo, 1991), 22–24, and Varela, *Colón y los Florentinos,* 78–81.

204. On Ribeiro's life and career, see Vigneras, "Cartographer Diogo Ribeiro."

205. AGI, Justicia, 1146, N. 3, R. 2, block 3, fol. 46v, 22 October 1544, question 14 of questionnaire provided by Diego Gutiérrez, followed by testimony on that question from various pilots. Eight of the eighteen pilots mentioned Ribeiro, while one pilot (Cristobal Cerezo de Padilla) mentioned Toreno. When asked specifically in question 19 about the charts the two men used to make, most could answer.

206. Cerezo Martínez, *Cartografía náutica,* 185. The pilot was Martín de Uriarte.

207. AGI, Indiferente, 1204, no. 21, undated 1533 petition from Diego Gutiérrez to be appointed cosmographer, supported by a petition signed by Cabot, eleven pilots, and eighteen shipmasters; Indiferente, 1961, L. 3, fol. 82rv, 7 November 1533 request for information on Gutiérrez; and Contratación, 5784, L. 1, fol. 58v, 21 May 1534 appointment of Gutiérrez as cosmographer with an annual salary of 6000 *maravedís* (mrs), or 16 *ducados* (ds).

208. On 15 February 1566, Sancho gave this son the power to act in his place while he went to court; see AGI, Justicia, 792, N. 4, fol. 57r. The younger Sancho probably filled in as cosmographer, and not just in legal matters, for in July the council ordered that the elder Sancho be paid his full salary despite the absence; see AGI, Indiferente, 1967, L. 16, fol. 32rv, 4 July 1566. I know of no later references to the younger Sancho.

was not successful, though his complaints did lead to the inclusion of cosmographers on the inspection committee.[209] When Gutiérrez solicited testimony from eighteen pilots, asking if it was true that for the last twenty years he and his sons had made all of the charts and instruments sold in Seville, most of the pilots agreed without reservation.[210] While this testimony surely suffers from a selection bias, Medina himself testified that the pilots had no choice but to buy Gutiérrez's charts.[211]

At that time, at least three members of the Gutiérrez family were making charts. Luis, the eldest son, was married, with his own household and a store from which he sold charts and instruments, though he had no official license to do so.[212] The second son, Sancho, was separately licensed to make charts, probably as a consolation prize for the failure of his petition to be appointed cosmographer.[213] The younger Diego does not seem to have been active yet, though he was probably working as his father's assistant; he was licensed in his own right in 1554, in essence inheriting his father's position after his death.[214]

Though Cabot left Spain in 1548, and Diego Gutiérrez was suspended from office in late 1552, the Gutiérrez sons continued to dominate the trade, not only making new charts and nautical instruments, but also repairing older ones.[215] Though Medina abandoned the attempt to sell charts in Seville, a new threat to the Gutiérrez monopoly arose from Jerónimo de Chaves. Jerónimo was the son of Alonso de Chaves (pilot major since 1552), and in his own right a cosmographer and professor of cosmography at the Casa.[216] He apparently started to make and sell charts and instruments, for in 1556 Sancho Gutiérrez challenged his right to do so, arguing that the prohibition on the selling of instruments by the pilot major extended to his entire family.[217] There is no evidence that the younger Chaves was ever successful in selling charts to the pilots, though some of his work survives, included by Ortelius in his atlas and appearing in diagrams in Chaves's own books.[218]

The Gutiérrez brothers continued to dominate the scene through the 1570s, outlasting all rivals, though leaving only sporadic records.[219] In 1569, Diego unsuccessfully petitioned to be named cosmographer, arguing that the two cosmographers remaining were insufficient.[220] Diego was probably dead by 1574, when Sancho claimed to be the only one in Seville making charts.[221] By the time of his death in 1581, Sancho had been the only cosmographer for long enough that the post was described as traditionally monopolistic.[222] When the Gutiérrez family monopoly began, they were the least educated and worst-connected among a large number of cosmographers in Seville. By the time of Sancho's death, a monopoly on chart sales was seen as an important perquisite of the position.

Zamorano and Vigliarolo: 1581–1596

The 1580s and 1590s were characterized by battles between two new cosmographers, Rodrigo Zamorano and

209. AGI, Indiferente, 1963, L. 7, fol. 84v, 17 February 1540 *cedula* saying that Cabot and Gutiérrez should not have a monopoly on charts or instruments and that anyone with a license could sell them; see also Indiferente, 1207, no. 61, stating that the inspection system was changed on 9 March 1545.

210. AGI, Justicia, 1146, N. 3, R. 2, block 3, fol. 46v, 22 October 1544, question 14 of questionnaire provided by Diego Gutiérrez, followed by testimony on that question from various pilots.

211. AGI, Justicia, 1146, N. 3, R. 2, block 3, fol. 19v, 3 September 1544 statement of Pedro de Medina.

212. AGI, Justicia, 1146, N. 3, R. 2, block 2, fol. 3v, 19 August 1544 statement of Alonso de Chaves complaining about the Gutiérrez family; block 3, fol. 10r, 9 September 1544 statement of Alonso de Chaves reiterating his complaint; and block 3, fol. 8rv, 28 August 1544 response from Diego Gutiérrez.

213. AGI, Indiferente, 1206, no. 24, 27 October 1539 depositions of witnesses presented by Sancho Gutiérrez to support his petition to be appointed cosmographer, and Indiferente, 1963, L. 7, fol. 45rv, 12 December 1539 *cedula* ordering Sebastian Cabot and the cosmographers to see if Sancho Gutiérrez was fit to make charts and instruments. The inspection seems to have gone smoothly, for thereafter he was referred to as licensed.

214. AGI, Contratación, 5784, L. 1, fol. 99v, 22 October 1554.

215. One notable case involved a lodestone used to retouch compasses; see note 219.

216. AGI, Indiferente, 1963, L. 8, fols. 94r–95r, 29 November 1541 appointment of Jerónimo de Chaves as cosmographer, and Contratación, 5784, L. 1, fol. 95rv, 4 December 1552 appointment of Chaves as the first professor of cosmography.

217. AGI, Justicia, 792, N. 4, fols. 49v–52r, transcript of 1556 suit, introduced by Sancho Gutiérrez as a reason to recuse Alonso de Chaves from judging his instruments. The issue was never resolved.

218. The maps in his books are small diagrams illustrating such topics as the winds and the shape and position of the earth. On his known works, see Karrow, *Mapmakers of the Sixteenth Century,* 116–18, and Martín-Merás, *Cartografía marítima hispana,* 126, 129–30 (color reproductions), and 132.

219. One of the most prominent was a family fight for control of a lodestone used to remagnetize pilots' compasses; see AGI, Justicia, 792, N. 4, and Ursula Lamb, "The Sevillian Lodestone: Science and Circumstance," *Terrae Incognitae* 19 (1987): 29–39, reprinted in *Cosmographers and Pilots,* item VII.

220. AGI, Indiferente, 2005, petition from Diego Gutiérrez, received 30 March 1569, and Indiferente, 1967, L. 17, fols. 139v–40r, 7 April 1569 request for more information from the Casa officials.

221. AGI, Patronato, 262, R. 9, fol. 10r, 10 March 1574, question 3 of questionnaire presented by Sancho Gutiérrez and testimony on that question by various pilots, and Justicia, 931, N. 6, 22 February 1577 testimony by Cristobal Garcia de la Vega describing Diego as dead.

222. Though Pulido Rubio listed the date of his death as 13 August 1580 (*Piloto mayor,* 981), he was active at the beginning of 1581; he may instead have died 13 August 1581. Sancho was present at the 30 April 1581 exam of Gonzalo Baez Bello, but was not mentioned in Juan Camacho's December 1581 exam or any thereafter (AGI, Contratación, 52A, nos. 7 and 8). On the post of cosmographer as a monopoly, see AGI, Patronato, 252, R. 77, block 2, image 25, 5 May 1584 report from the Casa officials to the Council of the Indies.

Domenico Vigliarolo. The two competed not only for the trade in charts and instruments, but also for the more prestigious position of pilot major and for the status of preeminent cosmographer in Seville. They were the first of the more educated cosmographers to also succeed in selling charts to the pilots, and under their tenures the sale of charts and instruments to the pilots became much more closely linked to other cosmographical activities in Seville. Because of the personalities of the people involved and their tendency to refer every controversy directly to the Council of the Indies, their debates provide invaluable evidence about the sale of charts in Seville at the end of the century and the ever-changing balance between restricting trade and ensuring availability.

Rodrigo Zamorano was not interested primarily in selling charts to the pilots. He had been appointed cosmography professor after some years of experience teaching at the university level and was only later given an honorary post as cosmographer, and thus permission to sell charts. His own account indicates that he was drawn into the chart trade through his work teaching pilots and providing charts for specialized expeditions.[223] By 1584, however, Zamorano was sufficiently involved in selling charts to think his monopoly worth defending against the encroachments of a new cosmographer, Domenico Vigliarolo.

Vigliarolo was born in the town of Stilo in the kingdom of Naples, which was ruled by Philip II of Spain.[224] Little is known about Vigliarolo's early life, but at some point he entered the church, studied cosmography, and began making charts. In the early 1580s, a proposal for finding longitude at sea brought him to the attention of the Spanish Council of the Indies. While in Madrid awaiting preferment, Vigliarolo asked for permission to go to Seville, saying that he had heard that they needed people to make nautical instruments and charts. This set the stage for a decade of competition and acrimonious debate between him and Zamorano. While much of the debate was purely about status and economic advantage, punctuated by recurring complaints of destitution, it also raised broader issues about the difficulties of regulating the chart trade.

Vigliarolo encountered determined opposition in Seville. His stated intent of entering the chart trade threatened local interests, and the inspection committee refused to approve his charts for sale.[225] When questioned, the pilot major, Alonso de Chaves, based his case on Vigliarolo's foreign status (as a subject of the kingdom of Aragon rather than of Castile) and the manifest disadvantages of giving the secrets of the Indies to outsiders; he even suggested that the officials should confiscate all the charts in Vigliarolo's possession. Chaves argued that keeping foreigners out of the chart trade was a matter "of much importance for the security, pacification, and calm of the said navigation to the Indies."[226] Because for reasons of state foreigners were forbidden to own charts, they certainly should not be in charge of their production.

Vigliarolo, naturally, saw the issue differently, presenting himself as simply filling the demand for charts, which would otherwise cause pilots to buy uncertain and unregulated charts in Portugal.[227] Since that possibility was usually mentioned only to illustrate the lack of locally made charts, it is not clear how common it was in fact for Spanish pilots to use Portuguese charts, but some scattered mentions survive in the legal records.[228] In any case, the Council of the Indies continued to assert the need for local manufacture of charts, both for the income and for the chance to control the product. Hoping to tap into this sentiment, Vigliarolo gathered up petitions and testimony to take with him to Madrid, where his maneuvers were largely (if belatedly) successful.[229]

The Council of the Indies tried to find a compromise. They were sympathetic to Vigliarolo's complaint that he could not make enough money selling charts, and were reluctant to let him leave Spanish service altogether, but rejected the idea of letting him make additional money by selling charts to foreigners. Instead the council suggested that Vigliarolo be given a salary equal to that of the cosmography professor (Zamorano), for the two jobs were equally necessary to the proper regulation of navigation.

223. AGI, Patronato, 262, R. 11, blocks 1 and 2; Indiferente, 740, no. 165, 20 August 1583 *consulta* on raising his salary; and Contratación, 5784, L. 3, fol. 27rv, 5 September 1583 *cedula* raising his salary from 60,000 to 80,000 mrs.

224. For a brief biography of Vigliarolo, see Agustín Hernando Rica, "Los cosmógrafos de la Casa de Contratación y la cartografía de Andalucía," in *Miscelanea geografica en homenaje al profesor Luis Gil Varon* (Córdoba: Servicio de Publicaciones de la Universidad de Córdoba, 1994), 125–43, esp. 134–36. For more on Vigliarolo's work in Naples, see pp. 222–24 in this volume. And, for an account of the competition between Vigliarolo and Zamorano, quoting many of the relevant documents, see Pulido Rubio, *Piloto mayor,* 647–95.

225. AGI, Patronato, 252, R. 77, block 2, images 28–29, 20 April 1584 sworn statement of Alonso de Chaves and Rodrigo Zamorano.

226. AGI, Patronato, 252, R. 77, block 2, image 31, 4 August 1584 statement of Alonso de Chaves.

227. AGI, Patronato, 252, R. 77, block 2, images 32–33, undated 1584 petition from Domenico Vigliarolo.

228. See, for example, AGI, Contratación, 642, N. 2, R. 1, 1568 proceedings following a request from Alonso Diaz for the return of a confiscated chart, and Indiferente, 1088, L. 13, fol. 10r, 20 February 1585 petition from the Universidad de Mareantes.

229. AGI, Patronato, 262, R. 1, block 2, undated petition from Domenico Vigliarolo; Indiferente, 1952, L. 3, fols. 147r–48r, 7 October 1586, appointment; Indiferente, 741, N. 128, 30 October 1586 *consulta* on raising Vigliarolo's salary; and Contratación, 5784, L. 3, fols. 45v–46r, 23 November 1586 *cedula* raising his salary to 80,000 mrs. He also was given a one-time payment of 300 *reales,* or about 10,000 mrs; see Indiferente, 426, L. 27, fols.143v–44r.

The king approved this proposal, with the additional condition that Vigliarolo teach others to make charts, presumably to avoid future problems with scarcity.[230]

The position in Seville, however, was not all that Vigliarolo had hoped for, either financially or in terms of prestige, and left him little time for his own cosmographical projects.[231] Vigliarolo was also not very successful at selling charts or instruments, though he blamed his failure on Zamorano's continuing obstruction.[232] Nor were Zamorano and Vigliarolo alone in their attempts to profit from the chart trade, for in 1592 a new chartmaker applied for a license, claiming that Vigliarolo's charts were insufficient and echoing many of his earlier complaints. This new threat was Jerónimo Martín, a pilot from Ayamonte who claimed to have been making charts and other instruments in Seville for the past eight years, aided by his cosmographical studies and his long experience of the places in question.[233] Ever cautious, the Council of the Indies requested information from local experts, who were first to watch him make a chart. According to one testimonial, not only were Martín's charts well drawn and his writing clear and legible, but he also had the rare skill of making new charts from reports.[234] Despite testimony from experts, a report from the Casa officials on the need for another cosmographer, and another petition from Martín claiming that the shortage was so great that people were again reduced to buying charts in Lisbon, Martín was not appointed.[235] Nonetheless, he probably continued to sell charts.

By 1594, competition was sufficient that Vigliarolo complained of abject poverty and threatened to return to Naples.[236] The following year, he gathered up all of his papers and set off on foot to Madrid to beg for favor. The Council of the Indies suggested giving him 500 *ducados* (more than double his annual salary) to convince him to stay, but such solicitude was too late, and Vigliarolo left for France.[237] Writing to friends in Spain, Vigliarolo described dinner engagements with the best people in town, generous loans, and offers of salaries to persuade him to stay, all in marked contrast to his treatment in Seville.[238] No more is known about his career.

It is not clear precisely who sold charts to the pilots during these fifteen years. Vigliarolo testified that he tried, but judging from his complaints he was rarely successful, and he was frequently absent. Though several charts of his survive, none was precisely suitable for sale to pilots in Seville. A Mediterranean chart dated 1589 presumably dates from the period he spent in Naples for his health.[239] An ornate manuscript atlas may date from about the same period, though the examples given for using the volvelles at the back are for the last years of the century.[240] Whatever the date, the atlas clearly focuses on Europe and the Mediterranean; it includes large charts of the Aegean and Adriatic Seas, while ignoring the Spanish possessions in both the New World and the East Indies. The only chart to show the New World at all (no. 5) shows the North Atlantic (plate 40). While this atlas clearly demonstrates Vigliarolo's skill, it says nothing of the sort of geographical details he would have made available to the pilots.

Zamorano also testified to making charts for sale to the pilots, but never mentioned if he succeeded in getting them approved, or if indeed he sold any, and none of his charts survive. Vigliarolo complained in 1589 that certain unnamed people were not only making charts without a license, but also selling them to foreigners, but it is not clear to whom he referred.[241] Jerónimo Martín did testify to selling charts, but he was unlicensed at the time, so it seems unlikely that Martín produced the bulk of the charts sold. Though the periodic complaints from the Universidad about scarcity were not disinterested, they probably did reflect an unsettled period in the market. Given the complaints about scarcity and high prices, it may be that

230. AGI, Indiferente, 741, N. 128, 30 October 1586 *consulta;* see also the earlier *consulta* in N. 96, 20 August 1586.

231. This was exacerbated by Vigliarolo's frequent illnesses, absences, and problems being paid; see AGI, Patronato, 251, R. 77, block 1. For his attempts to better his position, see Patronato, 251, R. 77, block 2, images 56–58, November 1590 petition for position at court as cosmographer or to be named pilot major in place of Zamorano, and Indiferente, 741, N. 96, 6 June [1591] petition for a chaplaincy.

232. AGI, Indiferente, 1090, L. 17, fols. 18v–19r, 11 January 1588 summary of petition from Domenico Vigliarolo.

233. AGI, Patronato, 261, R. 8. This is probably the same Jerónimo Martín from Ayamonte who was examined for a license as a pilot to Tierra Firme on 9 February 1590.

234. This testimonial was from the astronomer and medical doctor Simón de Tovar, who was also a family friend; see Vicente Maroto and Esteban Piñeiro, *Ciencia aplicada,* 380–81 and 423. It is much more detailed than the testimony provided by the experts as requested by the council.

235. AGI, Patronato, 261, R. 8, image 25, petition from Martín; images 27–28, 10 February 1593 report from Casa officials; and images 31–36, February 1593 testimony of Rodrigo Zamorano, Alonso de Chaves Galindo, and Diego de Albendín.

236. AGI, Indiferente, 2007, 2 November 1594 petition from Vigliarolo.

237. AGI, Indiferente, 868, 17 August 1595 *consulta* of the Council of the Indies. The eventual order was for 300 *ducados*.

238. AGI, Patronato, 262, R. 11, images 41–42, 6 August 1596 letter sent by Vigliarolo from Bordeaux to clockmaker Maestro Pedro (may be Pedro Grateo), and image 44, undated letter sent from Vigliarolo to surgeon Romulo Folla.

239. The chart is now in Madrid, Servicio Geográfico del Ejército; see Martín-Merás, *Cartografía marítima hispana,* 120–21.

240. This atlas is now in the collections of the Hispanic Society of America; see Sider, *Maps, Charts, Globes,* 35–36. This seems to be the same atlas described in Cesáreo Fernández Duro, *Disquisiciones náuticas,* 6 vols. (1876–81; reprinted Madrid: Ministerio de Defensa, Instituto de Historia y Cultura Naval, 1996), 6:566–67, though the 1598 date he referred to on the title page has since been erased.

241. AGI, Patronato, 251, R. 77, block 2, images 33–34, 27 November 1589.

there was a genuine lack of charts, at least at times. The prices quoted for charts, however, indicate that they approximately doubled over the course of the second half of the sixteenth century, while pilots' salaries (also higher due to scarcity) approximately tripled (see table 40.1).

Secrecy, Protectionism, and the Rights of Foreigners

The career of Vigliarolo indicates the complexity surrounding the laws about secrecy and nationality.[242] The concerns about secrecy raised by Chaves and Zamorano were clearly self-interested, but they reflected a long-standing trend in Spanish practice. It is well known, from laws dating from at least the beginning of the sixteenth century and reaffirmed by the licensing oaths of all pilots and cosmographers, that all details of navigation, including charts, were supposed to be kept secret. Charts provided information helpful to anyone hoping to sail to the new territories—their latitudes, compass bearings from known points, and dangers to be avoided. Because the Spanish government wished to keep other countries from trading with, settling in, or attacking the Spanish territories, the charts, and accompanying descriptive information in any form, were considered state secrets to be centrally controlled and not divulged without prior permission. All pilots had to swear not to allow their charts to come into the possession of foreigners and had to turn in outdated charts to be destroyed. Furthermore, they could not be licensed, or even admitted to the required lectures on cosmography, without first proving that they were citizens of Castile. Chartmakers, too, had to swear not to sell the charts they made to foreigners, and the Council of the Indies explicitly denied Vigliarolo's 1586 petition to set aside the limitation. Books on navigation could not be printed without permission, and were routinely refused that permission if they went into too much detail about the routes to the Indies.[243]

This sort of geographic information, in turn, was genuinely being sought by foreigners (as well as by Spaniards in foreign countries). In the sixteenth century, ships and settlements in the New World were subject to frequent attack from corsairs (as the Spanish called those sailing all types of enemy ships), who stole charts when they could. Sir Francis Drake, for example, was reportedly jubilant about capturing charts for the Pacific. Drake (and others) also frequently kept the pilots from the ships they captured rather than freeing them with the rest of the crew.[244] Thus, the objections to allowing foreigners to have access to charts were in line with a long-standing policy, which in turn was based on a vision of the utility of charts held by the Spanish and their enemies alike.

These laws, however, were never intended to be absolute, or to keep secret all information about navigation—for this was readily acknowledged as a lost cause. There was no sure way to prevent pirates from obtaining charts from captured ships, and no one was willing to suggest that pilots should not let themselves be captured. Even the arguments about which charts should be used assumed that the charts would reach the hands of outsiders; otherwise, the depiction of the Line of Demarcation would not have been such an important issue.

Vigliarolo was not the only foreign chartmaker to set up shop in Seville, though he was the first since Cabot to defect so publicly. Twenty years earlier, Sancho Gutiérrez had successfully argued that a certain Andrés Freile should be forbidden to make charts because he was Portuguese himself and the son of a Portuguese cosmographer.[245] By the time Vigliarolo was trying to sell charts, the arguments about the necessity of secrecy were supplemented by arguments about the need to protect native chartmakers and not allow foreigners to steal their business. The importance of these latter arguments is clear from the lack of reaction to Vigliarolo's flight to France. Just before he left, the Council of the Indies had suggested that he knew too many secrets and should be persuaded to stay. Nonetheless, once he did leave, no one seemed to care. There is no record that his absence was discussed by the Council of the Indies or that they were concerned about the missing charts. The only Spanish records known to even mention Vigliarolo's presence in France were those presented by Rodrigo Zamorano in his attempt to prove that Vigliarolo had abandoned his post.

So what does this say about attempts to control information about navigation? First of all, it seems clear that the rules about secrecy were invoked to inhibit competi-

242. This issue has scarcely been ignored. On secrecy in general, see J. B. Harley, "Silences and Secrecy: The Hidden Agenda of Cartography in Early Modern Europe," *Imago Mundi* 40 (1988): 57–76, esp. 60–65. On Spanish secrecy in particular, see Martín-Merás, *Cartografía marítima hispana,* 153–54; idem, "Cartografía de los descubrimientos," 90–93; and Geoffrey Parker, "Maps and Ministers: The Spanish Habsburgs," in *Monarchs, Ministers, and Maps: The Emergence of Cartography as a Tool of Government in Early Modern Europe,* ed. David Buisseret (Chicago: University of Chicago Press, 1992), 124–52, esp. 125. For a comparison with Holland, see K. Zandvliet, *Mapping for Money: Maps, Plans and Topographic Paintings and Their Role in Dutch Overseas Expansion during the 16th and 17th Centuries* (Amsterdam: Batavian Lion International, 1998), 94–98. See also Richard L. Kagan, "Arcana Imperii: Mapas, ciencia y poder en la corte de Felipe IV," in *El atlas del rey planeta: La "Descripción de España y de las costas y puertos de sus reinos" de Pedro Texeira (1634),* ed. Felipe Pereda and Fernando Marías (Madrid: Editorial Nerea, 2002), 49–70.

243. See, for example, Chaves, *Espejo de navegantes,* and Escalante de Mendoza, *Itinerario de navegación.*

244. Harry Kelsey, *Sir Francis Drake: The Queen's Pirate* (New Haven: Yale University Press, 1998), esp. 97 and 169.

245. AGI, Indiferente, 1966, L. 15, fols. 17v–18r, 16 December 1563 order from the council to the Casa not to allow Freile to make maps if he was Portuguese, and fols. 30r–31r, 10 January 1564 chapter in a letter to Casa officials saying that they should obey the order.

tion as much as to control information. Zamorano (like Gutiérrez before him) attacked everyone in Seville who tried to compete with him; foreigners like Vigliarolo merely provided him with additional ammunition to use against them. The fact that the Council of the Indies chose to overlook considerations of secrecy to ensure a plentiful supply of charts indicates the importance of this latter type of consideration.

But the lack of concern is also evidence of a subtle shift in the attitudes toward geographic information, from an emphasis on state secrecy to an emphasis on propaganda. As the author of one book argued in 1582 in an unsuccessful attempt to get permission to publish it, enemies and pirates *already* knew all they needed to.[246] When another cosmographer argued that the authorities would be greatly remiss not to carefully go over all geographic information before allowing it to be published, his fear was not of revealing secrets, but of publishing assertions or data that could later be used against the Spanish in territorial disputes.[247] The charts Vigliarolo took with him would not have been useful for this sort of purpose, and that may have been one of the reasons why his departure aroused so little concern.

Conclusions

While the charts sold to the pilots have not survived, the records of the Casa de la Contratación, especially the lawsuits among the chartmakers themselves, provide us with enough information about who made and sold charts to draw a few general conclusions. Throughout the century, the pilots themselves, despite their lack of institutional power, were very active in determining both who was licensed to sell charts and who was successful in selling them. In addition, they were not shy about commissioning special-purpose charts or buying them from Portugal when the ones available in Seville did not meet with their approval. The Council of the Indies was less successful in meeting their agenda regarding charts. Despite their attempts to make sure that there was a plentiful supply of adequate charts, it proved difficult to balance this desire against the countervailing desire to keep details about the charts away from foreigners and against the attempts of each chartmaker to obtain a monopoly in their production.

As the number of cosmographers decreased over the course of the sixteenth century, the competition between them became increasingly vociferous, the attempts at monopoly more blatant, and the shortages more of a problem. By the time that Andrés García de Céspedes finished the reform of charts and instruments in Seville, Rodrigo Zamorano was the only official cosmographer, and he served as pilot major and cosmography professor, leaving him little time to make charts for the pilots. To alleviate this shortage, the council finally approved the petition of the former pilot Jerónimo Martín, appointing him cosmographer for a term of two years.[248] From this time forward, the position was an official monopoly, though this monopoly never prevented unlicensed makers from selling charts.

Because of the detailed rules surrounding the practice of navigation, Spanish nautical cartography was closely regulated by the state. These regulations were devised and enforced by both the Casa de la Contratación in Seville and the Council of the Indies at the royal court and always betrayed a tension between the desire of the pilots to use charts as tools of navigation and the desire of the government to have charts serve as statements about the locations of territories. Within this broad framework, there were also other tensions: between the makers of the official pattern charts and the people who made those used by the pilots at sea, between the makers of charts and their users, between the desire to restrict access to information and at the same time make it available to those who needed it, and finally between the desire to create controlled monopolies and the fear of letting any one person get a stranglehold on chart production.

Though for the purposes of this chapter I have dealt separately with sea charts as part of the nautical bureaucracy, the creation and revision of the official pattern chart, and the charts sold to the pilots, the close connections among these topics are obvious. The workshops centered in Seville and overseen from the royal court all formed part of the same coherent tradition, distinct from both the Mediterranean tradition of the Mallorcan school and the Portuguese tradition in Lisbon. This tradition was of cartographers in the service of the state, providing technical support to the Spanish voyages to the East and West Indies, and so attentive (albeit to varying degrees) to the needs of both the pilots and the colonial administrators. Born of the Columbian voyages, this tradition changed over the course of the sixteenth century, but always retained close ties to both navigational practice and government supervision.

246. Escalante de Mendoza, *Itinerario de navegación,* 13.

247. AGI, Patronato, 259, R. 72, 18 February 1578 letter from Juan Bautista Gesio to the king.

248. Martín was appointed under the name Jerónimo Martínez de Pradillo; see AGI, Contratación, 5784, L. 3, fol. 100rv, 26 August 1598.

appendix 40.1 Cosmographers and Allied Professionals at the Casa de la Contratación, 1503–1603 (In Order of First Appointment)

A chartmaker (*maestro de hacer cartas y instrumentos*) had a license to make and sell charts and instruments to the pilots, contingent on their passing inspection by the pilot major and later by a committee appointed for the purpose. A cosmographer (*cosmografo*) had all the rights and duties of a chartmaker, and in addition was expected to sit on the examining tribunal at the pilots' licensing exams. The post of professor (*cathedrático*) was created in 1552, and this job involved teaching cosmography and the use of instruments to would-be pilots in required daily lessons. The pilot major (*piloto mayor*) was in charge of inspecting charts and instruments and overseeing the licensing exams. I have included in this table appointments of pilot major, assistant to the pilot major, and substitute pilot major when the appointees were also cosmographers.

Person	Job	Date Appointed	Annual Salary, in *Maravedís* (mrs)	Notes
Giovanni Vespucci	Pilot	22 May 1512	20,000 mrs	Relieved of post 18 March 1525
	Chartmaker	24 July 1512	None	Licensed to sell copies of pattern chart without formal post
	Substitute pilot major	26 June 1526 (with Nuño Garcia Toreno)		Likely never served; died after 1528
Andrés de San Martín	Chartmaker	Before 24 July 1512	None	Licensed to sell copies of pattern chart without formal post; left with Magellan; died 1521
Francisco Faleiro	Unspecified	30 April 1519	35,000 mrs; raised to 50,000 mrs on 10 August 1532	Consistently treated as a cosmographer; died ca. 1574
Nuño Garcia Toreno	Chartmaker	13 September 1519		Died 22 June 1526
	Substitute pilot major	26 June 1526 (with Giovanni Vespucci)		Never served
Diogo Ribeiro	Cosmographer	1 July 1523	30,000 mrs	Died 1533
	Assistant to pilot major	2 August 1527	None	Appointed to help Fernando Colón; stopped in March 1532 by Cabot's return
Alonso de Chaves	Assistant to pilot major	2 August 1527	None	Appointed to help Fernando Colón; stopped by Cabot's return
	Cosmographer	4 April 1528	30,000 mrs	
	Lecturer to pilots	21 August 1528	None	Stopped by Cabot's return
	Pilot major	11 July 1552	Unspecified	Retired with pension 21 April 1586; died 24 August 1587
Diego Gutiérrez	Cosmographer	21 May 1534	6,000 mrs	Stripped of office 24 September 1552; died 1554
	Substitute pilot major	6 March 1548 (initially with Hernando Blas)		Power of substitution expired December 1548
Alonso de Santa Cruz	Cosmographer	7 July 1536	30,000 mrs	Died 9 November 1567
	Royal *contino* (at court)	26 December 1537	35,000 mrs	Given permission to receive both salaries simultaneously
Pedro Mexía	Cosmographer	20 April 1537	30,000 mrs	Died 17 January 1551
Gaspar Rebelo	Chartmaker	23 July 1537	None	Last appeared in the records in a 15 May 1538 order that Cabot let him make charts
Pedro de Medina	Chartmaker	20 December 1538	None	Died 1567; absent from Seville for some years previously
	Cosmographer	24 January 1539	None	Order said he was to be treated as a cosmographer

APPENDIX 40.1 (*continued*)

Sancho Gutiérrez	Chartmaker	12 December 1539	None	Died 13 August 1581
	Could attend exams	18 July 1544	None; no vote	
	Cosmographer	18 May 1553	10,000 mrs	
	Professor (interim)	25 May 1569	30,000 mrs	Interim replacement for Jerónimo de Chaves; replaced by Diego Ruiz 3 March 1574
	Professor (interim)	19 October 1575	Unspecified	Interim replacement for Diego Ruiz (who died before 30 September 1575); post given to Rodrigo Zamorano 9 December 1575
Jerónimo de Chaves	Chartmaker	29 November 1541	None	May have been a cosmographer (wording ambiguous)
	Professor	4 December 1552	30,000 mrs	Abandoned post in 1568; died after 10 March 1574
Diego Gutiérrez	Chartmaker	22 October 1554	6,000 mrs	Replaced his father, Diego Gutiérrez, after the latter's death; unsuccessfully petitioned to be named cosmographer 30 March 1569; dead by 1574
Diego Ruiz	Cosmographer	11 March 1573		
	Professor	11 March 1573	60,000 mrs	Took office 3 March 1574, but dead by 30 September 1575; it is not clear that he ever served
Rodrigo Zamorano	Professor	20 November 1575	60,000 mrs; raised to 80,000 mrs on 5 September 1583	Retired from post 23 February 1613 after a ruling that he could not be both pilot major and cosmography professor
	Cosmographer	26 August 1579	No additional salary	Held post until his death 24 June 1620
	Interim pilot major	13 April 1586	As Alonso de Chaves	Initially appointed for four years; appointment renewed on 7 July 1590; replaced by Andrés García de Céspedes 12 November 1596
	Pilot major	14 April 1598		Held post until his death 24 June 1620
Domenico Vigliarolo	Cosmographer	7 October 1586	10,000 mrs; raised to 80,000 mrs on 23 December 1586	Left for France in 1596
Jerónimo Martín	Cosmographer	26 August 1598	80,000 mrs	Appointed for a two-year trial period on the same terms as Vigliarolo; requested renewal 19 June 1600; died 1602
Antonio Moreno	Cosmographer	21 September 1603	10,000 mrs; raised to 80,000 mrs ca. 1610 and to 112,000 mrs ca. 1611	Appointment made permanent 14 February 1607
	Professor	28 October 1612	50,000 mrs during Zamorano's lifetime, 100,000 mrs thereafter	
	Pilot major	2 January 1625	50,000 mrs	Died 2 January 1634

APPENDIX 40.2 TIMELINE OF THE OFFICE OF PILOT MAJOR AT THE CASA DE LA CONTRATACIÓN, 1508–1620 (*ITALIC* INDICATES TEMPORARY APPOINTMENTS)

Date of Appointment	Person	Absences/Death
22 March 1508	Amerigo Vespucci	Died in office 22 February 1512
25 March 1512	Juan Díaz de Solís	Left on a voyage in August 1515; died early 1516
27 July 1515	*Francisco de Coto*	Solís's brother; served as his substitute during voyage
5 February 1518	Sebastian Cabot	Spent much of 1521 in England and attended 1524 meetings at Badajoz, both with no known substitute; left on a voyage of exploration March 1526
26 June 1526	*Nuño García de Toreno* and *Giovanni Vespucci*	Appointed by royal *cedula* to substitute for Cabot; Toreno had died four days earlier; no evidence that Vespucci served in this office
2 August 1527	*Hernando Colón*	Appointed by royal *cedula* to substitute for Cabot, with assistants Alonso de Chaves and Diogo Ribeiro
March of 1532	Sebastian Cabot	Cabot again pilot major; left Seville after March 1548, abandoning the post; died in England in 1557
6 March 1548	*Hernando Blas* and *Diego Gutiérrez*	Declared by Cabot to be his substitutes; confirmed 9 July 1548, with an expiration date five months thereafter
After September 1549	*Hernando Blas*	Appointed by the Council of the Indies to serve as substitute pilot major, but before June 1550 accepted a convoy post
19 June 1550	*Diego Sánchez Colchero*	Appointed by the Casa officials in the absence of Cabot and Blas
11 July 1552	Alonso de Chaves	Took possession 1 October; retired with pension 21 April 1586; died 24 August 1587
13 April 1586	Rodrigo Zamorano	Four-year term renewed 7 July 1590; temporarily replaced during pattern chart revision
16 September 1595	*Pedro Ambrosio de Ondériz*	Temporary appointment to be in force during pattern chart revision; died before returning to Seville
15 May 1596	*Andrés García de Céspedes*	Temporary appointment to be in force during pattern chart revision; held until 1598
14 April 1598	Rodrigo Zamorano	Reappointed after pattern chart revision; held office until his death on 24 June 1620

APPENDIX 40.3 REVISIONS OF THE *PADRÓN REAL*, 1508–1600

Date	Revision
1508	The first pattern chart was assigned to Amerigo Vespucci (pilot major); he was working on it with Nuño García Toreno in 1510.
1512	Juan Díaz de Solís (pilot major) was asked to revise the pattern chart with the help of Giovanni Vespucci.
1515	A chart made by Andrés de Morales was accepted as the pattern chart.
1518	Fernando Colón was asked to revise the pattern chart.
1526	Fernando Colón again was asked to revise the pattern chart. A chart made by Alonso de Chaves may have been accepted as the pattern chart in 1528.
1535–36	A chart was made under the supervision of Juan Suárez de Carbajal of the Council of the Indies. Initially, Fernando Colón was asked if he had finished the pattern chart entrusted to him. In his absence, the revision was entrusted to Sebastian Cabot (pilot major), Alonso de Chaves, Franciso Faleiro, Diego Gutiérrez, Pedro Mexía, and Alonso de Santa Cruz. It was finished in 1536 amid protests from Cabot, Gutiérrez, and Santa Cruz.
1543–44	Sebastian Cabot (pilot major) revised the pattern chart, with the permission of Gregorio López of the Council of the Indies. This was done with the help of pilots and in the presence of Diego Gutiérrez, Pedro Mexía, and Alonso de Chaves, against the advice of Chaves and Mexía. The chart was completed before August 1544. It was said by Cabot and Gutiérrez to have been necessitated by pilots' complaints about the previous pattern chart. The chart was part of a general inspection of the Casa by López and was brought into a lawsuit by Chaves and Pedro de Medina about the charts in use and the conduct of Cabot.
1549–53	In 1549, Hernán Pérez de la Fuente of the Council of the Indies asked to oversee new patterns for both sea charts and world maps. He probably involved Francisco Faleiro, Pedro de Medina, Diego Sánchez Colchero, and Sancho Gutiérrez, for a 1560 *cedula* orders them paid for work done on the pattern chart. The work probably was done between 1550 and 1552, when Colchero was acting pilot major, for there is no other reason for him to have been involved. It probably also involved Diego Gutiérrez, who would not have been mentioned in the payment *cedula* because he died in 1554.
1561–62	Revision of the chart was mentioned in letters between the council and the Casa; no details are known.
1581–82	The chart was revised in preparation for an expedition to the Strait of Magellan; the revision involved a series of meetings at the Casa with Pedro Sarmiento de Gamboa and his pilot Antón Pablos (recently returned from the Strait), the cosmographer Rodrigo Zamorano, and other unspecified pilots and cosmographers. The revision made use of lunar eclipse observations made by Zamorano. This was probably a revision not of the pattern chart per se, but of a section of it containing the Strait of Magellan, for in 1593 the committee said the current pattern chart had not been revised in twenty-six years.
1593–95	Pedro Ambrosio de Ondériz (cosmographer major) was sent to Seville to revise charts and instruments. To discuss the revision, he held a meeting of pilots and representatives from the Universidad de Mareantes, as well as Rodrigo Zamorano and Domenico Vigliarolo and unspecified generals, admirals, and officials. He decided to create six new pattern charts and to send pilots with new astrolabes to gather information needed for the revision. Ondériz died in 1596 while preparing to return to Seville to finish the revision.
1596–99	Andrés García de Céspedes replaced Ondériz in overseeing the revision. He was helped by Rodrigo Zamorano and Simón de Tovar. They gathered information from pilots on printed questionnaires. The finished set of six pattern charts was accepted as official on 3 May 1599.