

30 • Maps and Exploration in the Sixteenth and Early Seventeenth Centuries

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A cabinful: instruments, computations, maps, guesswork and lies and credibility gaps, travel-tales, half-dreamed, half-achieved, perhaps.¹

INTRODUCTION

The scenes are easily—too easily—imagined. Explorers plan their missions hunched over maps made by their predecessors. As they cross seas, they mark their progress on charts. When they see land, they sketch its outlines and transfer them to maps. When ashore, they do as much surveying as circumstances permit and make at least a rudimentary cartographic record of their penetrations inland. When they reach home, they pass on their newly won knowledge, in map form, for the guidance of their contemporaries and successors. Events like these, pictured in abundance by modern book illustrators, filmmakers, and romantic history painters, rarely happened. The connection between mapping and exploration in the early modern period is not nearly as close or direct as a mind informed by more recent practice might expect. The purpose of this chapter is to examine the nature of the connection in the sixteenth and early seventeenth centuries, to provide an outline of how it changed, and to make some suggestions toward an explanation of its limits. The most surprising effect on an intuitive or traditional understanding of the subject will be the challenge of a previously neglected fact: until late in the period, explorers used few maps and made fewer.

Some preliminary definitions and qualifications are necessary. For purposes of the present chapter, exploration is defined as route finding. An expedition counts as an exploration if its purposes included the discovery or firsthand scrutiny of an unused route or the perfection of a route of recent discovery. Scientific missions in the route finders' wake, reconnaissances for resources, missionary quests for potential converts, commercial journeys, military expeditions, frontier surveying trips, legal disputes in colonial courts, bureaucratic inquiries: all these, in the period in question, generated maps in far more abundance, and of far greater utility, than exploration, strictly defined, generally did, and much of the traditional historiography of exploration covers at least some examples

from at least some of these categories. The categories do not, in any case, occupy watertight compartments; route finders often had scientific, prospecting, evangelizing, military, surveying, legal, or political motives in mind, or missions of those kinds to execute along the way. Nevertheless, in order to keep the present undertaking within manageable proportions—and in the belief that distinctions, if made and kept as sharp as possible, tend to clarify any inquiry—it seems best to define exploration strictly and to confine inquiry to the links between mapping and route finding. Judged by breadth of relevance, this is by no means a narrow remit: routes are the arteries of world history, along which, in this period, long-range, thorough-going transmissions of culture took place that transformed the world. The problems of how new routes came to be sought and how, once explored, news of them was recorded, communicated, and incorporated in world mapping is a subject central to the history of cartography. For all the most conspicuous themes of world history in this period and ever since, its implications are transcendent.

No period or portion of the history of cartography has excited more interest in the past or inspired more passion than the early modern period. The proportion of relevant maps available in good facsimiles is higher than for any subject covered in earlier volumes of *The History of Cartography*. The amount of source material in print is formidable, as is the quantity of existing studies. Yet, overwhelmingly, existing work on the relevant material has been concerned with objectives unrelated, or tangentially related, to the main historical problems. Much of it has been antiquarian in character or directed toward problems of collecting, classifying, and curating early modern maps. Some inquiries have been vitiated by the heroic conception of the explorer as a firebrand of scientific trailblazing, whereas, as I hope we shall see, explorers usually had other priorities, and the knowledge they gained was,

Abbreviations used in this chapter include: *American Beginnings* for Emerson W. Baker et al., eds., *American Beginnings: Exploration, Culture, and Cartography in the Land of Norumbega* (Lincoln: University of Nebraska Press, 1994).

1. F. C. Terborgh, "Cristobal Colon," *Helikon* 4 (1934): 159.

for many reasons, extremely hard to incorporate into the stock of common wisdom. Besides, as work in volume 1 of the present series confirmed, a great deal of traditional literature is actively misleading because it has been based on risky assumptions about the cartographers' debt to explorers. Work on the history of exploration has tended to assume a close connection between exploration and mapping, without attempting to verify it.² Although the connection grew closer in the course of this period, it was always rent by chasms of imperfect communication and interrupted by traditional obstacles. Until well into the seventeenth century, what appeared on maps rarely matched what explorers discovered.

The subject can be approached under two main headings. First, it may be helpful to examine the use explorers made of maps in directing their searches toward particular targets or in finding their way along portions of their routes that had been previously explored. Two subdivisions deserve special consideration: the influence of speculative cartography on exploration and the use of indigenous maps by European explorers in unfamiliar climes. I shall then turn to my second main heading—explorers' feedback: their activities as mapmakers and the effects of exploration on cartography. This will require excursions on the means by which explorers' findings were recorded, transmitted, and incorporated into cartographic tradition; the new images of previously unmapped lands and uncharted waters, which became part of the mental equipment of the educated; and the revised notion of the image of the whole planet that accompanied the process. Meanwhile, the effects of exploration on cartography have to be located in the context of the changes that characterized the history both of the concept of the map in Europe and of the functions maps fulfilled. On all these subjects, the sources are frustratingly deficient. Relations between explorers and cartographers are almost entirely undocumented; one reason for considering the possibility that, for most of this period, most explorers cared little for maps is that they made so little mention of them, although the reverse argument might be made: that maps were so often used as not to occasion comment.

Underlying the whole inquiry are problems, unsolved in the existing literature and perhaps insoluble, that demand to be raised and need to be investigated. One might expect that the objectives of scientific cartography, on the one hand, and of exploration, on the other, were identical or at least compatible. In crucial respects, however, this was not so—or it became so only in the course of the period studied, as mapmaking technology improved and mapmakers and explorers found ways of serving each others' needs. Mapping and exploration were mutually nutritive projects, but this was recognized only slowly: at the start of the period, explorers showed very little interest in mapping their finds; by its end, it was normal for

cartographic professionals to accompany expeditions. In the period encompassed by these developments, the principal underlying problems to be borne in mind concerned, first, the extent of explorers' input into Europeans' changing image of the world; second, the influence of exploration on the development of cartographic techniques—compared with other sources of influence, such as political exigencies, military needs, commercial pressures, and scientific curiosity; third, the reliability of cartographic sources as evidence for the history of exploration; fourth, the indebtedness of Europeans to other peoples' science in the early modern period; and, above all perhaps, the reasons cartography responded slowly and selectively to explorers' findings.

2. The use of maps to reconstruct the history of exploration was first practiced to impressive effect by Alexander von Humboldt in *Examen critique de l'histoire de la géographie du nouveau continent et des progrès de l'astronomie nautique aux quinzième et seizième siècles*, 5 vols. (Paris: Gide, 1836–39), although he never published parts three and four, which were intended specifically to cover cartography and nautical astronomy. Manuel Francisco de Barros e Sousa, viscount of Santarém, followed a similar method, especially in *Essai sur l'histoire de la cosmographie et de la cartographie pendant le moyen-âge et sur les progrès de la géographie après les grandes découvertes du XV^e siècle*, 3 vols. (Paris: Impr. Maulde et Renou, 1849–52), partly with the purpose of seeking to establish Portuguese priority of discovery in disputed territories. The great work of Henry Harrisse, *The Discovery of North America: A Critical, Documentary, and Historic Investigation, with an Essay on the Early Cartography of the New World, Including Descriptions of Two Hundred and Fifty Maps or Globes Existing or Lost, Constructed before the Year 1536* (London: Henry Stevens and Son, 1892), which is still essential on the bibliography of the early history of the New World, exemplified the same misleading tradition, in which maps are treated as evidence of explorers' activity, as if cartography were an undistorting mirror of discovery. Harrisse's conclusions (pp. 244–51) rely heavily on maps as evidence of the "progress accomplished" (p. 269). It has been said of Harrisse that "as his learning increased his judgement deteriorated"; see James Alexander Williamson, *The Voyages of John and Sebastian Cabot* (London: G. Bell and Sons, 1937), 7. The brilliant work of Justin Winsor, *Geographical Discovery in the Interior of North America in Its Historical Relations, 1534–1700* (London: Sampson Low, Marston, 1894), reinforced the same tendency by illustrating almost every voyage and journey with supposedly corresponding details from the cartographic record. The success of these works combined to spread the incautious impression expressed by Stevenson that maps "often indicate, by mere touch, a story of exploration or discovery, concerning which the written documents are silent" (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 [1908–9]: 369–419, esp. 369), whereas really, because maps are subject to interpolation, emendation, speculative embellishment, and chronological uncertainties more complex than those characteristic of other documents, it is highly imprudent to accept their unsupported evidence. Contributions to the tradition are presented by R. A. Skelton, *Explorers' Maps: Chapters in the Cartographic Record of Geographical Discovery* (London: Routledge and Kegan Paul, 1958), and Peter Whitfield, *New Found Lands: Maps in the History of Exploration* (New York: Routledge, 1998).

EXPLORERS' USE OF MAPS

SPECULATIVE CARTOGRAPHY

Even the most adventurous explorers might be expected to have some use for maps, because their routes, however untried, are bound, at least in the early stages of a journey, to overlap with the pathways of predecessors, and maps of explorers' destinations—or of contiguous regions, if available—might be expected to come in handy. In the world around early modern Europe, where the extent of the unexplored portion was diminishing almost continually, maps could also help to direct would-be explorers to regions of opportunity. Nevertheless, the idea that explorers in search of unfrequented destinations, by unknown routes, should expect to be guided there by a map seems irrational. Or else the idea belongs to a genre of fiction in which the long-lost map—plucked, as often as not, from the dead or dying grasp of a predecessor on a half-trodden road—unlocks the way to a buried treasure, a lost city, or some wonder of the world. Yet speculative maps really could and did prove highly stimulating to susceptible imaginations.

In this respect, as so often in the modern history of exploration, the experience of Christopher Columbus is an irresistible starting point. In moments of vainglory, when he wanted to stress that his enterprise had been directly inspired by God, Columbus might insist that “to carry out the enterprise of the Indies I made no use of reason or mathematics or *mappaemundi*,”³ but his numerous other references to the influence of maps make it clear that this assertion should be treated cautiously. His study of globes in preparation for his transatlantic project is too well attested to be dismissed as a legend,⁴ and the famous globe associated with Martin Behaim of Nuremberg is a sample of the kind of artifact that might have served the explorer's purpose. Columbus can therefore be credited with a rational use of speculative mapping: to illustrate a speculation. John Cabot did the same. So, it is said, did Ferdinand Magellan.⁵ To follow a speculative map as a guide in the course of a real journey seems perverse. Yet that is what Columbus did. With Martín Alonso Pinzón he inspected, at least twice, on 25 September and 6 October 1492, the map he had aboard the *Santa María*. Columbus was in no doubt that his enterprise was directed to seas “never sailed before, as far as is known for certain.”⁶ Yet he had sufficient faith in the chart he carried to propose to alter his course on the strength of it.⁷ When he passed a region of the Atlantic in which his map had led him to predict an abundance of islands, he attributed his failure to substantiate those expectations not to a deficiency in his map, but to bad luck or myopic observations. These facts have excited much curiosity about what Columbus's map can be supposed to have depicted;⁸ they have even encouraged speculation that he

was merely reenacting a voyage by an unknown predecessor. The text of Columbus's account supports only one, modest, conclusion: this was a speculative map, which, like many speculative Atlantic charts of the period, showed numerous fantasy islands and included a reference to Cipangu, or at least gave Columbus and Pinzón some reason to believe that by a late stage of their transnavigation they had overshot that fabled land.⁹

Columbus's experience was typical. Cartographic tradition was full of Siren songs, misleading speculations that tempted explorers toward putative destinations that did not exist or that were imaginatively located on maps. The late Middle Ages scattered maps with more or less enticing objectives: the isles of Brasil, Cipangu, and Antilia; the Hesperides and the antipodes; a navigably narrow Atlantic; and visions of kingdoms of exaggerated wealth in ill-reported parts of Asia and Africa. Early modern cartography was, like the first earl of Birkenhead's dull judge, “no wiser . . . but far better informed,”¹⁰ equally credulous and even more inventive. Explorers from Europe were beckoned north by the myth of an open-water passage to the north pole; they were summoned to the northeast by the Golden Old Woman of the Ob¹¹ and the prospect of an ice-free route to east Asia; to the farthest south, the land of Terra Australis Incognita lay invitingly; El Dorado and other fabled treasure lands

3. Christopher Columbus, *Textos y documentos completos: Relaciones de viajes, cartas y memoriales*, 2d ed., ed. Consuelo Varela (Madrid: Alianza, 1984), 280.

4. Columbus, *Textos*, 44, and Bartolomé de Las Casas, *Historia de las Indias*, 3 vols., ed. Agustín Millares Carlot (Mexico City: Fondo de Cultura Económica, 1951), 1:62–66 (bk. 1, chap. 12).

5. Perhaps too exactly the same to be credible: the use of the globe and map to dramatize the explorer's presentation of his project may have been becoming a *topos*. Las Casas, *Historia de las Indias*, 3:173–76 (bk. 3, chap. 101).

6. Columbus, *Textos*, 16.

7. Felipe Fernández-Armesto, *Columbus* (London: Duckworth, 1996), 76.

8. Las Casas, whose abstracts, excerpts, and paraphrases of Columbus's texts are the only surviving sources on this matter, was convinced that the map in question had been made by the Florentine savant Paolo dal Pozzo Toscanelli, whose views on the transnavigability of the Atlantic were known to Columbus; see Las Casas, *Historia de las Indias*, 1:191 (bk. 1, chap. 38). But his opinion seems to have been based on an unwarranted inference. See Antonio Rumeu de Armas, *Hernando Colón, historiador del descubrimiento de América* (Madrid: Instituto de Cultura Hispánica, 1973), 267–70.

9. Francesca Lardicci, ed., *A Synoptic Edition of the Log of Columbus's First Voyage* (Turnhout: Brepols, 1999), 314, 317, 483, and 486–87.

10. Frederick Winston Furneaux Smith, Earl of Birkenhead, *Life of F. E. Smith, First Earl of Birkenhead* (London: Eyre and Spottiswoode, 1960), 99.

11. Sigmund von Herberstein, *Notes upon Russia: Being a Translation of the Earliest Account of That Country, Entitled Rerum Moscoviticarum Commentarii*, 2 vols., trans. and ed. Richard Henry Major (London: Hakluyt Society, 1851–52), 2:41–42.

proliferated in the American interior; a northwest passage supposedly lay around them and a narrow Pacific beyond them.

Almost none of the great delusive myths is likely to have originated on maps, but maps encouraged belief in them. Sometimes the reasoning that inspired speculative cartography was prompted or supplemented by classical authorities or legendary exploits, but mostly it was the result of theoretical or political agendas allied to wishful thinking. Columbus argued for an accessible Asia because the Atlantic had to be small to conform to a supposed opinion of Aristotle's, because of the opinions or evidence of Marco Polo or Marinus of Tyre, or because an enormous ocean would be repugnant to the mind of a rational Creator. To the other theorists, the north pole was in clear water because "there is no . . . Sea innavigable."¹² A northwest passage was necessary because the oceans of the world had to circulate unimpeded, and a narrow Pacific was necessary to confine the world to credible dimensions, to maintain symmetry with the Atlantic, and to guarantee the king of Spain's possession of the Moluccas. The existence of Terra Australis could be inferred from the known facts of how land and water were distributed across the face of the planet.

In geographical speculation, moreover, *l'appétit vient en mangeant*, and the pace of discovery had an overstimulating effect on inventive minds—just as today the capabilities of information technology are always being anticipated or exaggerated by pundits' predictions. New islands were discovered with such frequency—in the Atlantic in the fourteenth and fifteenth centuries and in the Indian, Pacific, and Arctic Oceans in the sixteenth and seventeenth—that it would have seemed inconsistent with experience to expect this acceleration to end. Myths of El Dorado were, in part, extrapolations from the real experience of Hernán Cortés and Francisco Pizarro. Pedro Fernández de Quirós seems to have strengthened his own hopes of finding Terra Australis by means of a misguided analogy with the enterprise of Columbus, whose dream of a narrow Atlantic had come true. The real discovery of Japan confirmed the legend of Cipangu, though it turned out to be closer to China than Marco Polo had said. Various encounters seemed to fulfill expectations of the realm of Prester John and even of the Amazons. Amid so many surprisingly revealed realities, few speculations seemed too strange.

In these circumstances, science nourished speculation. The rise of science is commonly hailed as one of the great features of the early modern intellectual history of Europe. Yet scientific epistemology is fallible, and the reliability of observation and experience depends on conditions that cannot be guaranteed in practice. Nonexistent islands can be "observed" or convincingly inferred by mistake from the presence of cloud banks or the flight of birds or the appearance of the surface of the sea or float-

ing objects. This is particularly so under the stimulus of wishful thinking. The islands of Rica de Oro and Rica de Plata, which occurred frequently on maps of this period, would have been useful to Spain—or to pirates intent on raiding Spanish galleons—for they were usually located well east of Japan, not far from the course ships normally followed from Manila to Acapulco.¹³ They did not exist, but they were often reported and became imbedded in cartographic tradition. The insular nature of California was "established" as a result of poor observation during Sebastián Vizcaíno's exploration northward from Acapulco in 1602.¹⁴ Nonexistent islands pullulate in maps because of well-attested principles of the history of cartography: it is safer to have too many islands on your chart than too few, and, owing to the difficulty of proving a negative, it is easier to introduce speculations than to excise mistakes. Therefore, as knowledge accumulates, islands multiply: misplaced islands are copied from previous maps in false locations and repeated in their true or improved locations, usually with new names, as the result of new information.

Cartography tended to multiply islands, but to shrink oceans. The sheer immensity of the Pacific seems to have been beyond the grasp of explorers who tried to measure it and cartographers who tried to map it.¹⁵ Their best efforts were consistently wrong—commonly by a margin of 50 percent. The results included a series of disastrous or harrowing attempts at transnavigation. Magellan's was the first: his belief in the feasibility of his project for a voyage to the Moluccas via the Great South Sea was inspired or supported—as at least two sources who knew him said—by a map attributed to "Martin of Bohemia" that depicted a strait to a narrow ocean.¹⁶ Inadequately

12. Robert Thorne, "Robert Thorne's Book," in *The Principal Navigations, Voyages, Traffiques & Discoveries of the English Nation*, by Richard Hakluyt, 12 vols. (Glasgow: James MacLehose and Sons, 1903–5), 2:164–81, esp. 178. See also David B. Quinn, ed., *New American World: A Documentary History of North America to 1612*, 5 vols. (New York: Arno Press, 1979), 1:180, and John Kirtland Wright, *Human Nature in Geography: Fourteen Papers, 1925–1965* (Cambridge: Harvard University Press, 1966), 90–92.

13. O. H. K. Spate, *The Pacific since Magellan*, vol. 1, *The Spanish Lake* (Minneapolis: University of Minnesota Press, 1979), 106–9. See Edmond Chassigneux, "Rica de Oro et Rica de Plata," *T'oung Pao* 30 (1933): 37–84.

14. John Leighly, *California as an Island: An Illustrated Essay* (San Francisco: Book Club of California, 1972), 30–39, and O. H. K. Spate, *The Pacific since Magellan*, vol. 2, *Monopolists and Freebooters* (London: Croom Helm, 1983), 120–22. See also R. V. Tooley, *California as an Island: A Geographical Misconception, Illustrated by 100 Examples from 1625 to 1770* (London: Map Collectors' Circle, 1964).

15. Spate, *Spanish Lake*, 100.

16. Samuel Eliot Morison, *The European Discovery of America*, vol. 2, *The Southern Voyages, A.D. 1492–1616* (New York: Oxford University Press, 1974), 381–82 and 398. On the problem of the attribution of this work, the discussion by Justin Winsor, ed., *Narrative and Critical History of America*, 8 vols. (London: Sampson Low, Marston,

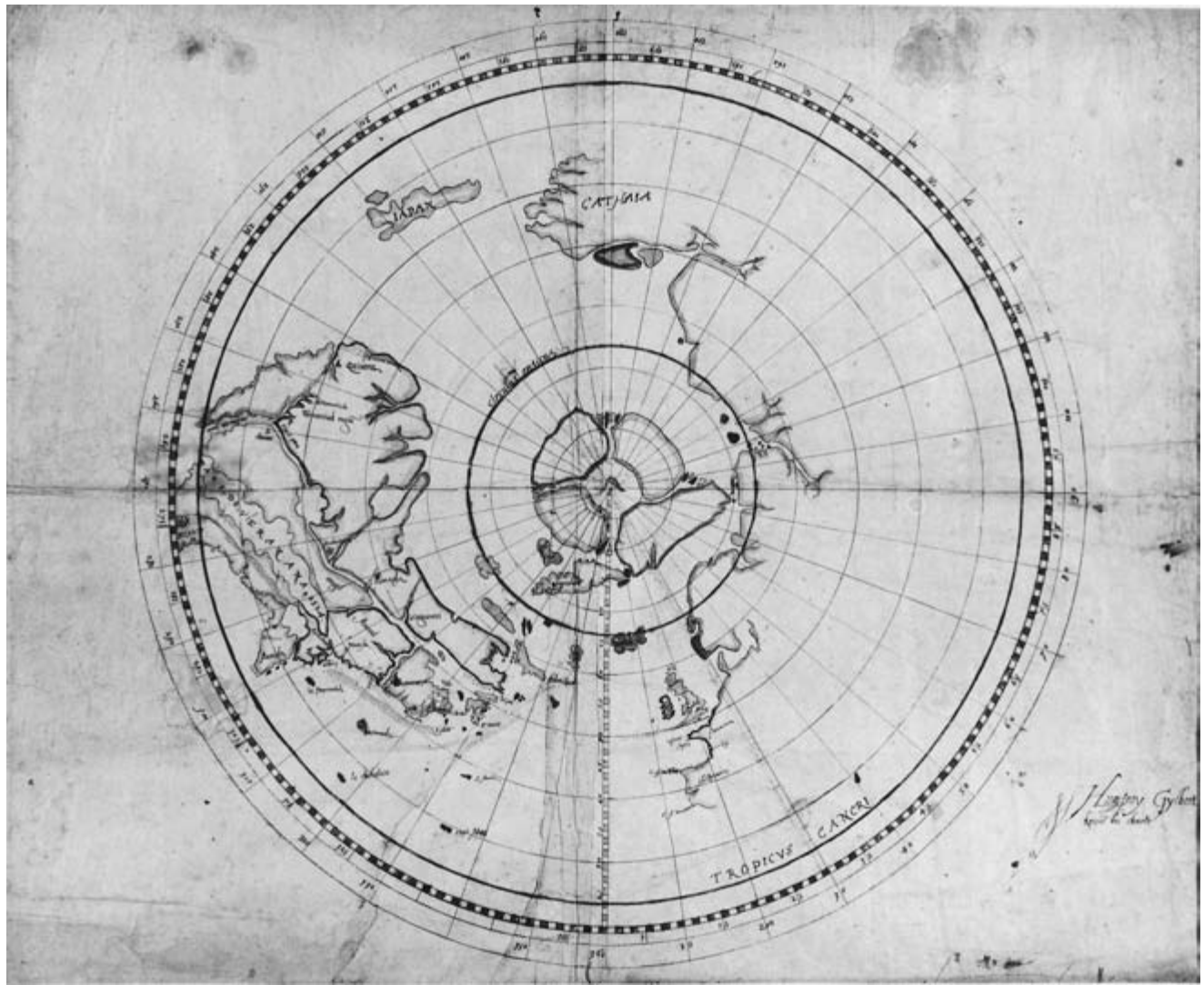


FIG. 30.1. SIR HUMPHREY GILBERT'S MAP, PROBABLY BY JOHN DEE, CA. 1582. Based on Mercator's map (fig. 30.2).

Size of the original: 50 × 62 cm. Photograph courtesy of the Rare Book Department (Elkins Americana), Free Library of Philadelphia.

prepared expeditions followed in search of the Solomon Islands, which, discovered in 1565, were literally lost in the vastness of the ocean. An even more remarkable case is that of the impact of speculative cartography on the search for the Northwest Passage. Sir Humphrey Gilbert and John Dee made speculative maps showing wide-open seaways around northern America in an attempt to encourage explorers and attract investors (fig. 30.1).¹⁷ Michael Lok, one of the most assiduous promoters of the idea of a northwest passage, attached great importance to the evidence of a map attributed to Giovanni da Verrazano.¹⁸ Mercator reproduced the myth.¹⁹ The navigable north pole was another feature stressed in Dee's cartographic efforts. Mercator, too, had made a special feature of this, devoting an inset to it on his world map of 1569

Searle and Rivington, 1886–89), 2:35n, 112–36, and 8:374–82, remains important. It is unlikely that a map by Martin Behaim is identified here, and certainly not his globe, which shows no American landmass. More likely, a map by Johannes Schöner is intended. For this interpretation, see also Laurence Bergreen, *Over the Edge of the World: Magellan's Terrifying Circumnavigation of the Globe* (New York: Morrow, 2003), 176.

17. David B. Quinn, ed., *The Voyages and Colonising Enterprises of Sir Humphrey Gilbert*, 2 vols. (London: Hakluyt Society, 1940), 1: 129–65, and Skelton, *Explorers' Maps*, figs. 62 and 74.

18. Skelton, *Explorers' Maps*, 119.

19. Letters of Mercator to this effect were cited and quoted by Hakluyt. See Richard Hakluyt, *The Principall Navigations, Voiages and Discoveries of the English Nation* (London: George Bishop and Ralph Newberie, 1589), 483–85, and idem, *A Particular Discourse Concerning the Greate Necessitie and Manifold Commodityes That Are Like to Growe to This Realme of Englande by the Westerne Discoveries*



FIG. 30.2. DETAIL OF THE NORTH POLAR REGION FROM GERARDUS MERCATOR'S 1569 WORLD MAP. The full map is illustrated as figure 10.12 in this volume. Size of this detail: 23.6 × 23.4 cm. Photograph courtesy of the Öffentliche Bibliothek der Universität, Basel (Kartensammlung AA 3-5).

(fig. 30.2). Apart from theoretical speculations, the best authorities for it were the now-lost fifteenth-century Arthurian romances, which ascribed to King Arthur a conquest of the north pole (along with Greenland, Lapland, and Russia), and the “*Inventio Fortunatae*”—a fourteenth-century book of travels in the northern seas, now also lost but presumably actually a romance.²⁰

Dazzling early successes in the search for windfall returns, such as the discoveries of new sea routes to India and the Moluccas or the penetration of Mexico and Peru, generated unrealistic expectations that could not be sustained or satisfied without deception or self-delusion. The most spectacular cases concern the search for El Dorado. Exploration had proceeded so far in North America as to make the legends of Cíbola and Quivirá rationally incredible well before the midpoint of the sixteenth century. Yet Giacomo Gastaldi featured Cíbola (called Cívola) on his influential map of the New World published in Venice in 1548, both Cíbola and Quivirá appear on Paolo Forlani's map of 1565,²¹ and the magnificent image of those realms provided Joan Martines with one of the most spectacular embellishments on his map of 1578 (plate 24). The Golden Lake reported by Antonio de Espejo in 1580 appeared on Richard Hakluyt's New World map of 1587 and was surrounded by the Seven Cities of Cíbola in Cornelis van Wytfliet's depiction of New Granada and Cali-

fornia ten years later. The Strait of Anian, the Northwest Passage, and the realms of Quivirá and “Cebola” are all prominent on the printed map dedicated to North America by Cornelis de Jode in 1593. Speculative mapping evidently influenced the image of El Dorado that Sir Walter Raleigh had in mind when he went to Guiana: Raleigh, indeed, was an enthusiastic client for fantasy, an apologist for Sir John Mandeville, and a defender of Pliny as an authority on the New World. The biggest speculative intrusion on maps of the period was Terra Australis. On Abraham Ortelius's world map, it seems to embrace the world. On Mercator's, it resembles the jaws of some macroparasite, ready to devour other lands; on Jodocus Hondius's, a hand reaching to grasp the other continents. In a most impressive and plausible map Quirós made after failing to find the continent, he strung together portions of the coast of New Guinea with bits of the coasts of islands he had reconnoitered, creating a partial outline of a putative continent.

Explorers' reports fed back into fantasy and resulted in maps spattered with mirabilia. The line between exploration and adventure, or between explorers' reports and travelers' tales, has never been exactly fixed. In the early modern period—which, according to later and current European notions, was prescientific or protoscientific—the line was blurred by three influences: first, the abiding effect of medieval travel literature, which was characterized by awestruck values and concerned to depict a world of wonder, not reduce it to easily classifiable facts; second, the public appetite for “curiosities,” which was stimulated by the explorers' discovery of an apparently ever more diverse world; and finally, the economics of exploration. It was a capital-intensive business that returned few profits sporadically. To get renewed backing, explorers tended to make exaggerated reports, especially with respect to potentially exploitable finds. Fictional travels became cartographers' sources just as, in the fifteenth century, chivalric romances of the sea had been mistaken as evidence of real journeys.²²

Lately Attempted . . . Known as Discourse of Western Planting [1584], ed. David B. Quinn and Alison M. Quinn (London: Hakluyt Society, 1993), 84–87.

20. For a clear example of a fourteenth-century romance that was widely misinterpreted as a real-life travelog in the sixteenth century, see Felipe Fernández-Armesto, “Machim [Robert Machin] (*supp. fl.* 14th cent.),” in *Oxford Dictionary of National Biography*, 60 vols. (Oxford: Oxford University Press, 2004), 35:463–64.

21. Philip D. Burden, *The Mapping of North America: A List of Printed Maps, 1511–1670* (Rickmansworth, Eng.: Raleigh, 1996), 22 and 40–41.

22. Pedro de Novo y Colson, *Sobre los viajes apócrifos de Juan de Fuca y de Lorenzo Ferrer Maldonado* (Madrid: Imprenta de Fortanet, 1881), and Henry Raup Wagner, “Apocryphal Voyages to the Northwest Coast of America,” *Proceedings of the American Antiquarian Society*, n.s. 41 (1931): 179–234.

INDIGENOUS MAPS

Explorers could escape from the defects of speculative cartography when they found cultures with reliable indigenous maps. The two cases in which indigenous maps can be shown to have fed into European tradition with the most radically transforming effects are attributable not to the work of explorers but to information-gathering exercises by state and church, respectively: the *relaciones geográficas* of New Spain in the late sixteenth century²³ and the Jesuit mapping of China in the seventeenth.²⁴ Nevertheless, knowledge of European explorers' indebtedness to indigenous mapping grows with every effort of research. An enormous advance was registered with the publication of *The History of Cartography*, volume 2.3, which contains examples of indigenous input into the earliest European mapping in periods covered by the present chapter, from Guiana to the Caroline Islands and from Peru to Hudson Bay. The possibilities of the subject do not yet seem exhausted.

As De Vorse has written, "Amerindian cartographers and guides in every region of the continent contributed significantly to the outlining and filling of the North American map."²⁵ Harley spoke of "a hidden stratum of Indian geographical knowledge" in early European mapping of the Americas.²⁶ Cortés used native maps, as well as guides, to obtain a picture of the Mesoamerican world and to lead his largely Nahua armies to Honduras and Guatemala.²⁷ Vasco Núñez de Balboa was said to have had the benefit, thanks to a native chieftain, of "de Tierra . . . vna figura."²⁸ Although indigenous maps are not mentioned, as far as I know, in connection with other route-finding or route-establishing forays in the region, it is worth raising the presumption that they helped. The knowledge of Mesoamerican geography revealed in Cortés's letters and grants of *encomiendas* extended far beyond what he knew from experience, and though this can be accounted for theoretically in various ways, no convincing explanation should omit the fact that he was surrounded by map-using, map-making cultures.²⁹ The Tabasco map of 1579 attributed to Melchior Álvaro de Santa Cruz is apparently a stray example of indigenous cartography.

Bark and hide maps, where examples survive or contemporary allusions exist, can be shown to have guided explorers in many parts of North America.³⁰ Detailed topographical maps and vast cosmic diagrams were drawn in the earth or composed of pebbles or sticks and corn for the wind to scatter.³¹ The map Alonso de Santa Cruz or an associate made on the basis of information supplied by members of Hernando De Soto's expedition of 1539–43 has more detail, portrayed with greater accuracy, than can plausibly be accounted for except as a result of indigenous mapping.³² An elderly local informant sketched the course of the Colorado River for

Hernando de Alarcón during his expedition in 1540; meanwhile, the landward branch of the same expedition collected a Zuni painting on skin of a group of settlements in the neighborhood of Hawikuh and sent it back to Spain.³³ Informants "set down" a "report of all the country" of the Chesapeake for Sir Ralph Lane during the Roanoke episode.³⁴ An Indian named Nigual made a surviving sketch map of New Mexico for Francisco Valverde de Mercado in 1602.³⁵ Iroquois used sticks to give Jacques Cartier an impression of the course of the St. Lawrence between rapids.³⁶ John Smith's ability to map Virginia was extended beyond the range of his own and his companions' explorations "by information of the Savages."³⁷ Powhatan himself drew "plots vpon the ground" illustrating for Smith the nature of country far

23. Barbara E. Mundy, *The Mapping of New Spain: Indigenous Cartography and the Maps of the Relaciones Geográficas* (Chicago: University of Chicago Press, 1996).

24. Helen Wallis, "The Influence of Father Ricci on Far Eastern Cartography," *Imago Mundi* 19 (1965): 38–45, and Theodore N. Foss, "A Western Interpretation of China: Jesuit Cartography," in *East Meets West: The Jesuits in China, 1582–1773*, ed. Charles E. Ronan and Bonnie B. C. Oh (Chicago: Loyola University Press, 1988), 209–51.

25. Louis De Vorse, "Amerindian Contributions to the Mapping of North America: A Preliminary View," *Imago Mundi* 30 (1978): 71–78, esp. 71.

26. J. B. Harley, "New England Cartography and the Native Americans," in *American Beginnings*, 287–313, esp. 290.

27. Barbara E. Mundy, "Mesoamerican Cartography," in *HC* 2.3: 183–256, esp. 187.

28. Antonio de Herrera y Tordesillas, *Historia general de los hechos de los castellanos, en las islas, y tierra-firme de el mar oceano*, 10 vols., ed. J. Natalicio González (Asunción: Guaranía, [1944–47]), 2:241, and an earlier edition, *Historia general de los hechos de los castellanos en las islas y tierra-firme del mar oceano*, 17 vols. (Madrid: [Tipografía de Archivos], 1934–57), 3:376, quoted in Harris, *Discovery of North America*, 477.

29. Mundy, "Mesoamerican Cartography," 194–95.

30. See, for example, Harald E. L. Prins, "Children of Gluskap: Wabanaki Indians on the Eve of the European Invasion," in *American Beginnings*, 95–117, esp. 112–13.

31. G. Malcolm Lewis, "Maps, Mapmaking, and Map Use by Native North Americans," in *HC* 2.3:51–182, esp. 61–71, and Gregory A. Waselkov, "Indian Maps of the Colonial Southeast," in *Powhatan's Mantle: Indians in the Colonial Southeast*, ed. Peter H. Wood, Gregory A. Waselkov, and M. Thomas Hatley (Lincoln: University of Nebraska Press, 1989), 292–343.

32. Lewis, "Maps, Mapmaking, and Map Use," 95, and William Patterson Cumming, R. A. Skelton, and David B. Quinn, *The Discovery of North America* (New York: American Heritage Press, 1972), 121.

33. Lewis, "Maps, Mapmaking, and Map Use," 108.

34. Quinn, *New American World*, 3:299.

35. Rainer Vollmar, *Indianische Karten Nordamerikas: Beiträge zur historischen Kartographie vom 16. bis zum 19. Jahrhundert* (Berlin: Dietrich Reimer, 1981), 29–30.

36. Lewis, "Maps, Mapmaking, and Map Use," 67–68.

37. John Smith, *The Complete Works of Captain John Smith (1580–1631)*, 3 vols., ed. Philip L. Barbour (Chapel Hill: By the University of North Carolina Press for the Institute of Early American History and Culture, 1986), 1:140–42 and 151; cited in Harley, "Cartography and the Native Americans," 290.

to the west.³⁸ Indians drew a portion of coastline for Bartholomew Gosnold in 1602 and for Samuel de Champlain in 1605.³⁹ Robert Cavelier de La Salle relied on a Cenis map drawn on bark in eastern Texas to tell him where he was in relation to the Spanish frontier.⁴⁰ Albeit not in an exploring context, the large number of further instances of indigenous contributions to early colonial mapping—from almost every region of the United States and much of Canada, using chalk or charcoal on native deerskins or on bark or wood or surface materials lent by Europeans for the purpose, by marking the ground, or by combining sticks, corn kernels, pebbles, and other such materials—leave no doubt about the potential of native mapping in North America to provide guidance for newcomers in unfamiliar environments.⁴¹

European explorers sometimes found themselves in areas where no cartographic tradition was recognized by them or recorded for us. Even in regions of that kind, however, they were dependent on local knowledge to find their way around. Thanks to the meticulous work of Adam Szaszdi Nagy, we can reconstruct the routes of pre-Columbian trade and travel in the Caribbean, which Columbus's native guides exposed to the newcomers.⁴² Columbus's praise of Arawak knowledge of the sea does not include any reference to anything recognizable as a map, but he does confess his own indebtedness to their information: "They sail all these seas, and it is wonderful how good an account they give of everything." His motive for seizing native captives was "to take them and get information of what to expect in these places."⁴³ According to a story Bartolomé de Las Casas told, two of the Indian captives who accompanied Columbus back to Europe were able to demonstrate the relationship of the islands Columbus reported by arranging beans on a flat dish.⁴⁴ This may say nothing about indigenous mapping or ways in which Arawak navigators substituted other forms of representation for maps, as conventionally understood, but it helps to demonstrate how indigenous information could be transferred.

How the relevant information was encoded in cultures like these, which have left no surviving maps, is beyond our knowledge. The possibilities include landmarks and sky marks, chants and verses, rituals and gestures.⁴⁵ In landward environments, such as those traversed by the Inca, it may be helpful to see the land itself as a map on a scale of 1:1, scored and scattered with mnemonic devices and guidelines. Unlike many other native peoples of the Americas, the Inca had nothing we would normally recognize as maps, but for route finding they seem to have relied on patterns formed by conspicuous shrines called *huacas* and lines laid along ridges where armies and pilgrimages passed; these were perhaps recorded in woven artifacts.⁴⁶ In northeastern North America, wampum could successfully be used to map routes—including, ac-

ording to the relation of the Jesuit François Le Mercier of 1652–53, lakes, rivers, mountains, portages, and waterfalls, so that "no one may get lost."⁴⁷ This raises the presumption that *quipu* (*kipu*) could also have been exploitable for similar purposes.⁴⁸ In the colonial period, peoples of Tahuantinsuyu could respond to Spanish demand for maps by making models out of "clay, pebbles, and sticks." If early colonial traditions can be trusted, this ephemeral mapping had preconquest ritual precedents.⁴⁹

A similar question might be raised—though not, in the present state of knowledge, answered—about the input of Asian cartographies into the work of European explorers. According to an admittedly late tradition, Vasco da Gama's Muslim pilot drew "a chart of India in the fashion of the Moors," with "meridians and parallels," and another indigenous map was obtained from the Samorin of Calicut.⁵⁰ The vague and speculative outline of Japan in European maps was transformed in 1580, when Jesuit mapmakers worked with indigenous models. Even in places where indigenous cartographic traditions are not represented by surviving maps, the dependency of

38. Lewis, "Maps, Mapmaking, and Map Use," 69.

39. Harley, "Cartography and the Native Americans," 291–93, and Samuel de Champlain, *The Works of Samuel de Champlain*, 6 vols., ed. Henry P. Biggar (Toronto: Champlain Society, 1922–36), 1:335–36.

40. Lewis, "Maps, Mapmaking, and Map Use," 95.

41. Mark Warhus, *Another America: Native American Maps and the History of Our Land* (New York: St. Martin's, 1997); Lewis, "Maps, Mapmaking, and Map Use"; and Vollmar, *Indianische Karten Nordamerikas*.

42. Adam Szaszdi Nagy, *Un mundo que descubrió Colón: Las rutas del comercio prehispánico de los metales* (Valladolid: Casa-Museo de Colón, Seminario Americanista de la Universidad de Valladolid, 1984), esp. 26–51.

43. Adam Szaszdi Nagy, *Los guías de Guanahani y la llegada de Pinzón a Puerto Rico* (Valladolid: Casa-Museo de Colón, Seminario Americanista de la Universidad de Valladolid, 1995), 7 and 14.

44. Las Casas, *Historia de las Indias*, 1:324–25 (bk. 1, chap. 74).

45. See, for example, Lewis, "Maps, Mapmaking, and Map Use," 52–53.

46. William Gustav Gartner, "Mapmaking in the Central Andes," in *HC 2.3:257–300*, esp. 265–68.

47. Lewis, "Maps, Mapmaking, and Map Use," 89.

48. Compare Gartner, "Mapmaking in the Central Andes," 289–94.

49. Gartner, "Mapmaking in the Central Andes," 285.

50. João de Barros, *Ásia, de João de Barros: Dos feitos que os portugueses fizeram no descobrimento e conquista dos mares e terras do Oriente*, 6th ed., 4 vols., ed. Hernâni Cidade (Lisbon: Divisão de Publicações e Biblioteca, Agência Geral das Colónias, 1945–46), 1:151–52; Jerry Brotton, *Trading Territories: Mapping the Early Modern World* (London: Reaktion Books, 1997), 81; and Francis Romeril Maddison, "A Consequence of Discovery: Astronomical Navigation in Fifteenth-Century Portugal," in *Studies in the Portuguese Discoveries, I: Proceedings of the First Colloquium of the Centre for the Study of the Portuguese Discoveries*, ed. T. F. Earle and Stephen Parkinson (Warminster, Eng.: Aris and Phillips with the Comissão Nacional para as Comemorações dos Descobrimientos Portugueses, 1992), 71–110, esp. 71–72.

European explorers is indicated by references in their own accounts. In what we think of as the late Middle Ages, Javanese maps were clearly of great practical utility. The extraordinary fidelity with which Francisco Rodrigues mapped the coasts between the Bay of Bengal and the Banda Sea, on slight acquaintance, would be inexplicable save by reference to indigenous maps, and the early Portuguese maps of eastern seas can safely be assumed to incorporate information from them. In 1512, a Javanese map that was said to include information from Chinese maps or sailing directions was dispatched to the court of Portugal by Afonso de Albuquerque, who called it “the best thing I have ever seen.” It was lost in a shipwreck in 1513. On his way to China, Tomé Pires saw local charts of the route to the Moluccas “many times.”⁵¹ It is tempting to try to reconstruct speculatively the Javanese mapmakers’ image of their world; any such enterprise would be fraught with the perils of speculation, but it is at least worth considering one possibility so far neglected: that the early cartography of “Java la Grande”—inasmuch as it reproduces a convincing image of part of the north coast of Australia—reflects Javanese tradition rather than European experience or inference.⁵²

EXPLORERS AS MAPMAKERS

TECHNICAL PROBLEMS

The difficulty of translating explorers’ reports into mapmakers’ codes was not just conceptual; it was also practical. The wit who once said of Columbus that “when he set off he did not know where he was going, when he arrived he did not know where he was, and when he got back he did not know where he had been” might have been speaking, with pardonable exaggeration, of most early modern explorers. To know where you are in the world means, in practice, being able to find your way back there; you have to fix your position, with something approaching reliability, in relation to at least one other known point. For that, you need either a grid of reference and a method for establishing your position on it or reliable devices for finding direction and for recording distance. None of these prerequisites was available to Europeans at the start of this period, and they developed only slowly and insufficiently during the course of it.

It may be useful to make some modifications to the tenacious orthodox view that exploration and the rise of science were closely connected phenomena of the early modern period in Europe. Some overlap between these two themes of the history of the time is undeniable. Exploring was an activity in which empirical observation was paramount: it was committed to a distinctly scientific epistemology; its results included the revision of written authority; and its findings fed into an increasingly realis-

tic, accurate, and therefore, in a sense, scientific world picture.⁵³ Most explorers, however, had little interest in or knowledge of science—even of the sciences of astronomy, navigation, and surveying and the related technologies, which seem to have been most relevant to their activities; those who professed such knowledge or interest have often appeared, on close inspection—to us as to contemporary critics—as ignorant, mendacious, or pretentious.⁵⁴ Columbus intimidated his crews by effecting the role of a savant or even a magus, but there is no evidence that he used even the simple quadrant he carried with him, except for show. He reckoned latitude by almost the crudest of means: he calculated the hours of daylight by using the movement of the guide stars around Polaris to measure the duration of the night in hours, then subtracted that number from twenty-four. He then compared the results with a printed table.⁵⁵ Amerigo Vespucci’s observations of the southern sky are interesting, but his status as a scientific navigator is no more secure than his right to any of the other achievements he claimed.⁵⁶ The stress placed on the rise of scientific navigation in traditional Portuguese historiography may have been somewhat exaggerated by national pride:⁵⁷ we

51. Armando Cortesão, ed. and trans., *The Suma Oriental of Tomé Pires . . . and The Book of Francisco Rodrigues . . .*, 2 vols. (London: Hakluyt Society, 1944; reprinted Nendeln, Liecht.: Kraus, 1967), 1:lxviii and 211; Heinrich Winter, “Francisco Rodrigues’ Atlas of ca. 1513,” *Imago Mundi* 6 (1949): 20–26; and Brotton, *Trading Territories*, 81–82. For other early references to Javanese cartography, see Joseph E. Schwartzberg, “Introduction to Southeast Asian Cartography,” and “Southeast Asian Geographical Maps,” in *HC* 2.2:689–700, esp. 690 and 697, and 741–827, esp. 766–76.

52. On Java la Grande, see Helen Wallis, “Java la Grande: The Enigma of the Dieppe Maps,” in *Terra Australis to Australia*, ed. Glyndwr Williams and Alan Frost (Melbourne: Oxford University Press, 1988), 38–81; W. A. R. Richardson, *The Portuguese Discovery of Australia: Fact or Fiction?* (Canberra: National Library of Australia, 1989); and Glyndwr Williams, “‘Java la Grande’: Still More Questions than Answers” (paper presented at the symposium *Cartography in the European Renaissance*, Madison, Wisconsin, 7–8 April 2000).

53. Onésimo Teotónio Almeida, “Portugal and the Dawn of Modern Science,” in *Portugal, the Pathfinder: Journeys from the Medieval toward the Modern World, 1300–ca. 1600*, ed. George D. Winias (Madison: Hispanic Seminary of Medieval Studies, 1995), 341–61.

54. E. G. R. Taylor, *The Haven-Finding Art: A History of Navigation from Odysseus to Captain Cook* (London: Hollis and Carter, 1956), 181 and 199.

55. Rolando A. Laguarda Trías, *El enigma de las latitudes de Colón* (Valladolid: Casa-Museo de Colón, Seminario de Historia de América de la Universidad de Valladolid, 1974), 5.

56. Morison, *Southern Voyages*, 294–97.

57. Portuguese traditions on this matter can be followed in A. Fontoura da Costa, *A marinaria dos descobrimentos*, 3d ed. (Lisbon: Agência Geral do Ultramar, 1960); Almeida, “Dawn of Modern Science”; Luís de Albuquerque, *Introdução à história dos descobrimentos* (Coimbra: Atlântida, 1962); idem, “Astronomical Navigation,” in *History of Portuguese Cartography*, by Armando Cortesão, 2 vols. (Coimbra: Junta de Investigações do Ultramar-Lisboa, 1969–71),

know of no readings of even remote accuracy made at sea with latitude-finding instruments in the sixteenth century and, as we shall see, remarkably few instances of explorers who were interested in making maps—even rough sketch maps, let alone measured documents disciplined by high standards of quantification and checked by such surveying techniques as were available at the time. Against these facts, claims that Portuguese navigators used scientific instruments as early as the time of Henry the Navigator appear incredible.⁵⁸ In late sources, Vasco da Gama is said to have carried a quadrant or mariner's astrolabe, but the only observations alleged to have been made by him were on land.⁵⁹

The poverty of sixteenth-century technology in this respect can hardly be overemphasized. According to Columbus, the navigator's art resembled prophetic vision.⁶⁰ For William Bourne, it was little better than guesswork.⁶¹ The surveying techniques that made accurate scale mapping and chartmaking possible were, in great part, developments of the seventeenth century, and most of the essential instruments were unavailable to explorers for most of this period. The telescope, the telescope-enhanced quadrant, the filar micrometer, the pendulum used as a standard of linear measurement—all these were seventeenth-century inventions. Before the application of triangulation—a technique explorers did not practice, as far as we know, until well into the seventeenth century—distances could only be estimated, even on land. At sea, such estimates depended for corroboration on techniques of very rough approximation: use of the log line and the sand clock. Although seasoned navigators had skills we have now lost and could make impressive judgments of relative latitude by observing the sun or the Pole Star with the naked eye,⁶² the only available technical aid for estimating latitude was the mariner's astrolabe or simplified versions of it, such as the quadrant and back staff. Refinements made before the 1620s added only marginally to the precision and reliability of the results.⁶³ Although the numbers of mariner's astrolabes and substitute devices grew in the sixteenth century and improvements were made that clearly reflect the seaman's needs, they never lost the connotations of rare arcana.⁶⁴

It is hardly necessary to add that the calculation of longitude was beyond the science of the time, even when practiced by the best-qualified experts in the privileged conditions on shore.⁶⁵ The quest for longitude resembled other Faustian yearnings of the age, such as the search for the philosopher's stone, the fountain of youth, the squared circle, and the secrets of hermetic tradition. Apart from estimation of distance traversed—a method subject to an alarming accumulation of error—the most commonly used shipboard method in the sixteenth century, recommended at some length in Alonso de Santa Cruz's *Libro de las longitudes*, was based on the erro-

neous assumption that longitude was related to magnetic variation;⁶⁶ the effect was to compound error. The accurate reading William Baffin obtained at sea in 1615, using the lunar distance method, stands out for its precocity. Even the improved range of possibilities that opened up in the seventeenth century, thanks to the development of the telescope, was effectively impossible to achieve on shipboard.

The best way to retrace a route on the open sea was to feel one's way along familiar winds—to navigate, as André Thevet said, “under the tutelage of the winds.”⁶⁷ The oceans were composed of wind corridors, to which most early modern navigation was confined: the Atlantic “triangle” of trade (better understood as a sort of ovoid); the monsoon routes of the Indian Ocean; the seaways around them, along the roaring forties, the west Australia current, and the southeast trades; and the remarkably restricted transpacific routes, beyond which—once the nature of the wind system had been established, slowly and painstakingly, by a series of Spanish voyages between 1520 and 1565—few explorers ventured. On the open

2:221–442; idem, *Curso de história da náutica* (Coimbra: Livraria Almedina, 1972); and chapter 38 in this volume. On the general problems of deploying the term “scientific” in this context, see Derek J. de Solla Price, “Philosophical Mechanism and Mechanical Philosophy: Some Notes towards a Philosophy of Scientific Instruments,” *Annali dell'Istituto e Museo di Storia della Scienza di Firenze* 5 (1980): 75–85, and Deborah Jean Warner, “What Is a Scientific Instrument, When Did It Become One, and Why?” *British Journal for the History of Science* 23 (1990): 83–93.

58. P. E. Russell, *Prince Henry “The Navigator”: A Life* (New Haven: Yale University Press, 2000), 236–38.

59. Barros, *Ásia*, 1:135, and Francis Romeril Maddison, “On the Origin of the Mariner's Astrolabe,” *Sphaera Occasional Papers*, no. 2 (1997), esp. 5.

60. Columbus, *Textos*, 325.

61. William Bourne, *A Regiment for the Sea and Other Writings on Navigation*, ed. E. G. R. Taylor (Cambridge: Cambridge University Press, 1963), 294.

62. Paul Adam, “Navigation primitive et navigation astronomique,” in *Les Aspects internationaux de la découverte océanique aux XV^e et XVI^e siècles: Actes du cinquième colloque international d'histoire maritime* (Paris: S.E.V.P.E.N., 1966), 91–111. Pedro de Medina's *Libro de cosmographia* of 1538 describes how to sail by the sun alone “if a pilot on the ocean were to lose his chart and compass”; see Pedro de Medina, *A Navigator's Universe: The Libro de Cosmographia of 1538*, trans. and intro. Ursula Lamb (Chicago: Published for the Newberry Library by the University of Chicago Press, 1972), 131–34 and 200–201.

63. Costa, *A marinaria dos descobrimentos*, 18–35 and 263–371.

64. Alan Stimson, *The Mariner's Astrolabe: A Survey of Known, Surviving Sea Astrolabes* (Utrecht: HES, 1988), and *The Planispheric Astrolabe* (Greenwich: National Maritime Museum, 1979), 42.

65. David C. Goodman, *Power and Penury: Government, Technology and Science in Philip II's Spain* (Cambridge: Cambridge University Press, 1988), 53–72.

66. Costa, *A marinaria dos descobrimentos*, 147–57.

67. André Thevet, *La cosmographie universelle*, 2 vols. (Paris: Chez Guillaume Chandiere, 1575), 2:907.

sea, navigators' mental maps were schematic and diagrammatic; the real relationships between places were of little relevance to the problems of navigation. This way of conceptualizing the seafarers' task is embodied in the tradition of the portolan chart. In the treatment of oceanic space, portolan charts' representation of relative distance seems distorted, because it reflects the navigator's quantifiable priority, what Chaunu called "temp-distance"—how long it takes to get from one port to another; here, too, the crisscross pattern of the wind rose seems to crowd out any notion of a grid, but only because direction-finding technology was more reliable than any of the available means for determining longitude and even latitude. Conceptually, the portolan chart was closer to the London Underground map than to a scale image; though capable of rendering coastlines with remarkable accuracy, it conveyed no real impression of distance across the open sea outside the Mediterranean and other seas similarly enclosed or nearly enclosed.⁶⁸ Similar distortions tended to affect maps compiled on the basis of seafarers' reports.

In partial consequence, even explorers who used maps as guides rarely thought of making maps themselves to guide followers in their wakes. It might be rash to put much faith in the tradition that Columbus was a chart-maker by trade or that he had, jointly with one of his brothers, a business that dealt in maps.⁶⁹ Yet, because his use—at least—of maps is well attested, it would be consistent for him to make some of his own. Moreover, he was explicitly commissioned by the Spanish monarchs, his patrons, to map his discoveries;⁷⁰ yet there is no evidence that he ever did so, despite his repeated promises.⁷¹ The only map ascribed to Columbus that illustrates any part of his discoveries is now known for certain to be a

forgery.⁷² Though his subordinate commander, Alonso de Hojeda, and a number of other witnesses reported the existence of a map showing the discoveries of Columbus's voyage to Paria in 1498, the map seems not to have been made by Columbus himself.⁷³ The maps attributed to his brother have never commanded much scholarly credence. The only generally accepted map from the hand of one of his shipmates, which seems to reflect real experience of his voyages, is the world map usually identified as the work of Juan de la Cosa, the "maestro de haser cartas" who shipped on Columbus's second Atlantic crossing.⁷⁴ (The map is figure 30.9 in appendix 30.1, which lists and illustrates pre-1530 manuscript maps of the new and old worlds, figs. 30.9–30.31). Questions have been raised concerning the authenticity even of this work. Its documented history goes back no further than the Paris bookshop where Baron Charles-Athanase Walckenaer was said to have bought it prior to 1832, when Alexander von Humboldt verified it—indeed, by his own account, correctly identified it for the first time—in the baron's

68. On the problems of determining accuracy, see Jonathan T. Lanman, *On the Origin of Portolan Charts* (Chicago: Newberry Library, 1987), 11–51.

69. The earliest sources on these matters—Las Casas's *Historia de las Indias* (1:161–64 [bk. 1, chap. 30]), and *Le historie della vita e dei fatti di Cristoforo Colombo*, attributed to Fernando Colón (see the edition in 2 vols., ed. Rinaldo Caddeo [Milan: Edizioni "Alpes," 1930], 1:96)—appear to be making inferences rather than stating facts; for a detailed discussion, see Juan Manzano Manzano, *Cristóbal Colón: Siete años decisivos de su vida, 1485–1492* (Madrid: Ediciones Cultura Hispánica, 1964), 135–42.

70. Martín Fernández de Navarrete, *Colección de los viajes y descubrimientos que hicieron por mar los españoles desde fines del siglo XV*, 5 vols. (Buenos Aires: Editorial Guaranía, 1945–46), 1:353, 357, and 363–64.

71. There are three or four possible indications to the contrary, though they can inspire little confidence. First, a claim, purportedly by Columbus, that he had made such a map is advanced in Antonio Rumeu de Armas, ed., *Libro copiadador de Cristóbal Colón*, 2 vols. (Madrid: Testimonio Compañía Editorial, 1989), 2:451–52, but this document, which is alleged to be an eighteenth-century copy of previously unpublished writings of Columbus, appeared, with no published provenance

or history, in a bookseller's hands just in time to command a high price in the prequicentennial excitement. Though it was widely welcomed by scholars, its inconsistencies with other, better-authenticated, materials make it highly suspect. Second, Las Casas, describing Columbus's efforts to find Hispaniola on his second voyage across the Atlantic in *Historia de las Indias*, 1:353 (bk. 1, chap. 84), speaks of interrogations addressed to natives on the island of Puerto Rico: "By means of signs, they were also asked for the whereabouts of Hispaniola, which in the language of that island and of those nearby was called Haytí, with the last syllable stressed; they pointed in the direction where it lay; and although the Admiral, according to his *carta* concerning the first discovery, understood, and could go directly there, he nevertheless was content to hear from them of its situation relative to his position." The context perhaps suggests that *carta* here means "map," but it is not clear how such a map, had it existed, would have helped Columbus, who was now in an area he had never visited before, except to confirm what he would have inferred anyway, that Hispaniola was roughly to the northwest. The fact that Columbus, at the time of his departure on his second voyage, had not yet made a map of his discoveries is confirmed by the requests that he do so that the monarchs continued to address to him. These requests continued until within a few days of Columbus's departure and resumed thereafter. Las Casas may therefore be presumed to have been misled by Columbus's repeated references to his intention—unfulfilled, as far as we know—to make such a map. The shipmate of Columbus's second voyage, Michele Cuneo, reported seeing many islands, "all of which the Lord Admiral made him put clearly on a chart." If this were really so, however, the map would subsequently have been presented to the monarchs in fulfillment of their demands or its loss excused. Finally, Piri Re'is is said to have had access to a map made by Columbus (discussed later).

72. Christopher Columbus, *The Log of Christopher Columbus*, trans. Robert Henderson Fuson (Camden, Maine: International Marine, 1987), 9.

73. HARRISSE, *Discovery of North America*, 408–10.

74. Juan Gil and Consuelo Varela, eds., *Cartas de particulares a Colón y relaciones coetáneas* (Madrid: Alianza Editorial, 1984), 219. On Juan de la Cosa, see Antonio Ballesteros Beretta, *La marina cántabra y Juan de la Cosa* (Santander: Diputación Provincial, 1954), 129–402.

library.⁷⁵ It evinces puzzling inconsistencies that have never been fully explained: the depiction of Cuba as an island, the continuous nature of the North American landmass, the realistic trend of its coast from southwest to northeast, the erratic position of the single meridian, the inconsistencies of style and scale in the depiction of the two hemispheres and the way the relationship between them is depicted, the extent of recorded explorations along the South American coast, the ambiguity concerning the possible existence of a strait in Central America, and the inclusion of what look like data derived from Cabot's voyage of 1497, undocumented elsewhere. And the identity of the purported author is problematic. These are not in themselves strong enough reasons to reclassify the map as inauthentic, but they illustrate the elusiveness of certainty in this field.⁷⁶

Until well into the seventeenth century, the rutter seems to have prevailed over the chart as the form in which seamen liked to obtain navigational information; in many recorded cases, this was also the form in which explorers preferred to collect it. The portolan charts of the Middle Ages, which survive in near-abundance, may not have been much used by navigators, whose traditional preference, established before portolan charts became available, was for written sailing directions. The history of the development of the sea chart is so obscure that we cannot even be sure that this type of document was developed for mariners' purposes; it may have been a visual aid to illustrate—for the enlightenment of passengers, landlubbers, and such interested parties as merchants—the data pilots preferred to carry in their heads or in rutters.⁷⁷ The prejudice in favor of rutters was tenacious. This was the form in which Portuguese surveys of the West African coast were collated in 1508 by Duarte Pacheco Pereira and those of Brazil by João de Lisboa before 1519 and again in the early 1530s by Pero Lopes de Sousa.⁷⁸ A document of the same kind, newly issued in Portugal and showing the coast of Brazil and the South American cone, seems to have been carried aboard the *Pelican* when Sir Francis Drake set off on his round-the-world mission in 1578, though he had at least one real map as well (a world map purchased in Lisbon).⁷⁹ Spanish pilots in the New World were issued similar documents, perhaps in preference to coastal charts.⁸⁰ The coastal surveys of much of the eastern seaboard of North America by Verrazano and Estevão Gomes in 1524–25 were recorded in rutters, not maps, though they were converted into visual aids by cartographers shortly afterward.⁸¹ In 1538–41, João de Castro, who was a first-rate draftsman capable of making accurately estimated drawings of harbors and coastal features and who was highly skilled in the use of the astrolabe, recorded his digest for navigators on the sea route to India in the form of rutters. Even Lucas Jansz. Waghenauer's *Spiegel der zeevaerdt* of 1584—a work that did much to recommend the serviceability of charts

for the coasts of Europe from Zeeland to Andalusia—still contained sailing instructions in traditional form, and Waghenauer's charts are characterized by one of their most assiduous students as “mere sketches.”⁸² Thevet's “Le

75. Alexander von Humboldt, “Ueber die ältesten Karten des Neuen Continents und den Namen Amerika,” in *Geschichte des Seefahrers Ritter Martin Behaim*, ed. Friedrich Wilhelm Ghillany (Nuremberg: Bauer und Raspe, Julius Merz, 1853), 1–12, esp. 1. Alexander von Humboldt, in *Examen critique* (1:xxiii), a work apparently conceived in part as a showcase for the recently discovered Juan de la Cosa map, said he recognized it for what it was, jointly with Walckenaer.

76. For summaries of the evidence and of scholarly opinion, which has generally been formulated on the assumption that the map is genuine, see George E. Nunn, *The Mappemonde of Juan de la Cosa: A Critical Investigation of Its Date* (Jenkintown, Pa.: George H. Beans Library, 1934); Ballesteros Beretta, *Marina cántabra*, 233–46; Arthur Davies, “The Date of Juan de la Cosa's World Map and Its Implications for American Discovery,” *Geographical Journal* 142 (1976): 111–16; and the most skeptical inquiry, Bernard G. Hoffman, *Cabot to Cartier: Sources for a Historical Ethnography of Northeastern North America, 1497–1550* (Toronto: University of Toronto Press, 1961), 87–97. Hugo O'Donnell, in “El mapamundi denominado ‘carta de Juan de la Cosa’ y su verdadera naturaleza,” *Revista General de Marina*, número especial, 3 (1991): 161–81, argues for composite authorship. Ricardo Cerezo Martínez, in “La carta de Juan de la Cosa (y III),” *Revista de Historia Naval* 12, no. 44 (1994): 21–37, and idem, *La cartografía náutica española en los siglos XIV, XV y XVI* (Madrid: C.S.I.C., 1994), answers some, but not all, of the arguments raised concerning the map's consistency. He also reveals (“La carta,” 32, and *La cartografía*, 116) that an examination of the map under infrared and ultraviolet light has been conducted at the Museo del Prado, revealing—in the only passage the writer quotes from a report dated 6 December 1987—“great consistency” (*gran homogeneidad*) of style and type of pigment throughout the map and “nothing out of the ordinary” (*ninguna cosa extraña*). A copy of the text of this report has reached me thanks to the kindness of María Luisa Martín Merás of the Museo Naval; it reveals nothing inconsistent with early sixteenth-century techniques and consistency in the pigments used in different parts of the map. A further contribution by Angel Paladini Cuadrado, “Contribución al estudio de la carta de Juan de la Cosa,” *Revista de Historia Naval* 12, no. 47 (1994): 45–54, argues suggestively but inconclusively for consistency of scale throughout the map.

77. Felipe Fernández-Armesto, “Introduction,” in *Questa e una opera necessaria a tutti li naviga[n]ti* (1490), by Alvise Cà da Mosto (Delmar, N.Y.: For the John Carter Brown Library by Scholars' Facsimiles and Reprints, 1992), 7–19, esp. 8–9. Compare Tony Campbell, “Portolan Charts from the Late Thirteenth Century to 1500,” in *HC* 1: 371–463, esp. 440. See also chapters 7 and 20 in this volume.

78. C. R. Boxer, “Portuguese Roteiros, 1500–1700,” *Mariner's Mirror* 20 (1934): 171–86.

79. E. G. R. Taylor, “The Dawn of Modern Navigation,” *Journal of the Institute of Navigation* 1 (1948): 283–89, and Richard Boulind, “Drake's Navigational Skills,” *Mariner's Mirror* 54 (1968): 349–71.

80. 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).

81. David B. Quinn, “The Early Cartography of Maine in the Setting of Early European Exploration of New England and the Maritimes,” in *American Beginnings*, 37–59, esp. 40–45.

82. C. Koeman, *Miscellanea Cartographica: Contributions to the History of Cartography*, ed. Günter Schilder and Peter van der Krogt (Utrecht: HES, 1988), 59.

grand insulaire et pilotage,” which he was compiling at the same time, was a book of charts and rutter combined.⁸³

Nor was the preference for rutters irrational; they could provide vital information that surviving sea charts of this period rarely or never carried, concerning, for example, currents, winds, hidden hazards, landmarks, depths, anchorages, port facilities, and the nature of the sea bed. Hydrography was still in its infancy, and for coastal navigation charts could be dangerously misleading. In a work completed by 1545, Martín Cortés lamented the impossibility of creating reliable charts, though he clearly saw their potential.⁸⁴ In 1580, Bourne alluded to the contempt in which masters held “Cards and Plats . . . saying that they care not for their Sheepes skins.”⁸⁵ William Borough thought much the same of foreign charts.⁸⁶ By 1594, John Davis considered a chart, together with a cross staff and compass, the indispensable equipment of a navigator, but admitted that, except for short voyages unaffected by the unsolved problems of cartography, “a Chart doth not expresse that certaintie of the premisses which is thereby pretended to bee given.”⁸⁷ Except in a very approximate fashion, on long voyages charts could not help mariners establish their course, because of magnetic variation, or determine their position on a grid, because of the difficulty of finding and representing lines of latitude and longitude. Efforts to represent magnetic variation made maps unusable; in the 1540s, Diego Gutiérrez produced surviving charts for the Atlantic that duplicated gradations of latitude, including the equator and the tropics, to a chorus of affected indignation from other mapmakers. His seems to have been a fairly common technique.⁸⁸ Charts could, of course, illustrate and complement rutters, but it was a long time before they could serve as replacements for them.

Soundings, which were the items of information that pilots most wanted on unfamiliar shores, began to appear on charts only around 1570; the practice of recording soundings was very slow to become generalized, spreading from the English Channel to the North Sea, the Baltic, and the Atlantic coasts of Europe generally in the 1580s and 1590s but not appearing on charts of coasts in regions of exploration until the Dutch introduced the practice with charts compiled on the basis of Cornelis de Houtman’s voyage to the East in 1595–97 (fig. 30.3). It gradually became general practice in the seventeenth century—for instance, in Portuguese charts of Brazil in 1610 and in charts of the Gulf of Cambay in 1616—and grew rapidly thereafter.⁸⁹ The inclusion of coastal profiles followed a similar course.⁹⁰

For all these reasons, from the point of view of the navigator and therefore, *a fortiori*, of all seaborne explorers, charts were not particularly user-friendly ways of recording information at the start of this period. They became so only very gradually, and relatively late, as their accu-

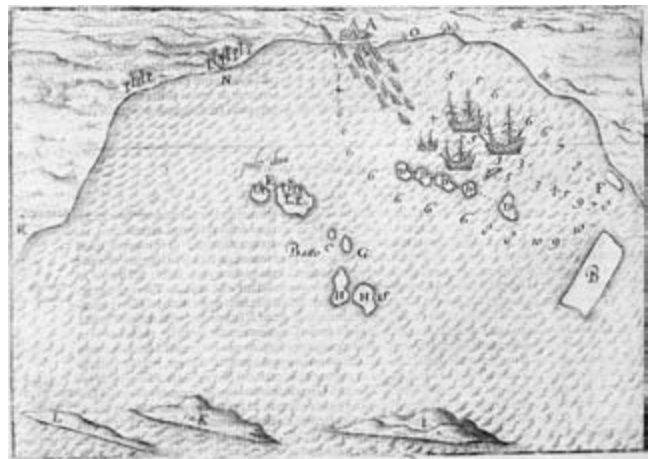


FIG. 30.3. EARLY EXAMPLE OF THE INCLUSION OF INFORMATION ON SOUNDINGS. The complete logbook of the first voyage of Cornelis de Houtman was published by Cornelis Claesz. in 1598. It contained several maps with soundings recorded, including the one shown here depicting the fleet’s arrival at Bantam.

Size of the original: 24 × 34 cm. Willem Lodewijksz., *Prima pars descriptionis itineris navalis in Indian Orientalem . . .* (Amsterdam, 1598), 20a. Photograph courtesy of Special Collections and Rare Books, Wilson Library, University of Minnesota, Minneapolis.

racy increased. Not until after 1600, when Edward Wright had worked on the basis constructed by Mercator and popularized the results, was a consistent projection available that was suitable to the needs of mariners—though not necessarily conformable to their desires.⁹¹

The early seventeenth century was a transitional period, when the chart began to take over the role of the rutter and to become an indispensable navigator’s aid. As

83. Frank Lestringant, *Mapping the Renaissance World: The Geographical Imagination in the Age of Discovery*, trans. David Fausset (Cambridge: Polity Press, 1994), 106.

84. Martín Cortés, *Breue compendio de la sphaera y de la arte de nauagar con nuevos instrumentos y reglas . . .* (Seville: Anton Aluarez, 1551; English ed., 1561), pt. 3, chaps. 2, 6, and 13.

85. Bourne, *Regiment for the Sea*, 294, second address to the reader.

86. See p. 1735 in this volume.

87. John Davis, *The Seaman’s Secrets (1633)* (Delmar, N.Y.: For the John Carter Brown Library by Scholars’ Facsimiles and Reprints, 1992), pt. 1, G2.

88. Ursula Lamb, “Science by Litigation: A Cosmographic Feud,” *Terrae Incognitae* 1 (1969): 40–57.

89. Marcel Destombes, “Les plus anciens sondages portés sur les cartes nautiques aux XVI^e et XVII^e siècles: Contribution à l’histoire de l’océanographie,” *Bulletin de l’Institut Océanographique, Monaco*, special no. 2 (1968): 199–222.

90. Koeman, *Miscellanea Cartographica*, 53.

91. Lloyd Arnold Brown, *The Story of Maps* (Boston: Little, Brown, 1949), 136–37, and John Parr Snyder, *Flattening the Earth: Two Thousand Years of Map Projections* (Chicago: University of Chicago Press, 1993), 43–49.

late as 1622—by which date it was normal for designated chartmakers to accompany exploring missions—Portuguese navigators used the rutter format to keep their instructions for route finding between Nagasaki and various ports in China and Southeast Asia.⁹² Yet, by that date, not only were the Portuguese producing serviceable charts of the seas around Japan for shipboard use, but Dutch navigators were also making an attempt to map the archipelago's coasts as they traversed them⁹³ as part of a systematic campaign to chart all the waters their shipping frequented.⁹⁴ This phenomenon, which might be called “the rise of the chart,” affected and was affected by seaborne exploration; as well as an aid to navigation, the chart had at last become the standard form in which new information was recorded.

THE RECORD OF PRACTICAL ACHIEVEMENT

Even explorers who were genuinely accomplished in cartography, such as Sebastian Cabot, Alonso de Santa Cruz, Andrés de Urdaneta, John Davis, and Guillaume Le Testu, are not known to have made maps during voyages. The work attributed to Sebastian Cabot, though generally incompetent, can be well informed where it copies other maps or information from written narratives, yet it is remarkably deficient in knowledge of expeditions on which the mapmaker sailed.⁹⁵ Santa Cruz passed the information he gathered in Cabot's company to Alonso de Chaves “by word of mouth.”⁹⁶ As a mapmaker, Le Testu was servile to tradition and tried to include everything heard from report or attested by authority. To some extent, the dearth of surviving maps and charts made during voyages may be a trick of the evidence. The maps that have survived are, for the most part, in two categories: those that were made and embellished at home, with decorative intent, for presentation or sale to rich patrons, and those that were printed for wide circulation. Absence of evidence is not evidence of absence, and it is not unreasonable to say that such utilitarian or well-used maps as did exist would probably have had a relatively low survival rate. Witnesses in lawsuits—not perhaps the most reliable source of testimony from historians' point of view—asserted that numerous Spanish explorers of the early sixteenth century obeyed their instructions to map their discoveries. Such maps were said to have been made on voyages by Vicente Yáñez Pinzón, Diego de Lepe, Alonso Vélez de Mendoza, Rodrigo de Bastidas, and others,⁹⁷ and the possibility that they really existed should not be discounted. Yet historians who insist, in default of evidence, on what would have happened or what must have been so are in danger of substituting obstinacy for imagination. Scholarship has to navigate between the Scylla of skepticism and the Charybdis of credulity.

It is possible to draw up a tentative list of exploring

ventures for which there is sound evidence that the explorers did make maps, because the maps themselves, or sketches for them, have survived; because their existence is reliably reported; or because the originals were credited by cartographers who copied them. Such a list can be supplemented with other expeditions about which presumptions in favor of mapmaking have been made but are more risky. The resulting catalog is small, but it shows gradually increasing activity and gradually increasing accuracy until mapping and chartmaking became established routines on exploring ventures in the seventeenth century.

Except where indigenous prototypes were available, the earliest surviving efforts at mapping by explorers seem feeble and amateurish. Once dubious or inauthentic material is excluded, no map or anything that might be called a map has survived from any exploring venture until near the end of the second decade of the sixteenth century. The sketch of the Caribbean (ca. 1520)—known, from the name of the expedition's patron, as the Pineda map—was obviously intended not to be of any practical help to a navigator in the Gulf of Mexico, but merely to convey to lay eyes a general impression of an immense, roughly circular gulf with the Yucatán Peninsula intruding from one side and an etiolated shape, intended to represent Cuba, from the other (see fig. 41.6). Indeed, a version of it was reproduced with just such a lay public in mind in an early edition of one of Cortés's reports. In spite of the fact that Cortés had access to Aztec maps, including what he reported as “a cloth with all the coast painted on it,”⁹⁸ his sketch simply reproduces Garay's, with one inauspicious modification: Yucatán is shown as an island.⁹⁹ Cortés's plan of Tenochtitlán (though presumably

92. C. R. Boxer, “Some Aspects of Portuguese Influence in Japan, 1542–1640,” *Transactions and Proceedings of the Japan Society of London* 33 (1936): 13–64, esp. 25–26.

93. See the sketch in Spate, *Monopolists and Freebooters*, 40.

94. F. C. Wieder, ed., *Monumenta Cartographica: Reproductions of Unique and Rare Maps, Plans and Views in the Actual Size of the Originals*, 5 vols. (The Hague: Martinus Nijhoff, 1925–33), vol. 1.

95. Henry Harrisse, *Sébastien Cabot, pilote-major d'Espagne: Considéré comme cartographe* (Paris: Institut Géographique de Paris, Ch. Delagrave, 1897).

96. Gonzalo Fernández de Oviedo, *Historia general y natural de las Indias*, 5 vols., ed. Juan Pérez de Tudela Bueso (Madrid: Ediciones Atlas, 1959), 2:307. Oviedo also had information from Santa Cruz in the form of what he called a *relación*, which seems from his handling of it to have included a rutter.

97. Harrisse, *Discovery of North America*, 416–19.

98. Hernán Cortés, *Letters from Mexico*, ed. and trans. Anthony Pagden (New York: Grossman, 1971), 94.

99. Vollmar, *Indianische Karten Nordamerikas*, 26; Cumming, Skelton, and Quinn, *Discovery of North America*, 68; Michel Antochiw, *Historia cartográfica de la península de Yucatán* ([Mexico City]: Centro de Investigación y de Estudios Avanzados del I.P.N., 1994), 93–95.

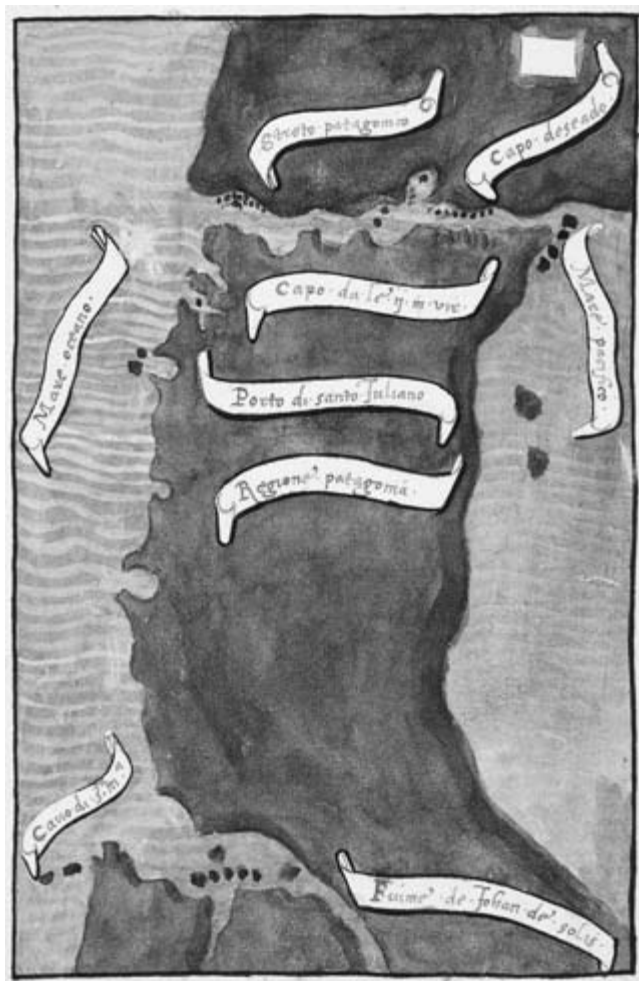


FIG. 30.4. ANTONIO PIGAFETTA'S SKETCH OF THE STRAIT OF MAGELLAN. Manuscript from Pigafetta's journal.

Size of the original: 23 × 15 cm. Photograph courtesy of the Biblioteca Ambrosiana, Milan (L103 sup, fol. 14v).

made with the aid of indigenous cartography)¹⁰⁰ is, in its surviving form, fancifully embellished with classical allusions. Another map, recording the explorations in the region of Nicaragua in 1523–24, which brought Gil González Dávila into touch with Cortés in Honduras, was mentioned convincingly in a letter of May 1524, but has not survived.¹⁰¹

At about the time of the Pineda expedition, Magellan set out on one of the most meticulously prepared of all the exploring ventures of the period. He had on board Gomes, whose experience might have qualified him to make maps; the total amount of technical and scientific expertise aboard Magellan's ships probably at least equaled that on any other expedition of the era. Yet it cannot be said that he or any of his shipmates actually used their skill to make maps during the voyage. Antonio Pigafetta certainly made an extremely crude sketch of the



FIG. 30.5. A NEAR-CONTEMPORARY COPY OF NICOLAS BARRÉ'S SKETCH OF THE FLORIDA AND SOUTH CAROLINA COASTS. The original, now lost, was presumably drawn during the 1562 expedition of Jean Ribaut; the copy was made by a Spaniard.

Photograph courtesy of the Museo Naval, Madrid (Col. Navarrete, vol. 14, fol. 459).

Strait of Magellan when he got home (fig. 30.4).¹⁰² There seem to be, however, no reasons—except sentiment and wishful thinking—to suppose that the maps that accompany a famous French presentation copy of his work derive from other sketches from his hand. Notoriously, Pigafetta's description of the route is so much at variance with that of the other surviving eyewitness report, by the "Genoese pilot," that the likelihood that Pigafetta had any relevant skills for mapmaking must be doubtful.

Alarcón, on the other hand, who led the fleet that sailed up the California coast in 1540 to complement Francisco Vázquez de Coronado's overland expedition, was an able cartographer who made charts and coastal views as he went along and was accompanied by a pilot, Domingo del Castillo, who has also been credited with a map of California.¹⁰³ In 1562, Nicolas Barré, a pilot aboard Jean Ribaut's ship on his expedition to Florida, made a sketch of the outline of the coast from San Agustín (Saint Augustine) to what became Port Royal in South Carolina; this survives in a tracing made by a Spanish agent (fig. 30.5).¹⁰⁴ Hernando Gallego could not locate the Solomon Islands in relation to the rest of the world in 1568 but was

100. Barbara E. Mundy, "Mapping the Aztec Capital: The 1524 Nuremberg Map of Tenochtitlan, Its Sources and Meanings," *Imago Mundi* 50 (1998): 11–33.

101. HARRISSE, *Discovery of North America*, 537.

102. Mateo Martinic Beros, *Cartografía magallánica, 1523–1945* (Punta Arenas: Ediciones de la Universidad de Magallanes, 1999), 16.

103. MORISON, *Southern Voyages*, 618.

104. William Patterson Cumming, "The Parreus Map (1562) of French Florida," *Imago Mundi* 17 (1963): 27–40. The tracing is now in the Museo Naval, Madrid.



FIG. 30.6. HERNANDO GALLEGO'S COASTAL CHART OF THE SOLOMON ISLANDS, 1568.

Photograph courtesy of the Biblioteca Nacional, Madrid (MSS. 2957, fol. 150r).

able to make useful and extensive charts of the coasts of six of them (fig. 30.6).

Martin Frobisher's expedition of 1576 was preceded by a lecture on cartography from Dee and equipped with an impressive array of brass instruments, maps, and blanks for making maps; all these preparations seem to have been in vain.¹⁰⁵ A shipboard origin cannot be asserted with any certainty for the sketches that accompanied George Best's 1578 account of Frobisher's search for the Northwest Passage, but they are not unrepresentative of the quality of maps explorers brought home or drew with hindsight for domestic audiences. On Francis Drake's circumnavigation expedition, Drake was said by Spanish captives to have spent almost all his time in the captain's cabin drawing the coastline and recording flora and fauna,¹⁰⁶ but the expedition was able to contribute only "barbarous cartography" in which little is recognizable.¹⁰⁷

Chartmaking was one of the major objectives of Pedro Sarmiento de Gamboa's mission through the Strait of Magellan in 1579–80. Although the primary purpose was strategic—to find a way of stoppering the strait against pirates—it was genuinely a voyage of exploration

because it was directed in part at the ill-charted or uncharted recesses of the strait and the tattered complexity of the archipelagoes off the southerly coasts of Chile. Simão Fernandes, a Portuguese pilot in the employ of Gilbert, certainly made a chart of the coasts he reconnoitered in North America in 1580. This is known by virtue of the copy made by Dee and dated 20 November of that year. It is uncertain, however, whether this was made from Fernandes's own observations or was copied from a Spanish chart. In 1582, Hugh Smyth executed "a little draught with his own hand" of the Kara Sea, which he had entered with the Muscovy Company's expedition in search of the Northeast Passage in 1580.¹⁰⁸ In 1583, Gilbert took a professional surveyor, Thomas Bavin, to St. John's, but "the cardes and plats that were drawing, with the due gradation of the harbours, bayes and capes, did perish with our Admirall."¹⁰⁹ Willem Barents's voyages of the 1590s produced charts of his route, including parts of the coast of Novaya Zemlya. An impressive chart was made by Stephen and William Borough of parts of the shores of the White and Kara Seas, but this reflected earlier experience.¹¹⁰

Even on the Roanoke voyage of 1585, which was accompanied by draftsmen as accomplished as Thomas Harriot and John White, the sketch made to accompany the expedition's first report and illustrate its anchorages was extremely haphazard. White produced one map that synthesized existing knowledge of the region of Virginia from Spanish and French maps, but went on to compile the findings of surveys undertaken under his own supervision and that of Harriot. He and Jacques Le Moyne de Morgues both worked with an engraver in mind.¹¹¹ Gosnold and Martin Pring returned from their reconnaissances of parts of the North American coast in 1602–3 and 1606 with newly sketched charts that have not survived, as far as is known, but that are the subject of allusions in other documents.¹¹²

On other seas, too, the pace of chartmaking quickened in the new century. Quirós and Luis Váez de Torres, who reconnoitered, respectively, La Australia del Espíritu Santo and the Torres Strait in 1605–7, were accom-

105. Taylor, *Haven-Finding Art*, 207–8.

106. Harry Kelsey, *Sir Francis Drake: The Queen's Pirate* (New Haven: Yale University Press, 1998), 179.

107. Spate, *Spanish Lake*, 249.

108. Skelton, *Explorers' Maps*, 108.

109. Taylor, *Haven-Finding Art*, 208.

110. Skelton, *Explorers' Maps*, 104.

111. P. H. Hulton, "Images of the New World: Jacques Le Moyne de Morgues and John White," in *The Westward Enterprise: English Activities in Ireland, the Atlantic, and America, 1480–1650*, ed. Kenneth R. Andrews, Nicholas P. Canny, and P. E. H. Hair (Liverpool: Liverpool University Press, 1978), 195–214, esp. 212–13.

112. David B. Quinn and Alison M. Quinn, eds., *The English New England Voyages, 1602–1608* (London: Hakluyt Society, 1983).

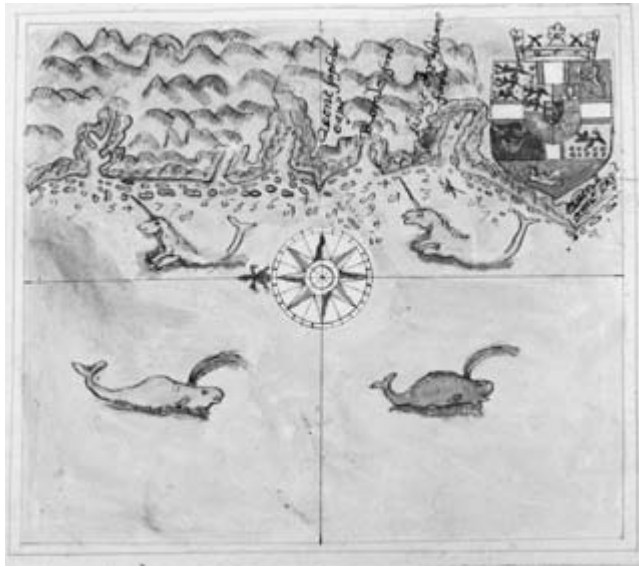


FIG. 30.7. COASTAL PROFILES OF THE WEST COAST OF GREENLAND BY JAMES HALL, CA. 1605. Size of the original: ca. 14 × 16 cm. Photograph courtesy of the BL (Royal MS. 17.A.XLVIII, fol. 10v).

plished chartmakers. James Hall, pilot of the expedition to Greenland for Christian IV of Denmark, dispatched in 1605 to search for evidence of the Old Norse colonies on that island, not only produced a series of coastal profiles but also included soundings on detailed charts of coastwise exploration northward to 68½ degrees north. They survive only in presentation copies embellished for the king's own perusal (fig. 30.7).¹¹³ Among the maps produced by English settlers in the first years of an enduring English presence in Virginia were Robert Tindall's scale charts of the navigation of the James and York Rivers undertaken by Captain Christopher Newport in 1607–8.¹¹⁴ Baffin's reliability as a chartmaker on his voyages of 1612–15, as pilot or commander, was vindicated by later work. He employed a grid. Champlain was an outstanding cartographer.¹¹⁵ Pedro Páez made only rough sketch maps in search of the source of the Blue Nile in 1618, but they became part of the detailed mapping included in the work of Manoel de Almeida.¹¹⁶

By this date, the responsibility of explorers to map their findings seems to have been widely assumed. The early seventeenth-century breakthrough in the mapping of northern Siberia and the Barents and Kara Seas is a hint of a new era; here, both Dutch and Russian expeditions seem to have been accompanied by cartographic specialists. Almost every extension of the routes navigated by Dutch vessels in the eastern Indian Ocean and the western Pacific in the early seventeenth century is documented on individual ships' charts.¹¹⁷ Thomas Blundeville's *Exercises* recommended that a mariner plot his course on a chart "that you may the more readily direct your ship

again to the place whereunto you would goe."¹¹⁸ In exploring Hudson Bay in 1631–32, Thomas James and Luke Fox evidently accepted detailed chartmaking as part of the job.

COLLATION OF EXPLORERS' INFORMATION

Along with technical deficiencies and traditional inhibitions, the absence of workable routines for transmitting and collating information delayed the convergence of exploring and mapmaking as allied activities and impeded the representation of explorers' findings on maps. The Spanish and Portuguese crowns maintained, in theory, what can be described as a cartographic service for expeditions destined for unfamiliar seas. From 1508, pilots licensed by the Casa de la Contratación in Seville were supposed to make regular returns in the form of corrections to standard-issue charts; these would, in theory, then be collated on a master map known as the *padrón real*, which it was the privilege of the pilot major (*piloto mayor*) to make and copy.¹¹⁹ This system, sound in theory, was chaotic in practice. Though historians of cartography have been unwilling to admit it, the fact that there are no surviving standard-issue charts that were made in pursuance of the *padrón* scheme probably means they never existed; no other Spanish archive of the period has disappeared. The "master-copy," kept in a chest and unlocked for lawsuits, was not a practical document—pilots who were witnesses in such lawsuits regularly indicated that they had never seen it outside the courtroom, much less added to it—but rather a device of the pilot major to protect his monopoly. Mapmakers who took pains to gain access to

113. Cumming, Skelton, and Quinn, *Discovery of North America*, 208 and 210–11.

114. Cumming, Skelton, and Quinn, *Discovery of North America*, 236–37.

115. See chapter 51 in this volume and Conrad E. Heidenreich, *Explorations and Mapping of Samuel de Champlain, 1603–1632* (Toronto: B. V. Gutsell, 1976).

116. See Skelton, *Explorers' Maps*, 275–78.

117. Skelton, *Explorers' Maps*, 207–27, and Patrick van Mil and Mieke Scharloo, eds., *De VOC in de kaart gekeken: Cartografie en navigatie van de Verenigde Oostindische Compagnie, 1602–1799* (The Hague: SDU, 1988).

118. Thomas Blundeville, "A New and Necessarie Treatise of Navigation, Containing All the Chiefest Principles of That Arte," in *M. Blundeville His Exercises, Containing Eight Treatises*, 4th ed. (London: William Stansby, 1613), 645–745, esp. 649; idem, *A Briefe Description of Vniversal Mappes and Cardes, and of Their Vse: And also the Vse of Ptholemey His Tables* (London: Roger Ward, for Thomas Cadman, 1589); and Brown, *Story of Maps*, 113.

119. HARRISSE, *Discovery of North America*, 259–68; José Pulido Rubio, *El piloto mayor de la Casa de la Contratación de Sevilla: Pilotos mayores del siglo XVI (datos biográficos)* (Seville: Tip. Zarzuela, 1923); and Edward Luther Stevenson, "The Geographical Activities of the Casa de la Contratación," *Annals of the Association of American Geographers* 17 (1927): 39–59.

the pilot major's material seem, from the lawsuits, generally to have made only selective use of it.¹²⁰ The pilots, according to Chaves, "did not know how to collect" data needed for the *padrón*.¹²¹ According to Gonzalo Fernández de Oviedo, pilots "intend only to make way and not to go taking accurate sightings, nor do most of them even know how to do it. . . . They do not know how to inform those in Seville . . . who make the maps."¹²²

All the maps traditionally said to be the *padrón* or to have been copied directly from the *padrón* might equally well have some other origin. The maps that were offered for sale—as witnessed, for example, by the complaint of the chief pilot of the Casa de la Contratación in 1513—were the work of independent mapmakers and did not conform to any standards.¹²³ In 1515, Spanish cosmographers attempting to establish the Tordesillas line relied on a map made independently by Andrés de Morales.¹²⁴ The world map of 1529 by Diogo Ribeiro (Diego Ribero) explicitly refers to corrections made according to the latest information, but its derivation from a *padrón* original is merely a presumption. Repeatedly—in 1514, for instance, in 1526, and again in the early 1530s—the Spanish crown initiated a never-completed project to organize accumulated contradictory information. The royal command to make an up-to-date *padrón* in 1526 was still unfulfilled in 1535, though the following year Chaves, one of the experts commissioned to correct "los padrones y cartas de navegar," did produce a map that Oviedo called "carta moderna" or "cartas modernas," but Oviedo expressly distinguished this map from the "newly completed pattern [*patrón*], examined by all His Majesty's cosmographers in Seville in the year 1536; but I would rather two or three of them had seen it and sailed with it." He promised to use this *patrón* in his own work in the future, which perhaps indicates that he had not seen it—unlike the maps of Chaves and Ribeiro, to which he refers repeatedly—or a copy of it.¹²⁵ The fact that the *padrón* was neglected and useless was often bemoaned but never remedied.¹²⁶ After renewed efforts to implement the scheme, it was effectively abandoned by the mid-1570s.¹²⁷ By the end of the century, standard charts of particular areas seem to have been used instead. The evidence collected by Sandman strongly suggests that maps kept by pilots major never attained their intended roles as standard patterns, that they never incorporated feedback from pilots on the intended scale, and that, of such maps as pilots did use, most were independent products.¹²⁸ Yet the tenacity with which the myth of the *padrón* is upheld is remarkable.¹²⁹ In practice, as we have seen, rutters remained preponderant, meanwhile, among the output of official aids to the navigation of distant seas in both Spain and Portugal.

The documents produced, whether maps or rutters, were intended for the exclusive use of selected beneficia-

ries; in practice, however, their contents became diffused in cartographic tradition as a result of espionage and piracy. Information was collated in map form in the course of what can loosely be called espionage: intelligence gathering by rival powers or potential commercial interests. Cartographers were suborned to leave one master and enter another's service; thus, information once privy to one monarch's subjects was circulated among another's.¹³⁰

The Cantino map is no mere repository of information but rather a lavish presentation object of high status, but it was acquired in Lisbon in 1502 for Alfonso d'Este, duke of Ferrara, by his diplomatic representative, Alberto Cantino. Because the date of this map is secure to within a few months, the topical nature of the information is beyond cavil.¹³¹ The first surviving cartographic record of the North Atlantic explorations of the brothers Gaspar and Miguel Corte-Real from 1501 to 1503 appears on a map apparently made for an agent of the Medici.¹³² In

120. The clearest case of a chartmaker's "borrowing" a so-called *padrón* for this purpose seems to illustrate this; see pp. 1130–31 in this volume.

121. Lamb, "Science by Litigation," 51.

122. Oviedo, *Historia general*, 4:346.

123. Lamb, "Science by Litigation," 44.

124. Herrera y Tordesillas, *Historia general* (1944–47 ed.), 1:283–85. To call this the "first Padrón" (as Ursula Lamb does in "The Spanish Cosmographic Juntas of the Sixteenth Century," *Terrae Incognitae* 6 [1974]: 51–64, esp. 54) is to exceed the evidence.

125. Oviedo, *Historia general*, 2:339, 3:8, 3:300–301, and 4:346–47. Oviedo usually used the terms *padrones* or *patrones* and *cartas de navegar* synonymously.

126. Lamb, "Science by Litigation," 42 and 51.

127. Lamb, "Spanish Cosmographic Juntas," 59, and Goodman, *Power and Penury*, 77.

128. But see also chapter 40 in this volume.

129. See, for example, David Turnbull, "Cartography and Science in Early Modern Europe: Mapping the Construction of Knowledge Spaces," *Imago Mundi* 48 (1996): 5–24, esp. 7–14.

130. Security was one source of inhibition. When Luis Váez de Torres navigated the strait named after him in 1606–7, the Spanish government tried to suppress news of it. But the facts leaked out, together with copies of Torres's own charts, and though no navigator repeated Torres's feat until 1770, when Cook navigated the passage, the insular nature of New Guinea was depicted on various maps in the intervening period. See Spate, *Spanish Lake*, 140, and Colin Jack-Hinton, *The Search for the Islands of Solomon, 1567–1838* (Oxford: Clarendon, 1969), 175–83.

131. J. B. Harley, *Maps and the Columbian Encounter: An Interpretive Guide to the Travelling Exhibition* (Milwaukee: Golda Meir Library, University of Wisconsin, 1990), 63. The Cantino map is illustrated in appendix 30.1 (fig. 30.10).

132. Appendix 30.1, figure 30.13; see also Samuel Eliot Morison, *The European Discovery of America*, vol. 1, *The Northern Voyages, A.D. 500–1600* (New York: Oxford University Press, 1971), 213–17 and 244–47. The map, known as Kunstmänn I, is now in Munich; see Ivan Kupčik, *Münchner Portolankarten: "Kunstmänn I–XIII" und zehn weitere Portolankarten / Munich Portolan Charts: "Kunstmänn I–XII" and Ten Further Portolan Charts* (Munich: Deutscher Kunstverlag, 2000), 21–27.



FIG. 30.8. MAP OF SPANISH DISCOVERIES IN THE NEW WORLD, ILLUSTRATED CA. 1511. This map appeared in a work by Peter Martyr dated 1511. Size of the original: 20 × 28 cm. Photograph courtesy of the Newberry Library, Chicago (Ayer *f111 A5 1511).

1501, a Venetian diplomat in Spain announced to a correspondent at home that he intended to order from companions of Columbus in Palos a map of “all the country that has been discovered.”¹³³ The Piri Re’is map of 1513 includes a depiction of the New World said to be based, in part at least, on information from Columbus captured in a naval action in the western Mediterranean, probably in one of the campaigns recorded for 1499, 1500, 1504, 1506, and 1511.¹³⁴ The “school” of mapmakers that flourished in Dieppe in the mid-sixteenth century had privileged access to news of French explorations that are, indeed, well represented in their work, but they were also adept at gaining information from Spain, Portugal, and England, some of which was not divulged in maps made in the countries concerned.¹³⁵

Most successful transmission of explorers’ findings into map form probably depended, as it had in the fifteenth century, on personal contacts, waterfront encounters, and the perusal of rutters, travelogs, or shipboard journals by the mapmakers. The motives were usually commercial. In the early sixteenth century, makers of lavish maps for rich men’s libraries, engravers of world maps for the press, and editors of updated editions of Ptolemy’s *Geography* were eager to include the latest revelations. The depiction of South America was revised according to the most recent voyages between the creation of the Cantino map and that of the successor derived from it a couple of years later by Nicolò de Caverio. The brisk business available for printers of updated maps is suggested by the output of Francesco Rosselli, Johannes Ruysch, Martin Waldseemüller, and Giovanni Matteo Contarini. The map of Spanish discoveries in the New World that illustrated a 1511 edition of Peter Martyr’s history of the enterprise (fig. 30.8) may represent a security lapse or a

deliberate act of divulgation—a leak—in the course of propaganda; it is important because it proves that although the *padrón* system did not work, discoveries were being recorded in map form in Spain. It includes the first appearance of Bermuda, discovered in 1505. Indeed, it is our main source for the full extent of the expedition of Pinzón in 1508–9. Meanwhile, Madagascar, which had been circumnavigated in 1506–7, was recognizably delineated in one of the great monuments to the cartographer’s art, the Miller Atlas of 1519.¹³⁶

Increasing competition among cartographers may have been a stimulus to their research into up-to-date explorers’ information in the 1520s, reflected by the incorporation of material from Lucas Vázquez de Ayllón’s reports by Giovanni Vespucci in a map of 1526.¹³⁷ The North American coast, followed by the navigations of Verrazano and Gomes in 1524–25, was reflected in charts of 1527 and 1529.¹³⁸ The Castiglione world map shows the coast explored by Gomes in a different ink from the rest with an annotation referring to “this year 1525”; it is hard to resist the conclusion that this map was made to be updated, with Gomes’s voyage particularly in mind.¹³⁹ Ribeiro’s world map of 1529 identifies locations along most of the North American coast by means of the names of the explorers responsible for discovering and reporting them.

The efforts of Diego de Ordás, Jerónimo Dortal, and Alonso de Herrera to open a route along the Orinoco in the 1530s inspired a map of the course of the river published by Oviedo, which was, in effect, a diagrammatic rendition of their accounts of their experiences. Oviedo

133. HARRISSE, *Discovery of North America*, 257.

134. For the 1513 map, see appendix 30.1, figure 30.19. Piri Re’is attributed a map in his possession to Columbus’s own hand and claimed that he had access to information from a shipmate of Columbus captured by Kemāl Re’is. See Svat Soucek, “Islamic Charting in the Mediterranean,” in *HC* 2.1:263–92, esp. 270. In the fifth of the annotations on his map, Piri Re’is wrote: “The coasts and island on this map are taken from Colombo’s map”; see A. Afetinan, *Life and Works of Piri Reis: The Oldest Map of America*, trans. Leman Yolaç and Engin Uzmen (Ankara: Turkish Historical Association, 1975), 28 and 31. For the dates of Kemāl’s campaigns, see Mine Esiner Özen, *Piri Reis and His Charts* (Istanbul: N. Refioğlu, 1998), 4–7.

135. On Dieppe cartography, see Jean Rotz, *The Maps and Text of the Boke of Idrography Presented by Jean Rotz to Henry VIII*, ed. Helen Wallis (Oxford: Oxford University Press for the Roxburghe Club, 1981).

136. 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), 220.

137. Appendix 30.1, figure 30.27, and Stevenson, “Geographical Activities,” 48–49.

138. See appendix 30.1, figures 30.28–30.31, and Kirsten A. Seaver, “Norumbega and *Harmonia Mundi* in Sixteenth-Century Cartography,” *Imago Mundi* 50 (1998): 34–58, esp. 38.

139. Appendix 30.1, figure 30.25; Cumming, Skelton, and Quinn, *Discovery of North America*, 74; and Carl Ortwin Sauer, *Sixteenth Century North America: The Land and the People as Seen by the Europeans* (Berkeley: University of California Press, 1971), 62–69.

was an important collator of explorers' information¹⁴⁰ and also reproduced in map form data on the Gulf of Panama confided by the pilots Francisco de Estrada and Hernando Peñate in 1526. Martim Afonso de Sousa's mission of 1531–32 to Brazil and the River Plate seems to have been a source of information for the Viegas Atlantic chart of 1534.¹⁴¹ The new information gathered by Francisco de Ulloa's voyage from Acapulco along much of the coast of California in 1539–40 found its way onto a map made in 1541 and another made in 1542 by Battista Agnese in Venice.¹⁴² Though Sebastian Cabot added little or nothing to the maps he made from his own experience as an explorer, his fabulous world map of 1544 (see fig. 40.20) includes allusions to findings made by the downriver voyage of Francisco de Orellana along the Amazon two years before. The whole length of the river is represented for the first time on a world map, in schematic form, embellished with some of the features Orellana reported: vast islands, riverside cities, and warrior-Amazons. This information must have been gleaned by personal inquiry, for, though the chronicle of the expedition was published by Oviedo in the next edition of his compendium of information on the New World, its author, Gaspar de Carvajal, had sent an abstract to Cardinal Pietro Bembo in 1543.¹⁴³ Though details of Cartier's explorations from 1534 to 1542 were very slow in reaching the work of most mapmakers, they began to be recorded on Dieppe maps between 1544 and the end of the following decade.¹⁴⁴

Some explorations acquired a special status: their tracks were shown on maps. The first recorded round-the-world navigation by Magellan's expedition started something of a fashion—or, more justly perhaps, a sporadic tradition—of including the courses, or supposed courses, of such expeditions. It would be risky, however, to assume that the information represented was always, or ever, culled firsthand or by reliable means. The written sources generated by Magellan's voyage contradict each other about his route across the Atlantic. The cartographic tradition embodies one version, which was already in print at the material time. So perhaps all we have is a cartographic representation of a literary confection.

The next round-the-world voyage was Drake's. The first maps that showed it were made to illustrate overt propaganda and cannot be assumed to reflect accurately the real experience of the voyage. The venture, which was largely confined to well-known routes, included only two episodes that might properly qualify to be called exploration. The first occurred in the vicinity of Cape Horn when, it was claimed, adverse winds forced a change of course that led the navigators to the conclusion that there was open water to the south of Tierra del Fuego.¹⁴⁵ Rather than a discovery, the presence of clear water south of the cape may have been an inference from information received from Spanish sources: an instance, as Drake's

disaffected shipmate Richard Madox claimed, of Drake's shameless willingness to present "things unknown . . . as explored."¹⁴⁶ The second episode occurred in or near San Francisco Bay, where Drake's claims to priority of discovery have generated inconclusive controversy ever since.¹⁴⁷

Hondius interviewed Drake aboard the newly returned *Golden Hind* and decorated some of his maps with heroic allusions to the voyage, including both these episodes. The belief in clear water south of Cape Horn passed into English cartographic tradition, and maps published over the following few years, down to the end of the century, by Hakluyt, Wright, and Hondius himself, all showed this feature, which was not admitted by most cartographers in other countries until after the demonstration by Willem Cornelis Schouten and Jacob Le Maire, who rounded Cape Horn in 1616, having missed the entrance to the Strait of Magellan on their way to the Spice Islands. Meanwhile, Davis's findings on his voyages in search of the Northwest Passage were incorporated in the first globe made in England by Emery Molyneux about 1592, as a result of a collaboration in which Davis or some of his shipmates took part.¹⁴⁸

EXPLORATION AND THE WORLD IMAGE

In view of all the obstacles to the collection, transmission, and collation of explorers' information in map form, we should not repine at the paucity of the results. On the contrary, it is remarkable that exploration should have contributed so much to the transformation of Europeans' world image in the early modern period. In some respects, of course, the explorers enhanced knowledge, and indeed, over this period as a whole, it is remarkable how the out-

140. See his self-characterization in Oviedo, *Historia general*, 3:288.

141. Mollat and La Roncière, *Sea Charts*, 224–26.

142. Morison, *Southern Voyages*, 626–27, and Henry Raup Wagner, "The Manuscript Atlases of Battista Agnese," *Papers of the Bibliographical Society of America* 25 (1931): 1–110, esp. 1 and 8–9.

143. Gaspar de Carvajal, P. de Alместo, and Alonso de Rojas, *La aventura del Amazonas*, ed. Rafael Díaz Maderuelo (Madrid: Historia 16, 1986), 16 and 66–87.

144. Skelton, *Explorers' Maps*, 93, and Winsor, *Narrative and Critical History*, 4:74–78 and 4:83–90.

145. Spate, *Spanish Lake*, 247–50.

146. Kelsey, *Sir Francis Drake*, 126–35.

147. See Kelsey, *Sir Francis Drake*, 180–92, for a powerful argument that Drake may not have sailed farther north than lower California; for a summary of the controversy, see Warren Leonard Hanna, *Lost Harbor: The Controversy over Drake's California Anchorage* (Berkeley: University of California Press, 1979), and, more recently, R. Samuel Bawlf, *Sir Francis Drake's Secret Voyage to the Northwest Coast of America, AD 1579* (Salt Spring Island, B.C.: Sir Francis Drake Publications, 2001), and idem, *The Secret Voyage of Sir Francis Drake, 1577–1580* (New York: Walker, 2003), 265–326.

148. Helen Wallis, "The First English Globe: A Recent Discovery," *Geographical Journal* 117 (1951): 275–90, esp. 279.

lines of the world and the relative positions and dimensions of parts of it began, in mapmakers' work, to approach the image that subsequent measurement and satellite photography have confirmed. That may, however, be a misleading conclusion, for the maps did the most to stimulate exploration when they were wrong. The explorers did much to revolutionize the appearance of the map of the world when they were deluded or deceptive.

In one of the short stories of Rafael Dieste, "El loro disecado," the young hero writes of the smallness of the world. The storekeeper with whom he is discussing this becomes outraged at this presumption. A later piece by the young man is entitled "The world is not as small as they say it is."¹⁴⁹ This story is a remarkably close analogy for the unfolding image of the world in European cartography of the sixteenth and seventeenth centuries. In order to shrink the Atlantic to navigably small proportions, Columbus estimated the girth of the globe at something around 25 percent less than its true dimensions.¹⁵⁰ Despite the skepticism with which some academic geographers treated Columbus's claims, belief in a relatively small earth remained influential. Negotiations over the Tordesillas line and its extension in the eastern hemisphere demonstrate this. The very act of mapping made the world seem small. In 1566, Carlos de Borja y Aragón thanked his father for a gift of a globe with the assurance that until he saw the world between his hands, he had not realized how small it was.¹⁵¹ Although this may be no more than the page-filling piety of a young man compelled to write a bread-and-butter letter, it is psychologically convincing and consistent with the way the world was really represented. The globe could be squeezed onto the favorite Renaissance fashion accessory: a medal.¹⁵²

The supposed size of the globe had diminished progressively in antiquity, from the vague vastness imagined by Plato through the 400,000 *stadia* estimated by Aristotle, the smaller figures—252,000 and 240,000 *stadia*, respectively—proposed by Eratosthenes and Posidonius, and the 180,000 *stadia* calculated by Strabo to the even smaller figures proposed in less influential texts.¹⁵³ This tendency continued in the Renaissance. Paolo dal Pozzo Toscanelli and Behaim both favored, if I understand them correctly, an estimate 13 percent too small.¹⁵⁴

Exploration should have been a corrective; instead it encouraged the "downsizers." The Magellan voyage is often said to have demonstrated the vastness of the Pacific, and indeed it should have done so—the shipboard calculations of distance traversed made by Francisco Albo, pilot of the *Trinidad*, are remarkably accurate—but the most widely circulated figures were those published in Pigafetta's journal,¹⁵⁵ which were seriously underestimated.¹⁵⁶ These were fertile mistakes. The image of a shrinking world, in which nothing was inaccessible, was

an encouraging mental environment for explorers' ambitions. It was typical of the growing interdependence of cartography and exploration that cartographers' speculations and explorers' fantasies nourished each other. At least until the development, in the seventeenth century, of adequate techniques for mapping explorers' findings, the story is not a scientific but a human one: not of a perfect union, but of a turbulent relationship; not of exactitude, but of error; not of progress in knowledge—at least not smooth or continuous progress—but of the productivity of creative deceit.

149. Rafael Dieste, *Historias e invenciones de Félix Muriel*, ed. Estelle Irizarry (Madrid: Cátedra, 1985), 116.

150. Columbus, *Textos*, 217, and George E. Nunn, *The Geographical Conceptions of Columbus* (New York: American Geographical Society, 1924), 1–30.

151. François de Dainville, *La géographie des humanistes* (Paris: Beauchesne et Ses Fils, 1940), 92 n. 3, and John Huxtable Elliott, *Illusion and Disillusionment: Spain and the Indies* (London: University of London, 1992), 7.

152. Peter Barber, "Beyond Geography: Globes on Medals, 1440–1998," *Der Globusfreund* 47–48 (1999): 53–80.

153. Germaine Aujac and the editors, "The Foundations of Theoretical Cartography in Archaic and Classical Greece"; idem, "The Growth of an Empirical Cartography in Hellenistic Greece"; and idem, "Greek Cartography in the Early Roman World," all in *HC* 1, respectively on 130–47, esp. 137; 148–60, esp. 148 and 155; and 161–76, esp. 169–74. See also Brown, *Story of Maps*, 28–32.

154. Paolo Emilio Taviani, *Christopher Columbus: The Grand Design* (London: Orbis, 1985), 413–27. See also Michael Herkenhoff, "Vom langsamen Wandel des Weltbildes: Die Entwicklung von Kartographie und Geographie im 15. Jahrhundert"; Ulrich Knefelkamp, "Der Behaim-Globus und die Kartographie seiner Zeit"; and Reinhold Janderek, "Reiseberichte nach China als Quellen für Martin Behaim," all in *Focus Behaim Globus*, 2 vols. (Nuremberg: Germanisches Nationalmuseum, 1992), 1:143–65, 1:217–22, and 1:239–72.

155. Pigafetta allowed 4000 "leagues" for the fleet's course across the Pacific, but located the Ladrões Islands only 260 or 270 leagues along their course north of the equator. He placed the fleet's intersection with the equator at 122 degrees and the Philippines 161 degrees west of the Line of Demarcation. See Antonio Pigafetta, *Magellan's Voyage: A Narrative Account of the First Circumnavigation*, 2 vols., trans. and ed. R. A. Skelton (New Haven: Yale University Press, 1969), 1:57–60, and idem, *Magellan's Voyage around the World*, 3 vols., ed. and trans. James Alexander Robertson (Cleveland: A. H. Clark, 1906), 1:84–91 and 104–5. Maximilianus Transylvanus, in his widely circulated summary of the voyage, placed the Ladrões 158 degrees west of Cadiz (164°16' west of Greenwich); see his *First Voyage around the World by Antonio Pigafetta and De Moluccis Insulis by Maximilianus Transylvanus*, intro. Carlos Quirino (Manila: The Filipiniana Book Guild, 1969). The same values were given in the versions of these works best known in the late sixteenth century; see Giovanni Battista Ramusio, *Navigazioni et viaggi: Venice 1563–1606*, 3 vols., ed. R. A. Skelton and George Bruner Parkes (Amsterdam: Theatrum Orbis Terrarum, 1967–70), vol. 1, fols. 349v and 355–56r.

156. Rolando A. Laguarda Trías, "Las longitudes geográficas de la memoria de Magallanes y del primer viaje de circunnavegación," 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), 137–78, esp. 151–73.

APPENDIX 30.1 PRE-1530 MANUSCRIPT MAPS SHOWING THE RELATIONSHIP
BETWEEN THE OLD AND NEW WORLDS

Name by Which the Map Is Known/Author	Date	Location
Juan de la Cosa (fig. 30.9)	1500	Museo Naval, Madrid (inv. 257)
Cantino (fig. 30.10)	1502	Biblioteca Estense e Universitaria, Modena (C.G.A.2)
King Hamy (fig. 30.11)	1502?	Huntington Library, San Marino (HM 45)
Vesconte Maggiolo (fig. 30.12)	1504	Biblioteca Comunale Federiciana, Fano
Pedro Reinel (Kunstmann I) (fig. 30.13)	Ca. 1504	Bayerische Staatsbibliothek, Munich (Cod. Icon 132)
Nicolò de Caverio (fig. 30.14)	1505	BNF (Cartes et Plans, S.H. Archives no. 1)
Pesaro (fig. 30.15)	Ca. 1505–8	Biblioteca e Musei Oliveriani, Pesaro
Kunstmann II (fig. 30.16)	1506	Bayerische Staatsbibliothek, Munich (Cod. Icon 133)
Kunstmann III (fig. 30.17)	Ca. 1506	Lost; survives in a redrawing from ca. 1843, BNF (Rés. Ge B 1120)
Vesconte Maggiolo (fig. 30.18)	1511	John Carter Brown Library at Brown University, Providence
Pīrī Reʻīs world map (fig. 30.19)	Ca. 1513	Topkapi Sarayı Müzesi Kütüphanesi, Istanbul (R. 1633 mük)
Vesconte Maggiolo (fig. 30.20)	1516	Huntington Library, San Marino (HM 427)
World map in the Miller Atlas, attributed to Lopo Homem, Pedro Reinel, Jorge Reinel (fig. 30.21)	Ca. 1519	BNF (Rés. Ge AA 640)
Jorge Reinel (Kunstmann IV) (fig. 30.22)	Ca. 1519	Lost; survives in a redrawing from ca. 1843, BNF (Rés. Ge AA 564)
Vesconte Maggiolo (Kunstmann V) (fig. 30.23)	Ca. 1519	Bayerische Staatsbibliothek, Munich (Cod. Icon 135, fols. 1v–2r)
Turin (fig. 30.24)	Ca. 1523	Biblioteca Reale, Turin (Coll. O.XVI.1)
Castiglione, attributed to Diogo Ribeiro (fig. 30.25)	1525	Biblioteca Estense e Universitaria, Modena (C.G.A.12)
Salviati (fig. 30.26)	Ca. 1525	Biblioteca Medicea Laurenziana, Florence (Med. Palat. 249)
Giovanni Vespucci (fig. 30.27)	1526	Hispanic Society of America, New York (MS. K. 42)
Diogo Ribeiro (fig. 30.28)	1527	Herzogin Anna Amalia Bibliothek, Weimar (Kt 020-57S)
Diogo Ribeiro (fig. 30.29)	1529	Biblioteca Apostolica Vaticana, Vatican City (Borgiano III)
Diogo Ribeiro (fig. 30.30)	1529	Herzogin Anna Amalia Bibliothek, Weimar (Kt 020-58S)
Giovanni da Verrazzano (fig. 30.31)	1529	Vatican Museums, Vatican City (Borgiano I)

[Note: Readers should consult the literature for detailed, high quality, and often color reproductions of all of these manuscript maps.]

(continued)

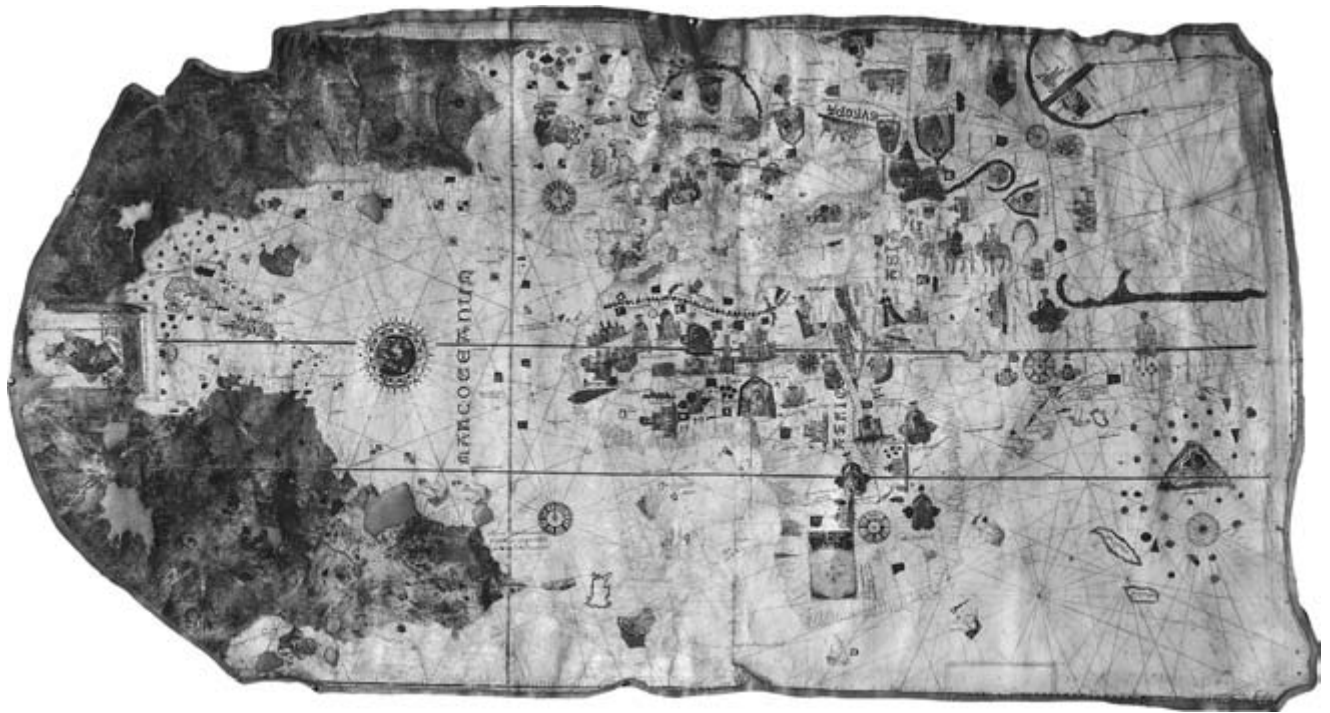


FIG. 30.9. WORLD MAP BY JUAN DE LA COSA, 1500.
Size of the original: 95.5 × 177 cm. Photograph courtesy of the Museo Naval, Madrid (inv. 257).

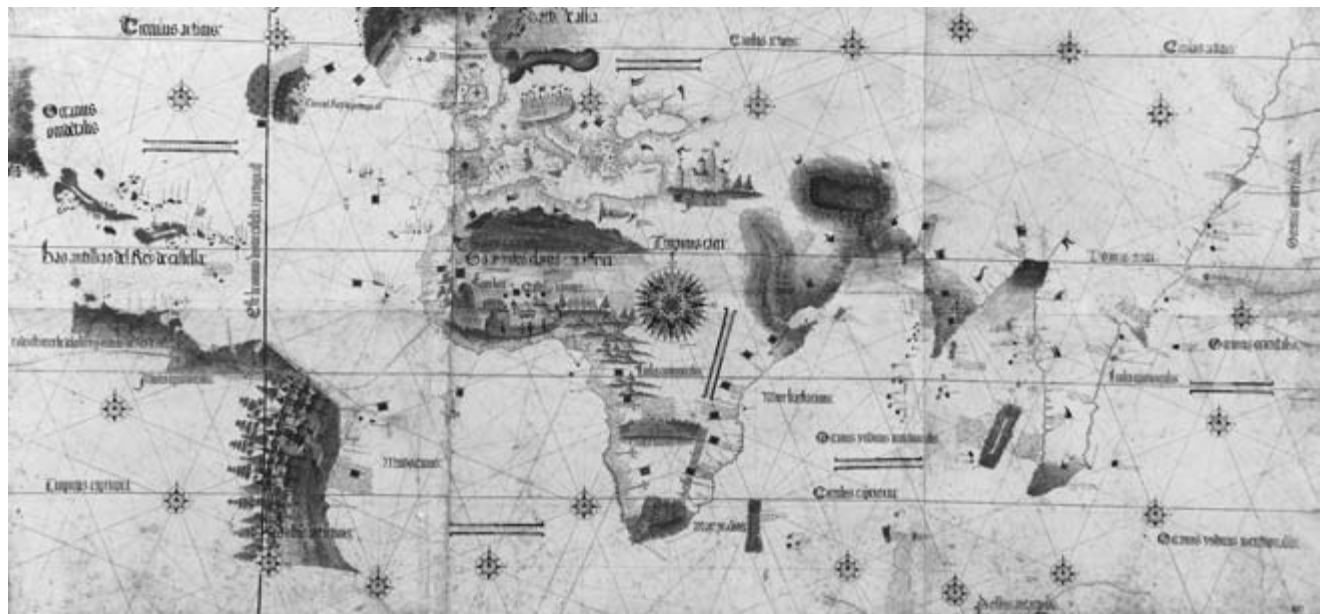


FIG. 30.10. THE CANTINO MAP, 1502. In three vellum leaves.
Size of the original: 22 × 105 cm. Photograph courtesy of the Biblioteca Estense e Universitaria, Modena (C.G.A.2).

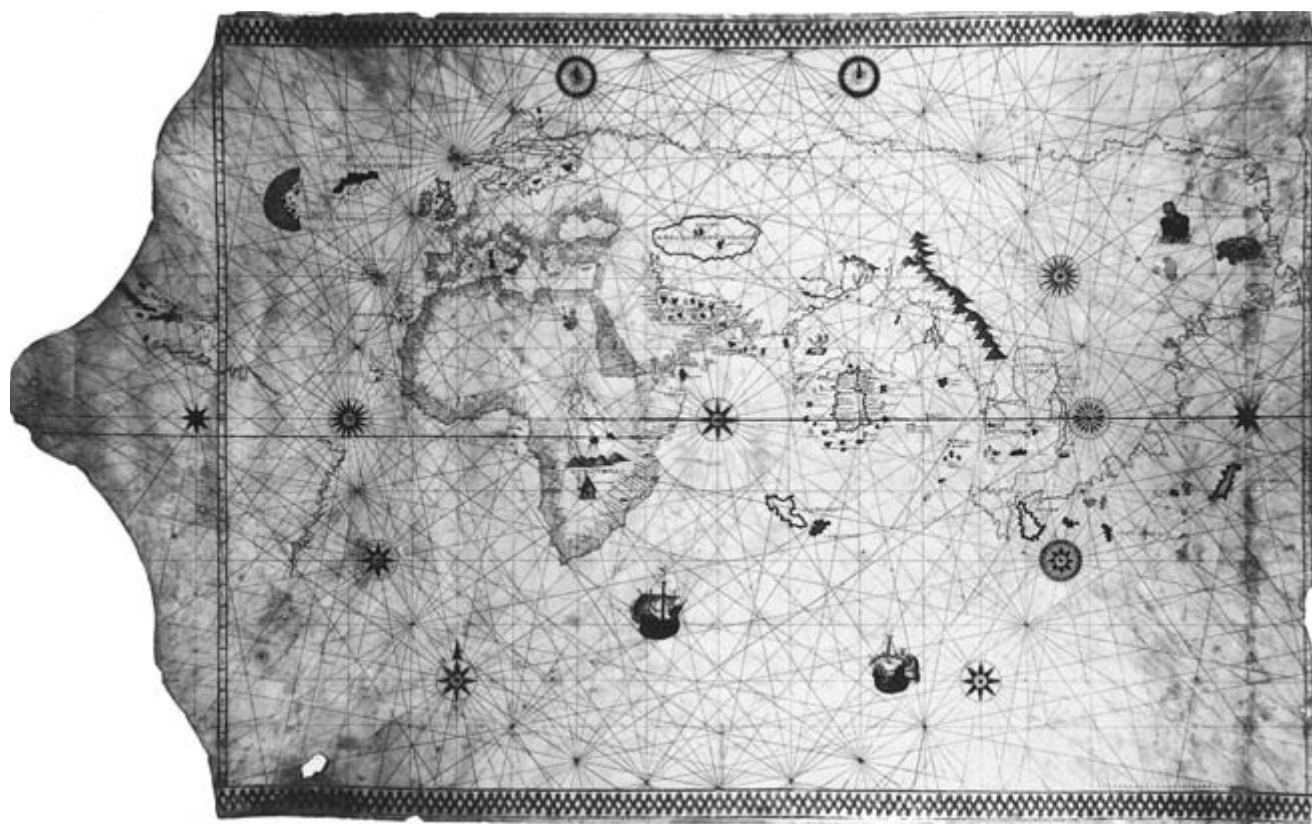


FIG. 30.11. THE KING HAMY MAP, 1502?
Size of the original: 58.5 × 94.2 cm. Photograph courtesy of the Huntington Library, San Marino (HM 45).



FIG. 30.12. VESCONTE MAGGIOLO'S MAP, 1504.
Size of the original: 92.5 × 139 cm. Photograph courtesy of the Biblioteca Comunale Federiciana, Fano.



FIG. 30.13. PEDRO REINEL'S MAP, CA. 1504 (KNOWN AS KUNSTMANN I).
Size of the original: 60 × 89 cm. Photograph courtesy of the Bayerische Staatsbibliothek, Munich (Cod. Icon 132).



FIG. 30.14. NICOLÒ DE CAVERIO'S MAP, 1505.
Size of the original: 115 × 225 cm. Photograph courtesy of the BNF (Cartes et Plans, S.H. Archives no. 1).

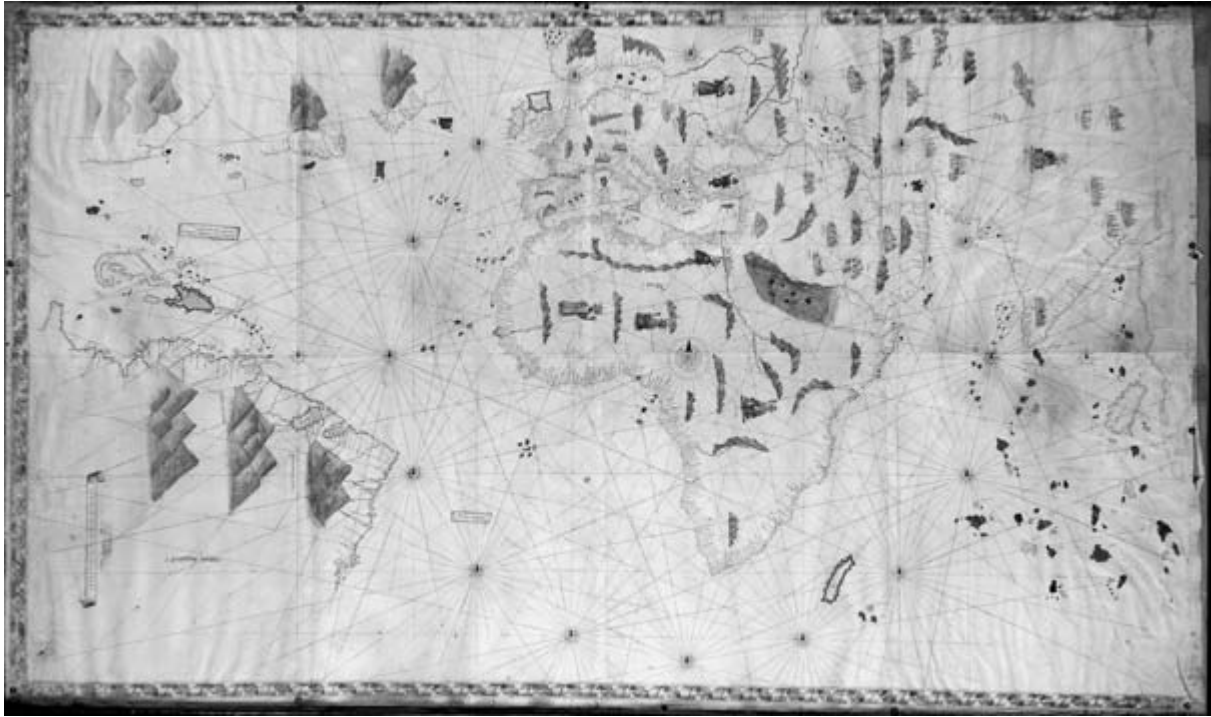


FIG. 30.15. THE PESARO MAP, CA. 1505–8.
Size of the original: 122 × 206 cm. Photograph courtesy of the Biblioteca e Musei Oliveriani, Pesaro.



FIG. 30.16. MAP KNOWN AS KUNSTMANN II, 1506.
Size of the original: 99 × 110.5 cm. Photograph courtesy of the Bayerische Staatsbibliothek, Munich (Cod. Icon 133).



FIG. 30.17. 1843 REDRAWING OF THE MAP KNOWN AS KUNSTMANN III, CA. 1506.
Size of the original: 117 × 87 cm. Photograph courtesy of the BNF (Rés. Ge B 1120).

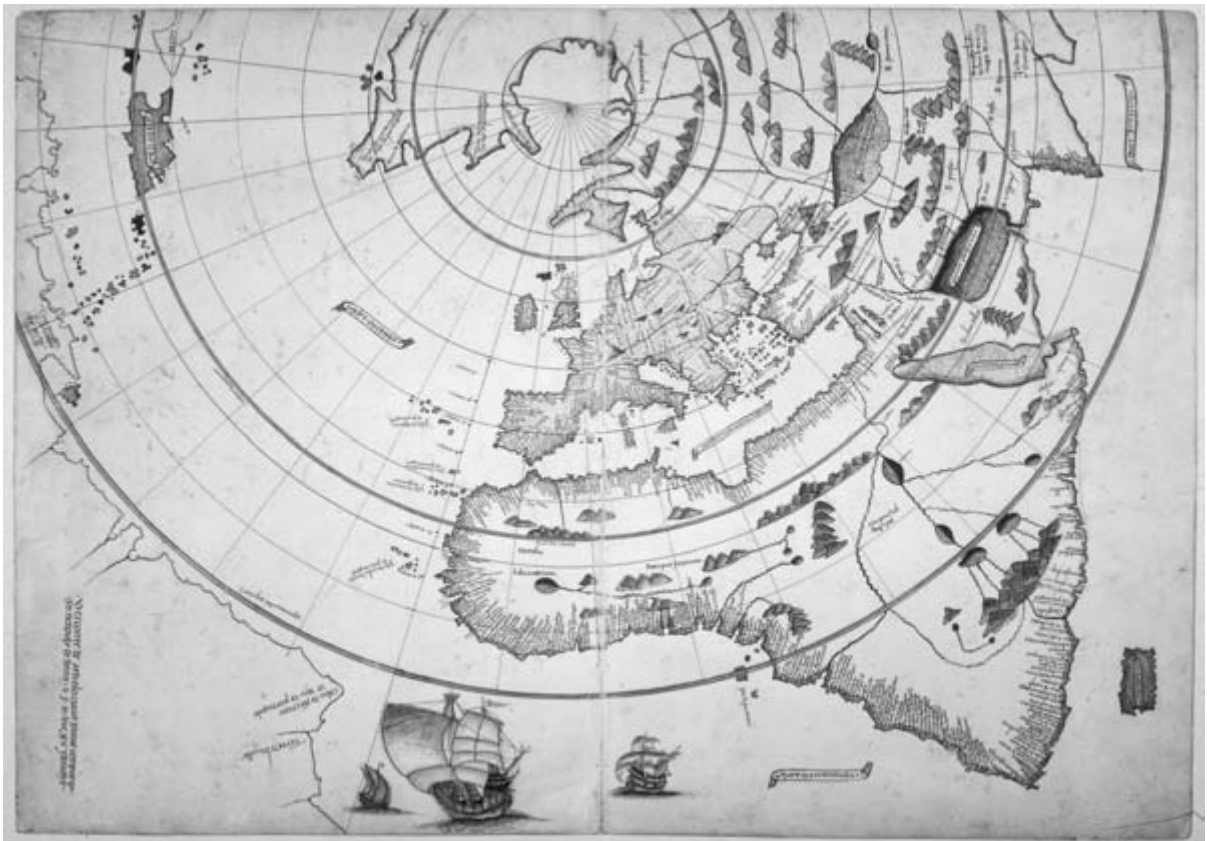


FIG. 30.18. VESCONTE MAGGIOLO'S MAP, 1511.
Size of the original: 39 × 56 cm. Photograph courtesy of the John Carter Brown Library at Brown University, Providence.

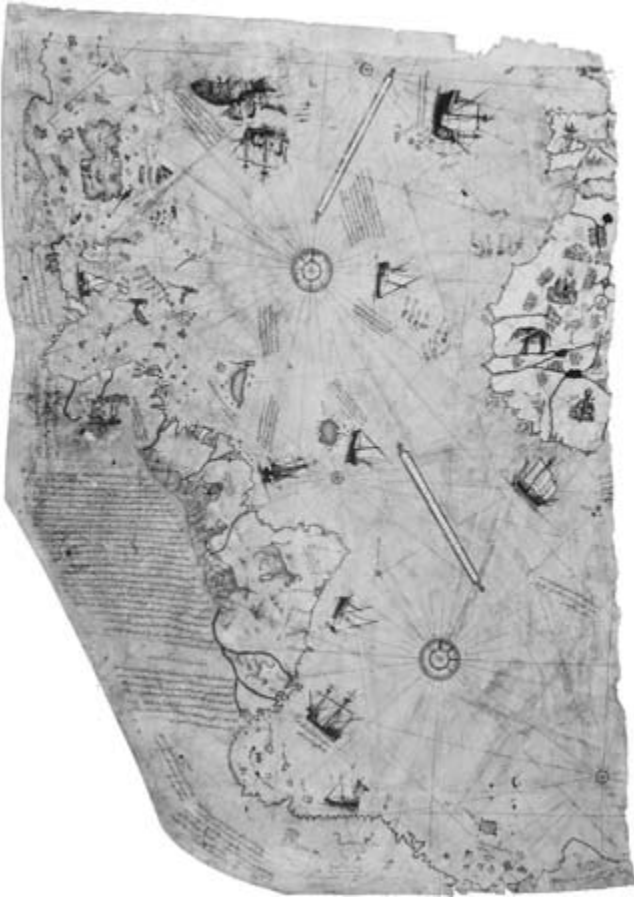
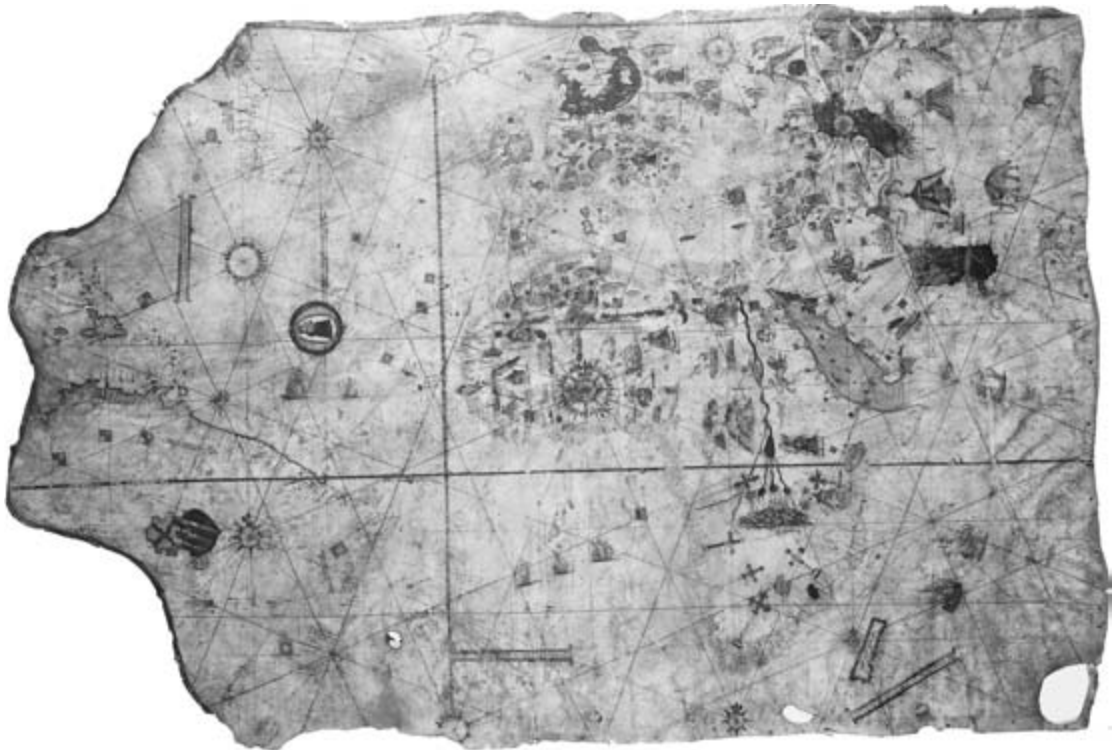


FIG. 30.19. (*left*) PİRİ RE'İS WORLD MAP, CA. 1513.
Size of the original: 90 × 63 cm. Photograph courtesy of the
Topkapi Sarayı Müzesi Kütüphanesi, İstanbul (R. 1633 mük).

FIG. 30.20. (*below*) VESCONTE MAGGIOLO'S MAP, 1516.
Size of the original: ca. 102 × 155 cm. Photograph courtesy of
the Huntington Library, San Marino (HM 427).



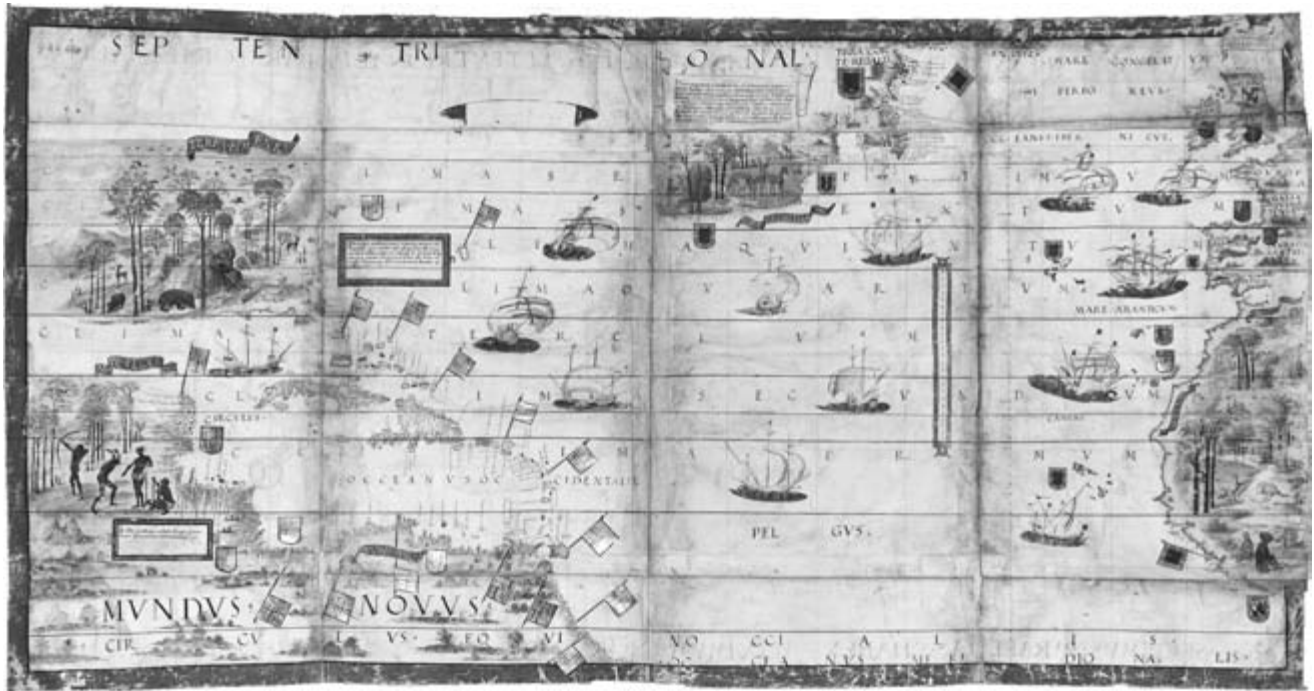


FIG. 30.21. WORLD MAP IN THE MILLER ATLAS, CA. 1519. Attributed to Lopo Homem, Pedro Reinel, and Jorge Reinel. Size of the original: 61 × 118 cm. Photograph courtesy of the BNF (Rés. Ge AA 640).



FIG. 30.22. 1843 REDRAWING OF JORGE REINEL'S MAP, CA. 1519 (KNOWN AS KUNSTMANN IV). Size of the original: ca. 65 × 124 cm. Photograph courtesy of the BNF (Rés. Ge AA 564).

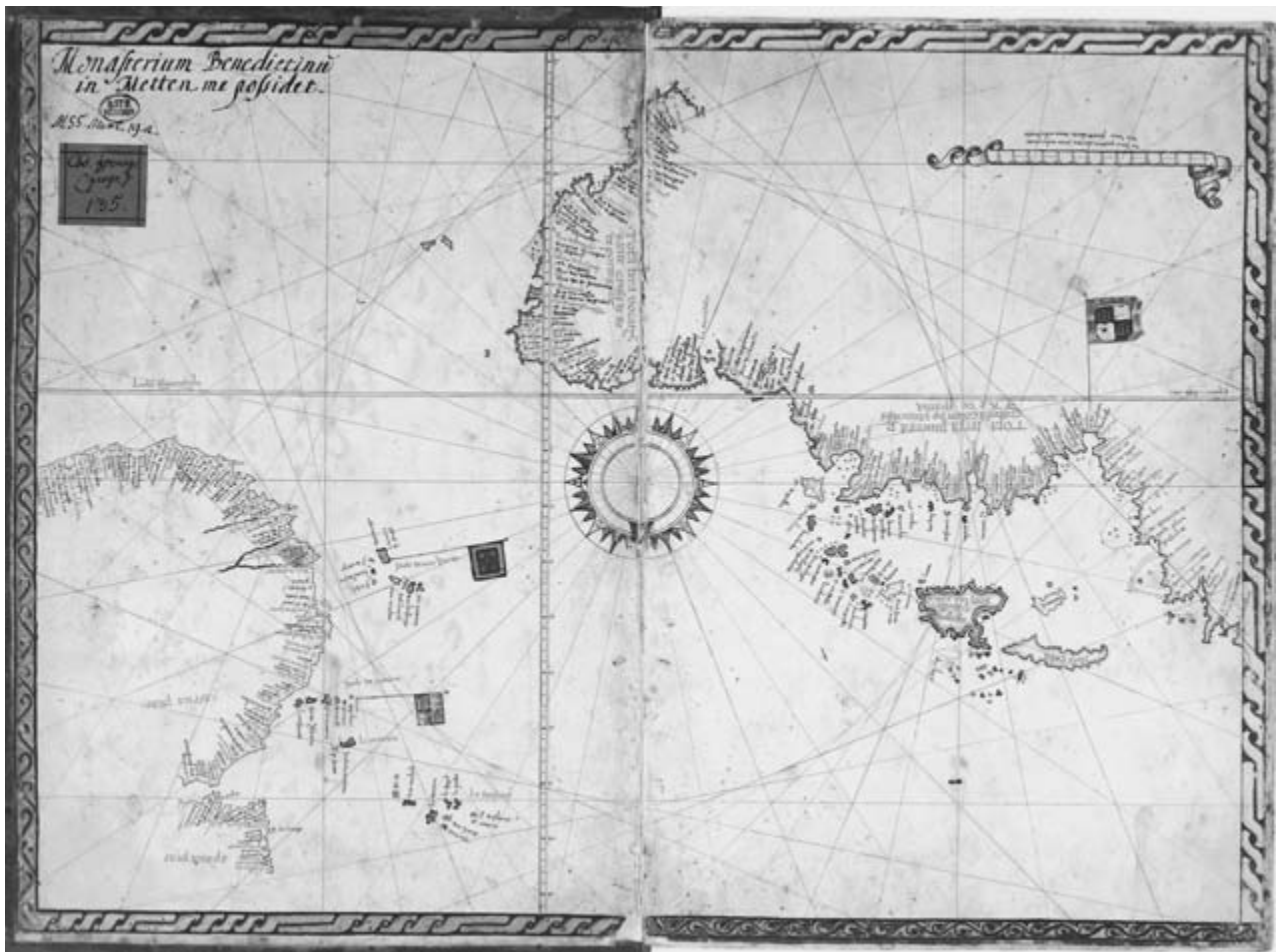


FIG. 30.23. VESCONTE MAGGIOLO'S MAP, CA. 1519 (KNOWN AS KUNSTMANN V).
Size of the original: ca. 38 × 50 cm. Photograph courtesy of the Bayerische Staatsbibliothek, Munich (Cod. Icon 135, fols. 1v–2r).



FIG. 30.24. THE TURIN MAP, CA. 1523.
Size of the original: 112 × 262 cm. Biblioteca Reale, Turin (Coll. O.XVI.1). By concession of the Ministero per i Beni e le Attività Culturali.



FIG. 30.25. 1525 MAP ATTRIBUTED TO DIOGO RIBEIRO (KNOWN AS THE CASTIGLIONE MAP).
Size of the original: 82 × 208 cm. Photograph courtesy of the Biblioteca Estense e Universitaria, Modena (C.G.A.12).



FIG. 30.26. THE SALVIATI MAP, CA. 1525. Attributed to Nuño García Toreno. Size of the original: 93 × 204.5 cm. Biblioteca Medicea Laurenziana, Florence (Med. Palat. 249). By concession of the Ministero per i Beni e le Attività Culturali.



FIG. 30.27. GIOVANNI VESPUCCI'S MAP, 1526.
Size of the original: 85 × 262 cm. Photograph courtesy of the Hispanic Society of America, New York (MS. K. 42).



FIG. 30.28. DIOGO RIBEIRO'S MAP, 1527.

Size of the original: 85 × 213 cm. Photograph courtesy of the Klassik Stiftung Weimar / Herzogin Anna Amalia Bibliothek (Kt 020-57S).



FIG. 30.29. DIOGO RIBEIRO'S MAP, 1529 (IN ROME).

Size of the original: 85 × 204.5 cm. Photograph © Biblioteca Apostolica Vaticana, Vatican City (Borgiano III).

APPENDIX 30.1 (*continued*)

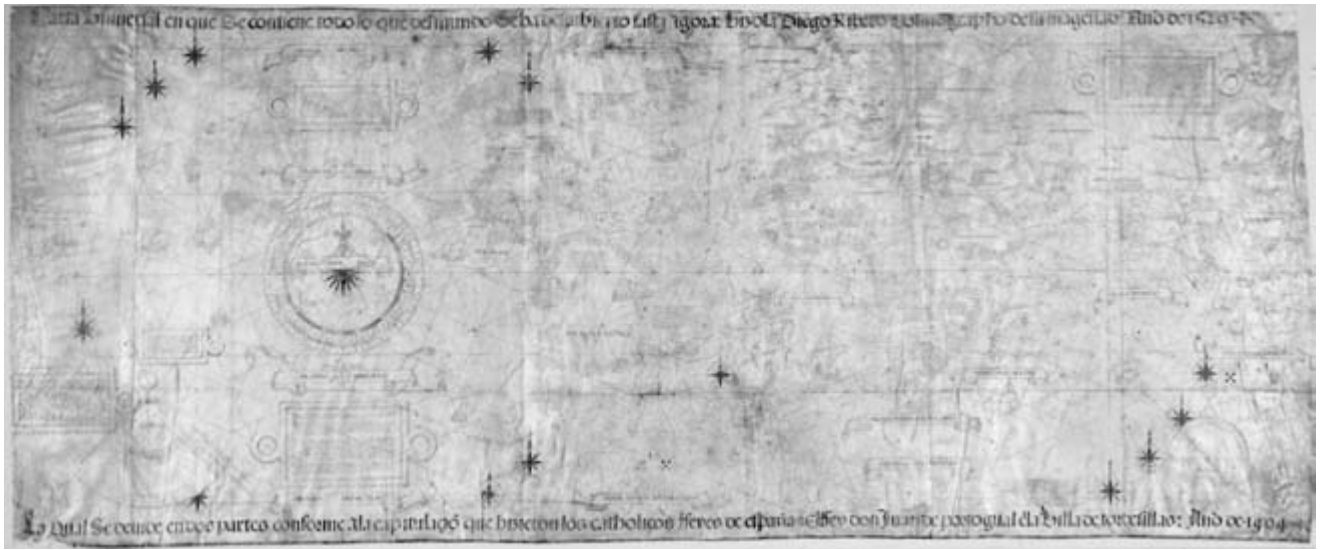


FIG. 30.30. DIOGO RIBEIRO'S MAP, 1529 (IN WEIMAR).
Size of the original: 87 × 210 cm. Photograph courtesy of the Klassik Stiftung Weimar / Herzogin Anna Amalia Bibliothek (Kt 020-58S).



FIG. 30.31. GIOVANNI DA VERRAZZANO'S MAP, 1529.
Size of the original: 127.5 × 255 cm. Photograph courtesy of the Vatican Museums, Vatican City (Borgiano I).