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ARTISANS AND PIRATES
Cosmography and Nautical Science in Early Modern Ottoman Mediterranean (1453-1595)

Büşra Dede

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Cosmography and Nautical Science in Early Modern Ottoman Mediterranean (1453-1595)

by

Büşra Dede

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Abstract

The nautical aspects of the Ottoman empire have been studied on several occasions. However, they have never been analysed in the light of the ideas and methods of contemporary craft epistemology. Following this working hypothesis, this thesis analyses the practical dimension of nautical and cosmographical knowledge developed by the Ottoman empire between the Conquest of Constantinople (1453) and the sultanate of Murad III (1574-1595) at the end of the 16th century, taking the Mediterranean as the epicentre of the scientific-technical activity of the Turkish world in this field. Furthermore, the central theme of this thesis is craft practices in the Mediterranean maritime world of the Ottoman empire. The analysis of scientific practices oriented towards navigation and cartographic representation of the Mediterranean basin, as well as the institutions of applied science, artefacts and epistemic communities that made this possible, constitute a superb case study for the history of early modern science in general and for recent studies on artisanal epistemology in particular. The study of the Turkish case- in line with the Portuguese and Spanish and even the Venetian case - reveals the presence of new communities of craft knowledge - such as pirates - in the production of nautical and cartographic techniques, in the construction of charts and maps and in the manufacture of vessels promoted and paid for by the sultanate. One of the central points of the research lies in placing the imperial arsenal (*Tersâne-i Âmire*), located in the strategic Golden Horn of present-day Istanbul, at the centre of a complex technical machinery of knowledge production. In this sense, the most original aspect of this research lies in evaluating this machinery in the light of the most recent historiography on modern science.

My thesis begins by addressing historiographical categories related to artisanal epistemology from the Ottoman framework. More specifically, I make a craft reading of the process of institutionalisation of Ottoman cosmography and nautical science starting from *Tersâne-i Âmire*. After analysing the main lines of action of Turkish artisans working in this institution, I examine a new epistemic community that I will call "pirate-artisan", as well as their main nautical and cartographic achievements. The category of pirate, or even pirate-artisan, is one of the most important notions in this thesis, since it takes on a new dimension since the Ottoman empire. These pirates will be considered artisans capable of making important contributions to the field of nautical and

cosmographic knowledge. Among them I will highlight the names of Hayreddin Barbarossa, Piri Reis, and Seydi Ali Reis, among others. From the work of these individuals that has come down to us, my aim is both to reveal their contribution to Ottoman science and technology and to introduce a category of practical men into the historiography of early modern science.

Resumen

Los aspectos náuticos del imperio otomano han sido estudiados en varias ocasiones. Sin embargo, éstos nunca han sido analizados a la luz de las ideas y métodos procedentes de la epistemología artesanal contemporánea. Siguiendo esta hipótesis de trabajo, esta tesis analiza la dimensión práctica del conocimiento náutico y cosmográfico desarrollado por el imperio otomano entre la llamada Caída de Constantinopla (1453) y el sultanato de Murad III (1574-1595) a finales del siglo XVI tomando el Mediterráneo como epicentro de la actividad científico-técnica del mundo turco en este ámbito. Dicho de otra manera, el tema central de esta tesis es las prácticas artesanales en el mundo marítimo mediterráneo del imperio otomano. El análisis de las prácticas científicas orientadas a la navegación y a la representación cartográfica de la cuenca mediterránea, así como a las instituciones de ciencia aplicada, artefactos y comunidades epistémicas que lo hicieron posible constituyen un magnífico estudio de caso para la historia de la ciencia moderna en general y para los estudios recientes sobre epistemología artesanal en particular. El estudio del caso turco – en consonancia con el caso portugués y español e, incluso, veneciano - revela la presencia de nuevas comunidades de conocimiento artesanal - como son los piratas - en la producción de técnicas náuticas y cartográficas, en la construcción de cartas y mapas y en la fabricación de embarcaciones promovidas y sufragadas por el sultanato. Uno de los puntos centrales de la investigación reside en ubicar el arsenal imperial (*Tersâne-i Âmire*), situado en el estratégico Cuerno de Oro de la actual Estambul, en el centro de una compleja maquinaria técnica de producción de conocimiento. En este sentido, el aspecto más original de esta investigación reside en evaluar dicha maquinaria a la luz de la historiografía más reciente sobre la ciencia moderna.

Mi tesis comienza abordando categorías historiográficas relacionadas con la epistemología artesanal desde el marco otomano. De forma más específica, hago una lectura artesanal del proceso de institucionalización de la cosmografía y la ciencia náutica otomana partir de *Tersâne-i Âmire*. Después de analizar las principales líneas de acción de los artesanos turcos que trabajan en esta institución, examino a una nueva comunidad epistémica que llamaré “piratas-artesanos”, así como sus principales realizaciones náuticas y cartográficas La categoría de pirata, incluso de pirata-artesano es una de las nociones más importantes de esta tesis, ya que desde el imperio otomano adquiere una

nueva dimensión. Estos piratas serán considerados artesanos capaces de llevar a cabo importantes aportes al ámbito del conocimiento náutico y cosmográfico. Entre ellos destacaré los nombres de Hayreddin Barbarossa, Piri Reis y Seydi Ali Reis. Desde el trabajo de estos individuos que ha llegado hasta nosotros, mi objetivo es tanto revelar su contribución a la ciencia y tecnología otomana como introducir una categoría de hombres prácticos en la historiografía de la temprana ciencia moderna.

Acknowledgement

First, I would like to thank my supervisor, Antonio Sánchez Martínez, who guided me through every process of my thesis and supported me with his ideas. Because he was always understanding and motivated me in every meeting we held, it always moved me to work harder. I am also very grateful to the members of the research project "Iberian Maritime Culture and Oceanographic Practices in the Mediterranean and the Atlantic: tacit knowledge, standardization, practical knowledge and geopolitics” (PID2019-111054GB-100) of which I am a member, directed by Prof. Sánchez from the Autonomous University of Madrid and Prof. Lino Camprubí of the University of Seville, and supported by the Ministry of Science and Innovation of the Spanish Government.[*] Also, thank you to the kind people, who helped me during my stay in Barcelona and Madrid. I, especially, thank the people involved in helping me in the library of the Maritime Museum of Barcelona and the National Library of Spain and National Historical Archive in Madrid, which I visited during my travels. They always helped me to look for the rare works in their library. Therewithal, I would like to thank Jorge Molero Mesa of the Autonomous University of Barcelona, who has always helped and facilitated me with the procedures since the first time I started PhD program in the department of History of Science of this university.

I would also like to thank the people, who helped me during my visits in the Istanbul University Central Library and Yeditepe University Library, which have resource-rich. I would also like to thank the librarians, who helped me, during my visit to the Presidential National Library in Ankara. I want to thank the staff of the Istanbul University Rare Works Library for helping me get the books, I needed. Many thanks to the academicians of Istanbul University and Fatih Sultan Mehmet Foundation University, for helping me in the history of science organizations and being hospitable.

Finally, I would like to thank my dear Mother, who has always supported me on this path I have taken.

[*] This project started on 1 June 2020 and ended on 31 December 2023, coinciding almost entirely with the development of this doctoral thesis.

To My Dear Mother

List of Figures*

***** As a complement to this list of figures, see the CD-Room attached to this thesis for all the images in this list.

Transliteration

The issue of transliteration in Ottoman studies is complex, due to the wide geographical, cultural, and linguistic scope of the subject. Spanning three continents for six centuries, the Ottoman empire was home to many language-speaking groups, living side by side, including Serbo-Croatian, Berber, Hebrew, Arabic, Persian, and Kurdish, in addition, to Turkish dialects. Moreover, Ottoman society and culture made possible, and even encouraged the overcoming of language barriers and cultural boundaries. Since a single transliteration, system would be incomplete grammatically, phonetically, or aesthetically, a way was needed to remain consistent, here. Therefore, I have given to accurately reflect the languages of the sources, used in the study, usually written in Ottoman Turkish and Arabic, their meanings in parentheses by writing them with their original names. When I could not find the exact equivalent of some concepts and names in English, I explained them as notes.

INTRODUCTION

Early Modern Science and Ottoman Empire: A State of the Art

Maritime activities that developed in the world of the early modern period had a very momentous place in the politics, economy, and expansionism of the Ottoman empire, as in many states. The conquest of Constantinople, in 1453, also marks a turning point in the commercial and political relations of the Ottoman empire with other states. The Ottomans, which made Constantinople the capital of the empire, went further in trading with many states and in choosing the sea route in its expansionist policies in line with its political interests. The new Ottoman city began to become a metropolis, where everything came together. The city attracted knowledge and science, commerce, and people. Mehmed the Conqueror took initiatives to bring many things, such as science and commerce together in Istanbul. The construction of madrasahs and shipyards started. These grew with the transfer of scientists and artisans to new capital city. These people were gathered in the capital and assigned to train scholars in madrasahs and artisans in shipyards. Shipbuilding activities started, especially in shipyards. Experienced artisans were needed in these production activities, and pirates, in the Mediterranean, began to be brought under Ottoman shipyard management and assigned to official duties. Merchant ships, warships, transportation during voyages and expansionist policies, these captains had a hand in it all. While the Ottoman navy, which descended into the Mediterranean with its ship production activities, was seen more intensively with the trade and maritime transportation carried out through the Mediterranean ports, pirates attracted a great deal of official attention as they tried to ensure the security of the ships carrying people, goods, and treasure.

My thesis analyses the practical dimension of nautical and cosmographical knowledge developed by the Ottoman empire between the Conquest of Constantinople (1453) and the sultanate of Murad III (1574-1595) at the end of the 16th century, taking the Mediterranean as the epicentre of the scientific-technical activity of the Turkish world in this field. The analysis of scientific practices oriented towards navigation and cartographic representation of the Mediterranean basin, as well as the institutions of applied science, artefacts and epistemic communities that made this possible, constitute a case study for the history of early modern science in general and for recent studies on artisanal epistemology in particular. Several questions arise in this regard: What does the Turkish case teach us about the role of artisans in the modern world in general and about craft epistemology in particular? What epistemic authority was attributed to pirates as an expert community in the field of nautical sciences?

The study of the Turkish case- in line with the Portuguese and Spanish and even the Venetian case - reveals the presence of new communities of craft knowledge - such as pirates- in the production of nautical and cartographic techniques, in the construction of charts and maps and in the manufacture of vessels promoted and paid for by the sultanate. One of the central points of the research lies in placing the imperial arsenal (*Tersâne-i Âmire*), located in the strategic Golden Horn of present-day Istanbul, at the centre of a complex technical machinery of info production. In this sense, the most original aspect of this research lies in evaluating this machinery in the light of the most recent historiography on early modern science.

Considering the spatial and temporal dimensions of Ottoman history, only a multidisciplinary team of researchers over a longer period would be capable of analyse all scientific and technological activities that took place in the context of empire in this period. Through this effort, it is quite possible that a multi-volume work emerged. Therefore, the scope of this thesis is limited to the end of the 15th century and 16th century, which also constitutes the beginning of the science and technology experiences of the Ottomans, produced and legitimized them, consumed, circulated and interchanged them. Because, although there are many studies on the history of Ottoman science in Turkey, there are studies focusing only on a single point, person, event, or a specific year in other academic circles. However, great scientific and technological steps were taken for the Ottoman history, and very rare works, like portolan charts or navigational books that worth studying, on the Ottoman studies born in this area. And these were made by the experienced artisans, the pirates, whom the Ottomans incorporated. Most importantly, it is extremely significant to look at the innovations and developments, in the nautical sense, to see the scientific and technological interaction of the Ottoman with other states, and how it was integrated into atmosphere of the period.

I tried to analyse the Ottoman Mediterranean in the context of the history of which it was a part, that is, within the general paradigms of European and Mediterranean history. In recent years, although there has been an increase in examining within this framework or on the Ottoman basis, these studies have not been able to show themselves fully. Thematic issues were examined only in the empire, and the findings were not evaluated as part of the general trends. I tried not to be confined to the boundaries drawn by this Ottoman exceptionalism, and tried to examine scientific and technological developments in the Ottoman empire, and the factors that encouraged these developments within broader historical paradigms.[1] Geographical discoveries and the consequent capitalist world economy, which gradually dragged much of the world towards an unequal economic partnership, it is not possible to understand the effects of the scientific and technological revolution on ship types, sails and defence systems without looking at issues.

I examine the practical dimension of information promoted by artisanal communities through the factors that stimulated scientific and technological developments in the early modern Ottoman empire. In this context, I begin my thesis by explaining these factors. Based on these situations, I present as an example the institutions that are the production centres of practical knowledge, such as shipyards of Spain and Portugal that play an active role in the Mediterranean. To understand the general situation, it is necessary to mention these institutions, albeit briefly, in the treatment of the Ottoman centre of nautical knowledge. After introducing *Tersâne-i Âmire* (Imperial Arsenal), which we consider as an institution of applied science, I dealt more specifically with the Ottoman artisans. I try to analyse these artisans with their works and instruments, they have produced. Because, if the examination of these artisans is done through the works, a clearer path is followed in terms of seeing the artisans' level of data on the science and technology and their contributions of the practical knowledge in Ottoman empire.

[1] Emrah Safa Gürkan, *Sultanın Korsanları: Osmanlı Akdenizi'nde Gaza, Yağma ve Esaret, 1500-1700* (Istanbul: Kronik Kitap, 2018), p. 9.

General and Universal Knowledge

Changing views on how the world is constructed and how it should be studied followed social, economic, and political changes in the early modern Mediterranean. The rise of cities, the development of merchant capitalism and long-distance trade, the development of large-scale industries such as textiles, armaments, and mining, the enormous expansion of overseas markets, oceanic exploration and the rising importance of visual culture, and the rising status of the visual arts with the invention of the artists' perspective, scientific inventions and research, practical knowledge, instruments, artisans and modes of production, or technological tools and scientific works used and produced by artisans, all these brought about an increasing value placed on objects and objects, and often an appreciation of people's skills and data. Who made these instruments? These complex, closely interrelated historical developments have influenced ways of approaching, investigating, and understanding the world.[2]

The new sciences required certain discoveries and new ideas, as well as changes in the types of questions asked and the methods used to answer them. Historians of science have increasingly embraced a variety of empirical approaches and values regarding knowledge about the world - an appreciation of info gained through hands - on manipulation and use of tools, the application of direct observation and experimentation, precise methods of measurement and other forms of quantification, and a positive evaluation of individual experience. These values and practices were very similar to those espoused by contemporary artisans and practitioners, such as painters, sculptors, carpenters, weavers, potters, architect/engineers, sailors, pharmacists, and farmers.[3] By "artisans/practitioners" is meant a diverse group of skilled tradesmen, like weavers and instrument makers, architects/engineers, and farmers, sailors, and practitioners involved in the design and construction of buildings, bridges, and the like.[4]

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[2] Pamela O. Long, *Artisan/Practitioners and the Rise of the New Sciences, 1400–1600* (Corvallis: Oregon State University Press, 2011), pp. 2-3.
[3] Long, *Artisan/Practitioners*, p. 3.
[4] Long, *Artisan/Practitioners*, p. 1.

Historical events that created a favourable climate for science, the acceptance of the work and experiments of artisans, and the expansion of natural history based on experience rather than book learning, triggered by the "geographic revolution". Some of these factors did not have a direct impact on science, but they created an atmosphere conducive to the acceptance of new ideas and methods.[5]

An essential starting point for any discussion of this influence on the development of empirical and experimental approaches from the late 15th and 16th centuries is Edgar Zilsel's thesis that he established the importance of artisanal influence for the 'Scientific Revolution'.[6] In order to fill this gap and therefore understand the epistemic value of practical knowledge, we need to know how and in what steps the structure of science, used in the framework of practical activities is reflected, conceptualized and externalized, for example, by various tools, and how it is used in more abstract ways that connect heterogeneous intellectual and practical fields to build systems of new data, it is necessary to investigate how it allows the creation of knowledge structures. Although written codification of at least some aspects of practical activities has existed since ancient times, the codification of these activities in the form of written texts, drawings, and models increased exponentially in the early modern period.[7] According to Kapil Raj, modern science is fully adoptable by all people because it is based on mathematical reasoning and is therefore 'ecumenical'. But despite its uniqueness, modern science was not created from nothing. Rather, it encompassed medieval learning of both West and East "like rivers flowing into the ocean of modern science". And, for Joseph Needham, although modern science is uniquely Western in origin, it is culturally universal.[8]

While science is universal, it also bears the mark of the regional conditions in which it is applied.[9] That is, the consumption of science – the ways in which scientific theories and practices are accepted in different fields – also bears the imprint of local

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[5] R. Hooykaas, "The Rise of Modern Science: When and Why?," *British Journal for History of Science*, 20 (1987): 453-473, p. 456.

[6] Pamela O. Long, "Trading Zones in Early Modern Europe," *Isis*, 106, 4 (2015): 840–847, p. 843.

[7] Matteo Valleriani, "The Epistemology of Practical Knowledge," in *the Structures of Practical Knowledge*, ed. by M. Valleriani, 1-19, (Switzerland: Springer International Publishing, 2017), p. 2.

[8] Kapil Raj, *Relocating Modern Science* (New York: Palgrave Macmillan, 2007), p. 2.

[9] D. N. Livingstone, *Putting science in its place: Geographies of scientific knowledge* (Chicago: The University of Chicago Press, 2003), p. 134.

conditions.[10] The meaning of particular scientific texts and theories has varied from place to place, and one way to uncover such geographies of reception is to determine how various cultures evaluated particular scientific works.[11] This is today one of the challenges of the so-called new global history.

Discussions of early modern scholarship typically begin with an apology for the terminology used.[12] "Science" does not evoke the same set of ideas in the modern reader as it did in the 16th century Ottomans. In this thesis, I discuss the scientific studies and technologies, and instruments, made by artisans in the field of maritime in a series of complex, multi-faceted and long-term developments traditionally called the "Scientific Revolution", by looking through the lens of the Ottoman empire, which had an substantial place in the early modern Mediterranean.[13]

Ottoman history of science was, until recently, one of the least known and least researched areas of the history of Islamic science. In fact, it would not be an exaggeration to say that it is one of the most neglected areas. Although research on the history of Ottoman science has increased considerably in recent years, there are many topics that need to be researched. Ottoman science is a term used to name the scientific activities carried out in the space and time dimensions, where the Ottoman empire ruled. Ottoman empire, which developed in a period of 600 years from the end of the thirteenth century to the twentieth century, was born as a small principality in Anatolia in the last decade of the thirteenth century and over time expanded Anatolia, the Balkans, most of the Arab countries and a part of Europe. Ottoman science includes the scientific activities carried out over the wide geographical region of the Ottoman empire. These scientific activities include copyright and translation movements in different branches of science and institutions dealing with science and education.[14]

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[10] Livingstone, *Putting science in its place*, p. 112.
[11] Livingstone, *Putting science in its place*, p. 113.
[12] Alison D. Sandman, "Cosmographers vs. Pilots: Navigation, Cosmography, and the State in Early Modern Spain" (PhD diss., University of Wisconsin, 2001), pp. 10-11.
[13] Long, *Artisan/Practitioners*, p. 1.
[14] Ekmeleddin Ihsanoğlu, "Osmanlı Bilim Tarihi Konusundaki Araştırmalar Hakkında Bazı Notlar" *Osmanlı Bilim Araştırmaları* (Istanbul: Istanbul Üniversitesi Edebiyat Fakültesi Yayınları, 1995), p. 47.

The Ottoman country, which spreads so widely in space and time dimensions, brings to the attention of researchers a wide range of human activities, including scientific ones. Although the historical development of Ottoman science can be evaluated with different approaches and from diverse angles, essentially two main phases follow each other. The first phase is dominated by classical Islamic science, which developed in the Middle Ages, and its influence continued until the last century. The second phase is the modernization process under the influence of modern Western science.[15]

In this thesis, we will see that through research on practical knowledge and artisanal epistemology in the early modern period, the information that the Ottoman empire received from both sides of the Mediterranean, namely the east and the west, with which it interacted, was synthesized, and transformed into its own scientific tradition. Numerous studies have been conducted about the Ottoman empire in the 15th and 16th centuries. However, research on who and how this scientific and technological development was carried out in the early modern Ottoman period is quite limited.

In the early modern period, the great breakthroughs in the studies on Ottoman science, and the subsequent collapses can be seen together. In the beginning, the Ottoman scientific tradition, which was influenced by the accumulation of the old Islamic culture and science centres, soon reached a point, where some aspects also influenced the old centres, and set an example for them. On the other hand, Ottoman scientists and artisans were aware of some scientific developments in Europe, in this period, and made selective transfers from Western science. Thus, the effects of Western science, gradually, began to see in the Ottoman world. This point, as Ottoman scientists and artisans have revealed with their own knowledge and efforts, led the Ottoman empire, which has come to represent the Islamic world, to the point of creating a unique synthesis between East and West.[16] Fundamental changes in science and technology, in the Ottoman empire, took place over a wide period. Therefore, in the historical process of Ottoman science, it is difficult to attribute the transition from East to West, to certain events or to start from a certain date. However, it can be said that the great breakthroughs initiated by Mehmed the Conqueror (1451-1481), who moved the

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[15] Ihsanoğlu, "Osmanlı Bilim Tarihi Konusundaki Araştırmalar Hakkında Bazı Notlar," p. 47.
[16] Ekmeleddin Ihsanoğlu, *Osmanlı Bilim Mirası* (Istanbul: Yapı Kredi Yayınları, 2017), Vol. I, p. 5.

Ottoman capital to Constantinople with the conquest, can be considered a milestone. Because these breakthroughs formed the foundations of the period of Suleiman the Magnificent (1520-1566), the Golden Age of the Ottoman empire.[17]

The issues I examine from the Ottoman perspective in my thesis are investigated by examining historical records related to an intercultural ‘contact zone’. All events, conquests, conflicts, production activities, people, artisans, and instruments are notions that exist and are known in this contact zone, that is, the Mediterranean. Given the scope and duration of the encounter between Ottomans and Europeans, as well as the presence of rich archival sources, this region offers an ideal opportunity to follow interactions between different specialist cultures in the creation of new information to demonstrate expanding the scope of social data studies by examining the construction of scientific info and, bringing contact zones into their own environment as legitimate sites of scientific knowledge production together with new historical source material. This is part of the more general point that national and regional histories, especially since the first globalization of the 16th century, cannot be understood by limiting the study to their geographical boundaries.[18]

It should not be forgotten that in the late Middle Ages and early modern period, science and technology circulation and transfer was carried out through the employment of skilled artisans. Because, during this period, there were no radical differences between the Western and Eastern worlds in terms of approaches to history of knowledge.[19]

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[17] Ihsanoğlu, *Osmanlı Bilim Mirası,* Vol. I, p. 5.
[18] Raj, *Relocating Modern Science*, p. 11.
[19] Tuncay Zorlu, “Osmanlı Deniz Teknolojisi Üzerine” *Türkiye Araştırmaları Literatür Dergisi*, 4, 2 (2004), 297-353, p. 297.

Sources and Bibliographical Notes

After briefly presenting the relationship between science and the Ottoman empire in parallel with developments on a global scale, it is necessary to briefly mention the sources of my thesis. First, on the subject of the Scientific Revolution and early modern science as a general context, which was the starting point of my research, my work is supported by a wide range of authors from different generations, including Herbert Butterfield, A. Rupert Hall, Steven Shapin, Joseph Needham, Thomas S. Kuhn, George Sarton, James Harvey Robinson, Walter Libby, A.C. Crombie, David Cahan and David Wootton, H. Floris Cohen, Stephen Pumfrey, Maurice Slawinski, Roy Porter and Mikuláš Teich, Peter Dear, Alfred North Whitehead, Marshall Clagett, among others.[20]

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[20] Herbert Butterfield, *The Origins of Modern Science 1300-1800* (New York: the Macmillan Company, 1959); A. Rupert Hall, *The Scientific Revolution 1500–1800: The Formation of the Modern Scientific Attitude* (London: Longmans, Green & Co., 1954); Steven Shapin, *The Scientific Revolution* (Chicago & London: University of Chicago Press, 1996); Joseph Needham, *Science and Civilisation in China*, 7 vols (Cambridge: Cambridge University Press, 1954–2005); Thomas S. Kuhn, *The Structure of Scientific Revolution* (Chicago: the University of Chicago Press, Second edition, 1970); George Sarton, *A Guide to the History of Science* (Newyork: Chronica Botanica Company, 1952); James Harvey Robinson, *An Outline of the History of the Intellectual Class in Western Europe* (New York: Marion Press, 1915); Walter Libby, *An Introduction to History of Science* (Cambridge: the Riverside Press, 1917); A.C. Crombie, *Medieval and Early Modern Science* (New York: Doubleday Anchor Books, 1959); David Cahan, *From Natural Philosophy to the Sciences: Writing the History of Nineteenth Certury Science* (Chicago & London: the University of Chicago Press, 2003); David Wootton, *The Invention of Science: A New History of the Scientific Revolution* (London: Penguin Books, 2015), and *Bilimin Icadı: Bilim Devrimi'nin Yeni Bir Tarihi* (Istanbul: Yapı Kredi Yayınları, 2019); and H. Floris Cohen, *The Scientific Revolution: A Historiographical Inquiry* (Chicago and London: The University of Chicago Press, 1994); Stephen Pumfrey, Paolo L. Rossi and Maurice Slawinski (eds.), *Science, culture and popular belief in Renaissance Europe* (Manchester and New York: Manchester University Press, 1991); Roy Porter and Mikuláš Teich (eds.), *The Scientific Revolution in National Context* (Cambridge: Cambridge University Press, 1992); Peter Dear, *Revolutionizing the Sciences: European Knowledge and its Ambitions, 1500-1700* (London: Palgrave, 2001); A. N. Whitehead, Science and the Modern World (Cambridge: Cambridge University Press, 1953); and Marshall Clagett (ed.) (1959), *Critical Problems in the History of Science* (Madison: The University of Wisconsin, 1962).

and the origins of modern science and artisans and their nautical instruments, occupy a very momentous place in my thesis.[21]

Most important of all, looking at the artisanal knowledge literature that constitutes the way out of my thesis, I benefited from the valuable studies of historians of science, who have very valuable studies on this subject, such as Edgar Zilsel, Paolo Rossi, Matteo Valleriani, Pamela H. Smith, Pamela O. Long, Paula Findlen, Benjamin Schmidt, Abraham Wolf, Derek J. de Solla Price, and my supervisor Antonio Sánchez Martínez.[22]

Among the extensive literature, the French historian Fernand Braudel's work *The Mediterranean and the Mediterranean World in the Era of Felipe II* (1949), Andrew Hess' book *The Forgotten Frontier: A History of Sixteenth Century Ibero-African Relations* (1978), and David Abulafia's *The Great Sea* (2011) were the main

[21] Arthur Clegg, "Craftsmen and the origin of science," *Science and Society*, 43 (1979): 186–201; John Henry, *The Scientific Revolution and the Origins of Modern Science* (New York: Palgrave Macmillan, 1997); R. Hooykaas, "The Rise of Modern Science: When and Why?," *British Journal for History of Science*, 20 (1987): 453-473; David N. Livingstone, *Putting science in its place: Geographies of Scientific Knowledge* (Chicago, IL: The University of Chicago Press, 2003); John H. Pryor, *Geography, Technology, and War: Studies in the Maritime History of the Mediterranean, 649-1571* (Australia: Cambridge University Press, 1992); Maria Pia Pedani, "Ottoman ships and Venetian craftsmen in the 16th century," *Seapower, Technology and Trade in Studies in Turkish Maritime History*, ed. by D. Couto, F. Gunergun, Maria Pia Pedani, 460-464, (Istanbul: Denizler Kitabevi / Kaptan Yayıncılık, 2014); Kapil Raj, *Relocating Modern Science* (New York: Palgrave Macmillan, 2007); Alison Sandman, "Spanish Nautical Cartography in the Renaissance," in *Cartography in the European Renaissance*, ed. David Woodward, 1095-1142, Vol. 3, Part 1 of *The History of Cartography* (Chicago and London: The University of Chicago Press, 2007); and Lewis Pyenson and Susan Sheets-Pyenson, Servants of Nature: A History of Scientific Institutions, Enterprises and Sensibilities (London, Harper Collins Publishers, 1999).

[22] Edgar Zilsel, "The Social Roots of Science," in *Edgar Zilsel: The Social Origins of Modern Science*, ed. by Diederick Raven, Wolfgang Krohn, and Robert S. Cohen, foreword by Joseph Needham, 3-6, (Dordrecht/Boston: Kluwer Academic Publishers Boston Studies, 2000); Matteo Valleriani, "The Epistemology of Practical Knowledge," in *the Structures of Practical Knowledge*, ed. by M. Valleriani, 1-19, (Switzerland: Springer International Publishing, 2017); Pamela H. Smith, "Science on the move: Recent trends in the history of early modern science," *Renaissance Quarterly*, 62, 2 (2009): 345–375, and *The Body of the Artisan: Art and Experience in the Scientific Revolution* (Chicago and London: University of Chicago Press, 2004); Pamela O. Long, "Trading Zones in Early Modern Europe," *Isis*, 106, 4 (2015): 840–847, https://www.jstor.org/stable/26455500, and *Artisan/Practitioners and the Rise of the New Sciences, 1400–1600* (Corvallis: Oregon State University Press, 2011); Pamela H. Smith and Benjamin Schmidt, eds. Making Knowledge in Early Modern Europe: Practices, Objects, and Texts, 1400-1800 (Chicago: University of Chicago Press, 2007); Abraham Wolf, *A History of Science, Technology and Philosophy in the 16th & 17th Centuries*, 2 vols., (London: George Allen & Unwin, 1968); Derek J. De Solla Price, *Little Science, Big Science ... And Beyond* (New York: Colombia University Press, 1963); and Antonio Sánchez, "Practical Knowledge and Empire in the Early Modern Iberian World. Towards an Artisanal Turn," *Centaurus*, 61, 3 (2019): 268–281.

guidebooks for me.[23] In addition, a few of the authors of the reference, I got comprehensive information from the English literature on the history of science, technology and cartography, are Tony Campbell (1987), Palmira Brummett (1994), John F. Guilmartin (2003), and Ian Manner (2007), among many others.[24] The details that Palmira Brummett gave in her work, titled *Ottoman Seapower and Levantine Diplomacy in the Age of Discovery* (1988), while describing the shipbuilding activities of the Ottoman empire, were very beneficial. Especially, in the economic context, the knowledge, about the events of the 16th century, was useful for me to see that the economic rivalries of the states with each other, in Mediterranean, pushed them to sea technologies. At the same time, giving the numerical status of the ships, produced in the shipyards, in the sections, related to the Ottoman naval power has been quite enlightening. Therewithal, John F. Guilmartin's *Galleons and Galleys* (2002) looks at the geographical and technological realities of naval warfare, tactical and technical developments in the changing patterns of warfare and trade, paying particular attention to their cultural, social, and economic context. He provided very significant information, while examining the ship types, and including the technological and tactical situation of the Ottomans in the momentous wars of the 16th century, such as the Battle of Lepanto.[25]

First, it should be questioned to what extent technological accumulation or practical and technical knowledge was an area that was examined in the Ottoman empire. The primary thing that stands out in this regard is the scarcity or inadequacy of science history and technology-oriented studies devoted to it, despite the wide research field that a 600-year-old state inevitably offers to academicians. The same problem also manifests itself in Ottoman maritime, which is the subject of my thesis.

[23] Fernand Braudel, *The Mediterranean and the Mediterranean World in the Age of Philip II*, trans. by Siân Reynolds (California: University of California Press, 1995); Andrew Hess, *Unutulmuş Sınırlar: 16. Yüzyıl Akdeniz'inde Osmanlı- Ispanyol Mücadelesi,* trans. Özgür Kolçak (Istanbul: Küre Yayınları, 2010); and David Abulafia, Büyük *Deniz: Akdeniz'de Insanlık Tarihi*, trans. Gül Çağalı Güven (Istanbul: Alfa Basım Yayın, 2012).

[24] Tony Campbell, "Portolan Charts from the Late Thirteenth Century to 1500," in *Cartography in Prehistoric, Ancient, and Medieval Europe and the Mediterranean*, ed. J. B. Harley and David Woorward, 371-463, Vol. 1 of *The History of Cartography* (Chicago and London: The University of Chicago Press, 1987); Palmira Brummett, *Osmanlı Denizgücü ve Doğu Akdeniz'de Diplomasi*, trans. H. Nazlı Pişkin (Istanbul: Timaş Yayınları, 2009); and Ian Manners, *European Cartographers and the Ottoman World 1500–1750 (Maps from the Collection of O. J. Sopranos)* (Chicago: The Oriental Institute of the University of Chicago, 2007).

[25] John F. Guilmartin, Jr., *Kalyonlar ve Kadırgalar,* trans. Ali Özdamar (Istanbul: Kitap Yayınevi, 2010).

There are much more unknowns than known on this subject. The reasons for the limitation in this area are multifaceted and have a complex structure.[26]

Terminological difficulties are perhaps the most deterrent. Those, who will work in this field, must overcome a difficult jargon consisting of maritime terms. For example, the dozens of ropes, sails, masts, spars, nails, timbers, and guns used on a sailing ship have separate names and functions. This jargon challenge continues with the addition of new challenges in our most substantial resource: archives. In addition to conceptual difficulty, reading and deciphering difficulties also present themselves. In fact, reading difficulty often appears as a natural extension of terminological difficulties. In other words, the issue is closely related to whether a term whose meaning you do not know reminds you of anything when you read it, whether it is written clearly or complexly. Documents and notebooks written in different Ottoman writing styles force the researcher into an intense work and learning process. Alias, the kitchen part of the job or the workshop side is quite tiring and long. Recent efforts to create technical dictionaries, encyclopaedic studies, and bibliographic works on maritime technology such as Lingua Franca are admirable, but they are not at a sufficient level.[27]

Another problem that draws attention regarding both archive documents and manuscripts is that, leaving aside miniatures, there are almost no original drawings, plans, figures, pictures or charts, which are considerable data for a better understanding of Ottoman naval technology.[28] Although the shortage of visual materials, which is largely valid for many other fields of science and technology in the Ottoman empire, is in a relatively better situation in the field of cartography, it should not be forgotten that most of this material consists of domestic and foreign scientific studies on the portolan charts, drawn by Piri Reis.[29]

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[26] Zorlu, "Osmanlı Deniz Teknolojisi Üzerine," p. 298.
[27] Zorlu, "Osmanlı Deniz Teknolojisi Üzerine," p. 299; and Henry&Renée Kahane and Andreas Tietze, *The Lingua Franca in the Levant: Turkish Nautical Terms of Italian and Greek Origin* (Urbana: University of Illinois Press, 1958).
[28] Zorlu, "Osmanlı Deniz Teknolojisi Üzerine," p. 299.
[29] Zorlu, "Osmanlı Deniz Teknolojisi Üzerine," pp. 299-300. Regarding the studies on Piri Reis and his portolan charts, see; Piri Reis, *Kitâb-ı Bahriyye,* trans. Fevzi Kurtoğlu ve A. Haydar Alpagot (Ankara: Türk Tarih Kurumu Yayınları, 1935); Afet İnan, *The Oldest Map of America Drawn by Piri Reis*,

I am examining the works and portolan charts of artisanal pirates, which are nautical instruments, which will serve as examples of the subject of my thesis. The first of these are Piri Reis's works, called the *First World Map* (1513), the *Second World Map* (1528) and *Kitâb-ı Bahriyye* (The Book of Navigation, 1520). At the same time, Seydi Ali Reis (Kâtibi)'s nautical books, titled *Kitâbü'l-Muhit* (the Book of Ocean, 1554), *Hulâsatü'l-hey'e* (The Summary of Astronomy, 1549), *Mir'ât-ı Kâinât* (The Mirror of The Universe, 1555?) and *Risâle-i Zâtü'l-Kürsî* (155?). Moreover, I am investigating the *Nautical Atlas* of Ali Macar (Hungarian) Reis (1567). Also, I am analysing two anonymous atlases made in the same period, which are similar to his nautical atlas. These are *Walters Sea Atlas* (1560-1570) and *Atlas-ı Hümayûn* (Imperial Atlas, 1570).

In a more general sense, the works of expert historians, such as Ismail Hakkı Uzunçarşılı, Halil Inalcık, and Mustafa Cezar, as a few examples of Ottoman historians, helped me to gain clarity on the Ottoman early modern historical atmosphere. Because the fact that these authors had different views, while describing Ottoman history in their work, provide a broad perspective. For example, one of these historians is Uzunçarşılı, his great work, titled Ottoman History (1947) in 6 volumes, allowed me to see comprehensively, what happened in the 16th century Ottoman political history. Therewithal, it was also very enlightening to read the works of Inalcık on certain periods of the Ottoman empire. For example, his book, titled *Fatih Sultan Mehemmed Han* (2019), which covers only the period of Mehmed the Conqueror, was

(Ankara: Türk Tarih Kurumu Yayınları, 1954); *Piri Reis'in Amerika Haritası (1513-1528)* (Ankara: Türk Tarih Kurumu Yayınları, 1954), and *Piri Reis'in Hayatı ve Eserleri* (Ankara: TTK Yayınları, 1992); Yusuf Akçura, *Piri Reis Haritası Hakkında Izahname (Die Karte des Piri Reis-Piri Reis amp-Carte de Piri Reis)* (Ankara: Türk Tarih Kurumu Yayınları, 1935); Muazzez İlmiye Çığ, "Piri Reis Haritaları Üzerinde Amerika"da Yapılan Geniş ve Derin Çalışmaları İçeren The Maps of the Ancient Sea Kings (Eski Deniz Krallarının Haritaları) Kitabının Türkçe Özeti (Bir Harita İle Birlikte)," *Belleten*, 56, 216 (1992), 405-435; Muzaffer Erendil, "Piri Reis Çağında Güçlü Donanma Anlayışı, Bilim ve Teknik," *Deniz Kuvvetleri Dergisi*, 546 (1990), 17-23; Fuad Ezgü, "Piri Reis", *Islam Ansiklopedisi*, 9 (1964), 561-565; Idris Bostan, "Piri Reis'in *Kitâb-ı Bahriyye*'sinde Bulunan *Tersâne-i Âmire* Planları," *Sanat Tarihi Araştırmaları Dergisi*, 1, 2 (1988), 67-68; and Andrew Hess, "Piri Reis and the Ottoman Response to the Voyages of Discovery", *Terra Incognita*, 6 (1974), 19-37.

momentous to see Sultan's political stance, and to understand the infrastructure of his works on science and technology, based on these.[30]

Before the studies focusing on specific people, time, and events about the history of Ottoman Science, it is only possible to reach the source that provides comprehensive information on the subject with the works of certain names For instance, some of the many studies are Adnan Adıvar's book, *Osmanlı Türklerinde İlim* (Science in Ottoman Turks), first published in Paris, in 1936, and the works of Fuat Sezgin (2007) and Ekmeleddin Ihsanoğlu (2017).[31] In literature, there are Idris Bostan, Fikret Sarıcaoğlu, Kemal Özdemir, Palmira Brummett, Svat Soucek, Christine Isom-Verhaaren, Gabor Agoston, Ian Manners, Mehmet Kiremit, Aykut Kazancıgil, Colin Imber, Andrew C. Hess, Emrah Safa Gürkan, Elina Gugliuzzo, Pınar Emiralioğlu, Suraiya Faroqhi, Kâtip Çelebi, and many others, who have specific studies on the history of Ottoman science and technology.[32] The works of Mustafa Gürbüz Beydiz

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[30] Halil Inalcık, *Iki Karanın Sultanı, Iki Denizin Hakanı, Kayser-i Rum Fatih Sultan Mehemmed Han* (Istanbul: Türkiye Iş Bankası Kültür Yayınları, 2019).

[31] Adnan Adıvar, *Osmanlı Türklerinde Ilim* (Istanbul: Remzi Kitabevi, 1982), Fuat Sezgin, *Islam'da Bilim ve Teknik* (Ankara: Türkiye Bilimler Akademisi Yayınları, 2007); Ekmeleddin Ihsanoğlu, *Osmanlı Bilim Mirası* (Istanbul: Yapı Kredi Yayınları, 2017); and Fuat Sezgin, *Islam'da Bilim ve Teknik*, trans. Abdurrahman Aliy (Ankara: Türkiye Bilimler Akademisi Yayınları, 2007).

[32] Idris Bostan, *Kürekli ve Yelkenli Osmanlı Gemileri* (Istanbul: Bilge Kültür Sanat, 2005), and *Osmanlı Devleti'nin Merkez ve Bahriye Teşkilatı* (Ankara, Türk Tarih Kurumu Yayınları, 1948); Fikret Sarıcaoğlu, *Osmanlı Tarihi Haritaları ve Tarihi Coğrafya Eserleri* (Istanbul: Çamlıca Basım Yayın, 2015); Kemal Özdemir, *Osmanlı Haritaları* (Istanbul: Creavite Yayıncılık ve Tanıtım Ltd. Şti., 2008); Svat Soucek, "Islamic Charting in the Mediterranean," in *Cartography in the Traditional Islamic and South Asian Societies,* ed. J. B. Harley and David Woodward, 263-292, Vol. 2, Part 1 of *History of Cartography* (Chicago, The University of Chicago Press, Chicago, 1992); Christine Isom-Verhaaren, *The Sultan's Fleet*, (London: I.B. Tauris, 2021); Gabor Agoston, *Guns for the Sultan: Military Power and the Weapons Industry in the Ottoman Empire* (Cambridge: Cambridge University Press, 2005), pp. 49-52; Ian Manners, *European Cartographers and the Ottoman World 1500–1750* (Maps from the Collection of O. J. Sopranos) (Chicago: The Oriental Institute of the University of Chicago, 2007); Mehmet Kiremit, *Seydi Ali Reis: Mir'atü'l- Memalik* (Inceleme-Metin-İndeks) (Ankara: Türk Dil Kurumu Yayınları, 1999); Aykut Kazancıgil, *Osmanlı'da Bilim ve Teknoloji* (Istanbul: Ketebe Yayınları, 2020); Colin Imber, *The Ottoman Empire, 1300-1650,* (Reprint, Bloomsbury Publishing, 2019); Andrew C. Hess, "The Ottoman Conquest of Egypt (1517) and the Beginning of the Sixteenth-Century World War," *International Journal of Middle East Studies*, 4, 1 (1973): 55–76; Emrah Safa Gürkan, *Sultanın Korsanları: Osmanlı Akdenizi'nde Gaza, Yağma ve Esaret, 1500-1700* (Istanbul: Kronik Kitap, 2018); Elina Gugliuzzo, "Sea Power and the Ottomans in the Early Modern Mediterranean World," *Aspects of War, Diplomacy, and Military Elites Series: History of Warfare*, 118 (2018): 79-91; Pınar Emiralioğlu, "Cartography and the Ottoman Imperial Project," in *the Sixteenth Century in Imperial Geographies in Byzantine and Ottoman Space*, Chap. 3, (Washington: Centre for Hellenic Studies, Trustees for Harvard University, 2013); Suraiya Faroqhi, *Artisans of Empire: Crafts and Craftspeople Under the Ottomans* (London: I.B.Tauris, 2009); and Kâtip Çelebi, *Deniz Savaşları Hakkında Büyüklere Armağan* (Istanbul: Kabalcı Yayınevi, 2007).

and Salih Özbaran about Ottoman artisans were guide me to reach more information.[33] The works of historians, such as Gregory McIntosh, Afet Inan, Gaye Danışan Polat and Giancarlo Casale, who focused exclusively on the works of artisans in the Ottoman empire, enabled me to reach more knowledge about the nautical instruments of artisans.[34]

First, Kâtip Çelebi's (d. 1657) work, titled *Deniz Savaşları Hakkında Büyüklere Armağan* (A Gift to the Elders About Naval Wars, 1656), written about Ottoman Maritime, constitutes the primary source. Because this book of Çelebi was written in the 17th century and is a recent history book for that time. Undoubtedly, he is someone who could obtain information by personally examining the shipyard and talking to the organization personally, and it can be said that he has the opportunity to obtain more information than we do now, in terms of being able to talk to the people and institutions of that time.[35] Afet Inan's book, titled *Piri Reis'in Hayatı ve Eserleri* (Piri Reis's Life and Works) was first published in 1974, and is one of the distinguished works, written on this subject. Also, the book, written by Gregory McIntosh in his work, titled *The Piri Reis Map of 1513*, contains deep investigations and analysis and is one of the important academic studies on this subject.[36] Idris Bostan is one of today's leading names about Ottoman maritime history, and his works have a very significant place in the Turkish academic literature on the Ottoman maritime organization and shipyards.[37]

The *Ottoman History of Science Literature*, which contains 18 volumes, Ottoman archive inventory within the scope of the concept, and methodology of Ottoman science, initiated by Ihsanoğlu, a Turkish historian of science and the founding general director of the Research Centre for Islamic History, Art, and Culture

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[33] Mustafa Gürbüz Beydiz, "*Tersâne-i Âmire*'de Çalışan Zanaatkârlar," *Bilecik Şeyh Edebali Üniversitesi Sosyal Bilimler Dergisi*, 2 (2017): 382-399; and Salih Özbaran, "Galata Tersanesinde Gemi Yapımcıları, 1529-1530," *Güneydoğu Avrupa Araştırmaları Dergisi*, 8-9 (2012): 97-102.
[34] Gregory McIntosh, *The Piri Reis Map of 1513* (Athens: University of Georgia Press, 2012); Afet Inan, *Piri Reis'in Hayatı ve Eserleri* (Ankara: Türk Tarih Kurumu Yayınları, 2018); Gaye Danışan Polat, "An anonymous Ottoman compendium on nautical instruments and navigation: Kitâbü'l-mürûri'l-ubûr fî ilmi'l-berri ve'l-buhûr," *Mediterranea* (Ricerche Storiche, August 2015); and Giancarlo Casale, "From Hungary to Southeast Asia: The Ali Macar Reis Atlas in a Global Context," *Osmanlı Araştırmaları*, 39 (2012): 54-62.
[35] Kâtip Çelebi, *Deniz Savaşları Hakkında Büyüklere Armağan* (Istanbul: Kabalcı Yayınevi, 2007).
[36] Gregory McIntosh, *The Piri Reis Map of 1513* (Athens: University of Georgia Press, 2012); and Afet Inan, *Piri Reis'in Hayatı ve Eserleri* (Ankara: Türk Tarih Kurumu Yayınları, 2018).
[37] Idris Bostan, *Kürekli ve Yelkenli Osmanlı Gemileri* (Istanbul: Bilge Kültür Sanat, 2005), and *Osmanlı Devleti'nin Merkez ve Bahriye Teşkilatı* (Ankara, Türk Tarih Kurumu Yayınları, 1948).

(IRCICA), between 1980 and 2004. The work of the same name, with a work of the *Ottoman Science Heritage* project, was the main source in this thesis, to reach a list of scientific works, made in Ottoman history. With all these pieces of information together, and creating a harmonious whole, under one roof was considerable, at the same time, in terms of comprehending the atmosphere of the period. Because of this, it is so wonderful to see that all these parts are interconnected and whole. It is impressive that the Ottomans created a science in their own world by following the scientific and technological activities that existed in the early modern period.

Information, on scientific and technological developments, which Ottoman historical books divide into small sections, is collected from separate books. And then, all these notions are enlarged through a lens. All of these are researched one by one, and in this way, a whole and general view can be reached. For example, Ihsanoğlu gives the sources in the Ottoman archives together with their authors, in his book, *Osmanlı Bilim Mirası* (Ottoman Science Heritage, 2017), as a result of his researches for many years.[38] Thanks to this resource, I was able to do a more specific, and detailed research by reaching a complete list of works, written in the 15th and 16th centuries, in the Ottoman empire. I wanted to give knowledge about the history of Ottoman science and technology in terms of artisanal epistemology to create a common language with these data from all these sources.

At the same time, Uzunçarşılı's inclusion of Ottoman cultural history was very useful in my research in terms of progressing from general to more specific issues.[39] Again, his work, titled *Central Organization and Naval Organization of the Ottoman Empire* (1948), is a more detailed study in history of technology.[40] This source, which talks about ships and ship technologies, contains very detailed information, when explaining the organization of the Ottoman navy. In this book, main topics, such as the establishment of Ottoman arsenals, artisans, shipyard personnel, Kaptan Pasha (captain

[38] Ekmeleddin Ihsanoğlu, *Osmanlı Bilim Mirası* (Istanbul: Yapı Kredi Yayınları, 2017).
[39] Ismail Hakkı Uzunçarşılı, *Osmanlı Tarihi* (Ankara: Türk Tarih Kurumu Yayınları, 2016).
[40] Ismail Hakkı Uzunçarşılı, *Osmanlı Devleti'nin Merkez ve Bahriye Teşkilatı* (Ankara, Türk Tarih Kurumu Yayınları, 1948).

of navy) and his flags, shipsbuilding activities and equipment, task groups, navy's voyage ceremony are explained with archive documents and chronicles of the period.[41]

One of the researchers, who has studied most comprehensively on the Ottoman artisan community, is Suraiya Faroqhi. Since Faroqhi covered the issue of artisanry comprehensively in his works, she did not elaborate on maritime. She examined craft guilds and Ottoman art guilds in general.[42] Also, the revised and articled version of Colin Imber's doctoral thesis, titled *The Administration of the Ottoman Navy during the Reign of Suleyman I, 1520-1566*, was published in *Archivum Ottomanicum* under the name *The Navy of Suleiman the Magnificent*. The work, which is the product of careful and meticulous work, is the most detailed study about the naval power in the Suleiman period and also includes technological developments.[43] He has indispensable works, especially Idris Bostan's work titled Ottoman Naval Organization: *Tersâne-i Âmire* in the 16th century, which introduces arsenal in every aspect to the academic world in the light of archive documents used intensively and skillfully. Many topics such as shipyard management, ship types and materials, personnel, technological developments, technical terms can be easily followed from the work.[44]

Brummet's article, titled *The Ottomans as a World Power: What We Don't Know About Ottoman Sea Power*, presented at the symposium on *The Ottomans and Sea* organized by The Skilliter Center for Ottoman Studies, Newham College, Cambridge in 1996. She expertly discusses some of the prejudices that surround sea power and presents his discussion within a theoretical framework informed by reliable evidence.[45] One of the most significant works devoted to this subject, which I

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41 Zorlu, "Osmanlı Deniz Teknolojisi Üzerine," pp. 307-308.

42 Suraiya Faroqhi, Artisans of Empire: Crafts and Craftspeople Under the Ottomans (London: I.B. Tauris, 2009).

43 Zorlu, "Osmanlı Deniz Teknolojisi Üzerine," p. 310.

44 Zorlu, "Osmanlı Deniz Teknolojisi Üzerine," p. 310. For Idris Bostan's works, see; Idris Bostan, *Osmanlı Akdenizi* (Istanbul: Küre Yayınları, 2017), "Fatih Sultan Mehmet ve Osmanlı Denizciliği," *Türk Denizcilik Tarihi*, ed. by Idris Bostan and Salih Özbaran (Istanbul: Boyut Yayıncılık, 2009), *Istanbul'un 100 Denizcisi*, (Istanbul: Istanbul Büyükşehir Belediyesi Kültür A.Ş. Yayınları, 2014), "Preveze Deniz Zaferi ve Sonrasında Akdeniz Dünyası," *Türk Denizcilik Tarihi*, ed. Idris Bostan and Salih Özbaran (Istanbul: Boyut Yayıncılık, 2009), *17. Yüzyılda Tersâne-i Âmire* (Istanbul: Küre Yayınları, 2018), "Kadırga'dan Kalyon'a XVII. Yüzyılın Ikinci Yarısında Osmanlı Gemi Teknolojisi'nin Değişimi," *Osmanlı Araştırmaları*, 24 (2004), 65-86, and "Piri Reis," *Türkiye Diyanet Vakfi Islâm Ansiklopedisi*, 34, 283-285, (Istanbul: Türkiye Diyanet Vakfı Yayınları, 2007).

45 Zorlu, "Osmanlı Deniz Teknolojisi Üzerine," p. 345; and Palmira Brummett, "The Ottomans as a World Power: What We Don't Know About Ottoman-Sea-power" The Ottomans and the Sea,

mentioned above, is undoubtedly *The Lingua Franca in the Levant: Turkish Nautical Terms of Italian and Greek Origin*. This work, which was created because of the intense and meticulous work of Tietze, Kahane and some other authors, contains articles on almost every subject related to maritime. The work, which can be considered as both a technical dictionary, an encyclopaedia, and a good source for Turkish literature, gives the researcher the opportunity to compare the Ottoman naval power with the naval powers of the Mediterranean countries in a terminological sense and find some common ties. The most important feature of the work is that the concepts are given considering the linguistic and cultural unity of the Mediterranean basin. In addition, Svat Soucek's article, titled *Certain Types of Ships in the Ottoman-Turkish Terminology*, is among the sources that should be mentioned with its etymological explanations on ship types.[46]

Manuscripts

The Ottoman artisans that I am examining, are pirates, who have many years of maritime experience. The pirates, who were thought to have a very high level of experience and data, were invited by the Ottoman Sultans to take over the shipyard and played a leading role in production of instrument and raising artisans. For this reason, in this thesis, the pirates, who contributed to the development of practical knowledge on science and technology in the Ottoman shipyards, are considered as artisans and are called 'artisanal pirates'. The primary sources, I use to analyse Ottoman artisanal pirates, such as Piri Reis, Seydi Ali Reis, Ali Macar Reis, are books, written by themselves. Additionally, I also examine *Walters Sea Atlas* and *Atlas-ı Hümayûn*, whose author is unknown.[47]

(London: The Skilliter Center for Ottoman Studies&Instituto Per L'Oriente C. A. Nallino, 2001), 1-21.

[46] Zorlu, "Osmanlı Deniz Teknolojisi Üzerine," p. 349.

[47] Ali Macar Reis, *Ali Macar Reis Haritaları*, Topkapi Palace Museum Library, Treasure, nr. 644; *Atlas-ı Hümayûn*, Istanbul Archeology Museum Library, nu. 1621; Piri Reis, *Kitâb-ı Bahriyye.* Süleymaniye Library, Hagia Sophia, nr. 2612; Seydi Ali Reis, *Kitâbü'l-Muhît*, Topkapi Palace Museum Library, Revan Mansion, nr. 1643; and *Walters Sea Atlas*, Baltimore: Trustees of the Walters Art Gallery, 1952, no. 105.

I reached works, such as Piri Reis's *Kitâb-ı Bahriyye* (1520), Seydi Ali Reis's nautical books, titled *Kitâbü'l-Muhit* (the Book of Ocean, 1554), *Hulâsatü'l-hey'e* (The Summary of Astronomy, 1549), *Mir'ât-ı Kâinât* (The Mirror of The Universe, 1555?) and *Risâle-i Zâtü'l-Kürsî* (155?), and also maps the Nautical Atlas of Ali Macar (Hungarian) Reis (1567), *Walters Sea Atlas* (1560-1570) and *Atlas-ı Hümayûn* (Imperial Atlas, 1570) from Istanbul University's Manuscripts Library and Rare Works Collection, Topkapı Palace Museum Library, Istanbul Maritime Museum and the Republic of Turkey Ministry of Culture and Tourism Manuscripts Institution. I accessed the digital images of these works from the websites of these institutions. Since some works had more than one copy, I took them from different places and added them to my thesis, e. g. Piri Reis's *Kitâb-ı Bahriyye*. These are places that offer rare works digitally, such as the Encyclopedia of Islam, the Library of Congress and the World Digital Library, MEDEA-CHART database, and the New York Public Library Digital Collections. At the same time, I have accessed images of the historical events, people, objects, charts or works, I mentioned in this thesis, at the National Library of France, Ambrosian Library (Milano), Archives of Humboldt University (Berlin), National Gallery of London, Bavarian State Painting Collections (Munich), Vienna Art History Museum, Palatine Library (Biblioteca Palatina di Parma, Italy), Baden State Library (Germany), and The Nasser D. Khalili Collection of Islamic Art (London).

Manuscripts are sources at least as considerable as archive documents with the information, they provide about Ottoman maritime and navy. Piri Reis's *Kitâb-ı Bahriyye* and Seydi Ali Reis's works named *el-Muhît* and *Mir'âtu'l-Memâlik* provide very significant knowledge, especially on oceanography and navigation in the 16th century. Kâtip Çelebi's famous work, named *Tuhfetü'l-kibâr fî esfâri'l-bihâr*, which is among the sources of the 17th century, covers the Ottoman navy, ship types and structures, raw material sources, chronological lists of Ottoman admirals and artisans, is not only provides data about geographical conditions, shipyards, foreign navies and ships, but also stands out with its feature of "bringing terminological explanations to the naval technology of the period", which is perhaps the most momentous for today's researchers.[48]

As I mentioned above, it was certainly difficult to find sources about nautical instruments of early modern Ottoman Mediterranean. Initially, I have not come across academic research that brings together the artisans and their instruments. First, it was necessary to determine the names of the pirates, invited to the Ottoman shipyard in the early modern period, to obtain separate information about them and to bring them together. Because while doing research on these artisans, it was very difficult task to reach their biographies or knowledge about them. It was necessary to scan historical sources, current academic studies, and to find data about the origins of these pirates, the inscriptions in their graves or their signatures on their charts, had to be examined.

Organizing and interpreting resources for the discovery of early modern people are notoriously difficult. Historians must flip through the piles of knowledge to reach the most basic findings about personal issues.[49] It was quite arduous process to bring all these facts and tools together, to give a general view, and then, to elaborate them specifically. Therefore, I followed this path; first, when looking at the subject, it was essential to know the early modern Mediterranean scientific atmosphere (communities and spaces of knowledge production, material culture and artefact, practices, and networks of circulation) in general terms. And in this context, it was necessary to research, and introduce together, what kind of breakthroughs the Ottomans made to keep up with this singular context of the history of science, or what kind of works were produced by the artisanal pirates, who kept up with this period.

On the other hand, there are many questions to be answered. What was effective in the Ottoman success, in the Mediterranean, in the 16th century? What factors contributed to their rapid advancement in shipping, and how? Or what factors supported this success? As a part of the Ottoman Mediterranean, was it scientifically

[48] Zorlu, "Osmanlı Deniz Teknolojisi Üzerine," pp. 306-307; and Kâtip Çelebi, T*uhfetü'l-kibâr fî esfâri'l-bihâr: Deniz Savaşları Hakkında Büyüklere Armağan* (Istanbul: Kabalcı Yayınevi, 2007), and *The History of Maritime Wars of the Turks*, translated from Turkish of Haji Khalifeh by James Mitchell (Istanbul: Kriter Yayınevi, 2019).

[49] James S. Amelang, *The Flight of Icarus: Artisan Autobiography in Early Modern England* (Stanford: Stanford University Press, 1998), p. 81.

and technologically, integrated into the existing atmosphere or could it be? Who did make the Ottoman nautical instruments? Who were these artisans and how did they work? How did the *Tersâne-i Âmire*, a centre where the Ottomans produced useful nautical and cosmographical instruments functioned? What was the contribution of the artisanal pirates, who joined the Ottoman navy, to the Ottoman science, technology, and instruments? Among the works that emerged in this process, it is necessary to look at the events, not just a certain person or case. These questions, which can be easily replicated and expanded, exemplify not only the challenges, but also the thought-provoking potential of attempting to connect objects, practices, texts, and ideas. Interest in material culture and the analysis of "local" knowledge, as well as new methodologies in the history of science that direct attention to creative practices and indigenous knowledge, have necessitated a closer look at earlier phenomena.[50]

As such, my thesis is written from Ottoman empire perspective, and remains thoroughly focused on the actions of them. Throughout this narrative, the emphasis is on Mediterranean science and technology. With each chapter, highlighting the role of individual political actors and the factions, while integrating into this scientific story, a discussion of the most prominent texts, charts, and other sources of information, on both practical and ideological levels.

[50] Pamela H. Smith and Benjamin Schmidt (eds.), *Making Knowledge in Early Modern Europe: Practices, Objects, and Texts, 1400-1800* (Chicago: University of Chicago Press, 2007), p. 6.

Overview

I divided my thesis into three main parts to find answers to the questions, I mentioned above. Part one has title that 'Maritime Culture and Practical Knowledge in Early Modern Mediterranean: A Reading from the Ottoman Empire'. The initial chapter, 'Artisans, Practical Knowledge and the Early Modern History of Science', aims to present the content of the practical knowledge literature, before opening a window on the Ottoman empire by focusing with the issues of 'Trading Zones in Early Modern Europe', 'Military Nautical Science and Technology', 'Spaces of Practical Knowledge: Shipyards and Arsenals', 'Hidden "Scientists": Artisans and their Artifacts'. This chapter explains what the area of knowledge and material culture of the early modern period were and how and by whom was produced. First, with this introduction, my purpose was to open a new place for the Ottoman side to examine this situation by putting the necessity for practical information. In the second chapter, titled 'The Mediterranean Basin, Epicentre of the Maritime Empires', I focused on a more specific subject, starting from the Mediterranean, which was the centre of the historical atmosphere of the 16th century, and going down to the borders of the Ottoman empire. Security of borders and commercial activities pushed the Ottoman's attention to the technological activities of the period. These activities meant maritime technology, that is, scientific and technological instruments used in the early modern Mediterranean. I examine these technologies by dividing into titles, which includes shipbuilding technologies, and nautical instruments.

The second part, titled 'Scientific and Technological Developments in Artisanal World of Ottoman Empire', contains the main topic of my thesis. Because it was significant to talk about the work of the Ottoman shipbuilding centre, which was established within the scope of maritime activities in this period, in the field of nautical instruments and technologies. This chapter is started with the period of Sultan Mehmet the Conqueror, the period considered as the birth of the Ottoman science and technology tradition. And in this period, there was founded the *Tersâne-i Âmire* that can be considered the centre of the practical knowledge of the Ottoman empire. This institution is very momentous in this thesis, as it is a place, where artisans come to the fore in the production of nautical instruments. For example, as will be mentioned in the following sections, the ships, produced by the artisans in the shipyard, under the instructions of Hayreddin Barbarossa and his tactical manoeuvrers, played a key role and provided a political gain of Ottoman situation in the Mediterranean. The subject of artisans, which I have dealt with one by one in this section, is under the titles of ‘Shipbuilding Activities at *Tersâne-i Âmire,* Working Lines of Artisans in Imperial Arsenal, and *Tersâne-i Âmire*’s Artisans and Ships Manufacture’.

I begin the third part by explaining with ‘the Role of Superior Artisan’, put forward by Zilsel. At the same time, I continue by describing ‘the Concept of Piracy in the Ottoman Empire’ and proceed more specifically. I separate the analysis of ‘Nautical Devices of Artisanal Pirates’ by talking about portolan charts, atlases, and nautical books as very influential cosmographical and nautical instruments in the early modern period. In this part, there is chapters about artisanal pirates with scientific works and nautical instruments, show their effects in history of Ottoman science.

In my opinion, it is significant to look the developments and progress of all these phenomena and periods, following each other to find answers the questions, I have formulated above. While explaining all these issues, no matter how much I tried to put limits on historical and political details, I must give these details about people and events. Because it was necessary for my thesis to start from the reasons for the formation of practical knowledge in the early modern period. While doing all these works, I use images a rich selection of figures that give visual support to my argument. I tried to get to the miniatures and visual elements of the manuscripts of the time, bearing in mind the importance of these images for the history of science and technology. Because it can be learned a lot of data, events, or situations from an artist’s miniature. The drawn ships, in the miniature depicting a war, are very useful for us to comment on the ship type and technology.

This thesis aims to shed light on the scientific and technological changes with artisans, and restructuring of Ottoman Mediterranean, in the early modern period, within the framework of the history of science. Hoping to be able to explain and give a new perspective the development of science and technology in the Ottoman empire. I believe that analysing the Ottoman case from the perspective of new ideas about culture and craft knowledge can shed light and teach us new dynamics of the functioning of early modern science obscured by mainstream historiography.

PART 1

Maritime Culture and Practical Knowledge in Early Modern Mediterranean: A Reading from the Ottoman Empire

CHAPTER 1

Artisans, Practical Knowledge, and the Early Modern History of Science

The Scientific Revolution is probably the most significant unifying concept in the history of science. Often referred to as the period from Copernicus to Newton (roughly 1500 to 1700), it is considered a central episode in the history of science, a historical moment in which the emergence of a unique view of the world and related institutions that we call modern science occurred.[51] It has been observed that many scientific ideas and technological instruments were developed, when the foundations of modern science were laid in the Mediterranean, at the end of the 15th century and 16th century. These technologies were nautical instruments, which were necessary by the political and social interests of the states. A profound transformation in attitudes towards the natural world, the material periphery, and their artistic representation during the early modern period, took place in a new environment of global trade and imperial ambition, in which commodities were produced, accumulated, consumed, and exchanged. These factors, stimulated by events that helped lay the foundations of the new natural philosophy that would eventually be called "science", left their mark on the period.[52]

As the history of early modern science relates to the primary formation of the content and methods, the narrative naturally changes as it continues to evolve. However, it is no longer just about the first scientific phase, where concepts, theories, and practices were traced back to a starting point in the so-called Scientific Revolution. Indeed, this is arguably the most important change in the history of science over the past generation: historians of science are now more generally concerned with uses of natural knowledge and with historical attitudes towards nature interpreted broadly.

[51] Margaret J. Osler (ed.), *Rethinking the Scientific Revolution* (Cambridge: Cambridge University Press, 2000), p. 3.

[52] Pamela H. Smith and Paula Findlen, *Merchants and Marvels: Commerce, Science, and Art in Early Modern Europe*, (New York: Routledge, 2002), p. 3; P. H. Smith, *The Body of the Artisan: Art and Experience in the Scientific Revolution* (Chicago: the University of Chicago Press, 2004), p. 18; and D. N. Livingstone, *Putting science in its place: Geographies of scientific knowledge* (Chicago: The University of Chicago Press, 2003), p. 92.

Paying attention to the terms of early modern actors' works have become a catchphrase in the history of science. This has led to a great expansion in the broad field of the historian of science.[53] In recent decades, instruments, related to questions of experiment and observation, have come to the fore in the research of historians of science.[54]

One of the most capital components of the reform, in the early modern period, was the revaluation of knowledge derived from the senses. The senses and personal experience began to form the basis of the so-called "new philosophy" and the "new way of doing philosophy" during this period. This led to intense interest in the reliability of the senses and the experiential knowledge based on them.[55] The emergence of a new philosophy represents a crucial shift in attitudes towards nature and the material world. This transformation involved a whole new set of beliefs and practices about nature. One of the most important components of this change was that in the 16th and 17th centuries, the search for natural knowledge became active and began to involve the body, that is, one had to observe, record, and physically relate to nature. Until recently, the story of the Scientific Revolution was largely told as a narrative about theoretical change. The story of the invention of the experiment, though important, is written as an intellectual history of practice. However, there are many arguments about the actions of these people, who institutionalized the new philosophy and made the new method of pursuit of knowledge, as a part of the habits of thought and action of early modern scientific culture. Among the authors who have explored these avenues are Edgar Zilsel, Paolo Rossi, R. Hooykaas, A. C. Crombie, M. Oster, R. S. Westfall, Eva G. R. Taylor, Jim Bennett, Pamela H. Smith, Pamela O. Long, Ursula Klein, Sven Dupré, and D. Raven, among others.[56]

So it can be said that the most fundamental change, in the history of science, has been the expansion of what can be seen as science, like forming ideas about the development of knowledge-producing practices, as well as focusing on texts and techniques.[57] These expanded fields now range from alchemy, astrology and natural

[53] Smith, "Science on the Move," p. 346.
[54] Sven Dupré and Christoph Herbert Lüthy, *Silent Messengers: the Circulation of Material Objects of Knowledge in the Early Modern Low Countries* (Berlin: Lit Verlag, 2011), p. 8.
[55] Smith and Schmidt, *Making Knowledge in Early Modern Europe*, p. 13.
[56] Smith, *The Body of Artisan*, p. 18.
[57] Smith, "Science on the Move," p. 361.

magic to medicine, medieval cathedral builders, farmers, miners and metalworkers, sailors and other artisans with all manner of technical knowledge.[58] Other aspects, which were previously considered outside of science, such as scientific institutions or fields, scientific practices or activities, artifacts and material culture, individual and collective mentalities, social and cultural movements and links between commercial networks and technical-practical knowledge, now occupy a central place.[59]

Practical knowledge is to achieve a particular product, for example, an artistic or mechanical work or specific outputs, like improvement applications or mathematical results, that follows a defined workflow. This can be a build procedure, a recipe, or even an algorithm, all of which are equivalent to a formal point of view. Most historians of science agree on practical knowledge represents the background received that characterized early modern period. According to American sociologist Richard Sennett, if the concept of 'craft' is extended to include all human activities, including theoretical ones, all crafts, also the most abstract ones, begin as bodily practice.[60] Moreover, the historical framework is often described as a dichotomy between practical and theoretical knowledge. And in science, such a dichotomy, is used heuristically as a research method.[61]

This new history expanded in different directions in the early modern period, all related to maritime expansion and the practical and utilitarian interests of the colonial empires involved.[62] However, these aspects can be grouped into three main areas: the terrestrial natural world, in which practices (as well as ethnology) such as natural history, medicine, pharmacopoeia, and alchemy stand out; the maritime world, where we find such branches of knowledge as cosmography, navigation, cartography, and shipbuilding; and the study of the heavens where we have astronomy and astrology.[63] In any case, when we are talking about the early modern world, it is very

[58] Smith, "Science on the Move," pp. 357-358.
[59] Sánchez, "Practical knowledge and empire," p. 269.
[60] Valleriani, "The Epistemology of Practical Knowledge," p. 1.
[61] Valleriani, "The Epistemology of Practical Knowledge," pp. 1-2.
[62] Lisa Jardine and Jerry Brotton, *Global Interests: Renaissance Art between East and West* (London: Reaktion Books, 2000), p. 61.
[63] Antonio Sánchez, "The 'Empirical Turn' in the Historiography of the Iberian and Atlantic Science in the Early Modern World: from Cosmography and Navigation to Ethnography, Natural History, and Medicine," *Tapuya: Latin American Science, Technology and Society*, 2, 1 (2019): 317–34, p. 4.

difficult to determine the boundaries between these areas of knowledge.[64] Whereas, with regard to the marine world, which is the focus of this thesis, there has been a remarkable change compared to the old historiography.[65]

The world of navigation, shipbuilding, and nautical cartography became objects of study in their own right in the history of science.[66] With the increasing use of trigonometry and compass in navigation, and the need to prepare and read portolans, knowledge of mathematics became even more essential for sailors.[67] It is no longer strange to see that the early modern historian ruled the history of science with nautical charts and astrolabes and not just telescopes, microscopes, or air pumps. The fields of astronomy, cosmology, and astrology, which were also revisited by the new generation of historians, maintained an inevitable relationship with cosmography, especially in the fields of astronomical navigation and the location of places, and in geodetic discussions about the world.[68] The word cosmography was readily applied to a wide range of things: a subject or discipline, texts about them, textual and non-textual products of them, especially charts.[69]

The articulation of artisanal expertise and epistemology took on value in the 16th century, as scientists became interested in nature as a way of learning about it. It was never clear to scientists how man knew nature, how he used his senses, how he produced objects. Thus, the artisans' bodily encounters with matter provided a model for the formation of the new scientific method.[70] Much of the artisanal knowledge is largely implicit, apprentices learned their craft not by reading texts, but rather by working with and observing practised artisans and through repetitive bodily experiences.[71] "Artisans/practitioners" were people, who worked with their hands in craft production (e.g. carpenters, weavers, and instrument makers) or performed

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64 Sánchez, "Practical knowledge and empire," pp. 2-3.
65 Sánchez, "Practical knowledge and empire," p. 3.
66 Sánchez, "Practical knowledge and empire," p. 3.
67 Clegg, "Craftsmen and the origin of science," p. 197.
68 Sánchez, "Practical knowledge and empire," p. 3.
69 Adam Mosley, "The Cosmographer's Role in the Sixteenth Century: A Preliminary Study," *Archives Internationales d'histoire des Sciences*, 59 (2009): 423-439, pp. 425-426.
70 Smith, *The Body of Artisan*, p. 20.
71 P. H. Smith, A. R. W. Meyers, and H. J. Cook (eds.), *Ways of making and knowing: The material culture of empirical knowledge* (Ann Arbor: The University of Michigan Press, 2014), p. 19.

complex practical tasks, such as farming or seafaring.[72] Jean-François Gauvin defines the artisan as follows:

> The artisans, having their eye on their task, do not select and apply to it at random what they apply, rather they see to it that their work comes to have a definite form. For instance, painters, house builders, shipwrights, and all other artisans, whomever you wish to choose, place all things in some order and compel one part to suit another and to harmonize with it until the whole thing, as they fashion it, has order and beautiful organization.[73]

A feature of the early modern period, in general, is that the world of crafts and learning existed in quite separate realms. The study of the natural world took place in universities, and it was called natural philosophy. Conversely, artisanal practice involved a hands-on process in which apprentices learned, sometimes formally under an apprenticeship contract held by a guild, and sometimes informally as part of a family unit. Crafts, such as spinning, weaving, and dyeing, and practices, like agriculture and shipping, were learned under the guidance of a skilled practitioner, often an older family member. In some cases, writing surrounds artisanal activities, such as records and accounts kept, craft arrangements, and specifications, created by bosses for jobs, and there may be other types of communicative and mnemonic tools, like drawings on paper or models made. However, the usual activity of artisanal practice was accomplished by doing something or performing some physical tasks.[74] In Zilsel's words, "these superior masters invent, experiment, and study."[75]

In the 1920s and 1930s, while the history of science as a discipline was taking shape, a new thesis emerged regarding the impact of artisans and artisanal culture in the Scientific Revolution. A group of scholars began discussing how the mechanical arts, that is, arts and crafts conducted by skilled artisans, influenced the development of the emerging mechanical worldview. The "mechanical worldview" was a shortened version of the idea that all motion and change is mechanical and that the universe itself operates, like a machine. This view evolved along with a complex of other ideas about

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[72] Long, *Artisan/Practitioners*, p. 4.
[73] Jean-François Gauvin, "Artisans, Machines, and Descartes's Organon," *History of Science*, 44, 2 (2006): 187-216, Special Issue: Artisans and Instruments, 1300-1800, p. 195.
[74] Long, *Artisan/Practitioners*, p. 4.
[75] Zilsel, "The Social Roots of Science," pp. 4-5.

the natural world and how to study it, often grouped under the term "new sciences."[76] There has never been a time in these centuries, when there was such great diversity of people at the forefront of scientific achievement.[77] In the 16th century, the occupational groups of people, at the forefront of scientific achievement, were very different from one another. These professionals include university teachers, professors of mathematics, anatomy and medicine, physicians, surveyors, sailors, engineers, etc., and finally instrument makers, opticians, pharmacists, surgeons, and other traders. These men, who quite different in their social origins and intellectual achievements, occupied positions in scientific hierarchy.[78]

According to Zilsel, in the period from 1300 to 1600, three layers of intellectual activity must be distinguished: university scholars, humanists, and artisans. The pioneers of causal thinking, during this period, were artisans. Some superior groups of manual labourers (artist-engineers, surgeons, naval and musical instrument makers, cartographers, sailors, artillery) have tried, studied, and used quantitative methods. The measuring instruments of sailors, cartographers, and marksmen were precursors to later physical instruments. However, the artisans lacked methodical intellectual training. Thus, the two components of the scientific method were separated by a social barrier: logical education was reserved for upper-class scholars, experimental causal interest and quantitative method were left to the craft of the common people. Science was born with the advancement of technology when the experimental method eventually overcame the social prejudice against manual labour and was adopted by rationally trained scientists. This was accomplished in about 1600.[79]

In 1942, Zilsel schematically presented how social changes in early modern Europe broke the social barriers between artisans and scientists and led to the emergence of modern science. This is known as "Zilsel thesis". His claim was that modern science emerged through collaboration between two different social groups.[80] Coinciding with the historic-sociological era in the history and philosophy of science

[76] Long, *Artisan/Practitioners*, p. 10.
[77] Robert Hall, "The Scholar and the Craftsman in the Scientific Revolution," in *Critical Problems in the History of Science*, ed. by M. Clagett, 3-23, (Madison: The University of Wisconsin, 1962), p. 3.
[78] Hall, "The Scholar and the Craftsman in the Scientific Revolution," pp. 3-4.
[79] Zilsel, "The Social Roots of Science," p. 3.
[80] Sánchez, "Practical knowledge and empire," p. 5.

in the 1960s, technical, mechanical, and artisanal cultures became part of the historiographical debate about the origins of modern science.[81] One of the big questions remained the one posed by Zilsel's thesis: the difficult relationship between artisans and scientists. This was highlighted by his commentary on the roles played by engineers, physicians, alchemists, cartographers, pilots, and instrument makers in the emergence of modern science in the works of historians of science Paolo Rossi and Reijer Hooykaas between the 1960s and 1990s.[82]

Therewithal, by the late 1960s, the search for a general understanding of science, spurred by the work of Thomas S. Kuhn, Derek John de Solla Price, and Robert K. Merton, led to a renewed interest in quantitative measurement and a close examination of scientific institutions and specializations.[83] What were the avenues of authority in different disciplines found cultural settings? Did all disciplines and technologies work in one way? What were the practical conditions for consolidating a new discipline? How have funding constraints and opportunities given rise to new research programs? Do civil unrest and war stimulate or retard the generation of new ideas? Who is qualified as a researcher in science? How did educational institutions create the scientific research model? Attention to these questions has yielded several complexes analyses and monographs. As the 1960s ended, the history of science as an erudite enterprise achieved an intellectual vitality that was envied by many and diverse commentators.[84]

The idea that artisans had a way of acquiring and conceptualizing their knowledge, which might be called epistemology, is a recent innovation in the historiography of early modern science; however, several different twentieth-century movements in history and social sciences led to the formulation of the term. "Artisanal epistemology" has been used by historians of science since the 2000s in studies that

[81] Sánchez, "The 'Empirical Turn' in the Historiography of the Iberian and Atlantic Science," p. 4.
[82] Sánchez, "Practical knowledge and empire," p. 5.
[83] Thomas S. Kuhn, *The Structure of Scientific Revolutions* (Chicago: The University of Chicago Press, 1970 (Second Edition)); Derek John de Solla Price, *Little science, big science—and beyond* (New York: Columbia University Press, 1986); and Robert K. Merton, *The Sociology of Science: Theoretical and Empirical Investigations* (Chicago: The University of Chicago Press, 1973).
[84] Lewis Pyenson and Susan Sheets-Pyenson, *Servants of Nature: A History of Scientific Institutions, Enterprises and Sensibilities* (London: Harper Collins Publishers, 1999), pp. 32-33.

highlight the contributions of artisans and practitioners to the Scientific Revolution.[85] In the 2000s and 2010s, historians sought to expand the constraints that the history of science, imposed on the old dichotomy between science and art. Thus, to emphasise the scientific dignity of artisans' logically justified understanding of nature, Smith introduced the notion "artisanal epistemology".[86] In describing the artisanal epistemology of the 15th and 16th centuries, Smith draws from widely dispersed geographical regions and chronological periods. She sees this as necessary in part because of the paucity of documentation on craft practices, let alone those that imply the artisans' understanding of nature.[87] And she continues like this:

> The benefit of this expansive geographical and chronological view has been to suggest the continuities and the pervasiveness of this epistemology. Although the ways artisans understood matter and their own workings in the material realm were articulated in different ways at various times and places, it is still possible to trace some continuities over distance and time. The pervasive character of the epistemology of handwork arose largely out of the experience of training by apprenticeship and its basis in the bodily techniques of observation, imitation, repetition, and active doing.[88]

In our philosophical tradition, the term epistemology is associated only with the study of foundations of the creation of theoretical, mental, conscious, and purely rational knowledge. Also, it has also been associated with the practical, manual, bodily, material, empirical, and experimental means of acquiring new scientific knowledge, produced by practitioners in the form of material artifacts. The historian Pamela H. Smith, one of its main representatives, interpreted the work of some artist groups in the context of the Scientific Revolution. Other historians, such as Pamela O. Long, have sought to undermine the dichotomy by confronting Zilsel's difficulties in demonstrating cooperation between scientists and artisans. Hence, Long introduced the socio-spatial concept of the 'contact or trading zone' and applied it to the early modern European context. In her words, trading zone are "areas, where artisans and other practitioners (trained as apprentices in workshops or, for instance, in hands-on training on construction sites) and educated people (trained at universities and other

[85] Pamela H. Smith, "Epistemology, Artisanal" in *Encyclopedia of Renaissance Philosophy*, ed. by M. Sgarbi, 1-19, (Springer International Publishing AG., 2018), 1-19, p. 1.
[86] Cristiano Zanetti, *Janello Torriani and the Spanish Empire: A Vitruvian Artisan at the Dawn of the Scientific Revolution* (Leiden and Boston: Brill, 2017), p. 18.
[87] Smith, *The Body of Artisan*, p. 28.
[88] Smith, *The Body of Artisan*, p. 28.

institutions), engage in basic communication and share their relevant expertise."[89] Somehow, the literature, on the active role of artisanal cultures and practical knowledge occupy, in the history of science, has grown exponentially over the past two decades, especially in researches of early modern science.[90]

This new view of the Scientific Revolution has been shaped by a growing interest in science as a cultural activity that can be studied not only as a set of theories, but also as a set of practices. Recent reviews of the practice of science by historians, sociologists, anthropologists, and philosophers have provided important insights. Indeed, one of the most efficient new perspectives to emerge from the turn of historians of science to the history of culture and the social construction of knowledge has been the focus on practices. Science began to be studied practically rather than as theories. This new approach allowed us to see how science became active in the 16th and 17th centuries.[91] In the early modern period, practical knowledge was constantly reorganized, technological innovations were introduced, the size and scale of technological enterprises, such as construction sites, increased significantly. Correspondingly, new forms of regional organization, and thus, new forms of economy, led to the emergence and development of new habits and workflows for more efficient production. Therefore, it is still possible to explore and identify some features of the established action sequences that make up workflows. For example, by examining the organization and layout of a workshop, it can be understood the workflow involved in the formation of the works it produces.[92]

The organization and structure of practical knowledge is closely related to the social context in which this information is used. Knowledge coexists with activities, their social arrangements, and organisations.[93] Because of this, it has also been restructured at the social and economic level. The social context of practical knowledge refers to a wide variety of different aspects of a given process, such as the division of labour at a construction site or the economic reasons that encourage increased production in a particular sector and region. Our understanding is at this level of social

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[89] Sánchez, "Practical knowledge and empire," p. 5.
[90] Sánchez, "Practical knowledge and empire," p. 6.
[91] Smith, *The Body of Artisan*, pp. 18-19.
[92] Valleriani, "The Epistemology of Practical Knowledge," p. 3.
[93] Valleriani, "The Epistemology of Practical Knowledge," p. 3.

contextual analysis, where practical knowledge is enriched by the causes, methods, and means by which it is codified. Above this heuristic subdivision is the structure represented by the information system that reflects the coded knowledge. This is the level of fully conceptualized data at which is also possible to detect what is often called scientific knowledge.[94]

According to this approach, scientific developments, based on practical knowledge, can be explained as a series of changes in the structure of information systems. Such changes provide a link with the structure of practical knowledge, but the link is determined by the social and institutional context, since this context that determines which aspects of practical knowledge are codified and thus, made more accessible.[95] Some of the factors that created a climate conducive to science, such as the acceptance of artisanal work and experimentation, and the extension of natural history based on experience rather than book learning, triggered by the "geographical revolution," had no direct impact on science. However, they created an atmosphere convenient to the acceptance of new ideas and methods.[96]

This approach seems appropriate for investigating the early modern period, as it is characterized by what might be termed the 'peak of activity intensity'. This term describes a continuous increase in the intensity of activities, due to the material wealth radiated by the accumulation of capital, because of business activity. Almanacs, treatises, mathematical instruments, written descriptions, and woodblock prints are just a few of the many possible examples that testify to such an intensity of activity. Practical activities were at the centre of positive economic progress, during this period. They were often mobilized by architectural businesses or by metallurgical-related activities, such as mining operations, or by the spread and use of heavy artillery and maritime operations. Due to practical activity, impressive peaks of "production intensity" took place in various fields around the world in the 16th, 17th, and 18th centuries. This means that production increases quantitatively.[97]

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[94] Valleriani, "The Epistemology of Practical Knowledge," p. 3.
[95] Valleriani, "The Epistemology of Practical Knowledge," p. 4.
[96] R. Hooykaas, "The Rise of Modern Science: When and Why?" *British Journal for History of Science,* 20, 4 (1987): 453-473, p. 456.
[97] Valleriani, "The Epistemology of Practical Knowledge," p. 4.

These scientific developments were perceived and occurred differently in each region. Regional traditions have acted to encourage or hinder technical or theoretical innovation. Regional cultures have adopted and used scientific knowledge differently, according to their self-understanding. The meaning of a particular scientific theory or text has shifted from one place to another. Indeed, scientific research has meant different things in distinct regional settings.[98] As Smith puts it: “This new effort, trade, and movement to look at the history of science through the lens of science is about natural materials and products, not only in the Americas, South Asia, and China, but also in Europe, showed how much information depended on local sources of information. Changes in early modern knowledge-making, then, should not be viewed as the achievement of a single group or society, but as the assimilation of knowledge, techniques, and ideas from a wide variety of sources and places. It is worth noting, however, that while natural knowledge was mass-produced in early modern society, the process of doing so created a new set of identities and hierarchies, especially in colonial contexts. In the 18th and 19th centuries, science sought to define and distinguish peoples, thus creating social and epistemic hierarchies. I dare say that until recently this was seen as part of the job of the historian of science, determining who belongs in the science story, that is, who is modern and scientific and who is not.”[99]

The production of science and the acceptance of scientific theories and practices in different fields also bear the traces of local conditions.[100] Like people, scientific ideas are not made on a flat cultural plain. Rather, they meet in certain places. The meaning of particular scholarly texts and theories has varied from place to place, and one way to uncover such geographies of reception is to determine how various cultures have evaluated particular scholarly work.[101] What has become clear is that scientific knowledge, in these regional settings, is closely linked to religious and political issues, and that adding regional adjectives to scientific research undertaken at the time makes sense, and contributes to what is known in different places as science.[102]

[98] Livingstone, *Putting Science in Its Place,* p. 89; and Smith, “Science on the Move,” p. 346.
[99] Smith, “Science on the Move,” pp. 371-372.
[100] Livingstone, *Putting Science in Its Place,* p. 112.
[101] Livingstone, *Putting Science in Its Place,* p. 113.
[102] Livingstone, *Putting Science in Its Place*, p. 92.

We come to what could potentially be the most paradigm-shifting trend in the history of science: the recent interest in trade and the global development of science in the early modern period. This field has expanded more generally with the growth of global history but is also the result of an emphasis on the transfer and movement of knowledge. In this period, natural knowledge moved not only geographically, but also epistemically, as the knowledge systems of different social and cultural groups intersected. Such movement resulted in new hierarchies of intellectual authority as well as new knowledge. This epistemic movement of objects, instruments, techniques, and ideas is recognized throughout the Mediterranean in the early modern period: new knowledge was created as things moved. From about 1300 onwards, worldwide trade, production, and consumption increased, and knowledge moved with them as goods travelled. This global movement has also helped to create new knowledge and practices about nature.[103]

According to the British historian Joseph Needham, modern science is culturally universal.[104] These fits well with the practical knowledge that arose in the cultural interactions of the early modern East and West. The boundaries between what we will call East and West seem to be completely porous in the early modern period. And even in conflict situations, there is mutual recognition of symbols and images, cultural cross-interaction, and a two-way traffic of influence at every turn. With these possibilities and their consequences, comes the inevitable recognition that traditionally completely separate cultural histories, are ready to be rewritten as joint East/West ventures.[105] The reciprocal East-West and West-East cultural exchanges, to which we have particularly noted figuratively, the original unifying opportunity dating back to post-Conquest of Constantinople, revolves around the East-West divide.[106] Changes, in attitudes towards knowledge of nature in the early modern period, are part of the story of the spread of knowledge and colonialism, and the movement between East and West through which objects, practices, texts, techniques, and knowledge are transmitted through world trade. This is the story of the intersection of local and scientific culture, revealing a new union of hands and minds, while also making a sharp

[103] Smith, "Science on the Move," p. 368.
[104] Raj, *Relocating Modern Science*, pp. 1-2.
[105] Jardine and Brotton, *Global Interests*, p. 8.
[106] Jardine and Brotton, *Global Interests*, p. 32.

distinction between what is considered scientific knowledge and what is relegated to the category of science.[107]

From a purely epistemic perspective, the relationship between practical and theoretical knowledge, often defined as one of the engines of scientific development in the early modern period, is redefined as the relationship between different knowledge structures. Practical knowledge, like that used by a Venetian shipbuilder in the manufacture of a galley in the 16th century, was at the centre of the theoretical developments that led to the emergence of Galileo Galilei's (1564-1642) theory of the resistance of materials. However, only certain aspects of this knowledge that were codified and thus reflected and conceptualized became available for such scientific development.[108] On the other hand, this coding was not done to support Galileo's research. Instead, it happened for reasons related to practical activity. This implies that the actors of the economics, forms, and codification processes of practical knowledge are the things that need to be explored first. This will explain how practical activities translate into the circulation of scientific literature and, finally, how coded knowledge becomes part of the theoretical and conceptual structures being established in this era.[109] To achieve this goal, Matteo Valleriani insists on a heuristic diversification of existing research on three levels of knowledge production mechanisms. These are: (1) the knowledge structure of practical activities, (2) the social construction of practical knowledge, and (3) conceptual structures of knowledge. The first concerns the practical knowledge, structured following the dictates of the workflow, and the sequence of actions required to achieve the desired product.[110]

At the other end of the scale is the layer of information systems, which tends to expand comprehensively and reflectively within its historical dynamics, making an analogy with the cognitive structures of abstraction and representation. In between is the network of people working within the framework of practical activities, whose social organization is constantly changing and is shaped by institutional bodies in social environments that are increasingly influential. These analytical layers do not mirror each other consistently. Rather, they trade with each other and develop dynamics that

[107] Smith, "Science on the Move," pp. 374-375.
[108] Valleriani, "The Epistemology of Practical Knowledge," p. 2.
[109] Valleriani, "The Epistemology of Practical Knowledge," p. 2.
[110] Valleriani, "The Epistemology of Practical Knowledge," pp. 2-3.

lead to a coexistence of different aspects of knowledge, which may ultimately explain how scientific knowledge re-influenced practical activities in a later age.[111] To make these concepts clearer, it is necessary to elaborate on Trading Zones, Military Science and Technology and Nautical Science, as essential aspects for the practical dimension of knowledge mentioned above.

1. 1. Trading Zones in Early Modern Europe

The term "Trading Zones" is used to refer to places, where artisans and other practitioners and educated people share important communication and related expertise.[112] This notion was first used by Peter Galison in his work, Image & Logic. Galison explains as follows:

> Like two cultures that are different from each other but live close enough to trade, they can share some activities while diverging on many others. What is crucial is that the two groups can cooperate in the local context of the trading zone, despite differences in classification, significance, and standards of demonstration. They can reach consensus on the exchange procedure and the mechanisms that determine when goods will be "equal" to one another. They may even both understand that the continuation of exchange is a prerequisite for the survival of the larger culture of which they are a part. I intend the term "trading zone" to be taken seriously, as a social, material, and intellectual mortar binding together the disunified traditions of experimenting, theorizing, and instrument building. Anthropologists are familiar with different cultures encountering one another through trade, even when the significance of the objects traded -and of the trade itself- may be utterly different for the two sides.[113]

Pamela O. Long's notion, Trading Zones, is framed by a rather different set of interests.[114] For a historian, focusing primarily on 15th and 16th century Europe, this concept helps to select and analyse a phenomenon that was widely apparent, but hitherto lacking a descriptive label.[115] There was a same situation in the Ottoman empire, like Europe in these times. The conditions of the period dragged the Ottoman

[111] Valleriani, "The Epistemology of Practical Knowledge," pp. 2-3.
[112] Pamela O. Long, "Trading Zones in Early Modern Europe," *Isis* 106, 4 (2015): 840-847, p. 840.
[113] Peter Galison, *Image & Logic* (Chicago: The University of Chicago Press, 1997), p. 803.
[114] Long, "Trading Zones," p. 841.
[115] Long, "Trading Zones," pp. 841-842.

empire into the same economic conditions and rivalries as the European states. Therefore, while doing this research, it is necessary to look at the concept of trading zones from the Ottoman side.

Long does not accept the concept of trading zones as the influence of some artisans on the development of science, as Zilsel points out. Rather, she states that trading zone stand as a description of exchanges between skilled and knowledgeable individuals in particular regions. These exchanges help legitimize the value of the practical and integrate it into the discourse of the learned. They are used not as a cause-effect process, but for objects, empirical approaches and data in the wider society, direct observation, instruments (especially measuring instruments), "artisanal epistemologies" as Smith calls them, and experimentation, is part of the development that helps bring forth "new sciences" as part of a growing appreciation for experimentation. While various new sciences also share in many of these values and approaches, it can be said that trading zones containing talented and knowledgeable cultures and the fusion of these cultures both facilitate developments and, are part of them.[116]

It is noteworthy that the arenas, where trade districts are shown to occur, new technologies are developed and large-scale government investment or ventures, are undertaken with equity investment by shareholders. For example, states, such as Venice and Spain funded large arsenals, where the development of ships and weapons, was an ongoing interest and trading areas, were well documented. It is important that the trading zones occur in the shipbuilding and artillery part of the arsenal. The growing interest, in instruments and their production and use in the 16th century, made them stores, a possible place for the development of commercial districts.[117] Long suggests that trade zones could usefully serve as a focus of further research in the early modern period, both in Europe and in other geographic areas. Such a focus will provide new insights into the complex interactions between those, trained in a practice or skill, and those, who come from learned traditions and combine both practice and learning. Benefit focuses will include the nature of the places, where such interactions take place, the participants, and the specific nature of their communications. This type of research

[116] Long, "Trading Zones," p. 844.
[117] Long, "Trading Zones," p. 845.

will contribute to our understanding of the processes by which research on the natural world was transformed in the early modern centuries.[118]

Rather than going into the historical details of the trading zones in the early modern Mediterranean, it is necessary to mention its active role in the development and dissemination of practical knowledge. Although the historical sources of the 16th century do not give a precise definition of the trading zones, they can more precisely determine the fields of activity, where the codification of these zones was carried out, as well as the definitions in the large production centres, such as the site surveys focusing on the later periods.[119] However, instead of describing the Mediterranean trade in its complexity, it would be more appropriate to look at the whole, to focus on the nautical science of early modern period, which is the subject of this thesis.[120]

During the 16th century, the Mediterranean basin became the scene of conflict, especially between Spain and its allies and the Ottomans. The causes of conflicts are religious and political-economic, that is, the defence and guarantee of freedom of trade. In this period, the Mediterranean basin was a rich trade and communication centre, despite these conditions.[121] The commercial and territorial expansion of Europe and the Ottoman empire, and the formation of long-distance trading networks in the Mediterranean, East, and Southeast Asia, led to an unprecedented movement of people and information. Knowledge acted with individuals, who migrated or settled in new lands, and with sailors, soldiers, and merchants pursuing trade and war.[122] And knowledge of various places was more revealed through the practical judgment and calculated observation of merchants, explorers, and sailors.[123] Knowledge moved as trade routes opened up and collectors eagerly sought out the rare and beautiful in objects, instruments, manuscripts, and printed books, sending information back to the metropolis with traveling agents. Economic and art historians began to explain how dependent the states were on the flow of goods, ideas, and people, particularly from

[118] Long, "Trading Zones," p. 847.
[119] Valleriani, "The Epistemology of Practical Knowledge," p. 11.
[120] Fernand Braudel, *II. Felipe Döneminde Akdeniz ve Akdeniz Dünyası*, trans. by Mehmet Ali Kılıçbay (Istanbul: Doğu Batı Yayınları, 2017), Vol. II, p. 298.
[121] Miguel Gotor, "Akdeniz," in *16. Yüzyıl Rönesans Çağı*, ed. Umberto Eco, trans. Adnan Tonguç (Istanbul: Alfa Yayınevi, 2019), 248-261, p. 248.
[122] Smith, "Science on the Move," pp. 368-369.
[123] Michael Wintroub, *The Voyage of Thought: Navigating Knowledge across the Sixteenth-Century World* (Cambridge: Cambridge University Press, 2017), p. 12.

circulation in the Mediterranean. The increased trade and the exchange of ideas and materials it created enabled cultural production to sprout. This understanding of the flow and interaction of goods and ideas between Eurasian societies, and their impact on science and technology, in the Mediterranean, makes it clear that the changes in the early modern period, did not develop in isolation.[124]

It becomes clear that the well-documented process of codifying practical knowledge, in the early modern period, was largely the result of positive economic development driven by technological innovation and the application of these new technologies. Because of the quantitative increase in practical activities, knowledge underwent a qualitative metamorphosis through coding, in the form of goods of production turned into knowledge as goods of exchange and as a means of making conceptual connections. Economic value, then, was no longer simply associated with the final product, but increasingly with the knowledge necessary to produce that final product. At this level, an increased need for information exchange can be traced back to the phenomena of knowledge transfer, circulation, and accumulation.[125] Therefore, the coding process started mainly for economic reasons. In a phase of positive economic development dictated by practical activities, the need to transfer and preserve knowledge eventually evolved into a new modality that required faster circulation of knowledge, and its more accessible display. Not only did the end products need to be evaluated, used, and appreciated, but also the knowledge necessary to obtain them.[126]

Early modern trading districts consisted of arenas in which the instructive teaches the artisan, and the artisan teaches the instructive, and the knowledge, contained in each arena, was valued by both types of "merchants". This exchange often involved direct one-on-one verbal communication. What required was that learned individuals value practical and technical knowledge, not only for what they could obtain in the material world (such as palaces or jewellery), but also as a form of knowledge.[127] Long argues that, in 15th and especially 16th century Europe, the number and spacing of trade zones, between the learned and talented, increased dramatically. In such trading areas, people, who "traded", tended to become more alike

[124] Smith, "Science on the Move," pp. 368-369.
[125] Valleriani, "The Epistemology of Practical Knowledge," p. 4.
[126] Valleriani, "The Epistemology of Practical Knowledge," pp. 4-5.
[127] Long, *Artisan/Practitioners*, p. 95.

and to lose their distinctiveness in their backgrounds. During these two centuries, many activities and certain places became commercial districts. In such “trading zones” both practitioners and knowledgeable humanists became closer together in their empirical values, knowledge bases, and customary practices of reading and writing, and of designing and manufacturing or constructing physical things. Trade zones have become common spaces, where educated and talented individuals interact, and exchange important information, as they often engage in constructive and productive activities, create innovative technologies, and write pamphlets and books on the topic at hand.[128]

One of the leading sectors of the economy was certainly connected with architectural enterprises. The early modern expansion of production centres as well as civil and military construction sites, such as Venice’s naval shipyards, was unprecedented. Such places brought together new management skills and all kinds of mechanical arts. Technological innovation, strong economic, and political interests are often framed in areas, related to military activity. The spread of the next generation of heavy, mobile artillery required literally every city and regional entity to develop new forms of defence. This structure gave rise to a new discipline of military architecture deeply associated with geometry, and a new figure of military officer trained in the mathematical arts. The so-called early modern revolution of the art of war and the great economy, it created, showed a profound need to organize, preserve, and develop practical knowledge, and therefore also to codify it.[129]

[128] Long, *Artisan/Practitioners*, pp. 95-96.
[129] Valleriani, “The Epistemology of Practical Knowledge,” pp. 13-14.

1. 2. Military Nautical Science and Technology

The slender and powerful silhouettes of galleys come to mind, when especially the great naval battles of the 16th century Mediterranean, is mentioned.[130] Perhaps this century when the most wars took place in the Mediterranean, wars arose, due to reasons such as political goals, conquest policies, commercial competition, and religious conflicts between European states, especially the Spanish Empire, the Republic of Venice and Portugal, and the Ottoman empire. Events was not just permanent conflict relations or constant cooperation of states. Alliances, between nations, were often temporary, and conflicts had not been permanent. In fact, some warring states cooperated from time to time, while some alliances were cast aside to gain more power, and influence over the Mediterranean. To give an idea about these relations, can look at the Ottoman-French alliance, the Ottomans against the Venetians, the Spanish Kingdoms against the Ottomans, the Ottoman conquest to Egypt, and the collaborations of the French with the Italian city-states. Alliances lasted as long as they were beneficial, and conflicts often resulted in one side, accepting the superiority of the other.[131]

Although Ottoman intentions, in the Mediterranean, were communicated with the conquest of Rhodes, in 1522, this was only achieved through the establishment of patient, and gradual supply bases, particularly in the Aegean. This process began in the late 1460s, during the reign of Mehmed the Conqueror. With their conquests, the Ottomans were able to position themselves, to give adequate support to fleet operations, in the middle of the Mediterranean, as we will see in later chapters.[132] According to Pryor, location was of equal importance to “a slow, relentless and strenuous drive to obtain bases and islands from which war galleys could control sea lanes”.[133] However, this was not something that could only happen with smart positioning. At the same time, more cleverly, constructed auxiliary instruments for navigation, were required. The 16th century was a period of almost uninterrupted

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[130] Braudel, *II. Felipe Döneminde Akdeniz ve Akdeniz Dünyası*, Vol. II, p. 710.

[131] Ceren Civlan, “A Brief Overview Of The Effects of Mediterranean Politics And Ottoman-Habsburg Conflict On The Modern European Identity,” *Academia Letters*, 2449 (2021): 1-4, p. 1.

[132] Elina Gugliuzzo, “Sea Power and the Ottomans in the Early Modern Mediterranean World,” *Aspects of War, Diplomacy, and Military Elites Series: History of Warfare,* 118 (2018): 79-97, pp. 84-85.

[133] John H. Pryor, *Geography, Technology, and War: Studies in the Maritime History of the Mediterranean, 649-1571* (Cambridge: Cambridge University Press, 1992), p. 90.

warfare in the Mediterranean region, in which not only large-scale wars, such as those at Preveza, Djerba and Lepanto were fought, but also constant raids, skirmishes and acts of piracy, and patrols to protect merchant shipping. In such a situation, it was clear that skilled sailors and adequate equipment were needed.[134]

Unsurprisingly, this nearly constant state of war has borne significant fruit, in the theory and practice of the nautical arts, promoted by both political and military leaders. Indeed, the cultivation of these fields was necessary for the survival of leaders in an age that historians of science have called the "Scientific Revolution". The wars and warriors of the era encouraged many important technical discoveries and innovations, changed the way of war was waged, and encouraged the development of new groups of practitioners or artisans, who could work with these discoveries and innovations. Many of these practitioners, in the arsenal, could have been called scientists or engineers in a later era.[135] In this sense, it is noteworthy that in the early modern period the arenas, where wars and trades took place, were often places that new technologies were developed, which fostered practical knowledge and increased the need for artisanal groups.[136]

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[134] Corradino Astengo, "The Renaissance Chart Tradition in the Mediterranean," *Cartography in the European Renaissance*, ed. by David Woodward, Vol. 3, Part 1 of *The History of Cartography*, 174-262, (Chicago: The University of Chicago Press, 2007), p. 174.
[135] Kelly DeVries, "Sites of Military Science and Technology," in *the Cambridge History of Science*, ed. by K. Park and L. Daston, 306-319, (Cambridge: Cambridge University Press, 2006), pp. 306-307.
[136] Long, "Trading Zones," p. 845.

1. 3. Spaces of Practical Knowledge: Shipyards and Arsenals

Arsenals proliferated, in Europe, in the 15th century and expanded in the 16th century. They became venues for multitasking and experiments involving both weapons and gunpowder production. In the arsenal, ballistics were tested, gunners were trained, and the construction of fortifications was designed and supervised. Some arsenals, including the famous Venetian arsenal, also functioned as shipyards, where ships were designed, built, and equipped. Various activities, in the arsenals, were supplemented by a large expansion of writings on artillery and ballistics, fortification and shipbuilding, and other naval activities.[137]

For example, the Venetian arsenal, the key to the defence, was famous throughout Europe (Fig. 1). By the 16th century, it had become a large, multifaceted enterprise. The arsenal, covering an area of about twenty hectares, was surrounded by more than four kilometres of walls and ditches. There were many employed hundreds of artisans, called *arsenalotti*[138], who were skilled workers, who earned a single guaranteed wage. The arsenal was organized to include three largely separate production areas. The largest part was devoted to building, repairing, and equipping ships. Another department produced ropes and cables, and a third department was tasked with the manufacture of weapons and gunpowder.[139]

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[137] Long, *Artisan/Practitioners*, p. 96.
[138] It is the plural of the Italian word Arsenalotto. Workers, who working in the Venetian arsenal under the protection of the Doge, were called Arsenalotti.
[139] Long, *Artisan/Practitioners*, pp. 100-101.

Figure 1. Depiction of an arsenal in the city of Venice, from Ottoman sailor and cartographer Piri Reis's *Kitâb-ı Bahriyye*. The fact that Piri Reis, depicted the city of Venice with various ships, may be because the Venetian Shipyard had a very effective place in ship production at that time. Originally composed in 1525, but this version of book from 1650. Place of publication and publisher not identified, https://www.loc.gov/item/2021667235/.

Beginning in the early 15th century, shipbuilders, in the Venetian Arsenal, experimented with various ship designs, often in competition with one another. A dynasty of native foremen of Venice, beginning with Teodoro Baxon or Bassanus, and Greek masters, who brought techniques from the island of Rhodes to the armoury, is notable. Baxon made several new designs, including a lightweight galley, which he made wider and heavier than the traditional ship without sacrificing speed. The Venetian Senate, which ruled Venice and controlled the arsenal, encouraged Baxon and native Venetian shipbuilders to produce innovative seaworthy designs.[140] And

[140] Long, *Artisan/Practitioners*, p. 101.

Galileo candidly began his epoch-making *Dialogues Concerning Two New Sciences* (1638) with the following statement:[141]

> The constant activity which you Venetians display in your famous arsenal suggests to the studious mind a large field for investigation, especially that part of the work which involves mechanics, for in this department all types of instruments and machines are constantly being constructed by many artisans, among whom there must be some who, partly by inherited experience and partly by their own observations, have become highly expert and clever in explanation.[142]

It is very valuable to have access to works written by the people of the period we work in. To give an example, the earliest extant treatise on shipbuilding was written, during the Palopano era in the ambiance of the Venetian armoury. Its author was Michael of Rhodes (d. 1445), a sailor, who wrote and illustrated his book mostly in the 1430s.[143] While not working directly for the arsenal, Michael wrote the book in its shadow, and was probably backed up by an insider with at least knowledge. Michael, presumably from the island of Rhodes, began working on a Venetian galley in 1401, at the age of about sixteen, in the position of rower. Later, he rose to various officer positions on more than forty voyages, which he carefully recorded in his autobiographical service record in his book. He gave his position on the ship as well as the captains and noble patrons of many of the ships, he served on. His book contains more than two hundred pages of an abacus, or mathematical treatise, that proves him to be a good mathematician, a portolan (directions), a chapter on the zodiac with fascinating illustrations of the zodiac signs, and many calendar materials related to topics like Easter date and full moon dates. A mouse eating a cat perched on top of it created its own unique crest (appropriating a privilege only granted to nobles) with two turnips on the side, and a lit M in the middle. The shipbuilding section, which deals with the construction of three types of galleys and two different round ships, includes numerous drawings in scale, such as those related to the construction of the hull.[144]

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[141] Cited in Allen G. Debus, *Man and Nature in the Renaissance* (Cambridge: Cambridge University Press, 1978), p. 10.
[142] Galileo Galilei, *Dialogues Concerning Two New Sciences* (New York: The Macmillan Company, 1914), p. 1.
[143] Pamela H. Smith, *From Lived Experience to the Written Word: Reconstructing Practical Knowledge in the Early Modern World* (Chicago: University of Chicago Press, 2022), p. 29.
[144] Long, *Artisan/Practitioners*, pp. 101-103.

Michael probably wrote his book to impress the Venetian nobility, who hired officers for their ships for each annual voyage. Although he is a practitioner, a sailor, and his book deals with the practices, in which he is involved, Michael's book is not just a practical manual, rather, it served different cultural uses in Venetian culture and the wider social spheres of maritime business. This is a document, written by a practitioner, a step on the road to the luxury cruise books sent to the library shelves of elite merchants and oligarchs, especially as the Italian cartographer Piero Falchetta demonstrates. Indeed, Michael's book is evidence of a trading zone. It shows that he learned mathematics, astrology, calendar matters, and shipbuilding, and that this knowledge went beyond the strictly practical aspects of his profession as a sailor.[145]

Returning to the subject of shipyards and shipbuilding, another example is the Spanish empire. The wars and conflicts between Spain and the Ottoman empire, one of the most powerful empires in the Mediterranean, lasted for almost a century. Spanish shipbuilding, in the 16th century, focused on two basic ship types: the galley and the galleon. The galley, also a sailing rowing vessel, had a shallow draft and was suitable for use in the Mediterranean. The centre of galley construction, especially during the rule of Philip II (1527-1598), was Barcelona's Arsenal (Fig. 2). Philip II began the reform of Spanish naval power, and in 1574, had built a fleet of 150 galleys. However, as Spain returned to the Atlantic, high-speed tidal currents, storms and huge waves made the galley unsuitable. And then, a second type of ship, the galleon, came into use. It was a large three-masted sailing ship suitable for Atlantic seafaring. It was either invented by the Venetians around 1520 or developed from the Portuguese caravel (its exact origins are uncertain), adopted by Spain. Spain's northern coast has become a hub for building galleons.[146]

[145] Long, *Artisan/Practitioners*, pp. 103-104.
[146] Long, *Artisan/Practitioners*, p. 99.

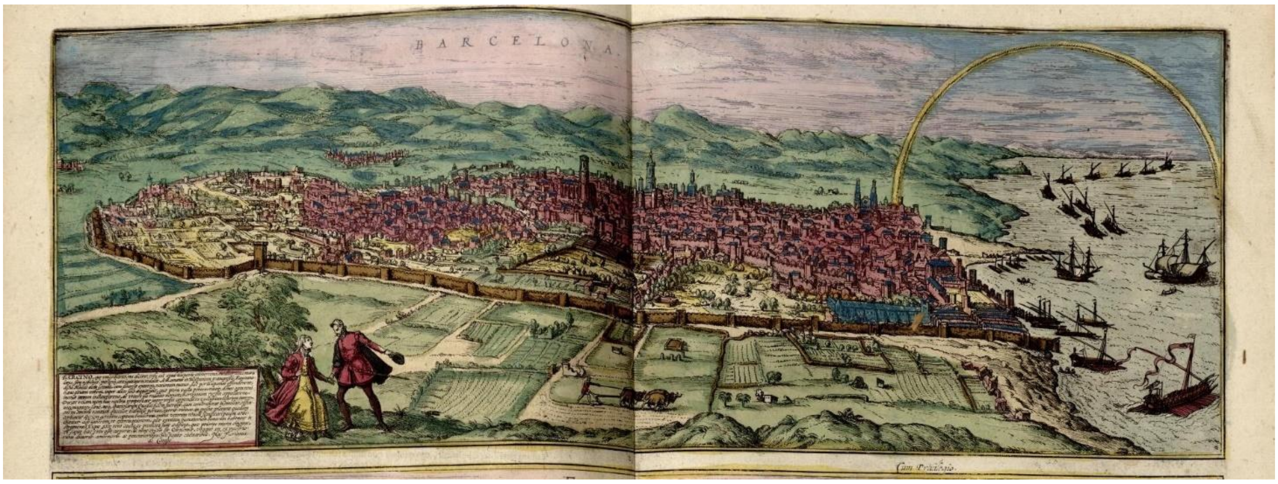

Figure 2. The arsenal can be seen in this depiction of Barcelona, Georg Braun, 1540, or, Frans Hogenberg, P. Von Brachel, Anton Hierat, Abraham Hogenberg, Simon Novellanus, Joris Hoefnagel, Jacob Hoefnagel, Jacob Van Deventer, and Henrik Rantzau. *Civitates Orbis Terrarvm*. Coloniae Agrippinae: apud Petrum à Brachel, sumptibus auctorum, to 1618 and 1612, https://www.loc.gov/item/2008627031/.

During this period, many types of ships were produced in the shipyards of various states, in the Mediterranean, to be used in trade, transportation, and wars. The most significant type of ships had the appearance of around 1200 cog, a deep keeled, rear rudder, two-headed boat sailing with a single square sail. Seaworthy and capable of transporting bulk goods, the cog was easily converted into warships by temporarily positioned forecastles at the bow and stern.[147] In post-classical times, this trend found its final expression, in the Mediterranean, war galley, a highly refined design that developed as an integral part of a system of warfare and trade that was oddly and somehow adapted to the Mediterranean. This system relied on fortified port cities, i.e., large trading centres with hinterlands rich enough to provide sufficient financial means to build, crew, and fleets of war galleys. The war galley was intertwined with the port city, protecting it from attack and enemies, and applying this as a unique Mediterranean amphibious warfare system. The control of distant ports and coastal fortresses was very significant for this system of war, and galley fleets were the main means of siege, and defence of such places. Naval warfare had a seasonal character, as galleys, and their smaller derivatives were originally designed to reach top speed by oar in calm weather

[147] Guilmartin, *Kalyonlar ve Kadırgalar*, p. 41.

conditions. This quality was reinforced by the annual cycles of agriculture, conscription, and trade.[148]

On the other hand, it seems that 'galley' is the best type of ship to represent of the Mediterranean tradition. The galley is a tall, slender, and elegant warship that moves with the power of a rowing, even though it has a sailing device. In the 16th century, the slim galley was about forty meters long, its width was equal to one-seventh of its length, its tonnage was up to a hundred tons, and it had a crew of 150 oarsmen, in addition to officers, sailors, and many soldiers. The 16th century galley was the product of thousands of years of development.[149] The Christian and Turkish galleys, who came face to face in Preveza (1538), where the Muslims prevailed, or in Lepanto, where the superiority passed to the Christians, came directly from the lineage of the Byzantine dromons. Byzantine dromons also came from Athens and Roman ships with three rows of oars, who dominated the Mediterranean in the first centuries of the Middle Ages. Combat techniques were also not very different from old times. In naval battles in the Mediterranean, the technique of spurting from the bow and embarking was mostly applied, and in practice, these battles consisted of the clashes of the enemy marines, whether in Salamis, Aigates Islands or Lepanto.[150]

The galley fleets sailed in the spring and summer to raid, lay siege, and occasionally engage in battle with another fleet. Operations in the fall and winter were the exception, usually carried out over shorter distances and with fewer ships.[151] Ordinary galleys were not the only rowing warships. Large galleys, Italian galea grossa -though some were purpose- built as military transports, they were converted merchant galleys-formed the tactical backbone of 15th century galley fleets. While the large galley was slower than ordinary galleys to sail, when rowing, in its high freeboard and sturdy handrail, there was crossbowmen, archers. And firearms users the advantages and protection of height, when engaged in combat with lower boats, and made it harder for common galleys to deal with.[152] Everything changed fundamentally in the 1510s

[148] Guilmartin, *Kalyonlar ve Kadırgalar*, p. 45.

[149] Okay Sütçüoğlu, *Piri Reis'in Gemileri: Rönesans Sanatına Meydan Okuma* (Istanbul: Ötüken Neşriyat A. Ş., 2019), pp. 68-70.

[150] Vittorio H. Beonio Brocchieri, "Denizler Hakimiyeti," in *16. Yüzyıl Rönesans Çağı*, ed. Umberto Eco, trans. Adnan Tonguç, 69-75, (Istanbul: Alfa Yayınevi, 2019), p. 70.

[151] Guilmartin, *Kalyonlar ve Kadırgalar*, p. 45.

[152] Guilmartin, *Kalyonlar ve Kadırgalar*, p. 123.

with the advent of vulgar galleys armed with head cannons on a central axis, which fired 30 to 50 libre.[153] The resulting tactical revolution depended on an awareness of the potential of heavy naval warfare equipment, a willingness to spend money to develop that potential, and an understanding that bow-gun-armed galleys were far more effective, when used in sideline fleets.[154] The situation was different for merchant ships. Especially, for goods with low cost for their weight, galleys were not economical as a means of transportation, due to their crowded crew, and limited load carrying capacity, which reduces the duration of their stay at sea. In addition, although fast and agile, relatively, fragile galleys were only suitable for calm and windless inland seas.[155]

As we will see in the naval battles that I will talk about later in Ottoman times, the way that these ships were handled, could mean the difference between defeat and victory. Mediterranean commanders naturally did not regard tactical homogeneity as a good thing and used oversized or extraordinarily heavily armed vulgar galleys as a tactical focus for victory. The first was called the bastarda, and the second was the lantern galley, because of the three ornate lanterns at the back. These lighthouses were vital for signalling, and maintaining the ship's position at night, and were the ultimate symbols of authority. The key to the distinction was how heavily armed the boat was, and that meant the number and quality of combatants in Mediterranean conditions, and cannon came into the equation later.[156] Perhaps, for the captains were relatively wasteful in terms of work force, their number was not high in the *trireme alla sensile* period, whereas the *quadrireme* (four rows of oars) *alla sensile* type boats, in which the oars were drawn in groups of four, were used as galleys with lanterns.[157] Emperor Charles V's ship *Riyale* (royal galley), which landed at the Tunis lighthouse in 1535, was one such boat, as was Andrea Doria's *Capitana* in 1539, with 26 rows (thus requiring 208 rowers).[158]

[153] Libre: a half-kilogram unit of weight measurement
[154] Guilmartin, *Kalyonlar ve Kadırgalar*, p. 125.
[155] Brocchieri, "Denizler Hakimiyeti," p. 70.
[156] Guilmartin, *Kalyonlar ve Kadırgalar*, pp. 123-124.
[157] Sütçüoğlu, *Piri Reis'in Gemileri*, p. 69.
[158] Guilmartin, *Kalyonlar ve Kadırgalar*, pp. 123-124.

Later, though not necessarily for strategic significance, because galley fleets rarely engaged in combat with each other, smaller rowing warships came (from large to small): galiot, fusta, and brigantine (pergende). Galiots were diminutive galleys, oarsed in pairs rather than in groups of three. While navigating the sidelines, galiots were much more disadvantageous than ordinary galleys in head-to-head combat, but they were more useful, had higher manoeuvrability, and could overwhelm the galleys by attacking from the flank and rear in close combat. Galiots, who also had low work force demands, was the perfect example of his dominant power. Fustas were even smaller. There were dual groups rowing in it. Like the galiots, the fustas were effective raiding vessels, it was useful for bringing news, and carrying reinforcements, as it was less difficult for rowers. The brigantines were the smallest of them all. It had 10 to 15 rows, and one oar and rower per seat. Armed with one or two cannons, these ships served as raid and delivery vehicles.[159]

As can be seen in the examples discussed, the trading regions were closely tied to the powerful states. The arsenals were essential for the military defence almost all Mediterranean states.[160] Increased social mobility found most relevant historical expression in the age of discovery. Different and innovative ship models, new navigational and computational techniques, and a new nautical astronomy and redevelopment of mathematical devices were just a few of the many new practical activities, produced in this era.[161]

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[159] Guilmartin, *Kalyonlar ve Kadırgalar*, p. 124.
[160] Long, *Artisan/Practitioners*, p. 120.
[161] Valleriani, "The Epistemology of Practical Knowledge," p. 14.

1. 4. Hidden "Scientists": Artisans and their artifacts

Artisans, sailors, shipbuilders, carpenters, smelters, and miners quietly worked on the advancement of technology and modern society. They had invented the sailor's compass and weapons, they built paper mills, wire mills, and stamping mills and blast furnaces and introduced machinery to mining in the 16th century. Overcoming the constraints of guild tradition and spurred on by economic competition for inventions, they were undoubtedly the true pioneers of empirical observation, experimentation, and causal research.[162] They were uneducated, could not read and write, and perhaps that is why we do not even know their names today. There were several groups among them, who needed more information than their colleagues, and therefore, received a better education. A remarkable professional group emerged in the 15th century. The men, we have in mind, can be called artist-engineers because they not only painted, sculpted, and built cathedrals, but also made engines, canals and weirs, guns, and forts. They invented new pigments, determined the geometrical laws of perspective, and made new measuring instruments for engineering and artillery.[163]

Artisans have a great share in the maritime field, which is the subject of this thesis. They made compasses and astrolabes, cross-staffs, and quadrants and invented the declinometer and inclinometer in the 16th century. Their measuring instruments are precursors to the modern physical device.[164] Some of these men were retired sailors or gunners. That is why nowadays, early modern surveyors and sailors are also considered representatives of the mechanical arts. They and the cartographers are more reputable to the development of surveying, observation, and experimentation. Superior artisans cannot be called scientists themselves, but they were direct predecessors of science. However, they were not regarded as respected scientists by the contemporary public.[165]

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[162] Zilsel, "The Social Roots of Science," p. 12.
[163] Zilsel, "The Social Roots of Science," pp. 12-13.
[164] Zilsel, "The Social Roots of Science," p. 13.
[165] Zilsel, "The Social Roots of Science," p. 14.

Learning by experience is one of the principles typically associated with artisanal cultures.[166] For artisans, experience was the only real path to practical knowledge (knowledge in what was then called the "arts"). For example, English navigator and compass maker Robert Norman, who founded the scientific experimental study of magnetism, writes in his *Neue Attractive* (1581) that his discoveries are "made through experience, reason, and proof", which is the basis of art. However, the book itself suggests that Norman had a very clear and precise idea of a controlled experiment, perhaps like the word 'showing'. Per artisans, the word "experience" encompassed both observation and experimentation. Thus, Portuguese sailors' observations of the African coast, Norman's observations of the behaviour of compass needles at sea, and his experiments with floating compasses were all "experience".[167] In the early modern period, a pivotal time in Mediterranean history, the roots of modern science underwent a shift that was expressed empirically by artisans.[168]

The hypothesis that Antonio Sánchez put forward by citing 'Iberian Science' as an example shows that he is right in this case: "In the early modern period, a pivotal time in the Mediterranean history, the roots of modern science underwent a shift that was expressed empirically by artisans."[169] These changes are especially seen in the fields of cosmography and navigation.

As the field of cosmography expanded and branched, so did its practitioners. In the 15th century, cosmographers were mostly university-educated scientists interested in world maps, geographic descriptions, and astronomical observations. During the maritime expansion of the late 15th and 16th centuries, cosmographers began to engage in a wide variety of cosmographic activities, some artisanal and others scientific. Although not a clearly demarcated profession or typical career, it is possible to identify some common features of early modern cosmographers.[170] For example, there were practical-oriented cosmographers, many with nautical experience, in the coastal areas of Europe, particularly Portugal and Spain. They usually came from families of sailors or merchants and worked on ships or in maritime ministries, such as *the Armazém da*

[166] Sánchez, "Practical knowledge and empire," p. 7.
[167] Clegg, "Craftsmen and the origin of science," p. 199.
[168] Sánchez, "Practical knowledge and empire," p. 7.
[169] Sánchez, "Practical knowledge and empire," p. 7.
[170] DeVries, "Sites of Military Science and Technology," p. 471.

Guiné e India (Guinea and India Warehouse) in Lisbon and *the Casa de Contratación* (House of Trade) in Seville. They differed in their knowledge of Latin and mathematics but were able to determine geographic latitude by simple methods and orientate using charts and globes.[171]

During the 16th century, the relationships between the various fields of cosmography changed. Geography gained independence, astronomy and geography were separated. By the end of this period, the all-encompassing term "cosmography" was in decline, and geography and astronomy became various fields of research, widely disparate, equally juxtaposed.[172] These 16th century cosmographers, later also referred to as "geographers", were representatives of a young and emerging science. Cosmography combined the natural philosophical concepts of scholarly scientists, the experience of sailors and travellers, and cartographic crafts.[173] It included a strong practical element, as well as the production of maps, especially portolan charts, globes, and descriptive narratives, where beauty was valued as highly as practical utility. It drew on studies of theology, history, and classical literature, as well as mathematics, astronomy, and navigation. In addition, geographic knowledge was indispensable for the development of trade and the measurement of new territories. Globes and charts became symbols of an emerging discipline revered by clergy, princes, merchants, scholars, and commoners, and elites old and new displayed the radiance of globes and other cosmographic objects. The emergence of geography was a trendsetter and exemplary for early modern natural knowledge, combining theory, empirical method, and artisanship.[174]

In the field of cartography, cosmographers have traditionally created portolan charts for the Mediterranean coast. These combined measurements of sea distances with the compass achieved remarkable accuracy in the more frequently drawn coastal areas, although it decreased over longer distances.[175] The translation of Ptolemy's *Geography*, in Florence at the end of the 14th and the beginning of the 15th century, is often presented as an exceptional event that would radically change the way of

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[171] DeVries, "Sites of Military Science and Technology," p. 471.
[172] DeVries, "Sites of Military Science and Technology," p. 470.
[173] DeVries, "Sites of Military Science and Technology," p. 471.
[174] DeVries, "Sites of Military Science and Technology," pp. 471-472.
[175] DeVries, "Sites of Military Science and Technology," p. 473.

geographical area' depicting.[176] To address this problem, Ptolemy had advocated the use of astronomical observation to monitor outlying areas and as many locations on the chart as possible. He used a grid of meridians and parallels, which made possible both the design of regional charts and the representation of the entire oikumene.[177] Manuscripts and early printed editions of *Geography* included a list of Ptolemy's measurements of latitude and longitude, as well as base charts derived from his properties. The leading cosmographers of the 15th century analysed this data and corrected it using contemporary observations.[178]

Portolan charts are the instruments that were made primarily for the ships going on a journey in the Mediterranean, because they show the ports and the shallow, and rocky places in the sea, and enable the sailors to easily find the direction.[179] Markingly, departing from the previous cartographic traditions of medieval Europe, the portolans were designed as nautical instruments to be used in navigation. And they were the first charts since classical antiquity that sought to mathematically systematize the representation of terrestrial space. Also, although the earliest charts of this type appear to be Genoese origin, Spanish historian Ramón J. Pujades argues that the geographic knowledge, they display comes from a common Mediterranean maritime experience.[180] Surviving portolans, from many countries, show that their use spread rapidly across the Mediterranean basin, from Catalonia and the Maghreb in the west to the Ottoman empire lands in the east.[181]

First examples of charts of portolan style include the Carte Pisane, dated 1270 (Fig. 3), the Catalan Atlas of 1375 (Fig. 4), and the Maghreb charts, dated between 1400-1450 (Fig. 5). Carte Pisane is the first chart that is oriented towards the magnetic north pole and, at first glance, shows the longitude range over which the Mediterranean

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[176] Patrick Gautier Dalché, "The Reception of Ptolemy's Geography (End of the Fourteenth to Beginning of the Sixteenth Century," in *Cartography in the European Renaissance*, ed. by David Woodward, Vol. 3, Part 1 of *The History of Cartography*, 285-364, (Chicago: The University of Chicago Press, 2007), p. 285.

[177] DeVries, "Sites of Military Science and Technology," p. 473.

[178] DeVries, "Sites of Military Science and Technology," p. 473.

[179] Tony Campbell, "Portolan Charts from the Late Thirteenth Century to 1500," in *Cartography in Prehistoric, Ancient, and Medieval Europe and the Mediterranean*, ed. by J. B. Harley and David Woorward, Vol. 1 of *The History of Cartography*, 371-463, (Chicago and London: The University of Chicago Press, 1987), p. 443.

[180] Ramón J. Pujades, *Les Cartes Portolanes: la Representació Medievald'una Mar Solcada* (Barcelona: Catalonia Cartographic Institute, 2007), p. 388.

[181] Campbell, "Portolan Charts," p. 443.

Sea extends accurately, with a margin of error of almost only 10 percent of its actual dimensions.[182]

Figure 3. *Carte Pisane*, Portolan chart of the Mediterranean and Black Sea, Anonymous (Italy), 1270, 1030 x 480 mm, Archive: National Library of France (Bibliothèque nationale de France), https://medea.fc.ul.pt/view/chart/50.

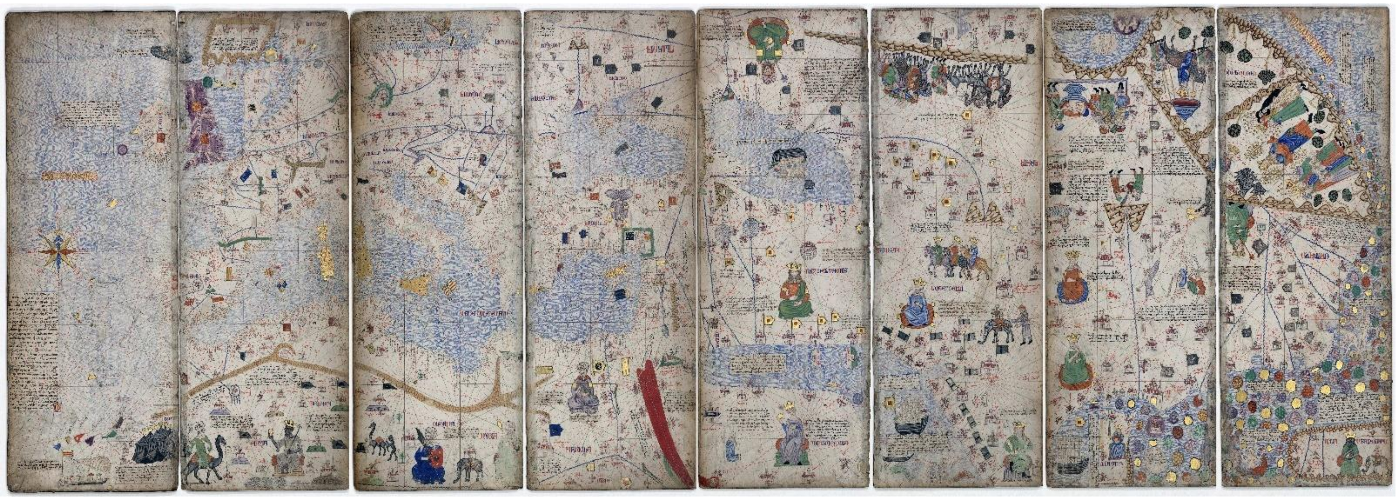

Figure 4. Abraham Cresques, *Atlas Catalan* (1375), Place: Palma de Majorca, Spain, Archive: National Library of France (Bibliothèque nationale de France), https://medea.fc.ul.pt/view/chart/410.

182 Zeki Tez, *Astronomi ve Coğrafyanın Kültürel Tarihi* (Istanbul: Doruk Yayımcılık, 2009), p. 239.

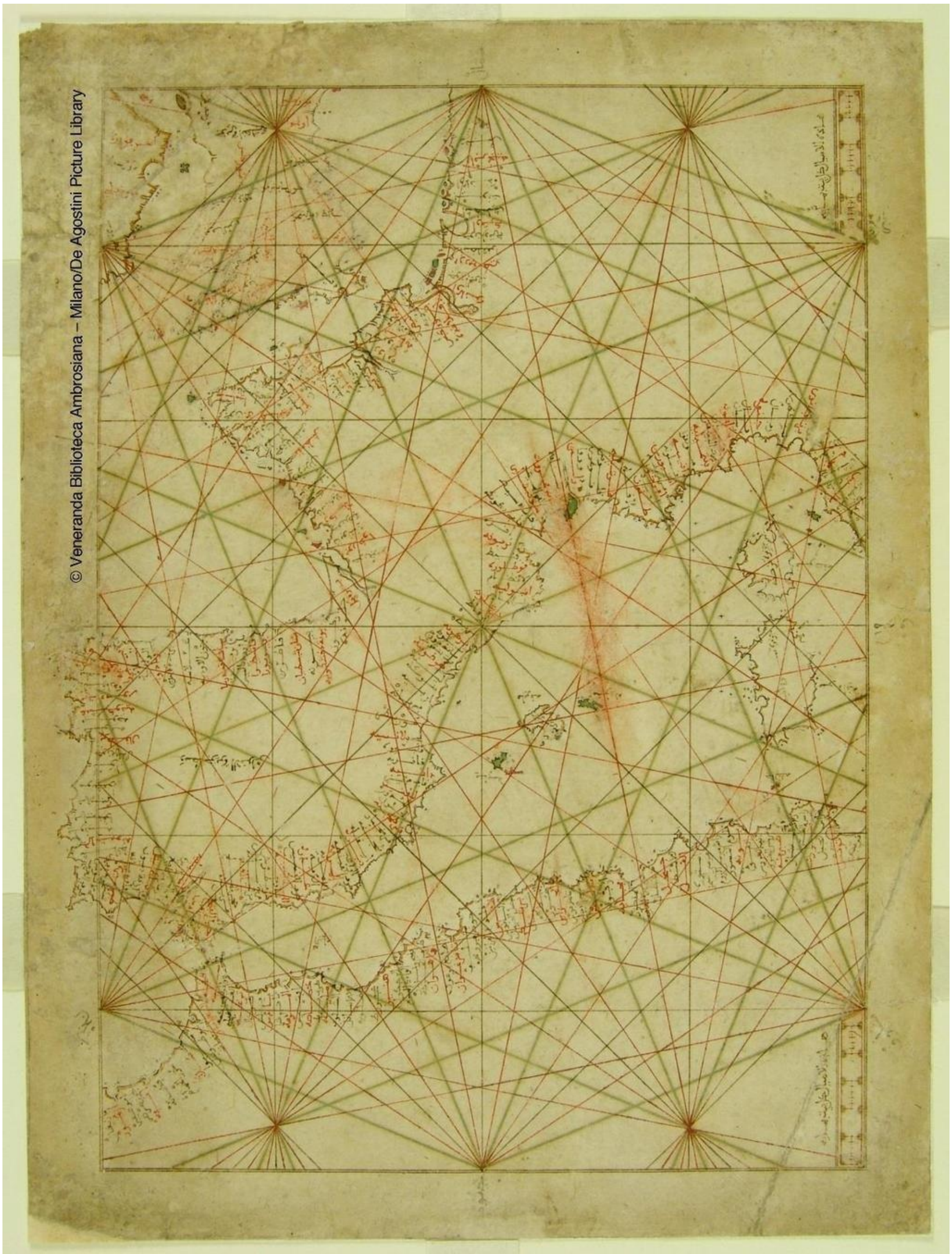

Figure 5. The Maghreb Chart, Portolan Chart of the western Mediterranean and western coast of Europe, Anonymous (Tunisia), 1400-1450, 160 x 230 mm, Ambrosian Library (Biblioteca Ambrosiana), https://medea.fc.ul.pt/view/chart/472.
This manuscript chart is drawn on paper in black and red ink with place-names in Maghrib script.[183]

[183] Svat Soucek, "Islamic Charting in the Mediterranean," in *Cartography in the Traditional Islamic and South Asian Societies*, ed. by J. B. Harley and David Woodward, Vol. 2, Part 1 of *The History of Cartography*, 263-292, (Chicago: The University of Chicago Press, 1992), p. 264.

There are wonderful examples of portolan charts and atlases, which were more common in the 16th century. The following charts made in Europe can be cited as an example: the portolan atlas dated 1375, the example given above, known as the *Catalan Atlas* and attributed to Abraham Cresques (1325-1387), a Jewish book ornamentalist, who lived in Palma, Mallorca, and portolan charts ascribed to one of the most important Italian Renaissance cartographers Battista Agnese (1514-64) (Fig. 6).[184] Another example is Rafel Soler's portolan chart of the Mediterranean and Black Sea, dated 1425-1450, also made in Palma de Mallorca and Barcelona (Fig. 7 and 8). Moreover, there are also many examples (Fig. 9), such as the magnificent portolan charts and atlases made by Portuguese cartographer Pedro Reinel (Fig. 10).

[184] Beau Riffenburg, *Antik Dönemden Günümüze Haritacılar*, trans. Çağlar Sunay (Istanbul: Türkiye İş Bankası Kültür Yayınları, 2012), p. 19.

Figure 6. Portolan chart depicting the Mediterranean by Battista Agnese dated 1541. [185] This atlas contains 10 charts. One of them, this Mediterranean chart has measures 22.5x16.5 cm. Reference extracted from World Digital Library: "Agnese Atlas", Library of Congress, Washington, DC. Original resource at: National Library of Spain, Madrid.[186]

[185] "World Digital Library," accessed September 14, 2022, https://tile.loc.gov/image-services/iiif/service:gdc:gdcwdl:wd:l_:19:47:8:wdl_19478:Varia_115_013/full/pct:100/0/default.jpg.
[186] "World Digital Library," accessed September 14, 2022, https://www.loc.gov/item/2021668712/.

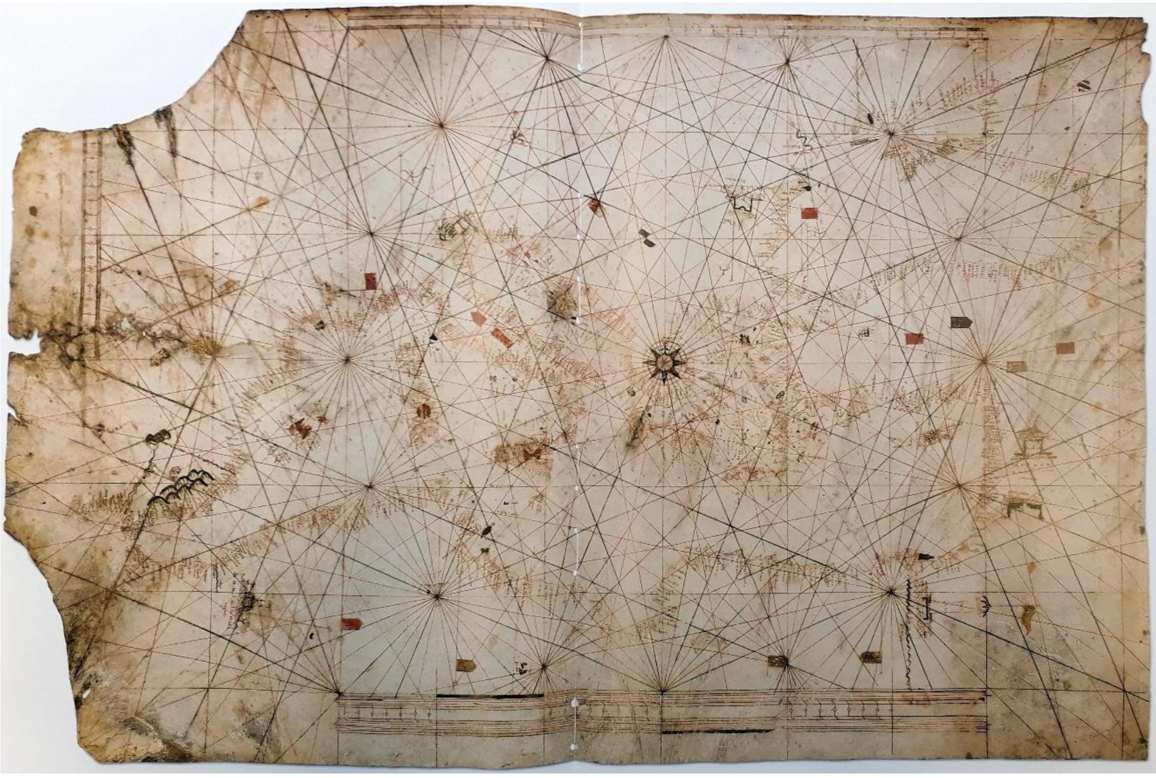

Figure 7. Rafael Soler, Portolan chart of the Mediterranean and Black Sea, 1425-1450, 880 x 570 mm, Palma de Majorca, Spain, Humboldt University Archives, https://medea.fc.ul.pt/view/chart/370.

Figure 8. Rafael Soler, Portolan chart of the Mediterranean, Black Sea and Western Europe, 1425-1450, 1000 x 620 mm, Barcelona, Spain, National Library of France (Bibliothèque nationale de France), https://medea.fc.ul.pt/view/chart/366.

Figure 9. Portolan Chart of the Old World and New World. The important Portuguese mariner, cartographer, and painter Fernão Vaz Dourado is thought to have made the atlas in 1580.[187] The chart, measuring 47x33.5 cm, is in the Bavarian State Library.[188]

[187] "World Digital Library," accessed September 14, 2022, https://tile.loc.gov/image-services/iiif/service:gdc:gdcwdl:wd:l_:08:91:8:wdl_08918:bsb00003364_00028/full/pct:100/0/default.jpg.

[188] "World Digital Library," accessed September 14, 2022, https://www.loc.gov/item/2021668459/.

Figure 10. Northeastern Atlantic Ocean and Northern Europe, in 1519, portolan chart in Pedro Reinel's *Nautical Atlas* of the World.[189] This chart is from the Miller Atlas in the collections of the National Library of France. It has dimensions of 42x59 cm.[190]

Portolan charts were that should be used with a compass, when the sailors cannot see the land and the stars in cloudy weather.[191] Especially in the 15th and 16th centuries, with the spread of portolan charts, it is seen that sailors got rid of the necessity of traveling by following the land. It can be said that the portolan charts are the current news sources of the period because they show the locations of the ports and trade centres. So much so that, according to Tony Campbell, a series of documents, from the late 14th century in Barcelona, are evidence of the portolan charts' trade.[192] It may be thought that these charts, which were made to be sold to sailors, should be up-to-date.

[189] "World Digital Library," accessed September 14, 2022, https://tile.loc.gov/image-services/iiif/service:gdc:gdcwdl:wd:l_:18:55:8:wdl_18558:T0000001/full/pct:50/0/default.jpg.

[190] "World Digital Library," accessed September 14, 2022, https://www.loc.gov/resource/gdcwdl.wdl_18558/?sp=1.

[191] Campbell, "Portolan Charts," p. 443.

[192] Campbell, "Portolan Charts," p. 437.

The portolan charts were developed, after the 13th century, and the most magnificent examples were in the 15th-16th centuries.[193] One important limitation of portolan charts are that, because they were used as navigational instruments, they typically depicted only the Mediterranean basin, and included few terrestrial details beyond the coastlines and sea routes of immediate interest to seamen.[194] The portolans, which indicated the harbours, coasts, islands, supplies, and stops, where ships can take shelter, had been enriched by bringing together the common features of Eastern and Western products in the Mediterranean that shopping was more intense. Among the common features of portolan charts were that made of leather to be resistant to moisture and salt, had a weathervane and an absolute scale indicator, that the rocks, in the sea, was drawn with black lines, shallow places with red lines, and the coasts with green and blue lines. Since charts were mostly copied from each other, and created by using similar sources, a common cartography language was formed. The circulation of charts, especially in the Mediterranean, has enabled the information processed on the portolan charts to have a common language.[195] Early modern portolan charts provide early evidence of the interdependence and interaction of learned and "practical" cultures.[196] This interaction can also be understood from the common signs, legends and historical events drawn on the charts.

First, craft is productive knowledge, and its products are records of practices as well as repositories of knowledge. It can be thought of an object as the remnant of an enormous number of cultural exchanges between individuals and their belief systems, organized practices, networks, and accumulated knowledge. Objects process the memory of the innovations and cognitions of previous generations and making them requires a great deal of expertise.[197] This specialization is the result of "a culture with multiple layers of socialization within a craft, a network of workshops, patterns of

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[193] Murat Tanrıkulu, "Portolan Haritaların Kaynağı, Genel Özellikleri ve Etkileri," *Harita Dergisi* ed. by Hasan Yıldız, 29-38, (Ankara: Türkiye Cumhuriyeti Millî Savunma Bakanlığı, Harita Genel Müdürlüğü, 2017), p. 33.
[194] Giancarlo Casale, "From Hungary to Southeast Asia: The Ali Macar Reis Atlas in a Global Context," *Osmanlı Araştırmaları*, 39 (2012): 54-62, p. 18.
[195] Fikret Sarıcaoğlu, *Osmanlı Tarihi Haritaları ve Tarihi Coğrafya Eserleri* (Istanbul: Çamlıca Basım Yayın, 2015), p. 15.
[196] Victoria Morse, "The Role of Maps in Later Medieval Society: Twelfth to Fourteenth Century," in *Cartography in the European Renaissance,* ed. by David Woodward, Vol. 3, Part 1 of *The History of Cartography*, 25-52, (Chicago: The University of Chicago Press, 2007), p. 37.
[197] Smith, *Ways of Making and Knowing*, p. 20.

consumption and production".[198] We need to use objects as a resource and think about it to research the knowledge of the craft. Because as it turns out, production techniques depended on the knowledge of artisans in the early modern period.[199]

Conclusions

Regarding the emergence of early modern practical knowledge and the contribution of artisans to science, I think that the Ottoman empire is the missing piece of the section I mentioned above. My hypothesis is that in the early modern period, when the empire was more active in the Mediterranean, due to the political and economic rivalries of the period, engaged in scientific and technological activities like other European states. Ottomans had developed own technology by fully adapting to these conditions. All these factors, namely economy, trade, and conquest policies, have made it necessary for states in the Mediterranean to adapt to the early modern science and technology. For the same reasons, they needed scientific and technological nautical instruments and the artisans, who made them. I think that these activities and the works of the Ottomans, which is a part of the Mediterranean, are worth mentioning.

The Ottomans, who had a very different culture and understanding from other European states bordering the Mediterranean, had a very varied perspective on artisans. As professor David N. Livingstone points out, the consumption of science and the acceptance of scientific theories and practices in different fields also bear the traces of local conditions.[200] It can be said that the Eastern and Western borders of the Mediterranean were completely permeable in the early modern period, and even in conflict situations, there was mutual recognition of symbols and images, cultural cross-interaction, and a two-way traffic of influence. With these possibilities and their consequences comes the inevitable recognition that seemingly disparate and traditionally separate cultural histories are ready to be rewritten as joint East/West ventures.[201]

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[198] Smith, *Ways of Making and Knowing*, p. 20.
[199] Smith, *Ways of Making and Knowing*, p. 20.
[200] Livingstone, "Putting Science in Its Place," p. 112.
[201] Jardine and Brotton, *Global Interests*, p. 8.

In this respect, it is worth recalling the definition given by the French historian Fernand Braudel in his book *The Mediterranean and the Mediterranean World in the Age of Philip II* (1949):

> By the necessities of history, the Mediterranean can only be a vast expanse that extends steadily beyond its shores and simultaneously in all directions. Indeed, when it comes to no longer plants, animals, hills, or climate, but humans, which no border can stop, and who overcome all obstacles, which can borders be drawn? The fate of people also determines the fate of the Mediterranean, expanding or narrowing its scope.[202]

This cultural exchange between East and West increased more after the conquest of Constantinople in 1453. The most striking fact of Ottoman history is the speed of the rise of the Ottoman navy. For more than a century, the Ottoman state focused solely on territorial conquest, and then, developed a growing, and increasingly effective navy, in the second half of the 15th century. The Ottomans succeeded very quickly, in challenging and defeating Venice, who was the main power, in the Mediterranean, and became a serious threat to other European powers.[203] But how?

In the Ottoman empire, the most active people, in raising artisans in the production stages of the maritime and navy in the shipyards, were the pirates. Piracy, which has a very different structure from the understanding in Europe, became the people, who were consulted in the navy management in the Ottoman shipyards. In other words, pirates, who are seen as a kind of sea masters, especially the people, whose names, and their works, I will give pages later, were of great stature in Ottoman maritime and made their names known in the scientific and technological developments.

As I mentioned above, it will be understood with the detailed examples in the following sections that there is no distinction between the artisan and the scientist in the Ottoman empire. The fact that captains, who were appointed to the head of navy with the special invitations of the Ottoman Sultans, based on the achievements of their craft and genius, rather than their social status, shows that the development of early

[202] Braudel, *II. Felipe Döneminde Akdeniz ve Akdeniz Dünyası*, Vol. I, p. 275.
[203] Elina Gugliuzzo, "Sea Power and the Ottomans in the Early Modern Mediterranean World," *Aspects of War, Diplomacy, and Military Elites Series: History of Warfare*, 118 (2018): 79-97, p. 87.

modern practical knowledge, in the Ottoman empire, was very varied from other European countries. This situation justifies Braudel's statement:

> The Mediterranean is not a sea, but a collection of seas consisting of a succession of watery plains connecting through wide gates between them. Thus, in the two large basins of the Mediterranean to the east and west, a series of narrow-seas are individualized between the various extensions of the continental mass. Each of these worlds has its own characteristics, its own types of ships, its own customs, and its own laws of history.[204]

[204] Fernand Braudel, *II. Felipe Döneminde Akdeniz ve Akdeniz Dünyası*, Vol. I, p. 180.

CHAPTER 2

The Mediterranean Basin, Epicentre of the European Maritime Empires[205]

Before explaining the factors that encouraged the orientation towards practical knowledge, which I mentioned above, from the perspective of the Ottoman empire, it is necessary to explain its geographical borders in the Mediterranean. The early modern Mediterranean is also the period, when wars, events, and innovations were most intense, just as Braudel explain.[206] We see European states and powers, such as Spain, Venice, and France representing the West, and the Ottoman empire representing the East as the sides of these wars. Based on this situation, it is possible to divide the Mediterranean into two as East and West. The reason we look at it this way is the practical dimension of knowledge, they developed by being influenced by each other, in these wars of two opposite directions. However, this type of information has been perceived and applied very differently because the two sides looked at the situation very distinctly.

Whereas conflicts and alliances based only on economic and political interests did not occur in the Mediterranean. There was an exchange of scientific and technological knowledge, which may have been the only good thing to emerge from these situations. Again, this exchange of information, which emerged from the competition of states with each other, led to the emergence of wonderful technical encounters. Cosmographic studies and nautical instruments made, during this early modern period, were most prominent. In addition, evidence of nautical charts, ship design, navigational terminology, and practice showed a great deal of interaction, between the naval traditions of the Mediterranean littoral Islamic and Christian states.[207] The activities of the states that wanted to conquer the strategically, located ports in the Mediterranean, and took trade under their control, were crucial to advance

[205] The title, Maritime Empires, is a general name to refer to states, such as Spain, Portugal, Venice, and the Ottoman empire, which came to the fore with their maritime activities in the early modern Mediterranean.
[206] Braudel, *II. Felipe Döneminde Akdeniz ve Akdeniz Dünyası*, Vol. I, p. 276.
[207] Svat Soucek, "Islamic Charting in the Mediterranean," p. 263.

in nautical technologies. One of these states was the Ottoman empire, which had very large borders in the Mediterranean.

The Ottoman empire's breadth of borders and the process of becoming more influential in the Mediterranean, goals furthered with the conquest of Rhodes, in 1522. This could be achieved, especially in the Aegean, through the establishment of gradual supply bases. This process began in the late 1460s, during the reign of Mehmed the Conqueror. With their conquests, the Ottomans were able to position themselves, to give adequate support to fleet operations, in the middle of the Mediterranean.[208] According to Pryor, location was of equal importance to "a slow, relentless and strenuous drive to obtain bases and islands from which war galleys could control sea lanes."[209] However, this was not something that could only happen with smart positioning. At the same time, more cleverly, constructed auxiliary instruments, for navigation, were required as compass, portolan charts, etc.

Moreover, sailors, who acted within the Ottoman empire, in these struggles, were also very effective. In the following sections, we will see, how effective the sailors serving, were in technological activities. For these seafarers were efficient artisans and central agents of all these technical, economic, anthropological, cultural, and religious transmissions and key elements of worlds. Whole of these are built, because of their maritime skills and its domination. They were not only 'maritime agents', but also economic brokers, cultural mediators, or informal, and self-organizing entrepreneurs. They all played central roles on the different shores of the Mediterranean.[210] To look to all these factors, especially the scientific and technological developments in early modern period, first, it is necessary to refer at the Ottoman Mediterranean.

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[208] Gugliuzzo, "Sea Power and the Ottomans in the Early Modern Mediterranean," pp. 84-85.

[209] John H. Pryor, *Geography, Technology, and War: Studies in the Maritime History of the Mediterranean, 649-1571* (Australia: Cambridge University Press, 1992), p. 90.

[210] Gugliuzzo, "Sea Power and the Ottomans in the Early Modern Mediterranean World," p. 86.

2. 1. Ottoman Borders of Mediterranean and History Overview

> Without that which brings peace to my heart, how else would my heart have found peace for so long?
>
> I have roamed the shores of the Mediterranean, Arabia, and Europe, and through the lands of Anatolia and Maghreb. And I written, my friend, all that needs to be written about each and every thing:
>
> What sort of places they are...[211]

Ottoman cartographer and artisan Piri Reis began with these words in his book, *Kitâb-ı Bahriyye* (Book of Navigation, 1521), and explained Mediterranean's islands, shores, and all shallow places. He told: "around when approaching from sea to land, I wish to know what is available everywhere."[212] The Mediterranean is such a sea that, with its history, culture, and legends, the most beautiful of all, it is very rich with various civilizations gathered around it, and hence it is a region of curiosity and admiration.

The Romans called it "Our Sea," while in English and Romance languages the term Mediterranean could be translated as the "Middle Sea" or the "Sea between the Lands." The Mediterranean, which is located at the intersection of Asia, Africa, and Europe, has connected societies surrounding the sea for thousands of years and has become a common area of intense economic, cultural, and political interaction. Greek temples in Sicily, Roman ruins in North Africa, Islamic palaces in Iberia, the Crusader castles in Syria, and the Ottoman walls in Greece prove that the Mediterranean is never a place with fixed national borders or stable ethnic and religious identities. On the contrary, it has been a controversial area, where different religions, policies and ethnic groups have met, mingled and conflict for thousands of years.[213] After all it is the epicentre of our cultural and scientific tradition.

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[211] Piri Reis, *The Book of Bahriyye,* ed. Bülent Özükan (Istanbul: Boyut Yayınları, 2013), p. 11.
[212] Reis, *The Book of Bahriyye*, p. 11.
[213] Monique O'Connell and Eric R. Dursteler, *The Mediterranean World: From the Fall of Rome to the Rise of Napoleon* (Baltimore: Johns Hopkins University Press, 2016), pp. 17-18.

The Mediterranean is a remarkable inner sea. It is relatively calm and navigable most of the year, with many miles of shoreline, countless harbours, and easy access to rivers, and with yet further access to the Black Sea and eastern Europe through the Dardanelles.[214] Connection and shopping played an capital role in the Early Modern Mediterranean.[215] It was, and remains, a unique contact zone in which a particularly diverse group of cultures intersected and engaged.[216]

In the Renaissance and early modern period, the Spanish, Venetian, and Ottoman empires emerged, creating composite states that consolidated governmental structures and contained considerable religious and cultural diversity.[217] The period from the second half of the 15th to the 16th century was a time of adaptation and consolidation among the chief Mediterranean polities (the Habsburg, Ottoman, and Venetian empire) in terms of not only geography, but also institutional structures. In terming them empires, it is important to make qualifications. First, despite their political heft, these were not the only actors in the region; conversely, the Mediterranean should be conceived of as a fluid patchwork of centres and shifting allegiances. Second, these empires were composite states incorporating broad and often disparate regions and including significant cultural and religious diversity. Their rulers grappled with imprinting their sovereignty and protecting their empires, at the same time looking for ways to expand their power through conflict or cooperation.[218]

In this vein, the unification of Castile and Aragon in 1469 united much of the western Mediterranean into a single system of federated kingdoms. To the east, Venice held the Adriatic coast of the Balkans and faced the Ottoman state across a porous and unruly frontier zone. The armies and navies of these expanding states occasionally clashed, but their diplomats also negotiated treaties, their merchants exchanged goods, and their scholars debated and learned from each other.[219]

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[214] Albert S. Lindemann, *A History of Modern Europe: From 1815 to the Present* (West Sussex: Blackwell Publishing, 2013), p. 45.
[215] O'Connell and Dursteler, *The Mediterranean World*, p. 387.
[216] O'Connell and Dursteler, *The Mediterranean World*, p. 21.
[217] O'Connell and Dursteler, *The Mediterranean World*, pp. 18-19.
[218] O'Connell and Dursteler, *The Mediterranean World*, p. 404.
[219] O'Connell and Dursteler, *The Mediterranean World*, pp. 350-351.

The Ottoman empire, which is the focus of this thesis, is one of the states that had a very large place in the history of the Mediterranean, due to its very wide coasts. The Ottomans entered a period, in which Sultan Mehmed II began to show his presence in the Mediterranean, in a remarkable way with the conquest of Constantinople in 1453. The conquest marked a key turning point in the fortunes of the Ottoman dynasty. The next 100 years witnessed dramatic changes in the empire, its structures, and institutions. In the years following the conquest, Mehmed II worked to consolidate his rule. He failed to take Belgrade in 1456; from 1463 to 1479 he was involved in a conflict with Venice, which resulted in the acquisition of several Greek and Albanian possessions by Venice. He expanded the Ottoman power in the Black Sea by conquering Trebizond in 1461 and Crimea in 1475. He unsuccessfully besieged Rhodes in 1480, and in the same year his forces attacked Otranto, establishing the first Ottoman stronghold in southern Italy. Whether this was a simple act of opportunity or an integral part of Mehmed's strategic vision of crafting a new Ottoman Roman empire, the initiative was cut short with his death, in 1481.[220] However, alongside the projection of Ottoman power, the empire also underwent significant innovations and adaptations following the conquest of Constantinople. Mehmed II's reign marked a turning point in the Ottoman evolution from principality to empire (Fig. 11).[221]

[220] O'Connell and Dursteler, *The Mediterranean World*, p. 406.
[221] O'Connell and Dursteler, *The Mediterranean World*, p. 413.

Figure 11. The Sultan Mehmet II by Gentile Bellini (active about 1460; died 1507), 1480, Oil (19th-century repaint) on canvas, perhaps transferred from wood, 69.9 × 52.1 cm, Main Collection of the National Gallery in London, nr. 3099. On loan: Long Loan to the Victoria & Albert Museum (2021-2024), Victoria and Albert Museum, London, UK, https://www.nationalgallery.org.uk/paintings/gentile-bellini-the-sultan-mehmet-ii.

After Sultan Mehmed II (1451-1481), during the reigns of Bayezid II (1481-1512) and Selim I (1512-1520), the expansion of the borders continued to be at the forefront (Fig. 12). These periods began with the Ottoman-Venetian wars (1499-1503). Then, Ottoman, which put an end to the two hundred and fifty years of Mamluk rule, crowned it with the conquest of Syria and Egypt.[222] The most significant Ottoman territorial acquisition after Istanbul came in 1516 and was partly due to commercial concerns. The continuous expansion of the empire that characterized Mehmed's reign continued under Bayezid: he consolidated Ottoman control of the Morea in a second war with Venice (1499–1503) and suppressed rebellions in the east that flared in the wake of the rise of Safavid Iran in 1501. However, Selim significantly renewed Ottoman expansion, especially with the conquest of Mamluk Syria and Egypt (Fig. 13).[223]

[222] Brummett, *Osmanlı Denizgücü ve Doğu Akdeniz'de Diplomasi,* pp. 23-24.
[223] O'Connell and Dursteler, *The Mediterranean World*, p. 408.

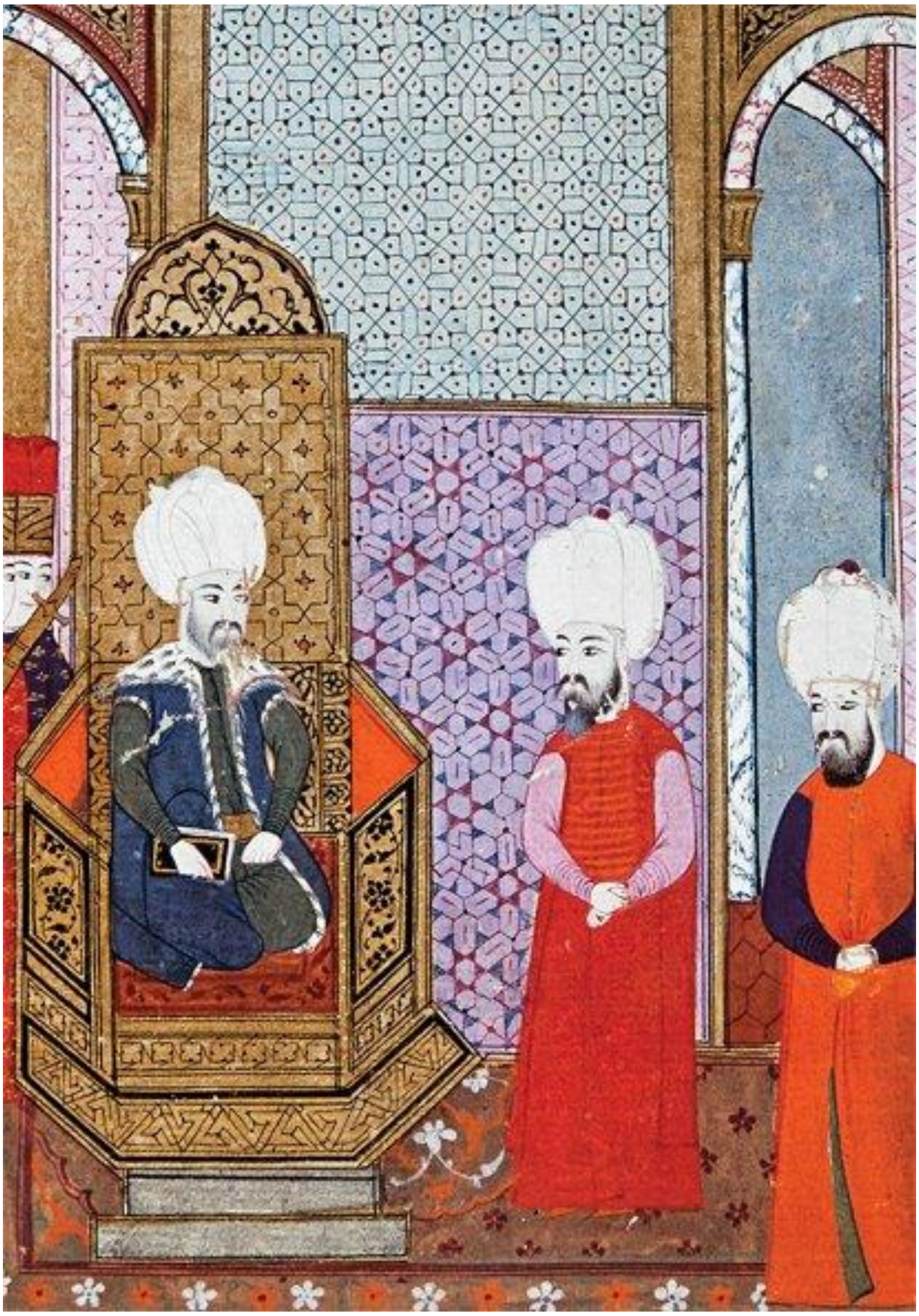

Figure 12. A miniature showing Bayezid II on his throne. Hoca Sâdeddin Efendi (d. 1599) presented his work, called *Tâcü't-tevârîh*, to Sultan Murad III in 1584, *Tâcü't-tevârîh*, Istanbul University Library, nr. 5970, vr. 366a.

Figure 13. Depiction of Selim I by Levnî (d. 1732). Levnî is the last great representative of Ottoman miniature art, 1700s, Topkapı Palace Museum Library, Ahmed III, nr. 3109, vr. 9b.

At the beginning of the 16th century, the expansion of the Ottoman state was blocked on its southern borders by the Safavids, and Portuguese (Fig. 14). In the same period, the western borders of the Ottoman empire were roughly divided into two regions: one is the sea region, where the Ottoman supremacy in the eastern Mediterranean, was decisively demonstrated, during the Ottoman-Venetian wars (1499-1503). Another, it is the land area, where the Ottoman army effectively expanded its control of the Balkans until, it came to a locking point later.[224]

Figure 14. The Yellow Coloured section shows the Ottoman lands in the 16th century. Gastaldi, Giacomo, 1500?-1565? Associated Name, and Abraham Ortelius. Representation of the Turkish Empire, Place of Publication Not Identified: Publisher Not Identified, 1570, https://www.loc.gov/item/2021668700/.

[224] Brummett, *Osmanlı Denizgücü ve Doğu Akdeniz'de Diplomasi*, p. 24.

The peak of Ottoman power in the Mediterranean was unquestionably reached during the reign of the most famous successor of Mehmed II, Suleiman the Magnificent (1520-1566). Under his leadership, the empire experienced a new wave of expansion and initiated significant legal, institutional, and cultural changes. While Selim focused his attention on the declining Mamluks in the south and the rising Safavids and Portuguese in the east, Suleiman turned his attention to the west in the first decades of his reign. This was due not only to the logistical challenges he faced in expanding Ottoman power in the Indian Ocean, but also to the failure of the Portuguese to completely cut off the spice trade, which made the issue a less pressing issue. Another motivation for turning west, apart from economic interests, which I will discuss in the next section, was the expanding Mediterranean presence of Suleiman's chief European rival, the Habsburg emperor, Charles V (Fig. 15).[225]

[225] O'Connell and Dursteler, *The Mediterranean World*, p. 410.

Figure 15. Portrait of Charles V (1500–1558), attributed to Venetian Renaissance painter Titian, 1548, 204,5 x 122 cm, Bavarian State Painting Collections, Alte Pinakothek, Munich, inventory number 632, https://res.cloudinary.com/tne/image/authenticated/s--P3En7I5v--/q_80/artworks/TIZIANO-VECELLIO-GEN-TIZIAN_BILDNIS-KAISER-KARLS-V-IM-LEHNSTUHL_CC-BY-SA_BSTGS_632.jpg.

In fairly rapid succession, Suleiman launched a series of campaigns that expanded his empire deep into Christian Europe (Fig. 16). In 1521, he conquered Belgrade, and in 1522, Rhodes, both of which his great grandfather, Mehmed II, had failed to take.[226] Following the Habsburg raid on the Ottoman Morea, which exposed the limits of the Ottoman navy, Suleiman turned his attention to the Mediterranean and in 1534 invited the famous pirate captain Hayreddin Barbarossa to become grand admiral of the Ottoman fleet. “Pirate entrepreneurs” like Barbarossa, who was born on the Greek island of Lesbos around 1466, had emerged in response to the expansion of Habsburg power in the western Mediterranean and entered alliances with threatened North African rulers. For the Ottomans, the infusion of materiel and naval experience that Barbarossa brought transformed the primarily land-oriented empire into a sea power competing for naval and commercial supremacy in the Mediterranean. This significant shift meant that for much of the next century and a half, conflict in the Mediterranean would play out on the sea. This became evident four years later, when a combined Spanish, Venetian, and papal fleet was defeated at Preveza, on the western coast of Greece, by a much smaller Ottoman fleet. Subsequent campaigns at sea also proved successful, until the siege of Malta, in 1565, when fewer than 10,000 defenders held off an Ottoman force two to four times larger.[227]

[226] O’Connell and Dursteler, *The Mediterranean World*, p. 411.
[227] O’Connell and Dursteler, *The Mediterranean World*, pp. 411-412.

Figure 16. Italian painter Titian's painting *Solimano il Magnifico, di mano di Tiziano*, painted in 1539, canvas, 99 × 85 × 2.1 cm, Vienna Art History Museum, Picture Gallery, 2429, https://www.khm.at/objektdb/detail/2427/.

The following evaluations can be made about the policy of Ottoman borders, the primary purpose was the protection of coasts and the Eastern Mediterranean. During the reign of Mehmed, the Conqueror, Venetian domination, in the Aegean Sea, was broken. And during the reign of Sultan Selim I, with the conquest of Syria and Egypt, the control of the Eastern Mediterranean coast was ensured. It is seen that the Ottomans continued their policies towards the Mediterranean, in the 16th century, as an extension of the previous periods. The conquest of Rhodes, by Suleiman the

Magnificent in 1522, is an indication that the Ottomans had a certain Mediterranean policy that was continuous, although it was revised, according to changing conditions.[228]

The political objectives of the Ottoman empire regarding its borders can be summarized as follows; the political goal, that each Sultan continued by taking from the previous one, was to expand the borders, to have more land, and to spread the religion that he was the protector. The American historian Palmira Brummett explained this situation as follows: "The Ottoman's purpose, in expanding its borders, in the 16th century, was the same as that of the European countries' voyages of discovery: to bring wealth, power, victory, and religious legitimacy."[229]

Based on this, it can be said that the motives of states, to realize their political goals, have pushed them to technological developments. In particular, the Ottoman empire's situation, at the beginning of the 16th century, was not dissimilar from that of Portugal or Spain. Ottoman empire was a newly consolidated, and rapidly expanding state, but one whose political, intellectual, and economic horizons were still firmly encircled by the Mediterranean basin.[230] Therefore, it was inevitable for the Ottoman empire, to integrate at least scientifically and technologically into a common culture in here. Accordingly, Ottoman empire had started to make incentives and investments, in the field of progress, in nautical science and technology.[231] On this subject, a reference to the Ottoman integration and adaptation to the rhythm of the period can be cited from Braudel. In the preface, he wrote for the English translation of his book, the following words:

> Two major truths have remained unchallenged. The first is the unity and coherence of the Mediterranean region. I retain the firm conviction that the Turkish Mediterranean lived, and breathed with the same rhythms as the Christian, that the whole sea shared common destiny.[232]

[228] Hüseyin Serdar Tabakoğlu, *Akdeniz'de Savaş: Osmanlı- İspanya Mücadelesi* (Istanbul, Kronik Kitap, 2019), p. 181.
[229] Brummett, *Osmanlı Denizgücü ve Doğu Akdeniz'de Diplomasi*, p. 16.
[230] Giancarlo Casale, *The Ottoman Age of Exploration* (New York: Oxford University Press, 2010), p. 7.
[231] Brummett, *Osmanlı Denizgücü ve Doğu Akdeniz'de Diplomasi*, pp. 32-33.
[232] Braudel, *The Mediterranean and the Mediterranean World in the Age of Philip II*, p.14.

2. 2. Trading Zones in Early Modern Mediterranean

The trading zones metaphor refers to arenas (symbolic or literal places), where people from diverse backgrounds, who may have quite different views and assumptions, communicate in significant ways.[233] If the production and continuous improvement of scientific and technological knowledge is at the basis of modern economic growth, this puzzle is one of the motivations or incentives. As stated in previous sections, one of the most important factors that push states to scientific and technological developments is economic competition.[234] The commercial competition, which was an effective factor in the development of practical knowledge, was included the Ottoman empire.[235] While Ottoman expansion has often been explained in terms of ghazi, or holy war, scholars now emphasize economy and policy over purely religious intentionality. Ottoman expansion was driven by a competition for markets and a desire to control sources of economic revenue, rather than territorial conquests by a one-dimensional society of soldiers motivated by a warrior ethos.[236]

The economic balance sheet of the early modern Mediterranean is quite complex, not the least because it is difficult to generalize about the sea's diverse parts and polities over such an extended stretch of time. That said, in broad terms, the economy experienced a phase of ongoing growth and vibrancy in the 16th century, and even into the 17th, before entering a period of significant change. In this second phase, certain sectors of the economy were in retreat, but a broader internal and external perspective reveals a much more dynamic and highly complex situation than is usually recognised. There is no doubt that the early modern Mediterranean economy changed dramatically; however, it is more accurate to think of the period as a term of harmony, diversification, and transformation rather than a regression paradigm.[237]

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[233] Long, *Artisan/Practitioners*, p. 94.
[234] Joel Mokyr, *A Culture of Growth: The Origins of the Modern Economy* (Princeton, NJ : Princeton University Press, 2016), p. 23.
[235] Brummett, *Osmanlı Denizgücü ve Doğu Akdeniz'de Diplomasi*, p. 23.
[236] O'Connell and Dursteler, *The Mediterranean World*, pp. 407-408.
[237] O'Connell and Dursteler, *The Mediterranean World*, p. 548.

For many years, it was believed that the economic decline in the Mediterranean began in the early 16th century in response to the rise of the Ottomans, the disruption of the spice trade by the Portuguese, and a commercial shift toward the Atlantic occasioned by the discoveries of Columbus. It is now quite clear that the economy has remained robust in most sectors throughout the century.[238] In the final analysis, the Mediterranean economy in the early modern period exhibited ongoing vitality and adaptability. After a strong 16th century, the global 17th century crisis had a serious impact, but merchants, artisans, and politicians adapted to these transformations with reasonable success.[239]

In general, it can be said that the commercial competition, in the Mediterranean, is coordinated with the technological developments. Because the European countries and the Ottoman empire's search markets for trade in the ports, and their desire to dominate these markets, led the states to competition, and herewith to conflicts and wars. In this case, the states had to use the equipment, to prevail of sea, namely the technological developments such as ships and weapons.[240] In this place, it is important to realize that the geographies of trade and information networks largely overlap in the Mediterranean, and it is this crucial common link that underlines the intercultural knowledge encounter in the region.[241]

In this quarter, rather than historical events and course, the heroes of the concept of trading zones emerge. Long, coined the concept of trading zones to help select and analyse a phenomenon that was evident in the wider era whereas, hitherto lacked a descriptive label.[242] Long applied the socio-spatial concept of the trading zones to the context of early modern Europe. In her words, trading zones are "arenas, where artisans and other practitioners and educated people, engage in important activities."[243] Ottoman empire, which was rapidly included in the trade zones, can be added this group.

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[238] O'Connell and Dursteler, *The Mediterranean World*, p. 548.
[239] O'Connell and Dursteler, *The Mediterranean World*, p. 559.
[240] Brummett, *Osmanlı Denizgücü ve Doğu Akdeniz'de Diplomasi*, p. 23.
[241] Raj, *Relocating Modern Science*, p. 19.
[242] Long, "Trading Zones," pp. 841-842.
[243] Sánchez, "Practical knowledge and empire," p. 5.

Examining the construction of scientific knowledge in the trading zone together with new historical source materials, not only to broaden the scope of social studies of knowledge, but also see the intersections of Western and Eastern science, is momentous. It is part of the more general point, the national and regional histories, cannot be understood by confining work to its geographical boundaries.[244] What was tried to be shown was the contact zone, a place to produce validated knowledge that would not have arisen, had it not been for the intercultural encounter between Western and Eastern intellectual and material practices. In other words, although this knowledge had different trajectories in specialist communities, in the East and West, and was adopted and integrated differently in the two regions, they participated in, and were constructed through the same circulation processes.[245]

As such, trading zones supported and even employed mathematicians, astronomers, and hydrographers for navigation, from their inception. Thus, these artisans were key actors in the early modern attempt to make and use knowledge.[246] Due to their commercial activities, states had to develop close relations with merchants and trade groups in other parts of the Mediterranean, especially the European states and the Ottoman empire. This has led to the emergence of new specialized intermediary groups, in which trading districts have access not only to local goods, but also to private information vital to their survival and continued trade. This information included the identification and value of potentially lucrative products ranging from plants and animals to manufactured goods, their geographic distribution, accounting and trading contracts, ship maintenance and repair, and navigation. It is substantial to realize that the geographies of trade and information networks largely overlap not only in Europe, also in the eastern Mediterranean, Asian and Indian Ocean worlds, and it is this crucial common link that underlines the intercultural knowledge encounter in the region.[247]

The importance of trading zones was because they also required continued efforts to develop certain technologies, or technological processes that often required practical interventions. Because of the work done, here covered the developing fields of practical measurement, engraving and construction, and cartography. And these

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[244] Raj, *Relocating Modern Science*, p. 11.
[245] Raj, *Relocating Modern Science*, p. 13.
[246] Raj, *Relocating Modern Science*, p. 16.
[247] Raj, *Relocating Modern Science*, pp. 18-19.

trade districts often included artisan-trained individuals, who pursue somewhat streamlined careers, and were not depended into a traditional artisan.[248] The these zones that flourished, in Europe and other places, in the 16th century, formed arenas for effective communication between artisanal and university-educated men, with the latter almost always having a higher social background than the former.[249] Also, it can be said that the commercial districts became the arsenal.[250] It is noteworthy that arenas, where occurred to be formed by trade zones, were often places, where new technologies are developed and/or where large-scale government investment or ventures, were undertaken with equity investment by shareholders.[251] For example, the location of trading zones can be volatile, as states, such as Venice and Spain finance huge arsenals, where the development of ships and weapons, are continuing interest and well documented. However, these places, where large capital investments were made, innovative technologies were in the process of development, or new tended, construction and redesign, were going on. Examples of trade zones are clearly shown in such places, whereas this is an area for further research.[252] First, before the Ottoman shipyards and scientific and technological studies, which we will see in the next section, it is necessary to know the general outlines of the Ottoman commercial zones.

The trade areas, which the Ottomans operated from the Mediterranean to the Indian Ocean, were the places, where the resources and personnel of the interconnected regions. Three commercial zones can be identified to establish a relationship between the eastward expansion of the Ottoman empire and the development of naval power, in an attempt to contain international trade. The first of these was the island-coastal region, where trade was carried out from the Ottoman coast to the west, to the Aegean Islands and from there to the Adriatic. The commodity, that left its mark on this region, was grain. The second was the Anatolia-Syria region, where the caravan trade from the land in the east-west direction, and trade from Iran to Eastern Anatolia and Syria, to Western Anatolia takes place. Silk, spices, and timber were the commodities that left their mark on this region, stretching from Istanbul to Aleppo, Tabriz, and to the top of the Persian Gulf. The third commercial region was the Eastern Mediterranean-Indian

[248] Long, “Trading Zones,” p. 842.
[249] Long, “Trading Zones,” p. 843.
[250] Long, “Trading Zones,” p. 844.
[251] Long, “Trading Zones,” p. 845.
[252] Long, “Trading Zones,” p. 845.

Ocean region, which stretched from Istanbul to Alexandria, Jeddah, India, and the shores of Malacca. The main passages, in this area, were the sea routes, the most significant commodities, were spices and copper. The routes, between these three regions, intersected. These were borders on which relations, were determined by markets, transportation facilities, and the energy of the merchant rather than political borders.[253]

2. 3. Nautical Science and Technology on the Mediterranean

According to Zilsel, the artisans invented measuring instruments, which are nautical and astronomical, which located in the centre in empirical observation and experimental research. The makers of rangefinders, for artillery, made compasses and astrolabes, crossbars and dials, and invented inclinometers in the 16th century. Their measuring instruments are precursors to the modern physical device. Some of these men were retired sailors or artillerymen. Finally, sailors were also recognized as representatives of the mechanical arts. Zilsel thinks that artisans and cartographers are more foreground to the development of surveying and observation than experimentation.[254]

Sailors, navigating the Mediterranean, invented and developed several scientific instruments, including being able to see land, and understanding winds and trends, to determine their position. Seen from this perspective, the maritime traditions of Europe and Ottoman empire, despite the exchange of information between the Mediterranean and the Atlantic in the last centuries of the medieval period, retain great differences between them because they must fit different needs and environments.[255] For example, Europe is a peninsula, and therefore, accessible by sea. But it is also a peninsula of peninsulas: Scandinavia, Iberia, Italy, Greece, Anatolia, Anatolian Peninsulas, and exceptionally the British Isles. This geographical reality not only encouraged the development of sea travel, but also accustomed Europeans to the long-distance transport of ships, people, and ideas.[256] The geographical, economic, and

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[253] Brummett, *Osmanlı Denizgücü ve Doğu Akdeniz'de Diplomasi*, p. 29.
[254] Zilsel, "The Social Roots of Science," p. 552-553.
[255] Brocchieri, "Denizler Hakimiyeti," p.70.
[256] Guilmartin, *Kalyonlar ve Kadırgalar*, p. 41.

cultural characteristics of each sphere of influence pushed ship design in different directions, and each had its own unique warfare technologies. However, due to the variations in the scientific development of the countries, in the Mediterranean, it is seen that there are in many varieties, in the navigational instruments used. First, the compass, astrolabe, the quadrant, Jacob's staff (cross-staff), and portolan charts were among the navigational tools used in early modern Europe, where these scientific and technological developments were seen before.[257] On the other hand, as we will see later, the situation was different, in the Ottoman empire, whose orientation towards maritime increased, after the conquest of Constantinople (1453).

Firstly, we should start with the subject of the compass to the subject of technological and scientific developments because the innovation of compass has been a great step in the continuation of all other developments. With the invention of compass in 12th century, it became easier to find directions in ship voyages, and this situation increased the voyages and contributed to trade and transportation. The number of ships, seen in the Mediterranean, has increased, and the states have preferred this mode of transportation more. The innovation of compass also increased the interest in chart drawings and brought the chart drawings closer to reality.[258]

Portolan charts and astrolabes came into play, which are a systematic collection of news about the geographical and meteorological features of coasts and ports, including the location of possible landmarks and other information. Essentially, maritime systems did not change for centuries, at least, until the 15th and 16th centuries. Between these centuries, the art of nautical technologies underwent tremendous development, and instruments changed rapidly. Journeys multiplied, ships of all kinds began to sail more confidently, following only partially known routes. Therefore, the art of navigation and progressive equipment/technologies were often decisive factors in the correct and safe arrival of the crew at their destination.[259]

[257] Mara Miniati, "Teknoloji, Seyahatlar, Denizcilik," in *16. Yüzyıl Rönesans Çağı*, ed. Umberto Eco, trans. Adnan Tonguç, 529-532, (Istanbul: Alfa Yayınevi, 2019), p. 531.
[258] Miniati, "Teknoloji, Seyahatlar, Denizcilik," p. 529.
[259] Miniati, "Teknoloji, Seyahatlar, Denizcilik," p. 529.

In 15th century, thanks to newly developed instruments, great advances were made in wayfinding methods. Most significantly, the compass, which consists of a magnetized pointer placed in a bowl of water and had been used in Europe, since the 12th century, had been replaced by the dry sailor's compass. The dry sailor's compass consisted of a freely rotating magnetized needle on a card with compass points marked. All this assembly was keeping in a box fixed on the ship's keel, in line with it. As the ship changed direction, the card also rotated, thus constantly showing the route of ship followed.[260]

Towards the end of the 15th century, the nautical astrolabe was developed, which was different from the normal astrolabe, and designed to be used, even in rough seas with strong winds, possibly to respond to the deficiencies of the quadrant (Fig. 17). Thanks to this new astrolabe, a brass instrument with a ring-like shape, it was possible to calculate the latitude of the ship by taking advantage of the noon rise of the sun in the sky, or the latitude difference of certain stars.[261] This instrument is the most widely used, and meaningful instrument in the history of nautical instruments. In addition to the nautical astrolabe (Fig. 18), the most widely used instruments are the compass for navigation, and the instrument known as Jacob's Staff, which consists of staves arranged in the shape of a cross and used to measure the height of celestial bodies (Fig. 19).[262] Besides these technological tools, it can be count portolan charts as another type of instruments. The portolan began to be used, which was a systematic collection of news about the geographical and meteorological features of coasts and ports, including the location of possible landmarks, and other information useful to sailors.[263]

[260] Beau Riffenburg, *Antik Dönemden Günümüze Haritacılar*, trans. Çağlar Sunay (Istanbul: Türkiye İş Bankası Kültür Yayınları, 2012), p. 22.
[261] Riffenburg, *Antik Dönemden Günümüze Haritacılar*, p. 22.
[262] Miniati, "Teknoloji, Seyahatlar, Denizcilik," p. 531.
[263] Miniati, "Teknoloji, Seyahatlar, Denizcilik," p. 529.

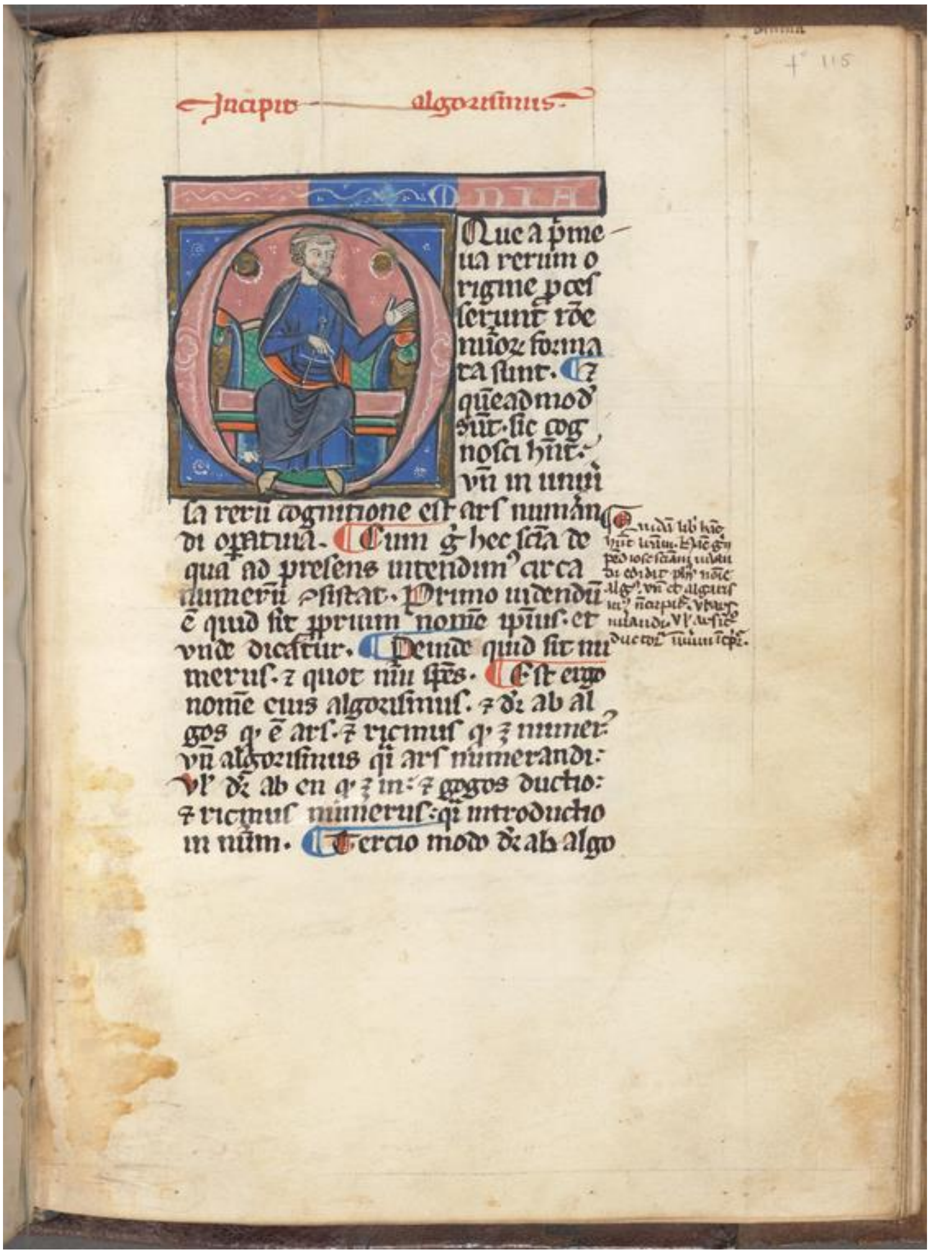


Figure 17. Quadrant from Joannes de Sacro Bosco's book, *De sphaera*, approximately 1240 – 1260, Manuscripts and Archives Division, The New York Public Library. "Algorismus" New York Public Library Digital Collections. Accessed November 11, 2023. https://digitalcollections.nypl.org/items/152af850-f054-0138-8739-0242ac110003.

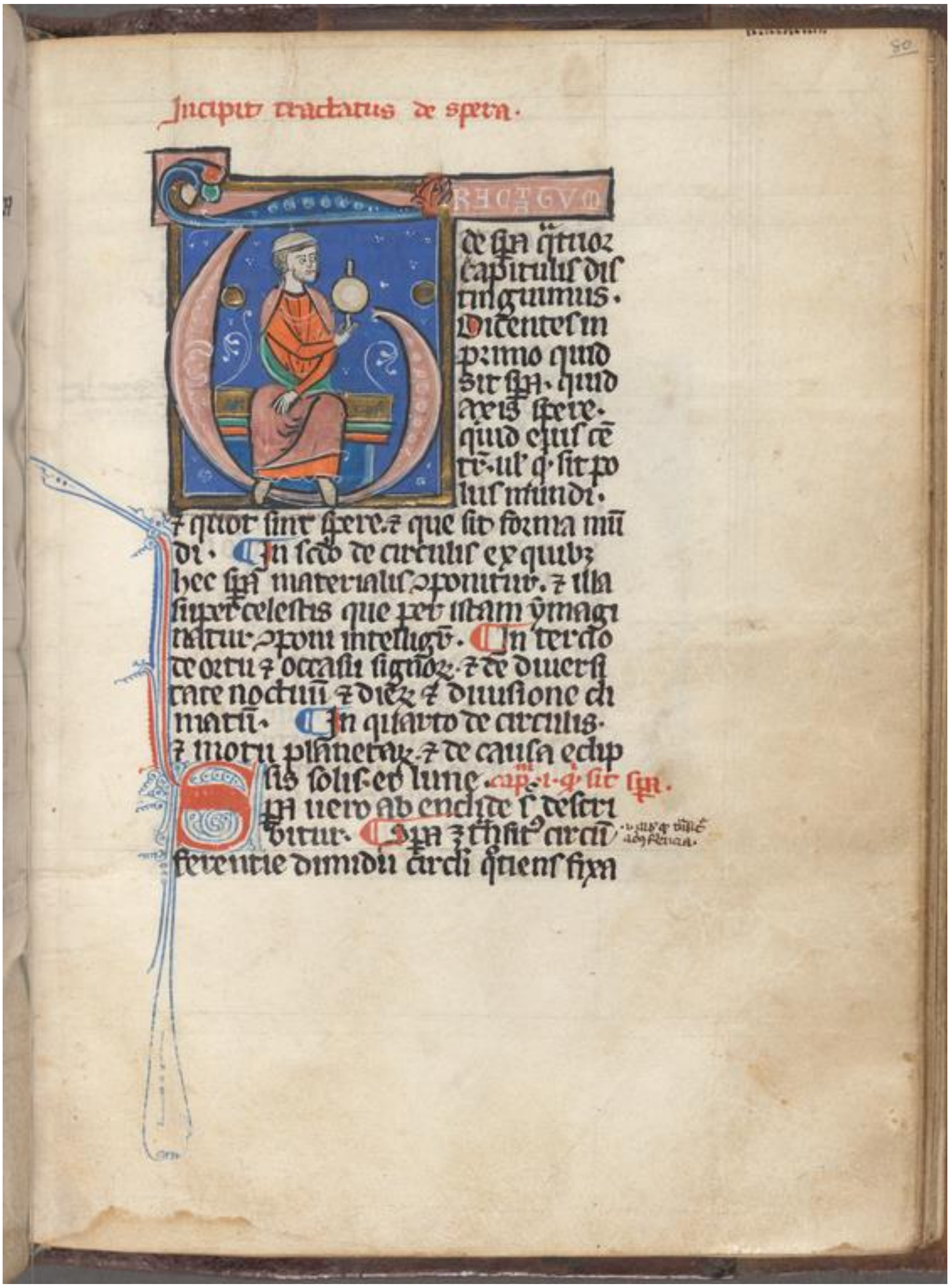


Figure 18. Astrolabe from Bosco's book, *De sphaera*, 1240-1260 Manuscripts and Archives Division, The New York Public Library. "De sphaera" New York Public Library Digital Collections. Accessed November 11, 2023. https://digitalcollections.nypl.org/items/0c555150-f054-0138-2661-0242ac110003.

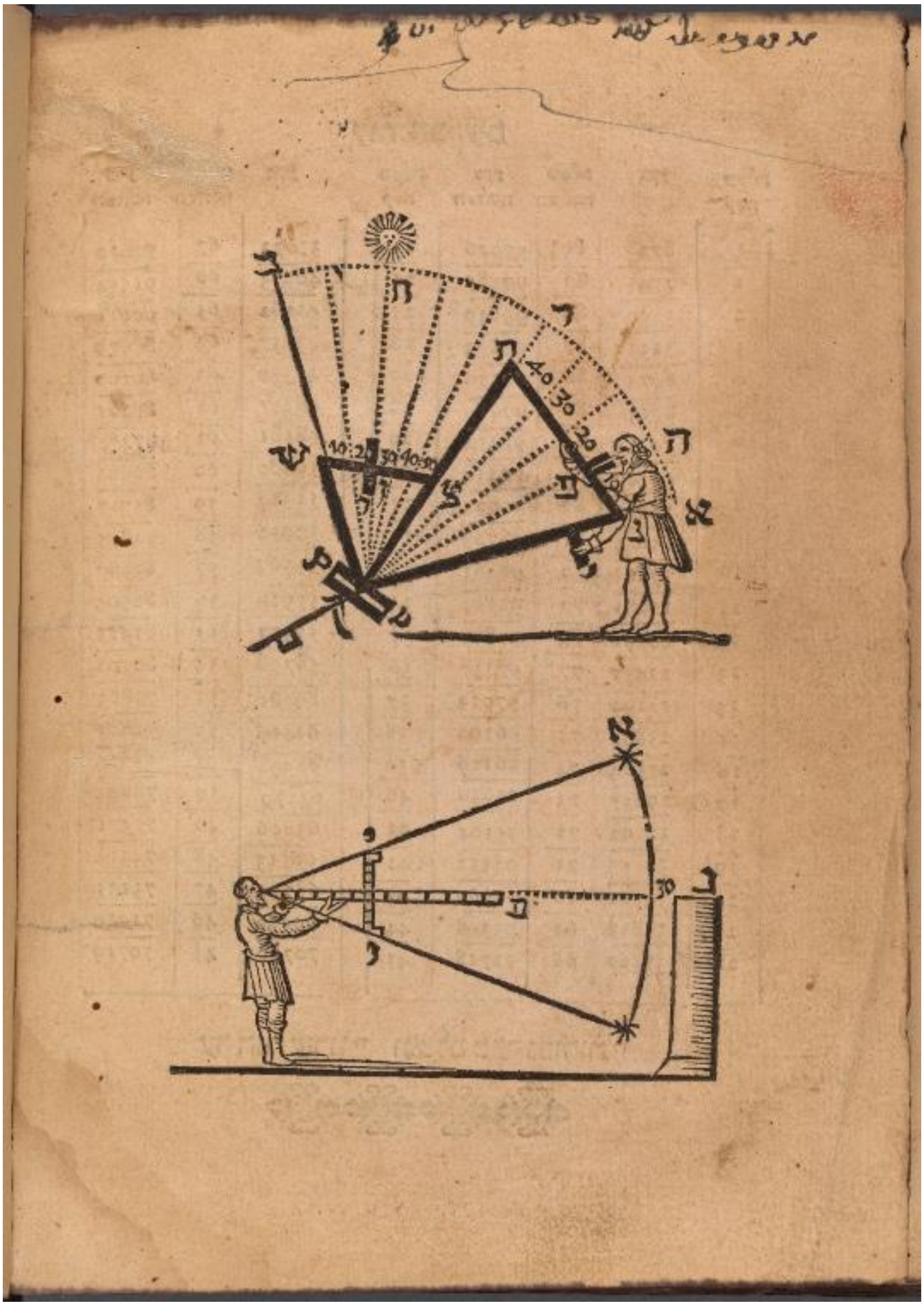


Figure 19. Dorot Jewish Division, approximately 1628 – 1629, The New York Public Library. "Jacob's staff" New York Public Library Digital Collections. Accessed November 11, 2023. https://digitalcollections.nypl.org/items/a5c31f84-05f5-ffc6-e040-e00a18060180.

Before analysing the nautical instruments used in the Ottoman empire, it would be needed to mention the general names of the instruments used in the Mediterranean in comparison with the Ottomans. The next section is about nautical tools used in the Ottoman empire.

2. 4. Nautical Instruments in Ottoman Maritime Culture

So that explain the concepts and developments in Ottoman nautical science, it would be more accurate to divide them into sections. Because we see that carried out in the field of nautical science in the Ottoman empire, technologies related to nautical instruments, and shipbuilding activities. These sections correspond to three essential topics: naval architecture and shipbuilding (considered as maritime instruments and cosmographic material culture), and nautical artifact, such as the astrolabe and the portolan chart.

2. 4. 1. Naval Architecture and Shipbuilding

Building a navy is a difficult process, and the Ottomans were not immune from the technical challenges of shipbuilding, developing naval skills, and training a competent cadre of sailors.[264] Establishing a naval empire depended on the ability to mobilize irresistible armies and navies. This situation encouraged the states to shipbuilding activities and compelled them to follow the shipping technology.[265] In this point, referring to the definition of Europe as the peninsula by Guilmartin, this geographical reality can be evaluated in terms of naval architecture and shipbuilding.[266] The geographical, economic, and cultural characteristics of each sphere of influence pushed ship design in different directions, and each had its own unique warfare technologies. Perhaps, most significantly, the attitudes of the ruling elites, towards maritime trade and war at sea, were fundamentally distinct.[267]

There are no detectable tidal events in the Mediterranean. During the trade and voyage season, that is, from late March to early October, the skies are usually clear, and storms are rare. Since antiquity, favourable winds and currents had directed trade to major routes that passed near the northern shore of the Mediterranean. The coast, in question, is full of harbours and beaches, where sailors can take a rest for the night or

[264] Gugliuzzo, "Sea Power and the Ottomans in the Early Modern Mediterranean World," pp. 82-83.
[265] Brummett, *Osmanlı Denizgücü ve Doğu Akdeniz'de Diplomasi*, p. 22.
[266] Guilmartin, *Kalyonlar ve Kadırgalar*, p. 41.
[267] Guilmartin, *Kalyonlar ve Kadırgalar*, p. 37.

take shelter in storms.[268] Most of the time, the water is clear, and the sea suddenly becomes shallow, enabling the sailor to approach land safely to determine his position. This process is facilitated by the presence of high mountain ranges near the coast that provide suitable triangulation points. All these factors enabled the early development of maritime trade, and specialized warships in the region, because there is credible evidence that from the outset the design of seaworthy ships in Europe, tended towards two extremes, round ships for trade and long ships for war.[269]

Carracks, a new type of ship, began to be seen in Europe from the second half of the 14th century and in the Mediterranean from the 15th century (Fig. 20). While it became a typical ship in the West, it was seen in very small numbers in the Byzantine and Muslim worlds, in the eastern Mediterranean. The Venetian Francesco Pizzigano's portolan chart (1367) is the first evidence of this new type of ship (Fig. 21, 22 and 23). Carracks had a large, wide, deep, and imposing hull with two to three decks, ideal for bulk cargoes. In the Venetian and Genoese documents, carracks with a tonnage of 300-600 tons are shown. The carracks had a flat floor at least amidships, a heritage from the cocha, and a curved stem with a marked rake and castles fore and back, the forecastle usually substantially higher than the after-castle. Its gradual disappearance from iconography, in the 16th century, is a sign of the gradual transformation of carracks into another large type of ship.[270]

[268] Guilmartin, *Kalyonlar ve Kadırgalar*, p. 43.
[269] Guilmartin, *Kalyonlar ve Kadırgalar*, p. 45.
[270] Ruthy Gerthwagen, "Nautical Technology," in *A Companion to Mediterranean History*, ed. Peregrine Horden and Sharon Kinoshita, 154-169, (Oxford: John Wiley and Sons, 2014), p. 164.

Figure 20. The model of Spanish carrack, 200 x 77 x 165 cm, Istanbul Maritime Museum, https://denizmuzesi.dzkk.tsk.tr/tr/content/499.

Figure 21. Francesco Pizzigano, Portolan chart of the Mediterranean, Black Sea and western Europe (1367), 1280 x 870 mm, Palatine Library (Biblioteca Palatina di Parma), https://medea.fc.ul.pt/view/chart/435.

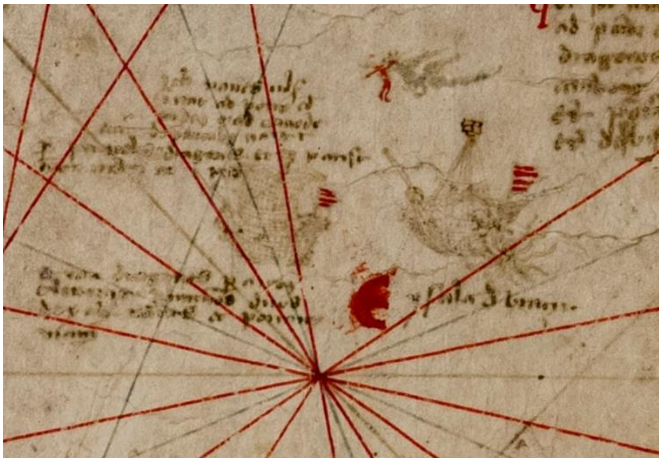


Figure 22. When it can be looked carefully at the Pizzigani portolan, 1367, cog/cochas can be distinguished.

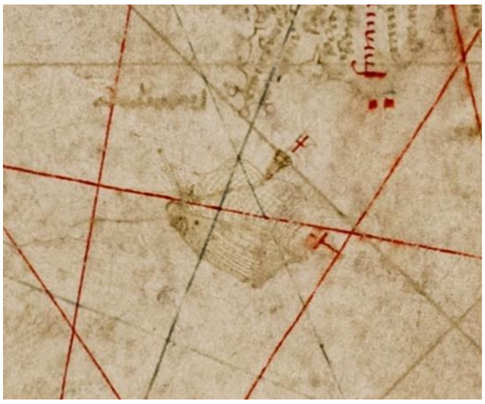


Figure 23. Cog/cochas from the Pizzigani portolan, 1367.

The introduction of the cog/cocha into the Mediterranean, in the late thirteenth century, led to major changes in steering gears with the adoption of the northern back rudder. It was easier to use than the traditional two side rudders, but also less vulnerable to collision and gave better overall control of the boat with a stick attached at a 90º angle to the tiller.[271] Until the late thirteenth century, latin sailing dominated both Mediterranean war galleys and merchant ships (Fig. 24). With the increase in ship size from the late twelfth century, from the thirteenth century the yardage of sails carried on two large masts could reach up to 6.5 metric tons. Three-masted late rigged ships were correspondingly heavier, requiring large numbers of men and a complex block-fighting system.[272]

When the cog/cocha was introduced to the Mediterranean, square sail was adopted, in this region, from the early 14th century. Carried on a single pole and serving all weather conditions, the width of the canvas can be enlarged or reduced as needed using bonnets. Added lifts made it easy to lift the sails. A more complex rope system allowed better control of the sail. This development, along with its trunk form, allowed the cocha to make round-trip voyages between the Mediterranean and Atlantic and northern Europe. The first evidence of two-masted cocha, in the Mediterranean, appears in a Catalan convention of 1375 (Fig. 25, 26, 27, and 28).[273] Also, the cocha was sweller than contemporary Mediterranean cargo ships, saving the wood needed to build the hull. This, together with the advantageous defensive capabilities afforded by

271 Gerthwagen, “Nautical Technology,” pp. 164-165.
272 Gerthwagen, “Nautical Technology,” p. 165.
273 Gerthwagen, “Nautical Technology,” p. 165.

its shape, explains its general adoption as a replacement for naves in the Mediterranean.[274] Like cocha, the carracks required one man for every five tons. On the other hand, it was uneconomical to adopt square sail for all types of galleys, where crew size remained constant, due to defensive and rowing needs. When these ships got bigger, large galley sailors for pilgrims, in Venice, carried three lateen masts, the sail on the mainmast being replaced in some cases by a square sail. These improvements may have enabled them to pass through the major roads running along the coasts.[275]

Figure 24. A galley in the 1487 manuscript by Konrad Grünenberg, Beschreibung der Reise von Konstanz nach Jerusalem - Cod. St. Peter pap. 32 / Konrad Grünenberg. Bodenseegebiet, 1487, Baden State Library, Karlsruhe, Cod. St. Peter pap. 32, https://nbn-resolving.org/urn:nbn:de:bsz:31-1272 / CC-BY-License.

[274] Gerthwagen, "Nautical Technology," p. 166.
[275] Gerthwagen, "Nautical Technology," p. 166.

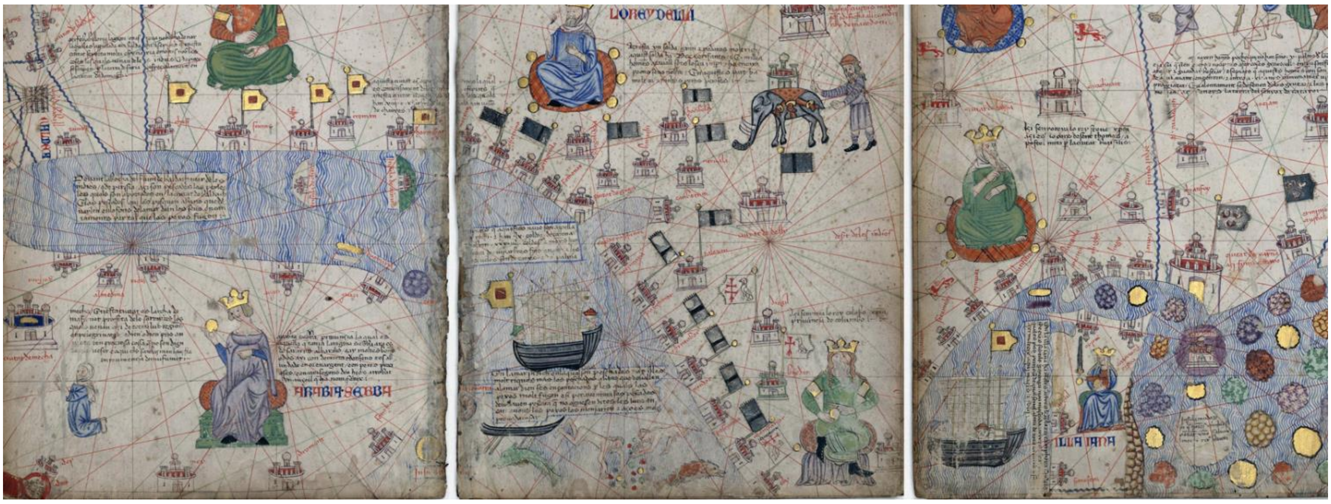
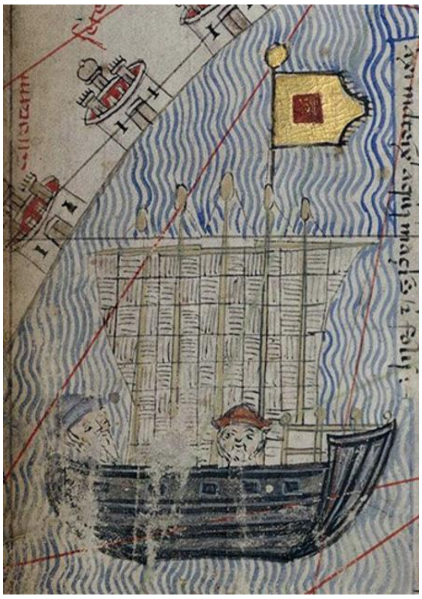


Figure 25. Part of *Atlas Catalan*, Abraham Cresques, *Atlas Catalan* (1375), Place: Palma de Majorca, Spain, Archive: National Library of France (Bibliothèque nationale de France), https://medea.fc.ul.pt/view/chart/410.

Figure 26. Cochas from *Atlas Catalan* (1375).

Figure 27. Cochas from *Atlas Catalan* (1375).



Figures 28. Cochas from *Atlas Catalan* (1375).

The caravel was a three-captain ship of the late 15th century with a square sail on the main and forward masts, and a lateen sail on the mizzen mast that made it easy to cross the Atlantic. Over time, the caravel has increased in size and length-to-breath ratio to increase it carrying capacity. Christopher Columbus sailed on such ships in 1492 (Fig. 29 and 30). To examine the physical remains of this Iberian-type ship, whose heyday lasted only a century, we must wait for the wreck of a caravel to be found. From the middle of the 16th century, it was gradually replaced by the galleon in the Mediterranean, mostly used by the Spaniards, Portuguese, and Venetians. However, the characteristics of the galleon were shared by the ships of other European peoples. The caravel and galleon were armed with heavy artillery and their main use was military. To withstand the weight and shock of artillery fire, the galleon's hull contained more ribs and struts than ships designed for cargo only. Under the bow was a distinctive beak that reminded us of the rams of traditional galleys. The forecastle was always lower than the rear structures, giving the galleon a distinctive, low crescent profile. The high structures of the main mast increased the ship's defensibility against attacks, which was still common in this era. On the other hand, with changes in military tactics, bow and back forts were no longer needed to defend against boats. And boats became longer, more aerodynamic, and lower in the water to improve sail quality.[276]

Figure 29. “The ships of Columbus”, The Miriam and Ira D. Wallach Division of Art (1888), Prints and Photographs: Picture Collection, New York Public Library Digital Collections. Accessed November 11, 2023. https://digitalcollections.nypl.org/items/510d47e1-1f55-a3d9-e040-e00a18064a99.

Figure 30. “The ships of Columbus”, The Miriam and Ira D. Wallach Division of Art (1892), Prints and Photographs: Picture Collection, New York Public Library Digital Collections. Accessed November 11, 2023. https://digitalcollections.nypl.org/items/510d47e1-1f5b-a3d9-e040-e00a18064a99.

[276] Gerthwagen, “Nautical Technology,” p. 166.

The 16th century was a very significant period, in which developments in shipbuilding and weapon power technologies were seen, as well as wealth accumulation. In this way, some kingdoms, separated from others, came a little closer to realizing their dreams of world domination. At the beginning of the 16th century, there were signs that the borders of world domination would be redefined in terms of naval power. The states that dominated the seas, tried to expand their spheres of influence from this period, in the world, whose borders were redescribed. Parallel to the redefinition of borders, in this period, the language of diplomacy and imperial discourse were re-explained in the world order. The power of the states to dominate the sea, made it possible to go far beyond the sovereignty claims of the rulers, and the borders determined by the armies.[277] Therefore, it is seen that the Sultans of the Ottoman empire, who aimed to expand their dominance, increased their incentives for shipyard building, shipbuilding technologies and activities, since the reign of Mehmed the Conqueror. In the next section, we will see that the sailors and artisans, in the Ottoman navy, produced different types of ships, or similar ones.

If we look other scientific developments, the science and art of cartography, first sprouted in the seas. The needs of seafarers drew the attention of geographers. In maritime, the route is fixed by means of the sun and the Polar Star reference points, and the distances are calculated, according to the speed of the ship. From the 12th century onwards, the compass began to be used. Later, the portolan charts became a systematic collection about the geographic features of coasts and ports, including the location of possible signs.[278]

[277] Brummett, *Osmanlı Denizgücü ve Doğu Akdeniz'de Diplomasi*, pp. 16-17.
[278] Miniati, "Teknoloji, Seyahatlar, Denizcilik," p. 529.

2. 4. 2. Nautical Artefacts and Mathematical/Astronomical Instruments

In the early modern period, the growth of trade, the onset of colonization, competition and the desire for dominance meant that practical mathematical techniques, such as navigation and cartography, were deemed much more important.[279] The art of navigation, which requires both theoretical and practical knowledge, covers various disciplines such as geography, mathematics, meteorology, and astronomy (Fig. 31 and 32). To what extent, and how this knowledge was used by early modern seafarers, has been explored more in the context of Arab and European naval history.[280] For example, in Portugal and Spain, the new science of a global nature was predominantly expressed in a practical way, and was subordinated to colonial empires, their vast networks, and circuits of geographic information. In this context, applied sciences, such as navigation, hydrography, cartography, topography, or geodesy, occupied a privileged place. Explorers, travellers, missionaries, traders, and soldiers, as well as sailors, cartographers, and naturalists, took personal experience as a legitimate means of gaining knowledge. The empirical method produced a large corpus of knowledge that was transmitted, distilled, and systematized in the vernacular. This corpus promoted a set of measures and mechanisms, overseen by the Crown in the form of institutions, new professions, and new works to regulate and control new practices and their practitioners.[281]

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[279] John Henry, *The Scientific Revolution and the Origins of Modern Science* (New York: Palgrave Macmillan, 1997), p. 22.

[280] Gaye Danışan Polat, "An anonymous Ottoman compendium on nautical instruments and navigation: Kitâbü'l-mürûri'l-ubûr fî ilmi'l-berri ve'l-buhûr," *Mediterranea* (Ricerche Storiche, August 2015), p. 376.

[281] Sánchez, "Practical knowledge and empire," p. 7.

Figure 31. Astrolabe from Zakarīyā ibn Muḥammad Qazwīnī's book 'Ajâ'ib al-makhlûqât va gharâ'ib al-mawjûdât, approximately 1203-1283, Spencer Collection, The New York Public Library. "Seated youth hold an astrolabe (top); Seated man with black-and-gray beard holds an astrolabe (bottom)" New York Public Library Digital Collections. Accessed November 11, 2023. https://digitalcollections.nypl.org/items/40087830-28ec-0138-cfd2-13f3f059aba4.[282]

[282] Iranian geographer Qazwīnī (d. 1283) wrote one of the common works of Islamic literature, containing encyclopedic information and prepared according to the geography and cosmography concepts of his time. It is known that this work was translated into Ottoman Turkish by Ahmed Bîcan in 1453 and was presented to Sultan Mehmed.


33-4
283
نهاد از ظل آنجا که نزدیکتر
باشد از عضاده و از جزو
ارتفاع آن ارتفاع اول
وقت عصر بود چون آفتاب
بدان ارتفاع رسید اول
وقت عصر بود فصل فی ارتفاع شخص یمکن الوصول الی اصله عصا
بر چهل و پنج جزو بنهد از اجزای ارتفاع آنگاه اصطرلاب بردارد و در مقابل
راس آن شخص بنهد از هر دو عضاده سوراخ بالا و سوراخ زیر آنگاه آنجا که
ایستاده بود بمقدار قامت باز پس شود آنگاه از مکان وقوف او بشمارد و زیادت
قامت تا آنجا که آن شخص بود و از شرط صحت این عمل آنست که مسافت میان
شخص و میان آن موضع آنجا که ارتفاع گرفته باشد مساوی باشد فصل
فی ارتفاع شخص لا یمکن الوصول الی اصله ارتفاع آن شخص بگیرد آنگاه ظل آن
ارتفاع معلوم کند و بر موضع قدم علامت کند آنگاه یک اصبع بر ظل افزاید
یا از و نقصان کند و ارتفاع این ظل بداند و عضاده را بر آنجا نهد و باری
مقدم میکند و باری تا آخر تا آنگاه که ارتفاع شخص یکبار دیگر بگیرد و بر موضع

Figure 32. Another example of an astrolabe from Qazwīnī's book, 1200s, Spencer Collection, The New York Public Library. "Seated man with white beard and eyebrows holds an astrolabe," New York Public Library Digital Collections. Accessed November 11, 2023. https://digitalcollections.nypl.org/items/410685b0-28ec-0138-1b51-2fff9d20b73d.

Despite that, historical studies, dealing with navigation techniques, instruments, and nautical charts in the Ottoman period, are relatively distinct. What methods did the Ottomans use, while navigating the sea? How did they determine the position and direction of the ship? What tools were used? These questions have not yet been clearly answered. When we look at the manuscripts and research in the Ottoman archives, it is seen that the main navigational devices of the Ottoman sailors were compass and portolan charts.[283]

Researching Ottoman navigation techniques is not without problems. Existing literature, on Ottoman maritime history, is lacking in its maritime techniques. It mostly emphasizes Ottoman sailors' reliance on compass and charts, butcharts but does not try to find out if they used other means to provide the above-mentioned measurements. Considering the long history of Ottoman maritime, it is essential to identify, and evaluate current scientific developments.[284]

It is very difficult to find the oldest information about technological instruments, such as compass and astrolabe in the Ottoman empire (Fig. 33). However, finding information, about such technological devices, is easier in works, written in the early modern times.[285] There are signs that the compass, was taken from the West in the 16th century, during the maturity of Ottoman maritime. Piri Reis mentioned in the *Kitâb-ı Bahriyye*, it is understood that the compasses, used by the Ottomans, were of Western origin. While talking about the importance and necessity of chart and compass for sailors, Piri Reis says that those, who do not understand them, should not go to sea and that they will be harmed when they do.[286]

[283] Polat, "An anonymous Ottoman compendium on nautical instruments and navigation," p. 376.
[284] Polat, "An anonymous Ottoman compendium on nautical instruments and navigation," p. 376.
[285] Mahmut Ak, "Seydi Ali Reis," accessed April 23, 2022, https://islamansiklopedisi.org.tr/seydi-ali-reis.
[286] Ekmeleddin Ihsanoğlu, "Osmanlıların Batı'da Gelişen Bazı Teknolojik Yeniliklerden Etkilenmeleri" in *Osmanlılar ve Batı Teknolojisi: Yeni Araştırmalar ve Yeni Görüşler*, ed. by Ekmeleddin Ihsanoğlu (Istanbul: Istanbul Üniversitesi Edebiyat Fakültesi Yayınları, 1992), 121-139, p. 137.

Figure 33. A compass used in the Ottoman empire, exact date unknown but was early 16th century, Istanbul Maritime Museum, https://cdn.islamansiklopedisi.org.tr/gorsel/Di%C4%9Fer%20foto%C4%9Fraf/osmanlilar-51.jpg.

In his ten-couplet poem about the compass, while describing the compass, he describes its developed form as a 32-pointed wind rose.[287] The fact that this instrument, which is called *beyt el-ibre* or *daire* (circle) in contemporary Arabic literature, and in Ottoman geographical sources, tool is called *pusula* (compass) in Kitab-Bahriye, apparently taken from the Italian word *bussola*, shows that the compass came to the Ottomans from a Western source.[288]

[287] This subject is examined one by one in the chapter 6, where Piri Reis and his works are analyzed.
[288] Ihsanoğlu, "Osmanlıların Batı'da Gelişen Bazı Teknolojik Yeniliklerden Etkilenmeleri," p. 137.

At the same time, we come across information about the compass in Seydi Ali Reis' book, entitled *Kitâbü'l-Muhît* (the Book of Ocean, 1554), on maritime geography and astronomy.[289] He mentions the compasses used in Portugal and France, and also the qibla-numa and compasses in Anatolia at that time (Fig. 34).[290] However, there is no statement about whether it is manufactured locally or not. Explaining in detail how compasses are manufactured, Seydi Ali Reis also explained the reasons that would prevent the device from working and the ways to eliminate its malfunctions.[291] Other nautical instruments in the *Mir'ât-ı Kâinât* (the Mirror of the Universe, 1550s?), which is another work of Seydi Ali Reis. Although the date of the book is unknown, it is certain that it was written before his death in 1562. He mentioned the astrolabe quadrant and the sine quadrant, the celestial globe, the equatorial circle, and armillary sphere in this book (Fig. 35).[292]

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[289] Mahmut Ak, "Seydi Ali Reis," accessed April 23, 2022, https://islamansiklopedisi.org.tr/seydi-ali-reis.

[290] This subject is examined one by one in the chapter 7, where Seydi Ali Reis and his works are analyzed.

[291] Ekmeleddin Ihsanoğlu, "Osmanlıların Batı'da Gelişen Bazı Teknolojik Yeniliklerden Etkilenmeleri," p. 137.

[292] Gaye Danışan Polat, "A Sixteeth Century Ottoman Compendium of Astronomical Instruments: Seydi Ali's *Mir'ât-ı Kâinât*," *Scientific Instruments between East and West: Scientific Instruments and Collections*, ed. Neil Brown, Silke Ackermann and Feza Günergun, 1-15, (Leiden: Brill, 2019), p. 7.

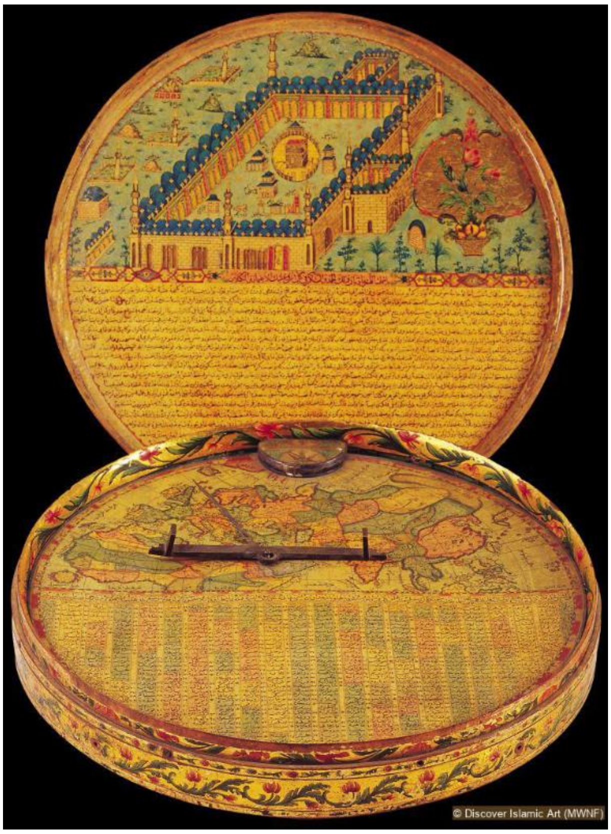

Figure 34. Qiblanuma, which I mentioned above, is a handheld astronomy instrument that means "showing the direction of the Kaaba". The example in the picture dates to 1738-1739. Earlier examples of navigation instruments used in the Ottoman empire may have been qibla compasses, as they had the same purposes as the compass. Gönül Tekeli, "Kıblenüma" in "Discover Islamic Art", *Islamic Art Museum With No Frontiers*, 2023. https://islamicart.museumwnf.org/database_item.php?id=object;ISL;tr;Mus01;41;tr&cp.

Figure 35. Astrolabe-quadrant from Ottoman empire, solid walnut, inscribed in red and black ink under a yellowish varnish; brass socket for the plumb-line; the lead weight for the plumb-line is housed in the instrument. 16.8 x 12.8 x 3 cm; radius of quadrant 12.5 cm. One side of the instrument carries a Prophatius astrolabe-quadrant for latitude 41°, with an unequal hour diagram (horary quadrant) above. The other side is a sine-cosine quadrant with arcs of sine and versed sine. There are brief instructions in Turkish and Arabic on the sides and edges. The maker's name appear on each side, with slight variations in some details of the signature. The nisbah of the maker, al-Ufi, indicates that he was from Of, a small town on the Black Sea. Estimated 16th century. The Nasser D. Khalili Collection of Islamic Art, Accession Number: SCI 40, https://www.khalilicollections.org/collections/islamic-art/khalili-collection-islamic-art-astrolabe-quadrant-sci40/.[293]

[293] F. Maddison and E. Savage-Smith, Science, *Tools & Magic*, The Nasser D. Khalili Collection of Islamic Art, volume XII, Part One, London 1997, cat. 156, pp. 266-268.

2. 4. 3. Guide of Seafarers: The Portolan Charts

The early modern era was a time of significant dialogue, both philosophically and pragmatically, about the nature and functioning of political society. Institutional structures and administrative practices, as well as theoretical conceptions of governance, were undergoing substantial change. In connection with these transformations, the concept of states as clearly delineated geographical entities, regardless of their composition and character, also began to become widely established. Despite the uncertainty of frontiers and the unruliness of life there, or perhaps better as a reaction to it, early modern polities became interested in more clearly demarcating their borders.[294] Attempts to mark political territories were part of a general increase in interest in charts. The early modern era was the first great age of cartography, experiencing what has been described as the "portolan explosion". As new worlds were explored and familiar ones discovered, there was a veritable explosion of charts for both artistic and practical purposes. Geography became a means to understand and articulate difference, as well as to inscribe power.[295]

The charts, showing the Mediterranean, preserved from antiquity and medieval times, were not intended to be used as a modern chart. Often, they were theological charts, historical narratives, amusements, or plans for the dreams of ambitious rulers. In other words, these early charts were for visualization to larger power and location schemes.[296] It could be argued that all pre-modern charts of the Mediterranean are part of what in Europe have been called the "art of memory", that is, a means of schematically structuring and remembering constellations of ideas. The focus was on the visual rendering of the relative positions of the rival realms around and within the Sea. In classical and medieval European charts, this geographical scheme is covered by a theological or historical narrative. With the growing interest in naming ports and major inland settlements in early Islamic charts, visualizing the approximate boundaries between peoples and kingdoms, according to the four cardinal directions seems to be the primary goal. Apart from Ottoman nautical charts, Islamic charts were not adorned with images of strange creatures and wonderful animals, ships, or castles,

[294] O'Connell and Dursteler, *The Mediterranean World*, p. 462.
[295] O'Connell and Dursteler, *The Mediterranean World*, p. 464.
[296] Emilie Savage- Smith, "Cartography," in *A Companion to Mediterranean History*, ed. Peregrine Horden and Sharon Kinoshita, 184-200, (Oxford: John Wiley and Sons, 2014), p. 184.

all of which adorned many later medieval European charts. They were not representing events in the history of Islam. The rise of Portolan charts reflects the growing interest in charts showing travel, trade, and naval voyages, beginning with the eleventh-century Egyptian proto-portolan diagram, and flourishing in workshops in Catalonia, Italy, and Constantinople from the 14th to the 17th centuries.[297]

Portolan charts attract and hold the attention by reason of their artistic features, as well as by their remarkable approach to scientific accuracy for so early a period. Portolan charts are based upon careful and what may be called scientific observations. There has been an improvement in the charting of the region to which most of them pertain, that is, the Mediterranean and the Atlantic coast in varying extent to the north and the south of Gibraltar. They too exhibited the geographical interests of the period to which they belong. They are the creations of seamen, navigators, explorers, chart-makers, artisans, who were leaders in the expansion of geographical knowledge, which is Mediterranean, the New World region of Africa, of India, and of America.[298]

On European charts, the Mediterranean chart is covered with an engraving of intersecting lines (called “rhumb” lines) connecting points around invisible circles. The radiating lines can serve as both copying aids for the chartmaker and navigational aids, with lines representing wind directions. While this is controversial, the development of portolan charts, with rhumb lines, was perhaps linked to the development of simple magnetic compasses in the 12th century.[299] In addition, portolan charts, with rare exception, are oriented with the north at the top, an idea which has since prevailed in all map construction. Herein one seems to find evidence of the influence of the compass in chart-making.[300]

The overall design of the portolan charts, together with the realistic shorelines, suggests a practical use for Mediterranean navigation.[301] These charts were eventually combined with mathematical coordinates in the Ptolemaic tradition of mathematical

297 Savage- Smith, “Cartography,” pp. 195-196.
298 Edward Luther Stevenson, *Portolan Charts: Their Origin and Characteristics with A Descriptive List of Those Belonging to the Hispanic Society of America* (New York: Knickerbocker Press, 1911), p. 1.
299 Savage- Smith, “Cartography,” p. 194.
300 Stevenson, *Portolan Charts*, p. 19.
301 Savage- Smith, “Cartography,” p. 194.

projection, and replaced with compass points or ‘winds’, parallels, and meridian grids. Thus, a cartographic form emerged that brought navigation and chart making into the ‘modern’ era.[302]

Markingly, departing from the previous cartographic traditions of medieval Europe, the portolans were designed as nautical instruments to be used in navigation. And they were the first charts, since classical antiquity that sought to mathematically systematize the representation of terrestrial space.[303] Portolan charts were likely complementary to navigational instructions found on Mediterranean routes and may have been used in planning and monitoring long-distance voyages where the pilot was often unable to see land. According to this theory, the chart's visual depiction of the space between two relatively distant ports would have allowed the pilot to plot a pelagic route more accurately and safely than he could have done using only the estimated distances and headings available on his route. To plot the optimal dead reckoning course for any route using a portolan chart, the pilot first had to locate the port of origin and destination on the chart and draw a straight line between them. Then, with a pair of dividers, he could use the rhumb lines and distance scale within the chart to determine the appropriate compass heading he would have to maintain to sail between the two points and estimate how far along his selected heading he would have to travel.[304]

The portolan chart, then, represented a considerable advance beyond the basic rutter; whereas the route contained only a limited list of specific navigational data, the chart could be applied much more broadly. A good portolan chart amounted to nothing less than a highly versatile visual representation of the two key pieces of information most relevant for any given course: distance and direction. This was equally valid for a great many different tracks, limited only by the number of ports depicted within it. With a pencil and a pair of dividers, a cartography-savvy pilot could potentially use his chart to determine the heading and distance between any two points contained within the chart itself, not merely those listed in his route. He could also use this to plot a more

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302 Savage- Smith, “Cartography,” p. 196.
303 Pujades, *Les Cartes Portolanes: la Representació Medievald’una Mar Solcada,* p. 388
304 Eric H. Ash, “Navigation Techniques and Practice in the Renaissance,” in *The History of Cartography: Cartography in the European Renaissance*, ed. by David Woodward (Chicago&London: The University of Chicago Press, 2007), Volume 3, Part 1, 509-527, p. 513.

direct or more convenient ocean course than the route he recommended, as many routes were heavily concentrated on coastal routes. Portolan charts were thus a remarkably concise way of recording and presenting vast amounts of navigational information as usefully as possible, "the best explanation or invention", as Martín Cortés de Albacar wrote in his book, *Breve Compendio de la Sphera y de la Arte de Navegar, con nuevos instrumentos y reglas* (1551), translated into English and published under the title *The Arte of Navigation* in 1561.[305]

Unfortunately, no one knows for sure whether portolan charts were used at sea in this way. Surviving charts are often missing the pencil marks and navigational scribbles one would expect to find on them if pilots had used them to determine and maintain their ships' course offshore. It is possible that the surviving charts were prepared solely for the consumption only of landbound collectors rather than practicing pilots, and that actual working examples were all discarded as they wore out. Alternatively, pilots may have worked on traced copies to preserve their expensive charts and discarded the drawings when they were finished. In any case, contemporary references clearly indicate that some charts were taken to sea and intended for use as practical navigational tools in planning and maintaining long, pelagic dead reckoning routes. Moreover, even on shorter coastal voyages, a chart became useful in providing information about the relative position and sequence of certain landmarks and maritime hazards, although this type of use would not necessarily have required that the charts be marked upon in any way.[306]

The most prominent feature of the portolan charts is that is depicted the Mediterranean basin, the region with the highest circulation as they were used as navigational instruments, and include the lanes directly used by the sailors and a few terrestrial details beyond the sea routes.[307] Because of this, no two are alike, and yet they have so many features in common that it appears they are copies of a collective original, or that there has been a conscious imitation by each chart-maker as he has set himself to his task of chart construction.[308]

305 Ash, "Navigation Techniques and Practice in the Renaissance," Volume 3, Part 1, p. 513.
306 Ash, "Navigation Techniques and Practice in the Renaissance," Volume 3, Part 1, p. 513.
307 Casale, *The Ottoman Age of Exploration*, p. 18.
308 Stevenson, *Portolan Charts*, p. 18.

The most striking other feature of the portolan charts was the set of overlapping lines that completely covered the chart. These lines emerged from compass rose, which had a circle of 32 points, placed around the chart and colour-coded, with eight cardinal directions black, eight between them green, and the remaining sixteen red. These rhumb lines formed a basis for denoting compass directions between any two places. When they combined with distances read from scales placed on charts, they were crucial for the use of charts at sea.[309]

Such then in origin, character, and importance are portolan charts with which modern scientific chart or map-making had its beginning. Apparently first constructed in the thirteenth century, they multiply rapidly throughout the 14th, 15th, and 16th centuries as before stated, retaining most of the characteristics exhibited in earliest examples. Though remarkable for their near approach to accuracy, it appears not a little surprising that the learned cartographers and artisans of the 16th century did not in general accept them at their value until Ptolemy's maps, by actual astronomical measurements, had been shown to be inaccurate (Fig. 36). With seamen, however, these manuscript parchment charts remained in favour long after the invention of printing and its use in the multiplication of charts.[310]

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[309] Sandman, "Spanish Nautical Cartography in the Renaissance," p. 1096.
[310] Stevenson, *Portolan Charts*, p. 28.

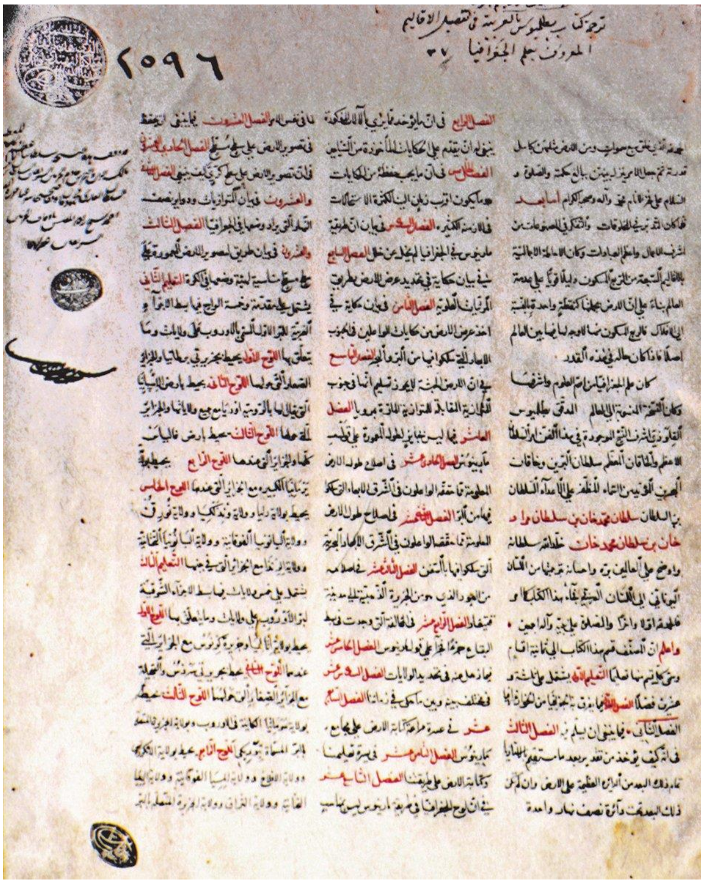

Figure 36. Title page of Ptolemy’s book, *Kitâbü’l-Coğrafya fi’l-maʿmûre mine’l-arż*, translated from Greek to Arabic by Mehmed the Conqueror. Ptolemy’s *Geography* was used by astronomers and cartographers in early modern period. Süleymaniye Library, Hagia Sophia, nr. 2596, https://islamansiklopedisi.org.tr/batlamyus.

Due to the need for practical knowledge based on the above elements, the Ottoman cartographers benefited from the tradition from its past, many geography books and maps from Europe and the Islamic world and produced original instruments that would leave important traces on world geography. As evidence that these traditions were benefited from, there are portolan charts in the archives of Topkapı Palace Library that have survived to this day. For example, Piri Reis wrote with these charts' names one by one on his portolan chart, dated 1513 (described in Chapter 6).[311]

[311] Italyan Kültür Merkezi, *XIV. -XVIII. Yüzyıl Portolan ve Deniz Haritaları*, (Istanbul: Güzel Sanatlar Matbaası A.Ş., 1994), p. 19.

Today, some of the best examples of 15th century portolan charts were found in Ottoman manuscript collections: including a chart by the Majorcan Master Johannes de Villadestes (1428) (Fig. 37), charts in Arabic by Ibrahim el-Kâtibî (1413-1414), and Ibrahim al-Mursi (1461) and some anonymous charts (Fig. 38).[312] In the Ottoman empire, especially, sailors were encouraged and rewarded to make portolan charts. The oldest known portolan chart, in the Ottomans, is Ahmad al-Tanjī el-Kâtibî's portolan chart (Fig. 39), dated 1413-1414, showing the Black Sea, the European and African coasts in the east of the Atlantic Ocean, and the British Isles. The Latin names of the twelve months were given in the lunar calendar in the portolan chart, which was arranged in Arabic. There are decorations and some figures in the portolan, prepared by al-Tanjī in Tunisia. Another portolan chart that guided the Ottoman sailors, was drawn by Ibrahim al-Mursi of Tunisia (Fig. 40) and is one of the precious examples of Islamic portolan charts. In the examinations made on the chart, dated June 24, 1461, which shows the Mediterranean, Aegean, Black Sea, and Western European coasts, the traces of the tradition, which were transmitted through climate charts, reflected in the 15th century, were emphasized. The al-Mursi portolan chart, which is linked to the portolan chart of Ahmed al-Tanjī, was also arranged in Arabic, and contains a sky map.[313]

[312] Casale, *The Ottoman Age of Exploration*, p. 18.
[313] Sarıcaoğlu, *Osmanlı Tarihi Haritaları ve Tarihi Coğrafya Eserleri,* pp. 16-17.

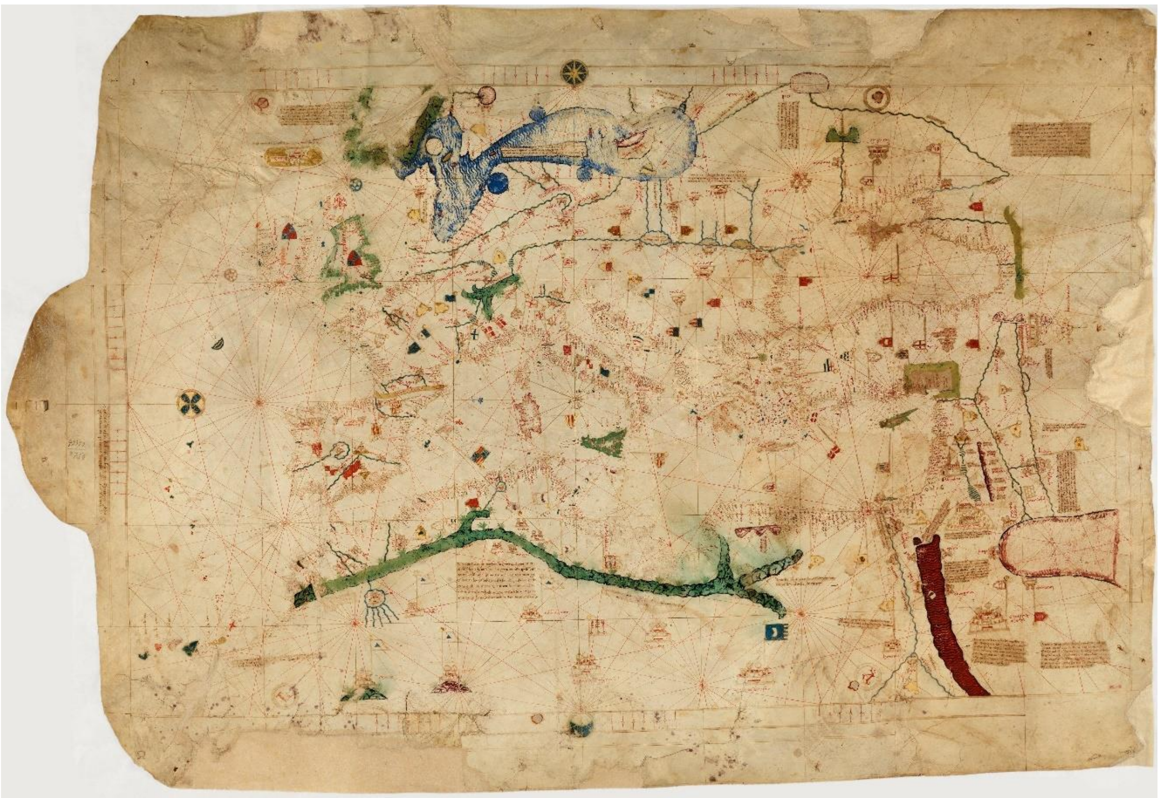

Figure 37. Johannes de Viladestes, Portolan Chart of the Mediterranean, Black Sea and Western Europe (1428), 1170 x 800 mm, Place: Palma de Majorca, Spain, Archive: Topkapı Sarayı Müzesi Kütüphanesi (Topkapi Palace Museum Library).

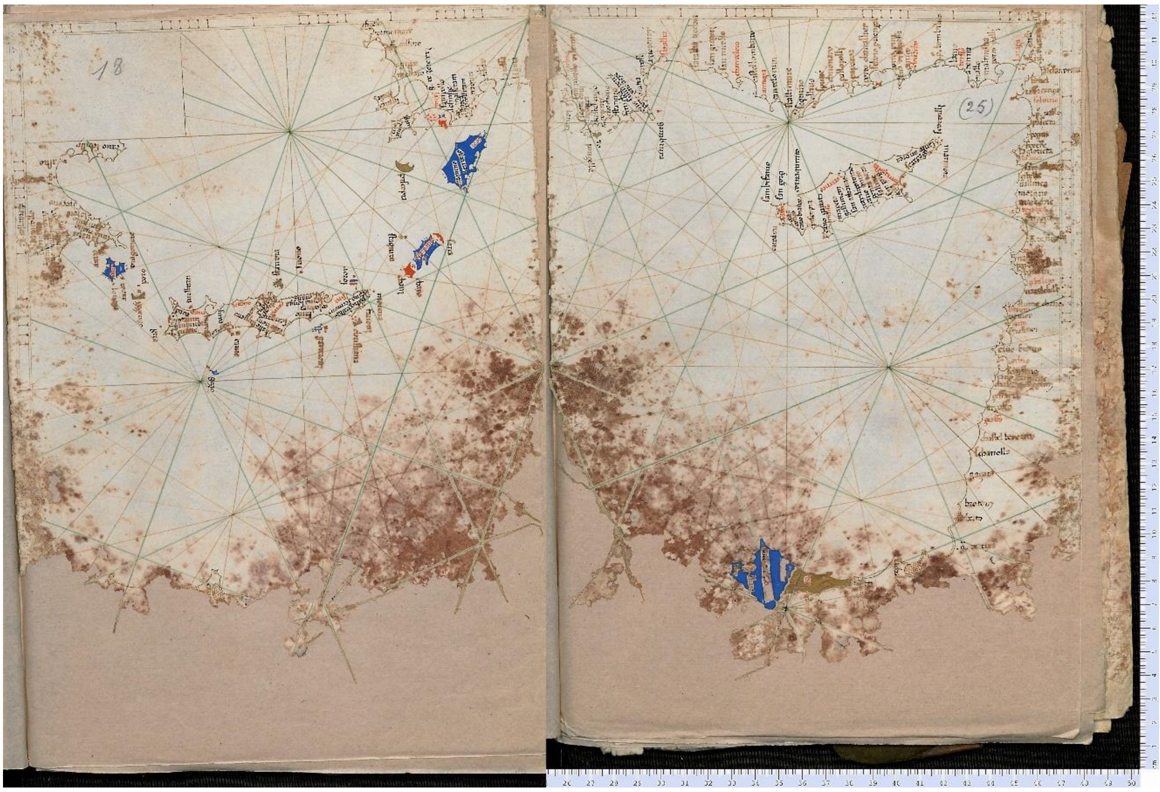

Figure 38. This anonymous portolan chart of the Western Mediterranean, found in the Topkapı Palace Archives and dated between 1450 and 1490, is an example of the tradition of portolan. Anonymous (Italy), Portolan chart of the western Mediterranean, 227 x 317 mm, 1450-1490, Topkapi Palace Museum Library, https://medea.fc.ul.pt/view/chart/1920.

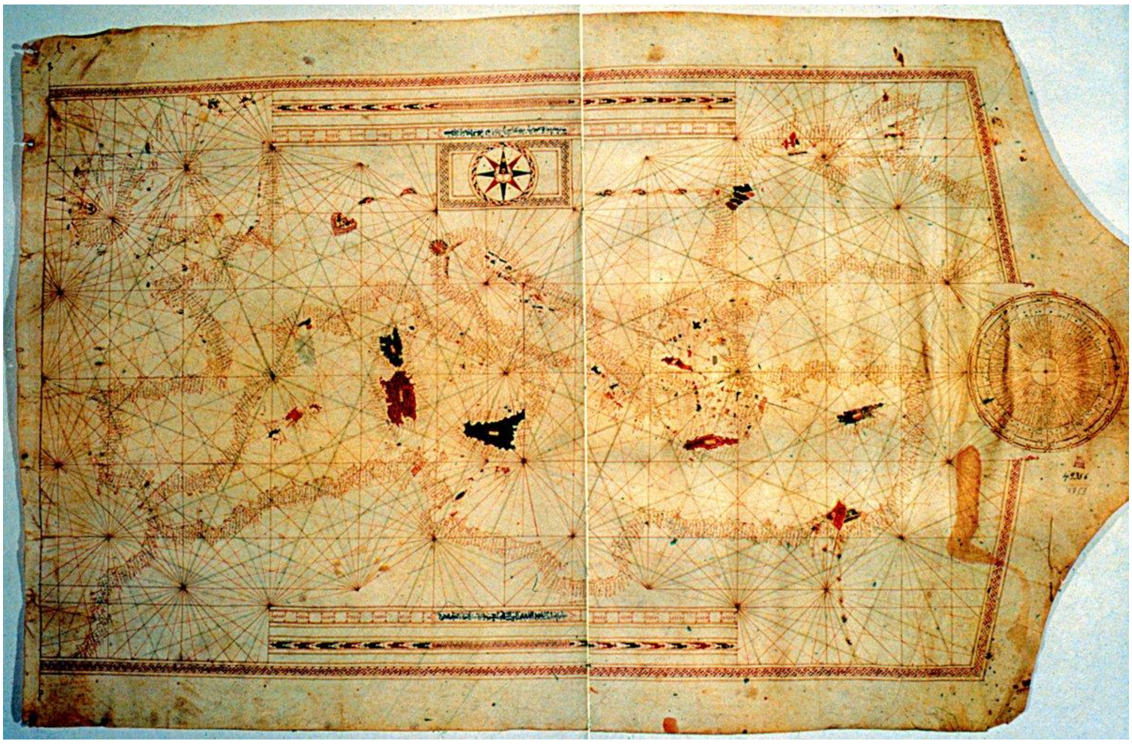

Figure 39. Nautical chart of Ahmad al-Tanjī el-Kâtibî, Chart of the Mediterranean, Black Sea and western Europe, dated 816 (1413), 900 x 550 mm, Topkapı Sarayı Müzesi Kütüphanesi (Topkapi Palace Museum Library), Treasury, nr. 1823.

Figure 40. Tabîb Ibrahim al-Mursi’s Portolan chart of the Mediterranean, Black Sea and western Europe, 1461, General Command of Mapping, Mapping Journal, January 2011 Number: 145, https://www.harita.gov.tr/images/dergi/makaleler/Harita_Dergisi_145.pdf.

Another example of portolan chart is that al Hacc Ebu’l-Hasan’s portolan chart. This chart shows the locations of Europe, Africa, and the Ottoman empire on three continents as far as Baghdad. Although we know very little information about Ebu’l-Hasan, it is seen that chart, the cities were depicted with castles, the names of thirty-six different regions and flags were given with the naming of the provinces.[314] The nautical chart was made of parchment. It is signed ‘Amel-i el fakir Hacc Ebu’l Hasan’ (work of the humble Hacc Ebu’l Hasan) and has legends in Arabic (Fig. 41). The portolan chart is a copy of Catalan portolan charts from 15th century, and was coloured in red, black, green, pink, and gold.[315] The central compass rose was located to the north of Sicily. There is a circular lunar calendar in the neck of the parchment, on the east side. Major cities, states, and fortified walls indicates. The Red Sea was painted red, the Atlas Mountains were depicted as lines of rocks, and flags mark state borders. There are illustrations of tents in the continent of Africa. Drawings outside the border, on the south and north edges, have not been copied from the original portolan chart, but were added by al-Hacc Ebu’l Hasan or another hand later. There are no compass lines in these sections. The fact that Ottoman flags continue deep into Europe, suggests that the nautical chart, dates from around 1560, during the reign of Suleiman the Magnificent.[316]

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[314] Sarıcaoğlu, *Osmanlı Tarihi Haritaları ve Tarihi Coğrafya Eserleri,* p. 17.

[315] Türkiye Cumhuriyeti Kültür ve Turizm Bakanlığı Kültür Varlıkları ve Müzeler Genel Müdürlüğü, *Piri Reis’ten Önce ve Sonra: Topkapı Sarayı’nda Haritalar* (Istanbul: Promat: Basım Yayın, 2013), p. 107.

[316] Türkiye Cumhuriyeti Kültür ve Turizm Bakanlığı Kültür Varlıkları ve Müzeler Genel Müdürlüğü, *Piri Reis’ten Önce ve Sonra: Topkapı Sarayı’nda Haritalar*, p. 107.

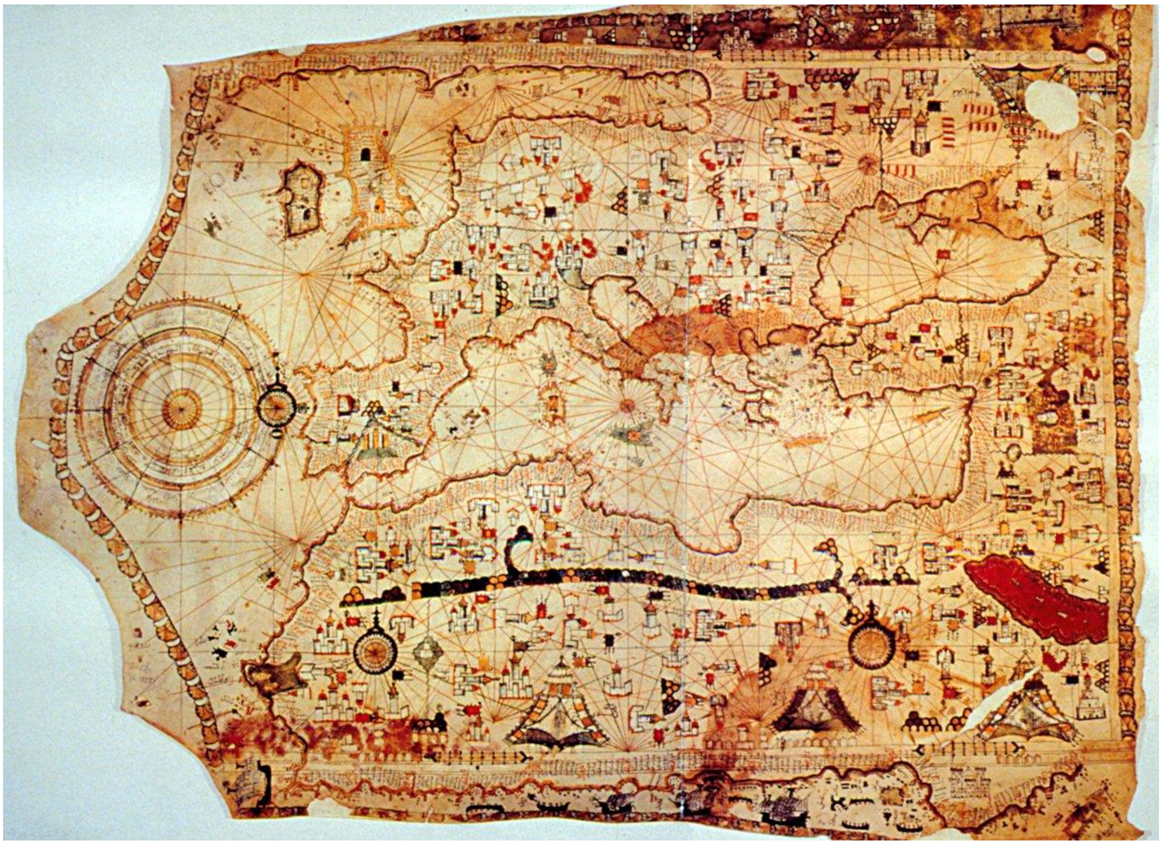

Figure 41. Portolan chart of the Mediterranean, Black Sea, and west coast of Europe of al-Hacc Ebu'l Hasan attributed to the reign of Suleiman the Magnificent, dated 1500-1550, 1000 x 740 mm. Topkapi Palace Museum Library, Hazine, nr. 1822.

The most special and rare examples are the first chart of Piri Reis (1513), the most well-known representative of Ottoman cartography, his nautical book, called *Kitâb-ı Bahriyye*, which is described as a complete portolan of the Mediterranean, and his second chart, dated 1528-29.[317] Further, there is the Atlas of Ali Macar Reis (1567), which has features of portolan charts and consists of seven parts, including the Black Sea and Marmara Sea, Eastern, Central and Western Mediterranean, Atlantic coasts and British Isles, Aegean Marmara Sea, and one world map. Another example of the same tradition, the anonymous atlas was noticed in 1984, and introduced, under the name *Atlas-ı Hümâyun*. The work, which is understood to have been prepared in the *Nakkaşhâne* for the palace, contains nine portolan charts.[318] They are one world map, portolan charts of the Black Sea and Marmara, Eastern Mediterranean and Aegean Sea, Central Mediterranean and Adriatic Sea, Western Mediterranean and Spain, Western

[317] Sarıcaoğlu, *Osmanlı Tarihi Haritaları ve Tarihi Coğrafya Eserleri*, p. 18.

[318] *Nakkaşhâne*: these are the workshops where painters, pencil workers, book embroiderers such as musavvir, illuminator, bookbinder, precious stone carvers, embroiderers, stonemasons, and glass makers gather.

Europe’s Atlantic coast, Adriatic Sea, British Isles, Aegean Sea, Peloponnese and Southern Italy, Europe, and North Africa. The anonymous atlas, which carries great resemblance to the Atlas of Ali Macar Reis, is dated to 1570.[319] Another Ottoman nautical atlas is Walters Sea Atlas, named, after the gallery in which it is located. Atlas, which is also the product of *Nakkaşhâne,* consists of eight pieces with one world map, including the Black Sea and the Marmara Sea, the Aegean, and the Eastern Mediterranean, the Central Mediterranean and the Adriatic Sea, the Western Mediterranean and Spain, Northwest Europe, Europe and North Africa, South Asia, and the Indian Ocean. It is thought that the Atlas, which is included in the type of portolan charts, was prepared to present the others to the palace, and around the same dates (1560-1570).

Conclusions

The political aims of the states made necessary for them to turn to technological developments. They needed nautical instruments to expand their borders in the seas, seek commercial markets, protect their ports, and sail to the seas. For these purposes, they turned to nautical instruments. When the states turned their faces to the seas, they first had to develop shipbuilding technology, and other tools to use with these technologies. Nautical instruments were, used in the Mediterranean, the compass, astrolabe, the quadrant, Jacob’s staff (cross-staff), and the portolan charts. However, in Ottoman empire, information, about the compass, astrolabe, and the portolan charts, can be accessed. Since these nautical instruments were interconnected, that is, they had to be used together, a compass was needed, during the manufacture of the ship, as well as a portolan chart for positioning at sea. At this point, it can be said that the Ottoman empire developed, and changed the scientific and technological developments that followed and incorporated into its own structure, by adding something from its identity. Concerning the portolan charts, for example, the Ottomans were aware of the latest geographical discoveries and Western European sources on geography.

[319] Sarıcaoğlu, *Osmanlı Tarihi Haritaları ve Tarihi Coğrafya Eserleri,* p.18.

It can be seen this situation, which justifies the concept of trading zones, in portolan charts and nautical instruments, which produced by artisans in the Ottoman empire, which we will see in more detail in the next section. In their original works, these artisans, which were also proficient in Islamic traditions, formed the Ottoman geography tradition by synthesizing the eastern, Islamic, and western, European geographical narrative and depiction traditions. In many cases, they added their own observations, when translating an ancient text or combining eyewitness accounts with the ultimate information on the world's geography.[320] It is worth examining within the framework of practical knowledge that these were made by artisans and scientists, who were raised in, or were invited to the Ottoman empire from other places.

[320] Manners, *European Cartographers and the Ottoman World 1500–1750*, p. 95.

Part 2

Scientific and Technological Developments in Artisanal World of Ottoman Empire (1453-1595)

The Institutionalization of Practical Knowledge

As mentioned in the previous part, in the early modern period, new institutions were established in practice aimed at the management of knowledge, the technical training of sailors and cartographers, the supervision of their work, and the construction of increasingly useful nautical instruments and artifacts. The two most relevant examples were the *Armazéns da Guiné e Índia* in Lisbon, and the *Casa de la Contratación* in Seville.[321] These institutions also required the creation of new professions, as well as the establishment of new fields of knowledge and new kinds of relationships between different epistemic communities. For example, new positions in cosmography, such as *Piloto Mayor* (Chief Pilot) and *Cosmógrafo-Mor* (Chief Cosmographer), created a meeting point between humanism and experimentation, the university and the seas, the theoretical people, and the artisans, in short, between the world of scholars and the world of artisans. They were people, who had studied astronomy and mathematics, but also had maritime experience. They were experts, chosen by the Crown, whose main task was to interact daily with illiterate captains and makers of nautical charts and other instruments for navigation. The science of state/empire was fed by the work of artisans to realize political projects, such as colonization and conquest.[322]

The new relationship between different cultures of knowledge was realized through the collective production of works. Some of these were old scientific instruments that were updated and adapted to new conditions. Some, like ships, went through a development process, and some, like the naval astrolabe, went through a simplification process. Others, such as nautical charts of latitudes and sea wheels, became sophisticated instruments filled with geophysical information on a global scale. For example, among the most interesting works, which have evolved in this way, are two cartographic models produced and preserved, respectively, during the 16th century, at *Armazéns* and the *Casa*: *Cartas Padrões d'el Rei* (the King's standard charts) and *Padrón Real* (Royal Pattern Chart).[323] Both took the form of planispheres and partial nautical charts, representing the total terrestrial surface known to Europeans at the time of their completion. These models were created, thanks to the complex

[321] Sánchez, "Practical knowledge and empire," p. 7.
[322] Sánchez, "Practical knowledge and empire," pp. 7-8.
[323] Sánchez, "Practical knowledge and empire," pp. 8-9.

relationship between several factors, the technical skills of the cartographers, the knowledge that the sailors brought from their expeditions. In these models, the places of influence of the Portuguese and Spanish Empires, located between latitudes and magnetic heads, preferably have been recorded. Once created, updated, and approved, they served as the standard for the realization of all nautical charts circulating in the empire's naval travel network.[324] The same was models of naval vessels, including ships, astrolabes, dials, crossed staff, compasses, clocks, wheels, and nautical charts, all of which had a very practical function, navigating safely between one point of the world and another. Artisans, in the service of the empire, were intermediaries in scientific instruments. Organizing and standardizing the field of cosmography, practices, practitioners and works allowed not only social recognition and professionalization of a new field of knowledge, but also its homogenization and control.[325]

On the other hand, if we look east of the Mediterranean, the events experienced, since the second half of the 15th century played a central role, in the Ottoman empire's orientation, towards scientific and technological developments. It is normal that the empire, which started with the conquest of Constantinople in 1453 and expanded to all directions towards the Mediterranean, the Balkans, the North African coasts, and the Middle East, needed new technologies to realize these political goals. Although it was seen that the Ottoman Sultans was interested in science, before the 15th century, the first major step towards the practical importance of scientific and technological developments was taken with the establishment of *Tersâne-i Âmire* (Imperial Arsenal) in 1455, presumably predating the above-mentioned Iberian centres. It was an institution, aimed to construct nautical instruments and works.[326] We see that *Tersâne-i Âmire* was established for the same purposes as institutions that work within the scope of the practical knowledge, like the *Armazéns* and the *Casa*.

[324] Sánchez, "Practical knowledge and empire," p. 9.
[325] Sánchez, "Practical knowledge and empire," pp. 8-10.
[326] Ihsanoğlu, *Osmanlı Bilim Mirası*, Vol. I, p. 59.

CHAPTER 3

The Birth of the Ottoman Scientific Tradition

Regional traditions have acted to encourage or inhibit technical or theoretical innovation. Local cultures have adopted scientific knowledge differently and put it to distinct uses according to their own self-understanding. The meaning of a particular scientific theory or text has shifted from one place to another. Indeed, scientific research itself has meant various things in dissimilar regional settings.[327] Some of the factors did not have a direct impact on science, such as historical events that created a favourable climate for science, the acceptance of the work and experiments of artisans, and the extension of natural history, because of experience rather than book learning, triggered off by the 'geographical revolution'. However, they created an atmosphere conducive to the admission of new ideas and methods.[328]

The consumption of science – the ways in which scientific theories and practices are accepted in different fields – also bears the imprint of local conditions.[329] Like people, scientific ideas meet in particular places. The meaning of certain scientific texts and theories has varied from place to place, and one way to uncover such geographies of reception is to determine how various cultures viewed specific scientific works.[330] Applied astronomy, precision mapping, resource inventory, and geodetic surveys are just a few of the scientific practices that states have mobilized to determine the boundaries of their territories and record their natural assets. Such activities immediately impose rational order on the apparent chaos of nature, give governments a sense of territorial coherence, and provide servants of the state with the geographic data necessary to fix taxes, stimulate economic growth, exploit resources, and maintain military defence. Scientific endeavour is both cause and effect of geographical agency.[331]

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[327] Livingstone, *Putting Science in Its Place*, p. 89.
[328] Hooykaas, "The Rise of Modern Science," p. 456.
[329] Livingstone, *Putting Science in Its Place*, p. 112.
[330] Livingstone, *Putting Science in Its Place*, p. 113.
[331] Livingstone, *Putting Science in Its Place*, p. 124.

By examining the construction of scientific knowledge in the contact zone, that is, the Mediterranean itself, I hope not only to enlarge the scope of social studies of knowledge by bringing these zones, along with novel historical source material, into their ambit as legitimate sites of scientific knowledge, not only to expand the scope of social studies of science, but also to show that practical knowledge and technological productions were made, science were actually produced in the entire Mediterranean. This is part of the more general point that national and regional histories, especially since the first globalization of the 16th century, cannot be understood by limiting the study to their respective geographical boundaries.[332]

Maritime imperatives encouraged a distinctly different scientific tradition, due to the extent of the Ottoman borders on the Mediterranean coast.[333] Therefore, scientific culture developed in a different discipline for the Ottoman empire from the Conquest of Constantinople in the 15th century and 16th century than other Mediterranean countries, but these developments were made for the same purpose. To fill this gap and, therefore, understand the epistemic value of practical knowledge, it is necessary to investigate how, and through which steps the structure of knowledge used in the frame of practical activities was reflected, conceptualized and externalized. For instance, by means of written treatises—and how this allowed for the creation of more abstract structures of knowledge that linked heterogeneous intellectual and practical fields to each other to build new knowledge systems. Although written codification of at least some aspects of practical activities has existed since ancient times, during the early modern period the codification of practical activities in the form of written texts, drawings, and models increased exponentially. That will be instructive in assessing the scientific and technological activities of the Ottoman empire.[334]

Initially, it should be said about their background, they had in shaping the Ottoman scientific tradition. Shortly after the Ottomans took their place on the stage of history as a small frontier principality in the northwest of Anatolia, they expanded rapidly and jumped into the Balkans. Subsequently, they created the largest and longest-lasting state in the Middle East and the Islamic World. However, the Ottoman

[332] Raj, *Relocating Modern Science*, p. 11.
[333] Livingstone, *Putting Science in Its Place,* p. 97.
[334] Valleriani, "The Epistemology of Practical Knowledge," p. 2.

empire did not create all its institutions and traditions by themselves, starting from scratch. They inherited the long-standing historical and cultural heritage of the Islamic World to which they belonged. This statement is also valid when it comes to scientific knowledge and institutions.[335]

Here, it is necessary to open a parenthesis about the historical and cultural heritage of the Ottoman empire. While determining the definition of the concept of Ottoman science, it was stated on various occasions that it encompassed the scientific activities that occurred and developed within the space and time dimensions of the Ottoman empire and that it had a unique line of development within its six-century history. The active interaction of the Ottoman empire with the ancient cultural and scientific centres of the Islamic world since the day, it was founded, played a momentous role in the formation of the Ottoman scientific tradition. For example, with active cultural relations in Iran and Central Asia, and over time Syria, Egypt, Hejaz and Iraq becoming a part of the Ottoman empire, its scientific and cultural life experienced great vitality. The fact that Ottoman Sultans and statesmen patronized scholars and invited them to their lands also increased the level of scientific studies.[336]

Likewise, it can be said that the two sides had the opportunity to follow each other, as the wide borders, they had in the Mediterranean, and the contact zones with the West were very wide because of the Ottoman's expansionist policies after the conquest of Constantinople. The Ottoman empire's territory extending from Rumelia to mid-Europe, its dominance in the Mediterranean and North Africa, increased its contacts with the Western Mediterranean and Europe. It is obvious that this geographical proximity facilitates transfer of knowledge. On the other hand, diplomats, travellers, merchants, sailors, artisans, pirates, refugees, prisoners, and scientists, invited by the Sultans, ensured the entry of many new scientific and technical knowledge into the Ottoman empire.[337]

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[335] Fahri Unan, "Klasik Dönem Osmanlı Bilim Anlayışı," in *Osmanlılarda Bilim ve Teknoloji*, ed. Yavuz Unat (Ankara: Nobel Yayın Dağıtım, 2010), 15-38, p. 15.
[336] Ihsanoğlu, *Osmanlı Bilim Mirası: Mirasın Oluşumu, Gelişimi ve Meseleleri*, Volume I, p. 57.
[337] Ihsanoğlu, "Osmanlıların Batı'da Gelişen Bazı Teknolojik Yeniliklerden Etkilenmeleri," p. 122.

The factors that caused the states to apply to the technology of practical knowledge and instruments, mentioned in the first part, due to the conditions of the early modern Mediterranean, also affected the Ottoman scientific tradition in the form of restructuring. While the siege of Constantinople showed that the Ottomans had new military organizations and many gunpowder weapons, the conquest and consolidation of the city also demonstrated that the Ottoman Sultans would launch their armies from an imperial city with a history of expansion, in the Mediterranean. At the same time, most of the narratives, describing the establishment of the Ottoman capital, in Istanbul, do not also emphasize the emergence of a large new Ottoman navy.[338] In the narrow strait, between the Mediterranean and the Black Sea, where trade routes from Europe and Asia converged, Istanbul had an extremely capital geographical position for the development of a naval force, as an element of state power. Therefore, Sultan Mehmed brought sailors from the coastal areas, which were the source of the Byzantine Empire's naval capability, to Istanbul. Likewise, merchants, using the sea, were settled in the rebuilt city, and they were exempted from taxes to encourage trade. Combining the resources of empire with the naval experience of Muslim frontier soldiers and artisans, the Sultan immediately ordered the construction of arsenals and war galleys. Thus, the establishment of an expensive and powerful navy became a significant goal that drew the Ottomans to the sea.[339]

Mehmed's vision of what it meant to rule from Constantinople broadened his maritime horizons. However, he faced a major obstacle, like Venice, which had the most powerful navy in the Mediterranean. While there have been previous conflicts with Venice, from this time to the early 18th century, the Ottomans and Venice often fought over strategic locations, where both needed naval power.[340] The Sultan ordered that many other ships be built quickly, in addition to the existing ships and that many sailors from all regions should be selected, for this purpose. Because Italians had a large navy and they dominated the seas, and in all the islands, in the Aegean, and wreaked havoc on Ottoman shores. Consequently, Sultan decided to prevent this

[338] Andrew C. Hess, "The Ottoman Conquest of Egypt (1517) and the Beginning of the Sixteenth-Century World War," *International Journal of Middle East Studies*, 4, 1 (1973): 55–76, p. 62.
[339] Hess, "The Ottoman Conquest of Egypt," p. 62.
[340] Christine Isom-Verhaaren, *The Sultan's Fleet*, chap. 4, para. 47.

situation, in every way, and to be the mighty lord of the whole sea, or at least to intercept them from damaging the coastal borders that the Ottomans had.[341]

Where would Sultan Mehmed apply his navy power? Geography, potential opposition, economic and political opportunities pointed to the use of the fleet in the Mediterranean. In the 15th century, the main reason, for the westward drift that maritime history exerted on the Ottomans, was based on the superior naval forces of the Venetians. Not only did the Venetians spread their Christian power to the Muslim shores of the eastern Mediterranean, but they also exerted a foreign influence on the Levantine economy from their eastern trading stations. Unlike the Venetian organization in the East, Mehmed directed an Ottoman expansion seaward along the domestic lines to channel the tax revenues of the Levant to Istanbul. Thus, the Ottomans and Venetians had conflicting economic interests that intensified other causes of war between these two very distinct states. In the naval conflicts that followed (1463–1479), the Ottomans advanced steadily against the Venetians, so much so that the Ottoman navy was now threatening Venetian control over the sea routes through the narrow straits at the mouth of the Adriatic.[342] At the end of the reign of Mehmed II, Ottoman borders extended in Anatolia from the Euphrates to the Adriatic Sea, and the Danube was the northern border from Belgrade to the Black Sea.[343]

The new Ottoman capital was managing on the maritime supply of foodstuffs and other goods, which required a fleet to protect the sea routes. Shortly after 1453, together with Lesbos in 1462 and Negroponte in 1470, the Sultan began to use the navy as a means of conquest.[344] Considering the fact that the naval expeditions of Mehmed's reign were made to accomplish such purposes, it is clearly understandable that the

[341] Isom-Verhaaren, *The Sultan's Fleet*, chap. 3, para. 48.
[342] Hess, "The Ottoman Conquest of Egypt," p. 63.
[343] Streusand, Douglas E., *Islamic Gunpowder Empires: Ottomans, Safavids, and Mughals* (Taylor and Francis Group, 2010) ProQuest Ebook Central, http://ebookcentral.proquest.com/lib/yediteuniv/detail.action?docID=625184. Created from yediteuniv on 2023-01-19 11:01:40, p. 42.
[344] Colin Imber, *The Ottoman Empire, 1300-1650*, Bloomsbury Publishing, 2019, https://www.perlego.com/book/2996587/the-ottoman-empire-13001650-the-structure-of-power-pdf, p. 292.

Ottoman navy greatly expanded, during the thirty years from 1451 to 1481, becoming a relatively effective instrument.[345]

Ultimately, the role of navy was limited, because of the men, who Mehmed chose to lead his fleet. They were skilled in many situations and experienced in ground warfare. However, they were not conversant sailors. It is difficult to know what kind of group of sailors, Mehmed might have used. We get hints from writers, like Kritovoulos, from his time that experienced sailors exist, but we don't know what experience they have in managing fleets.[346]

Most of Mehmed's highest-ranking officials came from the Balkan and Byzantine elites, but none of these groups was recorded as having much involvement at sea. Despite having extensive coastlines and gradual islands and ports, the Ottomans needed to devise methods for raising individuals, who would develop maritime expertise.[347] Being aware of this, Sultan Mehmed started to have ships built by experienced artisans. Information, about these ships, is limited. Nevertheless, when they built ships, artisans of Ottoman shipyard adopted the common types of ships throughout the Mediterranean.[348]

At the beginning of the 16th century, it is seen that the Ottomans continued their determination, to use naval power on the way to world domination.[349] Although Bayezid II, Mehmed's successor, is said to have been opposed to war as it marginally expanded the empire, he did not break the strong military leadership model that marked the Ottoman growth over the centuries. Instead of winning major land victories, this Sultan presided over the unprecedented development of a large and expensive navy.[350] Bayezid used his state's resources to build the largest navy in the Mediterranean. Sultan turned to the sea front for experienced navy commanders. Agreeing with experienced

[345] Isom-Verhaaren, *The Sultan's Fleet*, chap. 3, para. 99.
[346] Isom-Verhaaren, *The Sultan's Fleet*, chap. 3, para. 100-101.
[347] Isom-Verhaaren, *The Sultan's Fleet*, chap. 3, para. 102.
[348] Imber, *The Ottoman Empire*, p. 292.
[349] Brummett, *Osmanlı Denizgücü ve Doğu Akdeniz'de Diplomasi*, p. 136.
[350] Hess, "The Ottoman Conquest of Egypt," p. 63.

and skilled sailors, in Mediterranean, the Ottomans appointed senior Muslim pirates, such as Kemal Reis, to salaried positions in the navy.[351]

Therewithal that new men entered the fleet, Venetian envoys began filling their correspondence with reports that the Ottomans had made an extraordinary effort to build new galleys. Existing ship lists, for Ottoman military expeditions, were over 200 in 1498. Finally, artisans of Ottoman navy experimented with expensive new designs, and built some ships that were very large by Mediterranean standards. In May 1499, an Ottoman fleet of more than 250 units defeated the Venetian navy, in a high sea battle, for the first time. Four years later, the Ottomans emerged victorious, in a naval battle, against the Venetians, to maintain their commercial advantage.[352]

During the reign of the next Sultan, Selim I, the conquest of Egypt played a key role in Ottoman maritime affairs. The first event, which caused Sultan Selim to start working on the navy, can be called the Egyptian expedition in 1517. Because although there was no naval warfare, the presence of the navy was utilized.[353] On this occasion, the fact that the conquest of Egypt and Syria represents much more than a marginal contribution to the Ottoman economy was effective in the maritime orientation. With the establishment of Ottoman rule in Egypt, the last major trade route, in the eastern Mediterranean, took an additional opportunity to tax the trade passing through the ports of the Fertile Crescent. Equally momentous to this agrarian empire was the great contribution the conquest made to the Empire’s internal economy. Economically, by controlling the eastern Mediterranean, the Ottomans were able to easily integrate additional agricultural and commercial resources in the south into the imperial economy. In an era of urban bureaucracies, standing armies, and siege operations, such the substantial economic contributions supported Ottoman military expansion for the remainder of the 16th century. After that, the imperial rapprochement that began in Egypt, in the 15th century, had drawn its course by the first quarter of the 16th century, neither the Western nor the Eastern empires could benefit from this strategic region other than Ottoman.[354]

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[351] Hess, “The Ottoman Conquest of Egypt,” p. 65.
[352] Hess, “The Ottoman Conquest of Egypt,” p. 66.
[353] Cezar, *Mufassal Osmanlı Tarihi* (Ankara: Türk Tarih Kurumu, 2010), Vol. II, p. 779.
[354] Hess, “The Ottoman Conquest of Egypt,” pp. 71-72.

Having a strong fleet also became essential to the integrity of the empire. From its conquest in 1517, Egypt was a source of income for the Sultan and a source of food for the capital (Fig. 42). And since communication between the two was only possible by sea, it was necessary to maintain a fleet to guard the route.[355] Braudel says the following about the conquest of Egypt in his classical book:

> And surely the major event in the rise of the Ottoman empire, more significant even than the conquest of Constantinople was indeed the conquest first of Syria in 1516, then of Egypt in 1517, both achieved in a single thrust. This was the first glimpse of the future greatness of the Ottoman state. All the same, it was a landmark in Ottoman history. From the Egyptians, Selim gained much of value.[356]

With the conquest, the Ottomans would first make a profit by collecting taxes. The process of participating in the African gold traffic from Abyssinia and Sudan, and then in the spice trade towards the Christian world had been organized since Egypt. While the Turks settled in Egypt and Syria long after Vasco de Gama's tour of the Cape of Good Hope, these two countries were no extended the only ports of Far Eastern goods, but they were still important. Thus, the Ottoman borders, between the Mediterranean and the Indian Ocean, was completed and reinforced. By the way, this connection also connected the city of Istanbul with a large wheat, rice and broad bean producing region.[357] Thus, the empire gained lands that could only communicate with the capital by sea, and later, the gains, in North Africa, made naval power even more crucial. A defensive network of small fleets protected the Ottoman coastline and shipping routes from pirates and enemy attacks.[358]

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[355] Imber, *The Ottoman Empire*, p. 292.
[356] Fernand Braudel, *The Mediterranean and the Mediterranean World in the Age of Philip II*, trans. by Siân Reynolds, (London : Collins, 1974), Volume 2, p. 667.
[357] Braudel, *II. Felipe Döneminde Akdeniz ve Akdeniz Dünyası*, Vol. II, p. 461.
[358] Imber, *The Ottoman Empire*, pp. 41-42.

Figure 42. Piri Reis, who was a captain during Sultan Selim's conquest of Egypt, specifies in the *Book of Navigation* that he made step-by-step calculations with a compass on the Nile River, Place of Publication Not Identified: Publisher Not Identified, *Kitâb-ı Bahriyye* from the 1650 version (original version in 1521), https://www.loc.gov/item/2021667235/.[359]

[359] Piri Reis, *Kitâb-ı Bahriyye: Denizcilik Kitabı* (Ankara: Kervan Kitapçılık, 1973), Volume 2, p. 227.

We will see the details of the great preparations and production activities made in the Ottoman navy, after next chapter. However, it is known that Sultan Selim prepared for a great naval expedition that was kept secret. Although estimations are made on the reasons for his naval preparations, they are all conjectures. It was not known, exactly, why such a large navy preparation was made. It was assumed that the war preparations were for Rhodes. Because Sultan Selim, like the previous Sultans of the Ottomans, was also aiming to expand to the West. The eastern and south-eastern policies prevented him from achieving this goal. Whereas, since these reasons have disappeared, it can be speculated that the war preparations, made since 1518, were for any state, in the West.[360] Uzunçarşılı interprets the reason for Sultan Selim's naval preparations as follows: "The main reason, for this preparation, was the activity of Pope Leo X (Giovanni de Medici) for an expedition against the Ottomans. Taking advantage of the calm, in Italy, the Pope sent a cardinal to Austria, France, England, and Spain to make an alliance against the Ottoman state. Because of this attempt, the purpose of Sultan Selim was to keep the navy ready to prevent any attack, due to its wide beaches in the Mediterranean."[361] On the other hand, he had long accepted that a large navy was needed for a campaign, in Europe. For this reason, he had ordered the renovation of the ruined place, where the Byzantine shipyard was once located, and the establishment of new one.[362]

After Selim I, Sultan Suleiman ensured the development of the Ottoman navy, by applying to pirates. For this reason, during the long reign of Suleiman the Magnificent, the Ottoman empire reached the highest point, in the seas, and on land, and experienced the brightest period in administrative, legal, scientific, and economic terms.[363] The maritime of this period had two substantial areas of struggle, namely the Mediterranean and Indian seas, so that the Ottomans could dominate the lands in Europe and Africa. To rule Egypt, the Arabian Peninsula, and its surroundings, they had to dominate the Red Sea and the Persian Gulf.[364] Suleiman the Magnificent brought main goal to the fore on the Mediterranean, while reviving the traditional war policy against the West. This aim was Rhodes, which was extremely significant, in terms of

[360] Uzunçarşılı, *Osmanlı Tarihi*, Vol. II, p. 300.
[361] Uzunçarşılı, *Osmanlı Tarihi*, Vol. II, p. 300.
[362] Selahattin Tansel, *Yavuz Sultan Selim* (Ankara: Türk Tarih Kurumu, 2016), pp. 299-300.
[363] Cezar, *Mufassal Osmanlı Tarihi*, Vol. II, p. 790.
[364] Bostan, *Osmanlı Akdenizi*, p. 49.

domination of the Mediterranean. With the conquest of Rhodes, the journey, from Istanbul to Egypt, became much safer for Ottoman shipping.[365]

At the same time, the appointment of Hayreddin Barbarossa to the head of *Tersâne-i Âmire*, in 1520, provided great benefits in the technological production of the navy, and the training of experienced artisans and sailors. On this occasion, victories were won, thanks to experienced sailors, and the Ottoman lands expanded to the Western Mediterranean. Subsequently, the conquests of Tripoli in 1551, Djerba in 1560 and Tunisia in 1574 strengthened the Ottoman presence in North Africa. Communication, with these outposts, was by sea, and possession of them inevitably led to a naval rivalry with Spain, which was also trying to establish forts on the North African coast. These factors required an effective fleet, to the Empire's survival as well as expansion.[366]

Forerunners of, and skirmishers for, the Ottoman power in the Mediterranean, the corsairs contributed greatly to expansion of navy.[367] Many of the pirates eventually accepted positions in the Navy, where they were highly esteemed, in the end, the term corsair acquired the meaning 'expert sailor'. Turkish pirates first came to prominence in the last quarter of the 15th century. The earliest corsairs known to history by name were Barak Reis and Kemal Reis, uncle of the geographer, Piri Reis. Most of the remarkable figures of the Turkish naval history of the 16th century began their careers as corsairs, such as Hızır Reis (known in the West as Hayreddin Pasha or Barbarossa), Turgut Reis (Dragut of Italian sources) or Uluj Ali.[368]

After period of Suleiman the Magnificent, in Selim II's Sultanate, the stagnation of the work, in the navy, and the losses caused by the shortage of artisans and experienced people are momentous in terms of seeing the function that were applied in the previous periods. As it is seen, in the early modern period, it was inevitable for states to resort to technologies of practical knowledge, which played a key role in achieving their political and economic interests. I think it is essential that we know the historical background, the reasons and conditions that push states to resort

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[365] Isom-Verhaaren, *The Sultan's Fleet*, chap. 4, para. 59.
[366] Imber, *The Ottoman Empire*, p. 292.
[367] Kahane's and Tietze, *The Lingua Franca in the Levant,* p. 18.
[368] Kahane's and Tietze, *The Lingua Franca in the Levant,* p. 19.

to instruments of practical knowledge, before these scientific and technological activities and tools that we will see in the next chapters. As mentioned in the first chapter, we will see how the artisans, who were the most influential intermediaries of the early modern period, contributed to scientific and technological developments in the Ottoman empire. *Tersâne-i Âmire*, which was established as practical institution, which I will discuss below, and the works of artisanal pirates and sailors will be useful in seeing productions.

3. 1. Ottoman Shipbuilding Centre: *Tersâne-i Âmire* (Imperial Arsenal)

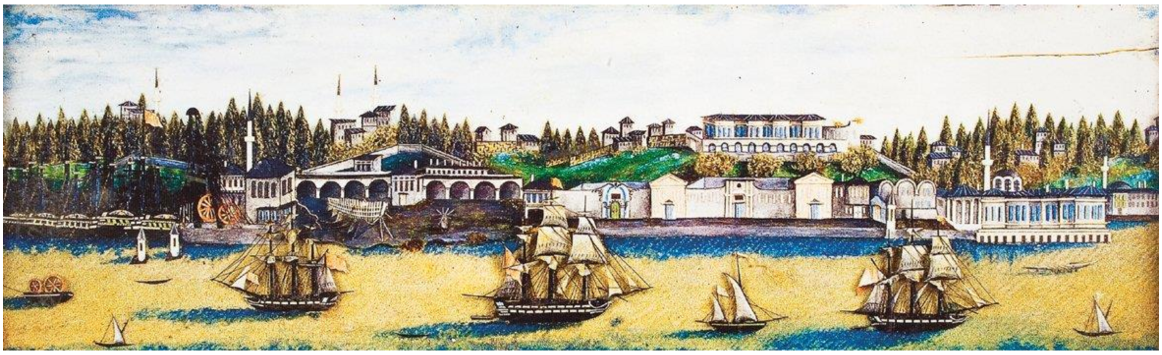

Figure 43. Depiction of galleons in *Tersâne-i Âmire* and Golden Horn on a drawer from 1831, Topkapi Palace Museum Library, CY, nr. 455, https://islamansiklopedisi.org.tr/tersane-i-amire.

Tersâne-i Âmire, which was established in the Ottoman empire, was one of the centres, where the production of nautical instruments of the early modern period was made. At the same time, it was the epicentre of the Ottoman maritime activities. This centre was formed in Gallipoli with the establishment of the Ottoman empire. Later, it became a fundamental organization in the Golden Horn, with the conquest of Constantinople in parallel with the expansion of the state (Fig. 43).[369] Sultan Mehmed, who saw that the still and deep waters of the Golden Horn were extremely suitable, commissioned Captain Hamza Pasha, to start the construction of the shipyard. Thus, the first shipyard established to be able to build ships, in 1455, in Istanbul. Then, the Ottoman empire started mostly building and equipping its nautical instruments, such as ships, in *Tersâne-i Âmire*. So that continue the activities of this shipyard, carpenters,

[369] Idris Bostan, "Tersâne-i Âmire," accessed September 17, 2021, https://islamansiklopedisi.org.tr/tersane-i-amire.

sailors, and artisans were brought from the coastal regions of the empire. In the miniatures of the late 15th century, the presence of galleys repaired on sledges in the Golden Horn, besides the anchored galleys and galleons in the harbour, indicates that the shipyard was in operation.[370] For example, Hartmann Schedel, who is a German historian and one of the first cartographers to use the printing press, published a book, which was known as *Liber Chronicarum* (World History) in 1493 (Fig. 44). In his book, partially depicted the Kadırga Port, which is shown in relation to the stables in a structure with a courtyard, especially outside the Topkapı Palace.[371]

Figure 44. Large engraving of Istanbul in Hartmann Schedel's *Liber Chronicarum* (World History, 1493) 129r-130v. https://dergipark.org.tr/tr/download/article-file/638027.

[370] Bostan, *Kürekli ve Yelkenli Osmanlı Gemileri*, p. 49.

[371] "Osmanlı Mimarisi," accessed November 15, 2021, https://istanbultarihi.ist/301-istanbulda-erken-donem-osmanli-mimarisi.

As a function of this shipyard, it can be said that it served as the base of the Ottoman Mediterranean fleet, where the imperial galleys were housed, and during the winter months, their maintenance and repairs were made. Simultaneously, Galata was the largest shipbuilding yard in the empire (Fig. 45 and 46). There were smaller arsenals at Sinope and Izmit, and shipbuilding facilities at various locations along the empire's coasts.[372]

Figure 45. Istanbul from Pirî Reis's *Kitâb-ı Bahriyye*, (Place of Publication Not Identified: Publisher Not Identified, *Kitâb-ı Bahriyye* from the 1650 version (original version in 1521), https://www.loc.gov/item/2021667235/.

[372] Colin Imber, *Studies in Ottoman History and Law*, Gorgias Press, 2010, https://www.perlego.com/book/1163150/studies-in-ottoman-history-and-law-pdf, p. 23.

Figure 46. Detail from Piri Reis's chart, when it can be looked carefully at the miniature, this detail can be thought to date back to the 1500s, since Piri Reis's book dates back to 1521.

The headquarters, in Istanbul Galata, had replaced Gallipoli as the main naval base of the empire. It was a natural choice, not only because Istanbul was the capital and centre of the empire, but also the Golden Horn was sheltered by the Galata and Istanbul hills to the east and west. Inasmuch as it was deep enough for ships to come almost in Istanbul. And it was the landlocked shore was the perfect place for a harbour and arsenal.[373] Mehmed the Conqueror had a small arsenal built, consisting of several shipyards and an administrative building called Divanhane, in Kasım Pasha, Aynalı Kavak, on the shores of the Golden Horn. Selim planned to enlarge it to consist of 300 berths extending from the Galata castle of Kağıthane at the other end of the Golden Horn, but even half of this number was not completed. With all that, the arsenal and the town of Kasım Pasha were expanded in the early years of Suleiman's reign, with 114 docks completed in 1522. In 1557, there were 123 of them. Each berth contained enclosed slipways, where ships could be built, beached for repairs, or sheltered, during the winter, and every berth could hold two ships.[374]

Summarize, the conquest of Istanbul, in 1453, was a milestone point for the Ottoman naval power. Together with Constantinople, the Ottomans, as I mentioned above, obtained the Golden Horn, one of the most reserved natural ports of the Mediterranean, with the Byzantine shipbuilding facilities and skilled labour at the

[373] Imber, *Studies in Ottoman History and Law*, pp. 26.
[374] Imber, *Studies in Ottoman History and Law*, pp. 26-27.

Kadırga Port, and turned this place into the epicentre of the Ottoman maritime, later known as *Tersâne-i Âmire*.[375] In Istanbul, this institution can be defined as the place where modern science was first applied. Maritime, which was seen as a good way to realize the policies of conquest in the Mediterranean, increased the interest in shipbuilding studies and technology in the Ottoman empire. Shipbuilding continued in the periods, after *Tersâne-i Âmire* was founded by Sultan Mehmed. To be an effective manager in the technology of the ships, produced in the shipyard and the navy created, they applied to the pirates and artisans of their time, who had a good understanding of maritime, and wanted these people to train artisans in the shipyard.

3. 1. 1. Shipbuilding Activities at *Tersâne-i Âmire*

It would be more appropriate to follow the construction activities in *Tersâne-i Âmire* to understand Ottoman scientific and technological developments. First, we see that, during the reign of Mehmed the Conqueror, expeditions were organized to Naxos and to Rhodes, Paros, Rineia and other islands near Kos. Shipbuilding was carried out to conquer the islands, where the pirates, who attacked the Ottomans took shelter. During the conquest of these islands, the navy admiral Yunus Reis had eighty galleys and a large number of cargo ships and ships carrying artillery.[376] Gradually, Ottoman control over the coastlines and islands increased, providing the ability to use the fleet for new conquests in the future.[377] I think that learning about the number of ships, in the navy, that sails to these islands brings us closer to the artisans. Because we see that in the *Mühimme registers* of these years, information about the artisans is given along with the expeditions and the number of ships produced.[378]

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[375] Gabor Agoston, "Karşılaştırmalı Perspektifle Osmanlı Askeri ve Deniz Gücü: Inebahtı Öncesi ve Sonrası," *Tarih Dergisi- Turkish Journal of History*, 76 (2022): 1-19, https://doi.org/10.26650/iutd.202201, p. 9.

[376] Franz Babinger states that Yunus Pasha was of Spanish or Catalan origin. (Babinger, Franz. *Fatih Sultan Mehmed ve Zamanı*, (Istanbul: Alfa Yayınları, 2021), p. 208), and Isom-Verhaaren, *The Sultan's Fleet*, chap. 3, para. 38.

[377] Isom-Verhaaren, *The Sultan's Fleet*, chap. 3, para. 42.

[378] Isom-Verhaaren, *The Sultan's Fleet*, chap. 3, para. 42.

Mühimme registers are the notebooks in which the copies of the edicts issued by the Ottomans after the approval of the Sultan on the issues decided in the Dîvân-ı Hümâyun (today's council of ministers) were recorded.

Since the Sultan understood the necessity of dominating the seas, especially during long distance expeditions, he ordered ships to be built in all over his country. Because he knew that the navy made the biggest contribution to his previous successes. When he examined the history of the ancient rulers, he saw that they achieved their greatest success in the seas and that they produced their greatest works in there.[379] After describing Mehmed's concept of expanding naval power, Kritovulos states that the key point, in this passage, is that sailors should be experts, not just any random enlistment in the army. Sultan needed men with naval expertise. This is the first time, Kritovulos has made this clear. It shows that even though the size of Mehmed's navy was large, Venice's experienced commanders made a difference in naval battles. However, this maritime expertise, unlike shipbuilding, could not be built immediately, and Sultan continued to rely on non-sailor experts to lead his fleet. Also, Kritovulos emphasizes how Mehmed's naval power was limited by not having Aegean islands. If he wanted to expand the Ottoman territory, his top priority had to be to gain control of the Aegean Sea.[380]

The Ottomans began to build large warships. Mehmed the Conqueror ordered a galleon of 3,000 fugi (tons) as an imitation of similar ships in the Venetian, Genoese, and Aragon navies, but sank while lowering it into the sea. Two Venetian galleons built, at the beginning of the next century, also suffered the same fate. The weight of the gunners, on the upper deck, combined with the narrowness of the beam, caused them to capsize.[381] Thus, it seems that the Ottoman navy had adopted the traditional maritime technology of the Mediterranean from its rivals. This tradition distinguished between heavy "round ships" used commercially and long galleys used as warships.[382] Despite costly disasters, round ships appeared in Ottoman war fleets, in the late 15th century. A document, dated 1487, lists weapons in two bargias and a gripar. The gripar looks like a small galleon that is often used as a commercial. According to Enveri, ships of this name had appeared in the navies of the Emir of Aydın, in the previous century,

[379] Kritovulos, *Kritovulos Tarihi (1451-1467)*, trans. Ari Çokona (Istanbul: Türkiye Iş Bankası Kültür Yayınları, 2018), p. 159.
[380] Isom-Verhaaren, *The Sultan's Fleet*, chap. 3, para. 50.
[381] Imber, *Studies in Ottoman History and Law*, p. 2.
[382] Imber, *Studies in Ottoman History and Law*, p. 1.

suggesting that they were a traditional Mediterranean type.[383] They were probably the same as Venice's late-rig grippo.[384]

After Mehmed II, Sultan Bayezid, who initiated a policy of expansion in the seas, the reconstruction of navy, started in the autumn of 1502, was a three-stage operation. These phases included repairing the fleet, dismantling some ships for refurbishment, and new shipbuilding.[385] Ship refurbishment was the dismantling of large ships and the building of brand-new ships. Materials obtained from dismantled ships were used to construct heavy and light galleys. These efforts to build lighter, more manoeuvrable ships were aimed at having a more difficult-to-capture fleet more suited to joint activities with other states at sea.[386] The Ottoman navy, built and maintained in large naval shipyards at Gallipoli and Galata, was physically demanding, but lacked effective leadership.[387] There was a need for artisans, who would carry out these construction activities and were closely aware of the ships produced with the latest technological developments. Of course, these people were pirates, who had gained experience in the Mediterranean. Thus, Sultan Bayezid brought Kemal Reis to the head of the Ottoman navy to realize these developments and to train sailors and artisans. Kemal Reis, who was an experienced sailor and an artisan, reorganized the Ottoman navy. He took many Turkish sailors, who made pirate in the Mediterranean and Africa, into Ottoman navy.[388] The number of shipyards has been multiplied. Larger ships were built. Ships of the galleon class, called "göke", were seen for the first time, in the Ottoman navy, in this period.[389] Long-range cannons began to be used on ships.[390]

[383] Imber, *Studies in Ottoman History and Law*, pp. 2-3.
Enveri; Ottoman poet and historian who lived in the 15th century. He has a book about the Ottomans in a section called '*Düstûrnâme*'.
[384] Imber, *Studies in Ottoman History and Law*, pp. 2-3.
[385] Brummett, *Osmanlı Denizgücü ve Doğu Akdeniz'de Diplomasi*, p. 138.
[386] Brummett, *Osmanlı Denizgücü ve Doğu Akdeniz'de Diplomasi*, p. 138.
[387] Streusand, *Islamic Gunpowder Empires*, p. 90.
[388] Uzunçarşılı, *Osmanlı Tarihi*, Vol. II, pp. 203-204.
[389] Erhan Afyoncu, *Sorularla Osmanlı Imparatorluğu* (Istanbul: Yeditepe Yayınevi, 2016), pp. 155-156.
[390] Brummett, *Osmanlı Denizgücü ve Doğu Akdeniz'de Diplomasi*, p. 138.

In 1499, two very large ships, the "göke", sailed with the Ottoman Imperial Navy. These ships were very different from the traditional one-masted ship, according to Kâtip Çelebi's (Haji Khalifeh) definition.[391] They were hybrid ships with a large galley on the lower deck and galleon-shaped upper deck and back. They carried oars as well as sails. A 17th-century miniature, partly based on Haji Khalifeh's depiction and largely guesswork, depicts them as four-masted ships. Unfortunately, there are no contemporary depictions of these ships. Their artisans might well have followed Venetian models, since he was a Greek named Gianni, who apparently learned to build ships in Venice.[392]

During the Ottoman-Venetian wars, in 1499-1503, Ottoman warships were feverishly built. The Ottoman historian of the that time, Hodja Sadeddin Efendi, states that preparations were made for the construction of 300 ship fleet, in the first year of the war.[393] Arnold von Harff, who was a German knight, claims quite exaggeratedly that saw eight hundred Turkish war galleys, and countless other types of ships, in Istanbul harbour, in the same year.[394] In the winter of 1500-1501, Bayezid II ordered the repair of the entire Ottoman navy, consisting of 200 galleys, 50 barges and 450 kalyatas, and frigates, in which large cannons were placed. These repairs were made at various selected locations. The number of warships, just in Lesbos, is about 120, including the 40 galleys, in 1502. Bayezid II employed various workers to repair the fleet. The request of carpenters, caulkers, as well as shipbuilding materials, from Chios could not be refused by the island's administration.[395]

While these efforts continue, Bayezid II ordered the preparation of a naval army of 60,000-70,000 men, consisting of rowers and sailors. This number was more than the need of a fleet of 300 ships.[396] The number of ships owned by the Ottomans, at the end of 1503, was impressive. Venetian doge Andrea Gritti presented, in his report, to the Venetian senate, the Ottoman fleet had 30 light galleys, 20 bowmen, 2 barges,

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[391] Imber, *Studies in Ottoman History and Law*, pp. 2-3.
The great figure of the 17th century Turkish scientific world representing positive thinking and the author of many works on various subjects.
[392] Imber, *Studies in Ottoman History and Law*, pp. 2-3.
[393] Brummett, *Osmanlı Denizgücü ve Doğu Akdeniz'de Diplomasi*, p. 137.
[394] Brummett, *Osmanlı Denizgücü ve Doğu Akdeniz'de Diplomasi*, p. 137.
[395] Brummett, *Osmanlı Denizgücü ve Doğu Akdeniz'de Diplomasi*, p. 137.
[396] Brummett, *Osmanlı Denizgücü ve Doğu Akdeniz'de Diplomasi*, p. 138.

several frigates, and 60 galleys, which were built by Italian Andrea Dere. He also explained that there are 8 heavy and 13 light galleys on the west coast of Chios. Thus, Bayezid II had still available large fleet, after the end of the war.[397]

At the beginning of the 16th century, outside the Ottoman empire, only the Knights of Venice, Spain and Rhodes had regular fleets in the Mediterranean. The presence of a navy helped the Ottomans conquer a vast territory stretching from Syria through Egypt to Morocco.[398] According to a report by the Venetian Andrea Gritti, Sultan Bayezid had at least 150 different types of ships, at his disposal, in ports throughout the empire (Galata, Gallipoli, Vlorë in Istanbul, and Volissa on the Adriatic on the west side of Chios).[399] The capacity of some of these shipbuilding sites was impressive. In the 1550s, 250 ships could be built or repaired in the shipyard, at a time. Yet, the *Tersâne-i Âmire* was the principal centre of Ottoman shipbuilding and maintenance.[400] When smaller shipyards are included, the number of Ottoman shipyards, for this period, is close to seventy. The Great Admiral, which held the governorship of the Islands province, also was commanding the Mediterranean navy of Ottoman empire. Therewithal, Mediterranean navy was the core of the Ottoman navy.[401]

By 1515, *Tersâne-i Âmire* had 160 eyes. According to the shipyard accounting books, between 1527 and 1531, the Ottomans built a total of 61 ships, 44 of which were galleys, and repaired 146 ships, 32 ships, which were galleys. Venetian Bailo Antonio Barbarigo stated, in 1558, that the Ottomans could build and equip 130 ships without difficulty, although he considered their ships built of wet timber to be of low quality.[402] Four years later, Bailo’s secretary claimed that the Ottomans could mobilize 170 galleys for long voyages, and 200 for short voyages, apart from pirate ships. The same secretary stated that the quality of Ottoman galleys had increased, citing the fact that Christian shipmasters, most of whom were Venetian, were working in *Tersâne-i*

[397] Brummett, *Osmanlı Denizgücü ve Doğu Akdeniz’de Diplomasi*, p. 139.
[398] Ágoston, *Guns for the Sultan,* p. 49.
[399] Ágoston, *Guns for the Sultan,* p. 50.
[400] Ágoston, *Guns for the Sultan,* p. 51.
[401] Ágoston, *Guns for the Sultan,* p. 52.
[402] Agoston, “Karşılaştırmalı Perspektifle Osmanlı Askeri ve Deniz Gücü,” p. 10.
Bailo or baylo means ambassador and mediator, and is also the name given to Venetian and some other Frankish ambassadors who served in Istanbul.

Âmire.[403] Ottoman navy had light galleys (*galie sotil*), which were warship accompanying 120-130 merchant ships, and 6-12 large galleys (*galie grosse*) designed to carry goods on commercial voyages and generally used as flagships. That is, there was big capacity of production in the Ottoman shipyard. With the construction capacity of the Venice shipyard, which had built or was building 12-21 of the average sized galleys (*galae bastarde*), they were close to each other. These figures should only be considered in terms of production, since many other ships were at sea under cruise, in addition to the ships in the production phase (Fig. 47).[404]

Figure 47. In this depiction by Vavassore, dated between 1530 and 1550, gökes, galleys and smaller sailing ships are seen in Istanbul. Giovanni Andrea Vavassore, City of Constantinople, (wood cut), ca. 1530/50, Staatsbibliothek Bamberg, IV C 44, Photo: Gerald Raab, https://istanbulsurlari.ku.edu.tr/en/essay/63/depicting-the-city-walls.

[403] Agoston, "Karşılaştırmalı Perspektifle Osmanlı Askeri ve Deniz Gücü," p. 10.
[404] Agoston, "Karşılaştırmalı Perspektifle Osmanlı Askeri ve Deniz Gücü," p. 10.

The great Venetian galleys were larger than their Ottoman-built counterparts. These galleys could carry 250 tons of cargo and more than 200 soldiers. After the war of 1537-1540, the Republic of Venice equipped more than 100 galleys, increased to 50 galleys previously in reserve, 100 light galleys, 4 (later 10) large galleys, 8 biremes, and 16 light couriers and reconnaissance ships. Until that time, the new shipyard had enough bays and docks to store spare vessels, which had been kept secret. Among these ships, 25 galleys were equipped with soldiers, in a short time, and kept in the dock ready to go to sea. The remainder of the navy was on land, their skeletons completed and ready for action, after they were caulked.[405]

The main change, made in *Tersâne-i Âmire*, was during the reign of Sultan Selim (1512-1520), who came after Bayezid II. It is seen that the Ottoman Sultans gave priority to maritime and from the reign of Bayezid II, they began to take part in the policies towards the Mediterranean and the Black Sea, and the Red Sea, and Indian seas. Sultan Selim I, who wanted to be strong in the seas as well as his victories on land, started the activities of expanding the shipyard to have a large navy. As a matter of fact, according to the information, given by Venetian bailo Nicolo Giustinian, in his letter, June 30, 1513, Sultan gave the order to build large shipyards in Gallipoli and Istanbul, which have each a hundred eyes with a capacity of two hundred galleys.[406]

Sultan Selim invited Selman Reis, who was Mamluks' commander of the Red Sea navy, to come to Istanbul, and wanted to benefit from his knowledge to improve the Ottoman maritime. In this way, there was step the establishment of a large shipyard in the Ottoman maritime, in Istanbul.[407] The Golden Horn shipyard, which was built during the reign of Mehmed the Conqueror, was no longer sufficient for the navy. It was decided to build a shipyard, like the French shipyard, instead of the one that had a Byzantine shipyard, but was in ruins, and a shipyard was built. Fifty thousand akce (silver currency minted and used in the Ottoman empire), which was a high amount at the time, spent on each of the shipyard stalls. The Sultan, who did not see enough a hundred galley, which ready to go to sea, ordered that another hundred and fifty ships be built. One hundred of them would be big galley, twenty would be fosta[408], twenty-

[405] Agoston, "Karşılaştırmalı Perspektifle Osmanlı Askeri ve Deniz Gücü," pp. 10-11.
[406] Idris Bostan, *17. Yüzyılda Tersâne-i Âmire* (Istanbul: Küre Yayınları, 2018), p. 29.
[407] Uzunçarşılı, *Osmanlı Tarihi*, Vol. II, p. 298.
[408] A kind of fine sailing warship in the Ottoman navy. (*Fustis* in Latin).

one would be barca[409], three would be big sailboat, and six would be perkendi.[410] During the studies carried out, in the shipyard, for Sultan Selim's preparation for an unknown expedition, 150 ships, three of which were of seven hundred tons in weight, built. After all this hard work, a fleet of 250 ships, in Istanbul and Gallipoli, was ready for war.[411] Arab rowers were brought from Syria and Egypt, for these ships. The new Golden Horn shipyard, which was established, in the state centre, during the reign of Sultan Selim, continued until the end of the Ottoman empire.[412] The most significant thing, is that the Ottomans turned towards naval technologies, and increased the speed of shipbuilding, and the navy grew considerably. After the reign of Bayezid II, this large amount of shipbuilding, in Ottoman navy, was a great gain, and incentive, for the following periods and especially for the reign of Suleiman the Magnificent (Fig. 48). It is seen that the interest in technological production models has increased, and this is accepted as a need, for the political purposes of the state. This development is very substantial for the following periods.

Figure 48. In the Prospect of Constantinople by Melchior Lorck (1526-1583), dated 1559, carracks, galleons, galleys and other small sailing ships can be seen among the rows of ships in the harbour. Melchior Lorck, Prospect of Constantinople, 1559, 42.5 x 1143 cm, Leiden University Libraries, https://digitalcollections.universiteitleiden.nl/view/item/2026523.

[409] It had a straight bottomed, which was a type of ship of the galleon class, that was used in warfare, until the early 16th century, but later only for shipping.
[410] Uzunçarşılı, *Osmanlı Tarihi*, Vol. II, pp. 298-299.
The name given by the Ottomans to the ships named brigantine in the navies of European countries. A type of ship with at least two sails.
[411] Tansel, *Yavuz Sultan Selim*, pp. 299-300.
[412] Uzunçarşılı, *Osmanlı Tarihi*, Vol. II, pp. 298-299.

Undoubtedly, the period of Sultan Suleiman was the most activity in the seas.[413] Because, in this period, great technological activities and production were carried out in shipyards. It is seen that the first remarkable shipbuilding activities was made in preparations for the conquest of Rhodes.[414] Domestic and foreign sources give various numbers, like between 300 and 700, about ships of the Ottoman navy, in the Rhodes campaign. The number of soldiers, in the navy, is considered to be among 50 and 60 thousand.[415] We see that the work done, in the navy, during the reigns of Bayezid II and Selim I, made a great profit, during the reign of Sultan Suleiman.[416] In this period, the appointment of pirate Hayreddin Barbarossa, to the head of the Ottoman navy, was one of the turning points. Hayreddin Barbarossa's maritime knowledge and experience are essential in examining the instruments of practical knowledge, produced in the Ottoman empire.[417]

During the reign of Sultan Selim II, the battle of Lepanto resulted in the Ottomans inflicting great losses.[418] After the defeat of Lepanto (1571), among the attempts started immediately to strengthen the navy, there were additions to the *Tersâne-i Âmire*. That year, to build more ships, some space was allocated from Has Bahçe, near to arsenal, and a shipyard with 8 arches, suitable for the construction of 8 ships, was built.[419] Although the imperial navy was built quickly, it cannot be said that it regained its former power, after this event. Guilmartin sees Lepanto not as a decisive battle in the normal sense, but as the culmination of an oared naval battle in the Mediterranean.[420] The increasing size of galleys and the high cost of operating have put galley fleets in an evolutionary predicament. The Ottoman defeat, at Lepanto, cost the empire heavy losses. Loss of sailors were taking a generation to recover, because of taking so long time to train an expert sailor. They had to move to a new foundation to make naval operations useful. The decrease, in the cost of artillery with the development of iron cannons, disrupted both the strategic balance and the order of

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[413] Bostan, *Osmanlı Akdenizi*, p. 49.
[414] Muzaffer Tayyib Gökbilgin, *Kanuni Sultan Süleyman* (Istanbul: Kronik Kitap, 2019), p. 23.
[415] Cezar, *Mufassal Osmanlı Tarihi*, Vol. II, p. 803.
[416] Cezar, *Mufassal Osmanlı Tarihi*, Vol. II, p. 912.
[417] Nazan Karakaş Özür, *500 Yılın Ardından Piri Reis* (Istanbul: Yeditepe Yayınları, 2015), p. 32.
[418] Streusand, *Islamic Gunpowder Empires*, p. 91.
[419] Idris Bostan, "XVI. Asırda Osmanlı Tersaneleri ve Gemi İnşa Tezgâhları," in *Mimarbaşı Koca Sinan: Yaşadığı Çağ ve Eserleri*, ed. by Sadi Bayram (Vakıflar Genel Müdürlüğü Yayınları, 1988), Volume 1, 125-129, p. 126.
[420] Streusand, *Islamic Gunpowder Empires*, p. 91.

naval tactics. The rising cost of the Mediterranean war eventually resulted in only the Ottoman empire having the ability to launch offensive campaigns. Ottomans lacked the manpower to do so after Lepanto (Fig. 49).[421]

Figure 49. The Battle of Lepanto caused the Ottomans to suffer great losses. Giovanni Francesco Camocio, the Ottoman and the Venetian fleet, during the Battle of Lepanto in 1571, dated 1574, Venice, Library of St. Marco, https://eng.travelogues.gr/item.php?view=45637.

Therefore, it is seen that the Ottoman navy and the production activities, in *Tersâne-i Âmire*, passed into a period of stagnation, after the navy equipment, and Kılıç Ali Pasha, who was the artisan trained by Hayreddin Barbarossa Pasha.[422] As Uzunçarşılı states, the Ottoman navy lost strength, which was raised to the highest level by Barbarossa, starting with Kemal Reis and after Kılıç Ali Pasha (1500-1587).[423] The

[421] Streusand, *Islamic Gunpowder Empires*, pp. 91-92.
[422] Uzunçarşılı, *Osmanlı Devleti'nin Merkez ve Bahriye Teşkilâtı*, p. 392.
[423] Uzunçarşılı, *Osmanlı Devleti Merkez ve Bahriye Teşkilatı*, p. 495.
Kılıç Ali Pasha, also known as Uluj Ali or Uluj Ali Reis, was an Ottoman sailor, who served as a sea captain for 16 years between 1571 and 1587. He is of Italian origin and his name, before he became a Muslim, was Giovanni Dionigi Galen. It goes by the name Occhiali in Italian sources.

fact that artisanal pirates, such as Barbarossa, Piali Pasha and Piri Reis, which I will analyse about later, were not replaced by other sailors, and the decrease in scientific and technological production activities, in *Tersâne-i Âmire*, caused losing power of the Ottoman navy.[424] It is significant to analyse the defeat of the navy from the point of view of the lack of experienced artisans and navigators.

I gave these construction activities together with the numbers from time to time. The reason is to show that the strong and large navy was wanted structured together with the technological developments in the Ottoman navy. Detailing the types of ships, produced in the periods mentioned here, is included in the Chapter 4. These improvements were through qualified artisans and artisanal pirates, who were taken into the Ottoman body. It is necessary to focus on the artisan staff of *Tersâne-i Âmire*, which was the first institution of the Ottoman empire to produce nautical instruments. Because there is no doubt that the artisans, behind all these activities, are worth mentioning. Through the artisanal pirates, who were put in head of the Ottoman navy, the creation of instruments, especially the ships, and the portolan charts and atlases were made by the artisans, trained or worked in new Turkish space of artisanal knowledge, after this period. For this reason, it can be said that these sailors, who were appointed to manage the shipyard, played a momentous role in ship buildings for the navy, and training new sailors and artisans.

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[424] Uzunçarşılı, *Osmanlı Devleti Merkez ve Bahriye Teşkilatı*, p. 495.

3. 2. Working Lines of Artisans in Imperial Arsenal

The construction of shipbuilding technologies and other nautical instruments undoubtedly involves multi-stage processes. For example, the technical work needs to be uncovered, until the raw material is processed, and the galley can float.[425] Adverting the artisan groups, who work in *Tersâne-i Âmire*, can be a guide for obtaining information about how the shipyard works and the Ottoman artisanal epistemology.

As can be understood from the above-mentioned activities in *Tersâne-i Âmire*, the Ottoman State employed many artisans in the making of nautical instruments, from galley construction to galleon.[426] Many specialized artisans and masters worked in the shipyard, and they were free people. However, some prisoners of war lived in the shipyard area, and these people were sometimes employed in shipbuilding.[427] The artisan group, in *Tersâne-i Âmire*, consisted of caulkers, carpenters, mast masters (*barudreşan*) and drillers. The caulkers were seen as the aristocrats of the workers. Caulkers were paid more than carpenters and mast masters.[428] Although the shipyard artisans were commanded by officers, they received a military salary like them.[429] Uzunçarşılı stated that after Sultan Selim's Syria and Egypt expedition, the Ottoman navy was well strengthened and the number of employees, such as ropers, carpenters and blacksmiths working in the shipyard, was more than three thousand.[430] He listed the artisans as miniaturists, carpenters, blacksmiths, caulkers and ropers. He indicated that carpenters repair the ship when cannonballs arrive or otherwise breach the ship. Blacksmiths repair iron-related defects on the ship. Caulkers caulk when the ship is flooded. Ropers repair ship ropes. The muralists also embroider on galleons.[431]

Idris Bostan, on the other hand, counted the artisans, working in *Tersâne-i Âmire,* in the 16th century, gives with their original names. These artisans are including *neccâr* (nejjars, carpenter), caulking, *pâru-tıraş* (oarsman), *haddad* (ironsmith), *meremmetçi* (mechanic), *tûc-ger* (reeler), *üstüpücü* (ship worker) and *humbaracı*

[425] Salih Özbaran, "Galata Tersanesinde Gemi Yapımcıları, 1529-1530," *Güneydoğu Avrupa Araştırmaları Dergisi*, 8-9 (2012): 97-102, p. 98.
[426] Beydiz, "Tersâne-i Âmire'de Çalışan Zanaatkârlar," p. 98.
[427] Beydiz, "Tersâne-i Âmire'de Çalışan Zanaatkârlar," p. 383.
[428] Suraiya Faroqhi, *Osmanlı Zanaatkârları* (trans. Zülal Kılıç) (Istanbul: Kitap Yayınevi, 2011), p. 98.
[429] Faroqhi, *Osmanlı Zanaatkârları*, p. 100.
[430] Uzunçarşılı, *Osmanlı Devleti'nin Merkez ve Bahriye Teşkilatı*, p. 398.
[431] Uzunçarşılı, *Osmanlı Devleti'nin Merkez ve Bahriye Teşkilatı*, p. 488.

(casting master).[432] If we explain these artisans with their duties, the nejjars were novice carpenters working in shipbuilding, and repair and other constructions in *Tersâne-i Âmire*.[433] Caulkers were the people, who take care of the caulking works of the ships, in charge of pitching and were recruited from among the novice boys.[434] *Pâru-tıraşs* were the masters, who row the ships, connected to *Tersâne-i Âmire*.[435] *Haddads* took part in the preparation of materials, made of iron.[436] *Meremmetcis* worked in the repair of ships, cellars and other additional structures at *Tersâne-i Âmire*.[437] *Tûc-gers* were masters, who make pulleys on ships.[438] *Üstüpücüs* were the people, who fill the gaps of the boats, ships and boats to be pitched or painted with oakum, so that they do not pass water.[439] *Humbaracıs* were people, who throw a type of bullet, made of iron and filled with explosive substances, with a mortar or by hand.[440] These people, who served in the shipyard and navy, were called the people of the shipyard. The number of people, in the shipyard, differed from time to time. As a matter of fact, the number of people in the *Tersâne-i Âmire*, which was 1800 in 1547, was 2652 after this date, and 2385, after the Battle of Lepanto.[441]

A document, dated 1518, shows the expenses incurred by the artisans, who built and repaired ships at the Gallipoli shipyard. These were divided into different categories. First, there was a small group of eight who specialized in shipbuilding artisans, oarsmen, caulkers, pulley makers, and gun-armorers, gunners, and ammunition maintenance and use. Altogether they were the largest group with just 81 men, 26 caulkers and 28 gunners.[442] He indicates that the main job of numerous caulkers was to maintain rather than build ships. The numbers increased slightly in the following years, reaching 127 by 1530, but never large. The records show that many

[432] Idris Bostan. *Osmanlı Bahriye Teşkilatı: XVII. Yüzyılda Tersâne-i Âmire* (Ankara: Türk Tarih Kurumu, 2003), p. 5.
[433] Bostan, *Osmanlı Bahriye Teşkilatı*, p. 66.
[434] Bostan, *Osmanlı Bahriye Teşkilatı*, p. 67.
[435] Bostan, *Osmanlı Bahriye Teşkilatı*, p. 68.
[436] Bostan, *Osmanlı Bahriye Teşkilatı*, p. 68.
[437] Bostan, *Osmanlı Bahriye Teşkilatı*, p. 68.
[438] Bostan, *Osmanlı Bahriye Teşkilatı*, p. 69.
[439] Bostan, *Osmanlı Bahriye Teşkilatı*, p. 69.
[440] Bostan, *Osmanlı Bahriye Teşkilatı*, p. 70.
[441] Bostan, *17. Yüzyılda Tersâne-i Âmire*, p. 115.
[442] Imber, *The Ottoman Empire*, p. 296.

of these men were apprentices, before enrolling in the janissary corps. Most artisans were temporary workers from the coasts of neighbouring countries.[443]

As in Gallipoli, there were permanent and temporary artisans at the shipyard, in Istanbul. Permanent workers were also recruits. And they formed groups of caulkers, carpenters, rowers, bombers, blacksmiths, mechanics. Their numbers were few, and the caulkers made up the largest group of 40 men, in 1530, a total of 90 artisans. Most of the artisans came from outside. According to one Venetian account, they were Greek shipbuilders mostly from Istanbul, Galata, and nearby islands. However, when business was urgent, they would come from faraway places, like Lesbos or Chios. Most of the master shipbuilders' names are unknown. In 1553, the Venetian bailo mentioned a Greek artisan, who named Michele Benetto, who had three or four master shipbuilders, under his command. There are reports from the 1520s that Venetian artisans were in Ottoman service. And in 1562, another bailo reported that Venetian shipbuilders worked in the arsenal, who had greatly improved the standard of shipbuilding. Other than that, there is no information available. Those, who did heavy work in the arsenal, were also workers, who served for six-month terms.[444]

The Ottomans kept the number of artisans at a certain level in the shipyards and worked with seasonal workers. Because it can be said that they thought that there is no need to employ extra workers for maritime activities that stop during the winter months. As a result, the Ottoman navy was dismissing master shipbuilders, at that time, to keep costs down for years without conflict at sea. However, they were free to work for private ship owners, during such recessionary periods (Fig. 50).[445]

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[443] Imber, *The Ottoman Empire*, p. 296.
[444] Imber, *The Ottoman Empire*, p. 297.
[445] Faroqhi, "Artisans of Empire," Chap. 3, para. 2.

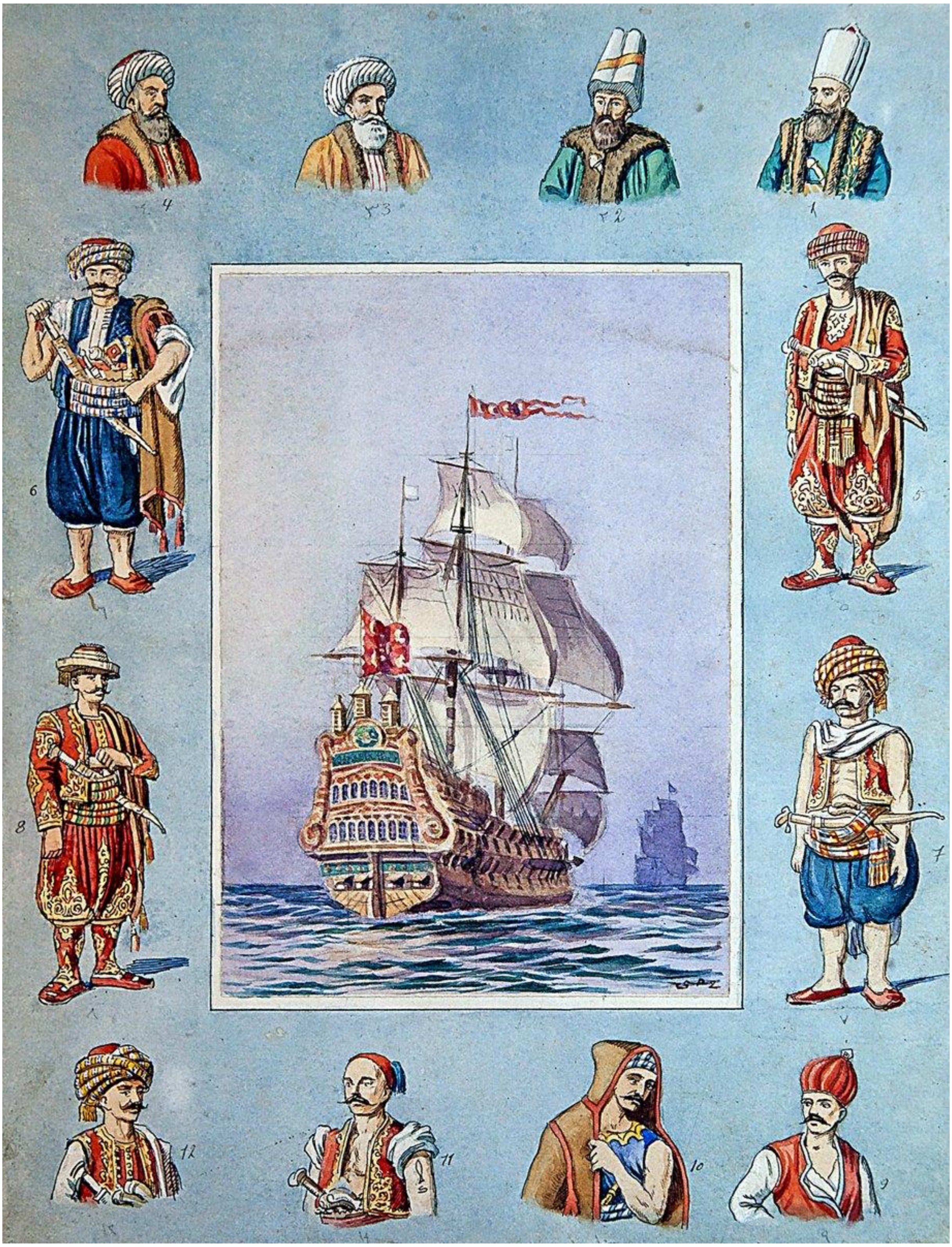

Figure 50. The clothes of the sailors in the Ottoman navy, and a galleon, in the 16th century. These people in the Ottoman navy worked to the duties, I mentioned above, (*Album of Hasan Hüsnü Tengüz,* Istanbul Maritime Museum, nr. 578, vr. 11a, 17th century, https://islamansiklopedisi.org.tr/bahriye.

There were three classes of workers in the arsenal. These were recruit boys in permanent employment, artisans, and infantrymen in temporary employment.[446] Skilled duties were divided between groups of permanently employed artisans and shipbuilders, who were seconded by the government. Infantrymen were responsible for most of the unskilled work.[447] Novice boys were separated into corps, according to their craft, as at Gallipoli, and charged, according to the scale of same wage. Since the customs revenues of the Galata port and the wages of the arsenal masters are accounted for separately, the total cost is not recorded in the account books that have survived from the Galata Shipyard.[448]

In addition, 'Kapudan Pasha', the admiral of the Mediterranean navy, who directed these artisans, was the most senior figure in the Ottoman navy. This appellation emerged in the 16th century (Fig. 51). There is no record of admirals before 1453. However, it was customary for the Gallipoli starboard governor to command the fleet, since it was apparently the most momentous naval base.[449] The Grand Admiral was the general manager of the Imperial Armoury, in Galata. The three high-ranking officers, under his command, were the captain, the officers' *kethüdâ*, and the commissar (Fig. 52).[450] The first of these, also known as the *kethüdâ* of arsenal or the officers' *kethüdâ*, seems to have been the senior representative of the galley captains and officers stationed in Galata.[451] In the fleet, the front galleys, there were required to carry a group of artisans, who were two carpenters, two caulkers, and two oarsmen served, at sea, to maintain the ships. It is seen that temporarily conscripted artisans are equally responsible for this service. Along with the arsenal, the Corps of Novice Boys provided a travelling workforce that could be dispatched to wherever government ships were under construction.[452]

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446 Imber, *Studies in Ottoman History and Law*, p. 29.
447 Imber, *Studies in Ottoman History and Law*, p. 24.
448 Imber, *Studies in Ottoman History and Law*, p. 29.
449 Imber, *The Ottoman Empire*, p. 300.
450 Imber, *Studies in Ottoman History and Law*, pp. 27-28.
Kethüdâ means supervisor.
451 Imber, *Studies in Ottoman History and Law*, pp. 27-28.
452 Imber, *Studies in Ottoman History and Law*, pp. 29-30.

Figure 51. Kapudan Pasha in the book of Mahmud Şevket Pasha, named *Osmanlı Teşkilât ve Kıyâfet-i Askeriyyesi* (Ottoman Organization and Military Uniforms), 1902-1903, Istanbul University Library, no. 9391, https://cdn.islamansiklopedisi.org.tr/gorsel/Minyat%C3%BCr/osmanlilar-17.jpg.

Figure 52. A painting showing Kapudan Pasha with sailors. In the engraving by Amedeo Preziosi, Kapudan-ı Derya, Çıplak Sergeant, Pasha Sergeant Major, Shipyard Sergeant Major, Galata Sergeant Major, and Içoğlan Sergeant are shown. Although the depictions in the engraving belong to the 18th century, they are important in terms of us being able to estimate the situation in the 16th century. Because the same job descriptions existed in the 16th century. Amedeo Preziosi, Ottoman sailors engraving, Mahmud Şevket Pasha, *Osmanlı Teşkilât ve Kıyâfet-i Askeriyyesi* (Ottoman Organization and Military Uniforms), 1902-1903, 37.5 x 48 cm, Istanbul University Library, nr. 9391, https://islamansiklopedisi.org.tr/kapudan-pasa.

Most of the artisans were Greek shipbuilders, who were called to arsenal service from Istanbul, Galata, Gallipoli and the surrounding islands and coastal areas, and from as far away as Lesbos, Chios, and Rhodes, in times of great need, while ships were being built or repaired. Arsenal's ledgers show only the number of days worked, not the total number of masters employed. According to Jean Chesneaux, in 1547, there were about two hundred skilled workers at the Arsenal, almost all Christian. Antonio Barbarigo told the number back at two hundred, in 1558. However, this could not be a fixed figure, as work at the Arsenal did not continue throughout the year, and the number of artisans varied with the amount of work at hand.[453] In 1553, Bernardo Navagerci reported that Rhodesian Michele Benetto, who was an artisan, earned fifteen akces a day. According to Marcantonio Donini, in 1562, there were several Venetian

[453] Imber, *Studies in Ottoman History and Law*, p. 30.

artisans in the shipyard, who had greatly improved Ottoman shipbuilding standards. These were either renegades, who entered Ottoman service with high salaries or were prisoners employed.[454]

During the reign of Sultan Suleiman, more Venetians began to work for the Ottoman navy. Some were Venetian nobility, possibly unofficially sent by the Venetian Republic. For example, Giovanni Francesco Giustinian reached to Istanbul, in 1531, to fight with Portuguese in the Red Sea. The following year, the grand vizier suggested to Ibrahim, to send a Dubrovnik squadron to India via Gibraltar. He had the task of building several galleons in the Ottoman capital. In 1533, he became an adviser to the Ottoman arsenal and worked there, until at least 1534. Another nobleman, who followed the same path, was Giovanni Contarini, who went to Istanbul in 1531.[455] Some sources say that he died the following year, while others say that he was alive and was a chief in the Turkish navy. He is probably known by the nickname Cazzadiavoli, and this is the same as the Ottoman captain Aydın Reis, who was a subordinate of Kemal Reis and participated in the conquest of Algeria, in 1516. And, Alvise Gritti’s brother Giorgio equipped four galleys for the Ottoman Sultan, in 1533.[456]

At the founding of the navy, Venetian sailors and artisans had many more members. Some came from Venice; others were Venetian subjects of Dalmatian or Greek origin. For example, the Greek Iani, who had worked for the Venetians, in 1498, made two cogwheels for the Ottomans. In the same period, Andrea Dere worked for Captain Davud Pasha. Upon the death of his master, the Venetians tried to persuade Dere to return, but he remained in Istanbul. First, the artisans, on the island of Crete, were interested in new works, in the Sultan’s arsenal. As Leonin, son of Michael of Crete, told the Venetian bailo in 1529, they thought they had a much better prospect of living, under the rules of Ottomans than Venetians.[457] They often compared Venetian and Ottoman fares, and then decided on the best one. The Ottomans knew this and often

[454] Imber, *Studies in Ottoman History and Law*, pp. 30-31.
[455] Maria Pia Pedani, “Ottoman ships and Venetian craftsmen in the 16th century,” in *Ottoman ships and Venetian craftsmen in the 16th century, in Seapower, Technology and Trade in Studies in Turkish Maritime History*, ed. by D. Couto, F. Gunergun, Maria Pia Pedani, 460-464, (Istanbul: Denizler Kitabevi / Kaptan Yayıncılık, 2014), p. 460.
[456] Pedani, “Ottoman Ships and Venetian Craftsmen in the 16th Century,” p. 461.
[457] Pedani, “Ottoman ships and Venetian Craftsmen in the 16th Century,” p. 461.

offered higher salaries than the Venetians. In 1574, the famous Venetian armoury carpenter, Alvise Sara, was offered to go to Istanbul and build large galleys (*galee grosse*). In 1588, the engraver Antonio Paronda worked for Ibrahim Pasha. In addition, other Greeks, who were Ottoman subjects, were also working in the arsenal.[458] For example, in 1554 Michele Bevetto of Rhodes was chief carpenter (*maestro d'ascia*), while Manolo of the same island was the one who determined the basic measure (*dada il sesto*) for each galley built in that arsenal. Even the Suez arsenal sometimes had arrivals from Venice, circa 1534. For example, an unidentified Venetian was making war galleys for the governor, Hadım Suleiman Pasha (1525-1538) (Fig. 53).[459]

[458] Pedani, "Ottoman ships and Venetian Craftsmen in the 16th Century," p. 461.
[459] Pedani, "Ottoman ships and Venetian Craftsmen in the 16th Century," p. 461.

Figure 53. Hadım Suleiman Pasha (1467-1547), 31st Grand Vizier of the Ottoman empire, depicted by Arolsen Klebeband in his book *Die Klebebände der Fürstlich Waldeckschen*, Arolsen Court Library, 1590s, 1,256 × 1,504 pixels, https://doi.org/10.11588/diglit.3863#0469.

Many people, who came to Istanbul from Venice to become sailors or arsenal workers, were exiled from the lands of the Republic. The documents give the names of some of them. In 1525, the admiral of the Ottoman arsenal, the Venetian convert Francesco di Giovanni, sent the bailo to the Pope to ask for a passport for the carpenter Bortolo Mezavolta, who had been exiled for a murder on the territory of the Republic, and wanted to go to Istanbul. In 1534, while the carpenter Francesco dalle Cornare was living in Istanbul, an officer (*sopracomito*) in Giorgio Gritti’s galleys was Giovanni

Mida, who was sentenced to pay Venetian customs. Another naval officer came to town with a group of caulkers and carpenters.[460] While some Venetians willingly went to Constantinople, others were taken prisoner. Some converted to Islam and started a new career in the Ottoman empire. The most famous example of this is the Venetian Hasan Pasha, who became Kapudan Pasha in 1588, and died in 1591. His early name was Andrea Celeste (Fig. 54).[461]

[460] Pedani, "Ottoman ships and Venetian Craftsmen in the 16th Century," p. 461.
[461] Pedani, "Ottoman ships and Venetian Craftsmen in the 16th Century," pp. 461-462.

Figure 54. Venetian Hasan Pasha is generally known as Kılıç Ali Pasha. The date of the oil painting, depicting him, is unknown, date is unknown, Istanbul Maritime Museum, https://islamansiklopedisi.org.tr/kilic-ali-pasa.

Some secrets of the Venetian shipbuilding art were passed to the Ottomans through the master artisans. They worked with navy project builders, such as the humanist Vettor Fausto, who built a famous galleon and a ship (*quinquireme*) with 28 divisions and 5 oars, each with five men on board.[462] Nicolò Frassidonio, one of the people, who worked for him in the 1530s, went to Famagusta, during the Cyprus war. He was captured by the Ottomans, became a Muslim, and started to work in the Ottoman arsenal with a daily salary of 20 akce. He made a small copy of Fausto's 8-oar galleon and was later sent to the Black Sea to build a large galleon. During this period, the Ottomans tried to imitate the Venetians in both ships (*maone*) and light galleys (*galee sottili*). They thought that they had been defeated by such ships, in Lepanto, and that if they wanted to win again, they had to follow the enemy ships and technology. Venetian documents also tell us that Kapudan Pasha's galley, in 1568, had a quinquereme of five men per oar.[463] As can be seen, in *Tersâne-i Âmire*, there were many artisans, who worked in the production of ships, one of the most indispensable nautical instruments of the early modern period. Most of them were artisans from different countries, and they were assigned to train new artisans.

Conclusions

As seen in this chapter, maritime imperatives encouraged an entirely different scientific tradition, due to the vastness of the Ottoman borders on the Mediterranean coast. Therefore, after the conquest of Constantinople in the 15th century and in the 16th century, the Ottoman Empire's scientific culture developed in a different discipline than other Mediterranean countries, but these developments were made for the same purpose. As we mentioned in the first chapter, this chapter, which is significant to see how the artisans, the most effective intermediaries of the early modern period, contributed to scientific and technological developments in the Ottoman Empire, is necessary to understand their working mechanisms.

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[462] Pedani, "Ottoman ships and Venetian craftsmen in the 16th Century," p. 462.
Type of oared warship.
[463] Pedani, "Ottoman ships and Venetian craftsmen in the 16th Century," p. 462.

The conquest of Istanbul, in 1453, was a turning point for the Ottoman naval power. It is momentous to see *Tersâne-i Âmire*, which was established as a practical institution, and the works of artisanal pirates and sailors. This institution can be defined as the first place, where modern science was applied in Istanbul. Maritime, which was seen as a good way to implement conquest policies in the Mediterranean, increased the interest in shipbuilding works and technology in the Ottoman Empire. Shipbuilding continued in the periods, after Sultan Mehmed established *Tersâne-i Âmire*. To be an effective manager in the technology of the ships produced and the navy created in the shipyard, they turned to the pirates and artisans of the period, who were well versed in maritime, and created a different tradition by asking these people to train artisans in the shipyard. It is also seen that developments, made by applying knowledge based on experience, are successful.

CHAPTER 4

Tersâne-i Âmire's Artisans and Ships Manufacture

Especially, after the 16th century, tremendous developments, in ship technology, which was nautical instruments of early modern period, begin. Even though each ship has a certain background, it has created a very arduous situation for the parties' producing ships, in the Mediterranean, to follow each other's ship technologies, namely technology transfers, conceptually. When the technical applications of the same ship, in different shipyards, are added, it has become impossible to distinguish the variations of a ship, even within the same century, let alone periods. To have its own ships and fleets, the Ottomans built shipyards, and produced similar ships, like other nations'.[464] The ships produced in Ottoman navy, in the 16th century, were the göke, barça, galleon, galley, and other small ships. It is necessary to mention the following some types of ships, used in wars.

Until the beginning of the 16th century, it is determined that the Ottoman ship technology mostly experienced a formation process and reflected a transitional feature. In this period, we see that the Ottoman navy gave stature to the galley type ships, which were traditionally common, in the Mediterranean, and mainly moved with oars, like Venice. However, we see that the Ottoman empire took an example, the ship technology of Spanish empire, which had ocean experience from time to time, and saw them as biggest rival in the Mediterranean.[465] As a result of this, the Ottomans also gave emphasis to the barca-type large sailing ships called "göke". This formation process continued, until Hayreddin Barbarossa was appointed as the Kapudan Pasha in the Ottoman navy, in 1534. The Ottomans, who mainly applied the Venetian shipbuilding techniques, made some changes in this field together with him. Barbarossa Pasha, who added his own knowledge and skills to the Ottoman ship technology, left its mark on this new era. Barbarossa and his men were not only sailors, during their long years of navigating the seas, they also specialized in ship repair and

[464] Sütçüoğlu, *Piri Reis'in Gemileri*, p. 33.
[465] Idris Bostan, "Kadırga'dan Kalyon'a XVII. Yüzyılın İkinci Yarısında Osmanlı Gemi Teknolojisi'nin Değişimi," *Osmanlı Araştırmaları*, 24 (2004): 65-86, p. 68.

construction by examining in detail the Spanish galleons, Naple's galleys and large trade barges belonging to various nations.[466]

Barbarossa believed that the *çektiri* were the most effective warships.[467] Because even if the big sailing ships sailed faster, when the wind was blowing, they were almost motionless in the stagnant weather of Mediterranean summer. Also, these ships were not suitable for use in bays and small ports like oar-weighted galleys. During the war, they were not move quickly and not catch up the enemy ships. This preference was especially maintained and adopted by the Ottoman sailors, and the Barbarossa school has always been influential. The claim that Ottoman ship technology could not keep up with the developing European maritime, cannot be resolved without taking this matter into account (Fig. 55).[468]

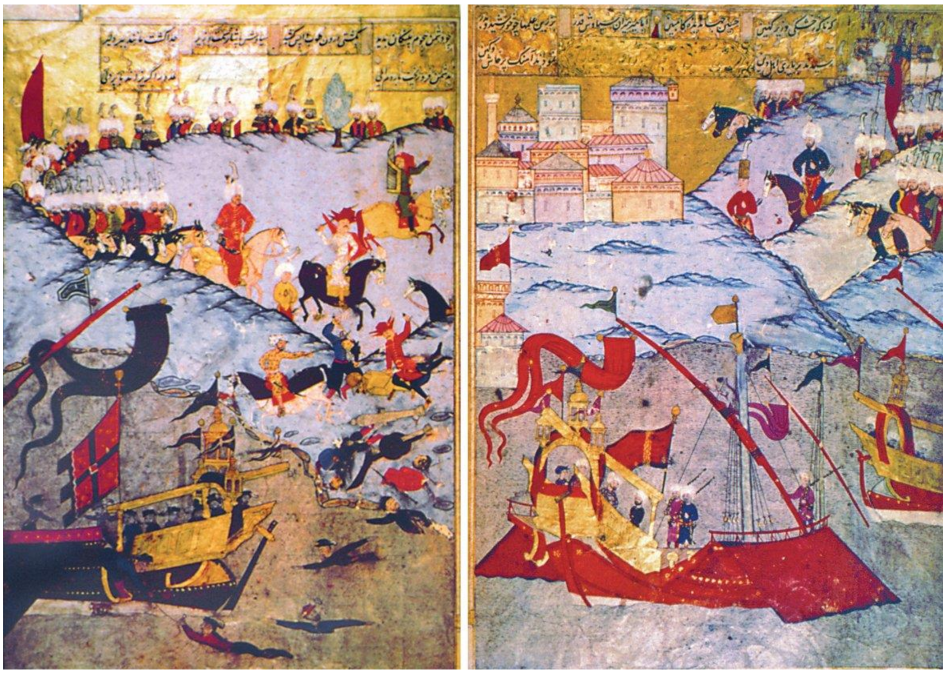

Figure 55. Two pages with miniatures depicting the battle of Navarino (*Şehnâme-i Selîm Han,* TSMK, III. Ahmed, nr. 3595, vr. 128b-129a), https://islamansiklopedisi.org.tr/navarin. This miniature shows that the Ottoman Sultan's entrance to Navarino with his soldiers and navy is shown. If we look at the characteristics of the ships produced in the period I mentioned, these ships are the göke, galleon, galley and other small ships. Examining these ships in detail can be useful to understand the technical situation of the period.

[466] Bostan, "Kadırga'dan Kalyon'a XVII. Yüzyılın İkinci Yarısında Osmanlı Gemi Teknolojisi'nin Değişimi," pp. 68-69.
[467] A class of ships that are both oared and sailing.
[468] Bostan, "Kadırga'dan Kalyon'a XVII. Yüzyılın İkinci Yarısında Osmanlı Gemi Teknolojisi'nin Değişimi," p. 69.

4. 1. Göke (Cog/Cocca/Kuka), the Ottoman Traditional Ship

The göke, was produced by Sultan Bayezid's order to build 'agile ships like sea snakes (*niheng-i âheng ships*)'.[469] There is an annotation on the göke drawing, which belongs to the original of the work, as 'it is the image of the göke that Sultan Bayezid Khan had built'.[470] This ship is like a short-lived test product in Ottoman naval history.[471] Göke was a tow class warship with oars and sails. According to Haji Khalifeh, the bottom of the *göke* was a barge and the top was a galleon.[472] While Matrakçı Nasuh refers to these ships as barca, Ferdowsi writes that the ships are oars and sailboats (Fig. 56, 57, and 58).[473] In 1488, in the navy, under the command of Hersekzâde Ahmed Pasha, which was prepared for the war with the Mamluks, there were gökes, as described by Tursun Bey, 'with their masts resisting the sky'. And when he sailed away, it looked like a tent had been set up in the sea. There were balls and darbzens in these gökes.[474] These ships were built, under the supervision of Kemal Reis and Burak Reis, as only 2 ships. According to Mustafa Âlî of Gallipoli, each of the two ships built, in 1499, was 26 feet long and 13 feet wide barge, and each had a thousand soldiers. Kemal Pashazade mentions this göke, as barca, and wrote that they look like dark clouds, which they had white sails, and that, in their banners, were gilded flags (Fig. 59).[475]

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[469] Brummett, *Osmanlı Denizgücü ve Doğu Akdeniz'de Diplomasi*, p. 136.
[470] Sütçüoğlu, *Piri Reis'in Gemileri*, p. 35.
[471] Sütçüoğlu, *Piri Reis'in Gemileri*, p. 33.
[472] Bostan, *Kürekli ve Yelkenli Osmanlı Gemileri*, p. 269.
[473] Matrakçı Nasuh, *Târih-i Sultan Bayezid*, trans. Mertol Tulum (Istanbul: Arvana Yayınları, 2015), p. 71.
Barca (barça) is a flat-bottomed, two or three masted sailing warship. It was used for warfare, until the early 16th century, but later, used only for transport. ("Barca," Ansiklopedika accessed October 13, https://ansiklopedika.net/osmanlida-yelkenli-gemilerden-barca-gemisi.html).
[474] Bostan, "Fatih Sultan Mehmet ve Osmanlı Denizciliği," Vol. I, pp. 335-336.
In wars, it is called cannons about 6-7 meters long, used to destroy the castle walls, throwing stone cannonballs.
[475] Bostan, "Fatih Sultan Mehmet ve Osmanlı Denizciliği," Vol. I, pp. 335-336.

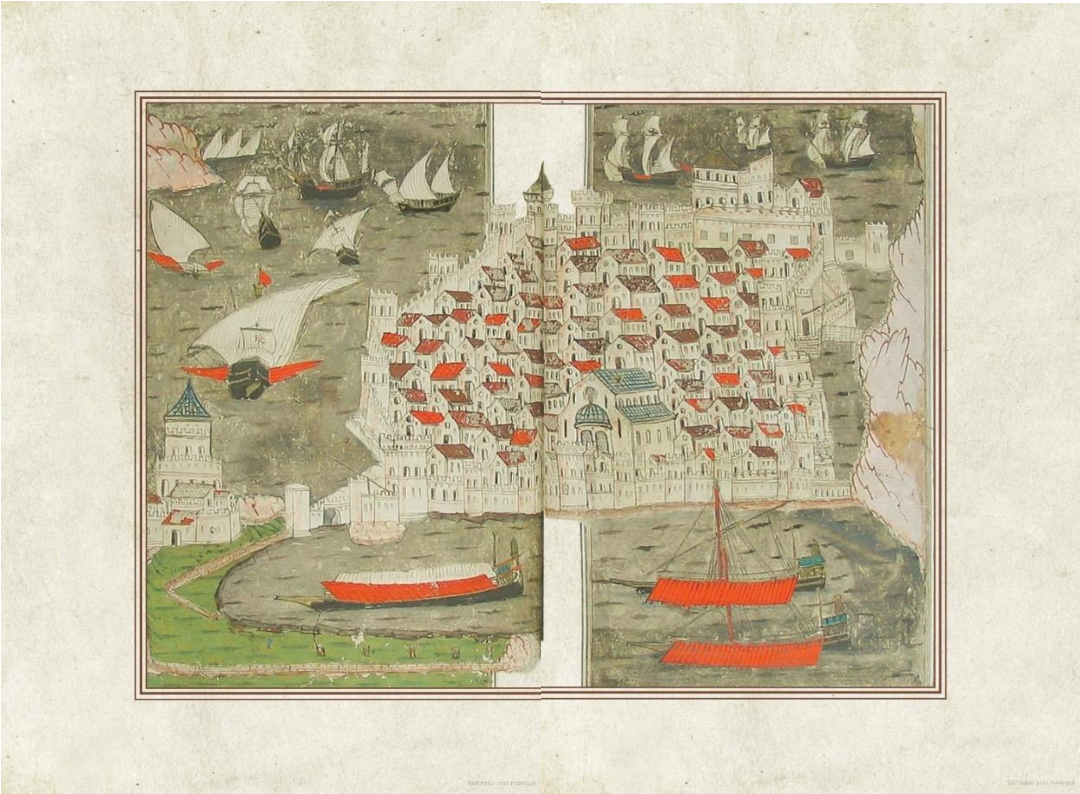

Figure 56 and 57. The ships in Matrakçı Nasuh's depiction of Modon Castle and Hisar Harbour in his work, titled *Târih-i Sultan Bayezid*, 1551. Matrakçı Nasuh, *Târih-i Sultan Bayezid*, vr. 24b-25a, 1540. https://www.google.com.tr/books/edition/Matrak%C3%A7%C4%B1_Nasuh/mEthEAAAQBAJ?hl=tr&gbpv=1&pg=PA419&printsec=frontcover.

Figure 58. Göke from Nasuh's depiction, Matrakçı Nasuh, *Târih-i Sultan Bayezid*, 1551, vr. 25a, 1540.

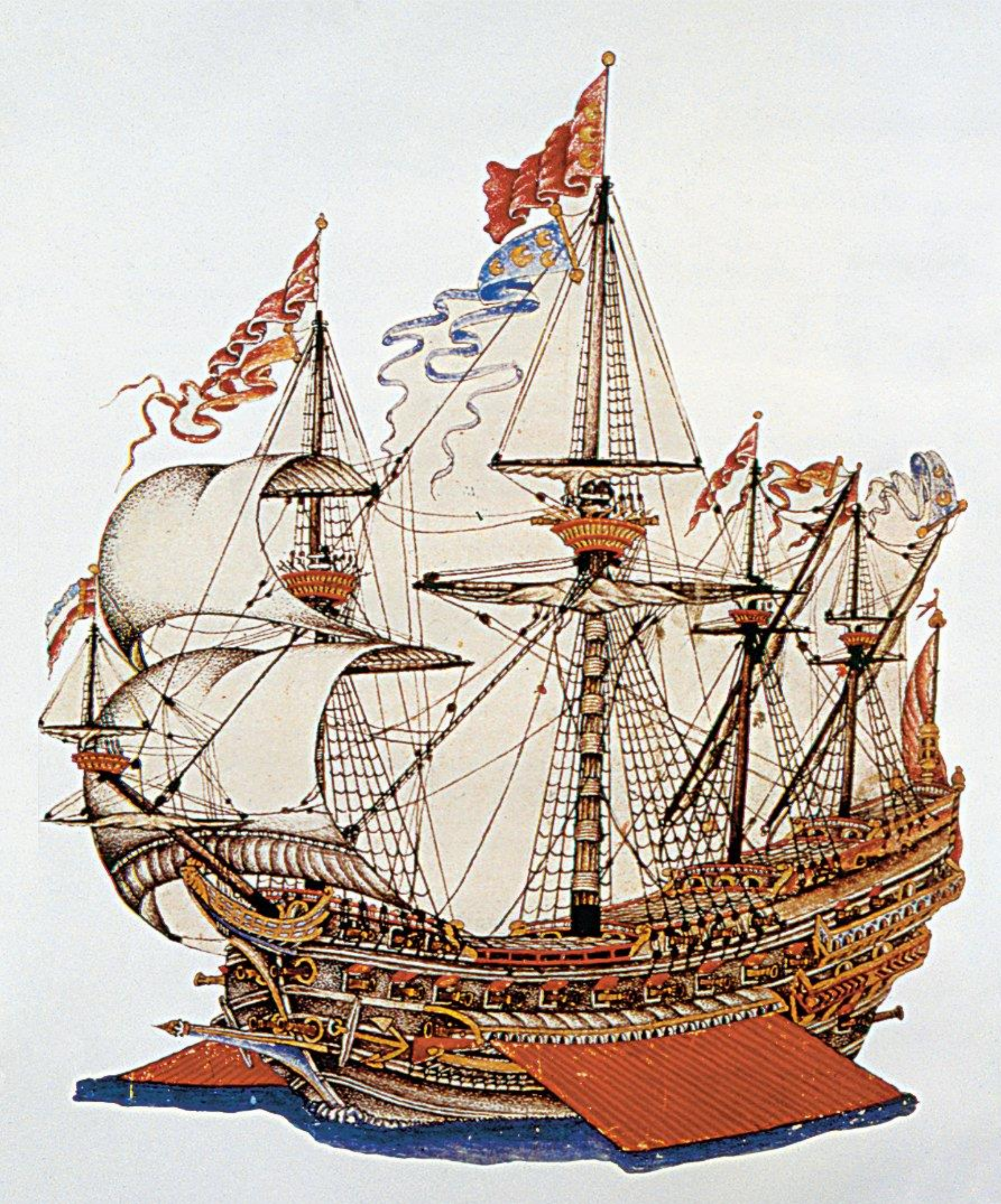

Figure 59. Depiction of a "Göke" from the period of Sultan Bayezid II. According to Haji Khalifeh, the bottom of the *göke* was a barge and the top was a galleon. Kâtip Çelebi, *Tuhfetü'l-kibâr fî esfâri'l-bihâr*, 1669, Topkapi Palace Museum Library, Revan Mansion, nr. 1192, vr. 17a, https://islamansiklopedisi.org.tr/gemi.

Haji Khalifeh, in his book *Tuhfetü'l-kibâr fî esfâri'l-bihâr* (The Precious Gift of the Elect, 1729), which is one of the most exceptional sources about the Ottoman maritime history, describes the Ottoman ships called "göke" as follows:[476]

> They had built two göke, each of which was 70 'zirâ's in length, and thirty ziras in width. And the span was formed by gathering and winding several trees. The diameter of its circle was four ziras. It was easy for forty armed warriors to sit around the göke, and fight with arrows and rifles. Workers and masters were among the Sultan's own men. While the equipment and tools used were from the Ottoman country, twenty thousand flori was spent on each. According to some experts, the architect of these göke was a master, named Yani. He had learned how to make these in Venice.[477]

In addition to the many galleys in the navy, during the reign of Bayezid II mentioned, there were two large 'göke', or round ships, seventy cubits long and thirty cubits wide.[478] They were built by an Italian (or Greek) shipbuilder, named Gianni or Yani, who had learned his art in Venice.[479] The ships had two decks. Next to each of them were two portholes into which, according to tradition, huge cannons were placed. Along the upper deck was a net with twenty-four oars on either side, each drawn by nine men. The backs of the ships resembled those of a galleon. Each of these ships contained two thousand soldiers and sailors. The command of one was given to Kemal Reis, and the other was given to Barak Reis.[480]

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[476] Kâtip Çelebi, *Deniz Savaşları Hakkında Büyüklere Armağan* (Istanbul: Kabalcı Yayınevi, 2007), p. 36.

[477] Çelebi, *Deniz Savaşları Hakkında Büyüklere Armağan*, p. 36.

[478] Isom-Verhaaren, *The Sultan's Fleet*, chap. 4, para. 17.

[479] Kahane's and Tietze, *The Lingua Franca in the Levant*, p. 12.

[480] Isom-Verhaaren, *The Sultan's Fleet*, chap. 4, para. 17-18-19.

Figure 60. Part of the Ottoman–Venetian War of 1499–1503, Battle of Zonchio; a sea battle between three large Venetian and Turkish carracks, labelled "Nave Loredan, Nave Turchesca and Nave Del Armer," with numerous smaller vessels around them. Engraving, dated 1499, was coloured by stencil, and hand printed from two blocks on two joined sheets of paper, production date: 1499-1500, British Museum, number: 1932,0709.1, https://www.britishmuseum.org/collection/object/P_1932-0709-1.

This visual is the Battle of Zonchio or Sapienza painting on the critical moment when Andrea Loredan and Alban d'Armer attacked Burak Reis' göke (Fig. 60). The inscription 'Chmali' on the figure, on the deck, is a reference to the Venetians' thinking that this ship belonged to Kemal Reis. In this picture, which is the first visual evidence of the use of cannons in a naval battle, the soldiers hold arrows, not rifles.[481] The fires that ended the war, seem to have spreading all three ships.[482]

A similar type of ship used in the Ottoman empire was the "Barça". As mentioned above, the term barça was used for *göke* in some texts from the 15th and 16th centuries.[483] Barça was a galleon type, flat-bottomed, two and three-masted

[481] Gürkan, *Sultanın Korsanları: Osmanlı Akdenizi'nde Gaza, Yağma ve Esaret, 1500-1700*, p. 107.
[482] Guilmartin, *Kalyonlar ve Kadırgalar*, p. 79.
[483] Bostan, *Kürekli ve Yelkenli Osmanlı gemileri*, p. 274

transport and warship (Fig. 61 and 62).[484] These ships were used in the Mediterranean between the 15th and 18th centuries (Fig. 63).[485] Due to their use in warfare, they had a capacity of approximately 83 cannons. Just as there were barça in the navy that went to Rhodes, there were also two barças in the navy that was left in the Rhodes enclosure in 1524. The fact that eight barças were repaired in the Galata Shipyard in 1527 shows that there were many barças in the Ottoman navy at the beginning of the 16th century.[486]

Figure 61. Barça from Haji Abu al-Hasan's portolan chart (1500-1550), https://medea.fc.ul.pt/view/chart/5807.

Figure 62. Barça from Haji Abu al-Hasan's portolan chart (1500-1550), https://medea.fc.ul.pt/view/chart/5807.

[484] Uzunçarşılı, *Osmanlı Devleti'nin Merkez ve Bahriye Teşkilatı*, p. 469.
[485] Kahane's and Tietze, *The Lingua Franca in the Levant,* pp. 98-99.
[486] Bostan, *17. Yüzyılda Tersâne-i Âmire*, p. 148.

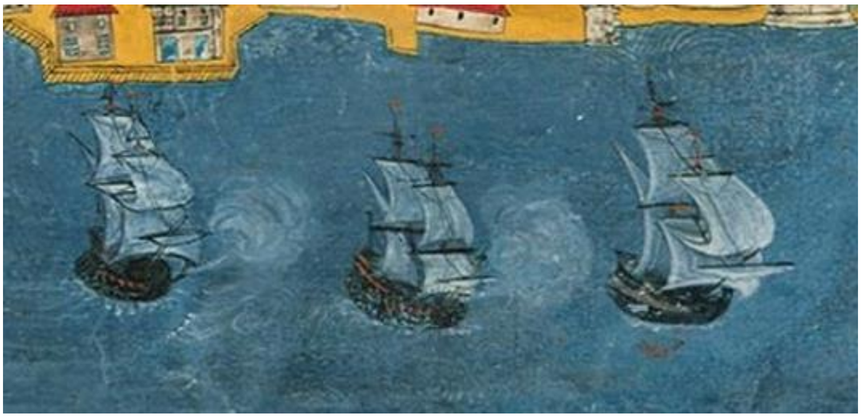

Figure 63. Barça from Matrakçı Nasuh's depiction of Istanbul in *Beyân-ı Menâzil-i Sefer-i Irakeyn-i Sultan Süleymân Han* (1537), Matrakçı Nasûh, Nasûh b. Karagöz Abdullah el-Priştinevî. *Beyân-ı Menâzil-i Sefer-i Irakeyn-i Sultan Süleymân Han*, https://portal.yek.gov.tr/works/detail/409390.

4. 2. Ottoman Galleon

Galleon was a two or three masted warship with sails and oars.[487] The word has been Turkified from Latin, and its pronunciation is closer to the Italian word 'galion' (Fig. 64). Galleons were mostly used in transportation from the beginning of the 16th century to the middle of the 17th century. They were finally developed at the beginning of the Cretan campaign (1645) and joined the navy as warships. Although the galley was the backbone of the Ottoman navy, the use of the galleon dates to ancient times.[488] Although galleon or similar type of ships were used, as both warships and merchant ships, this situation did not become widespread. The Ottomans, first, built the galleon, during the reign of Bayezid II. In the period of Sultan Suleiman, galleons, similar to the carracks of the Venetians, were built. Since these ships were sailing ships, it was difficult to advance in windless weather. Because of this, the production of galleons was reduced, and more emphasis was placed on *cektiri*, which are oars and sailing ships.[489] The galleon is a large ship with a size of 43 to 64 cubits, so it has a large crew (Fig. 65). Information, on the first use of galleons, in the navy, is very

[487] Çelebi, *Deniz Savaşları Hakkında Büyüklere Armağan*, p. 208.
[488] Bostan, *Kürekli ve Yelkenli Osmanlı Gemileri*, p. 278.
[489] Uzunçarşılı, *Osmanlı Devleti'nin Merkez ve Bahriye Teşkilatı*, p. 469.
Çektiri class ships were widely used in warfare and trade, especially in the 16th century.

limited (Fig. 66). It is understood that the large type of galleon and barca that went to Egypt, in 1554, were commercial ships used for transportation. In 1568, each of the three shipping galleons, in Egypt, could carry 500 passengers.[490]

Even though the galley was the backbone of the Ottoman navy, the use of the galleon dates to ancient times. Galleons were used both as warships in the navy and as merchant ships in transportation, but this situation never became widespread.[491] The galleon, as its name indicates, was of Spanish origin. Since the ships were incapable of manoeuvring and could not move quickly, the efforts of naval artisans, from the middle of the 16th century, added new features that gave these large ships superiority.[492] The galleon's superior size and artillery made it more effective, as a warship than a galley. It was much more heavily armed, and could be fired on the broadside, whereas rowing ships could be only ignited from the bow.[493]

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[490] Bostan, "Fatih Sultan Mehmet ve Osmanlı Denizciliği," Vol. I, p. 336.
[491] Bostan, "Kadırga'dan Kalyon'a XVII. Yüzyılın İkinci Yarısında Osmanlı Gemi Teknolojisi'nin Değişimi," pp. 68-69.
[492] Bostan, "Kadırga'dan Kalyon'a XVII. Yüzyılın İkinci Yarısında Osmanlı Gemi Teknolojisi'nin Değişimi," p. 66.
[493] Imber, *Studies in Ottoman History and Law*, pp. 4-5.

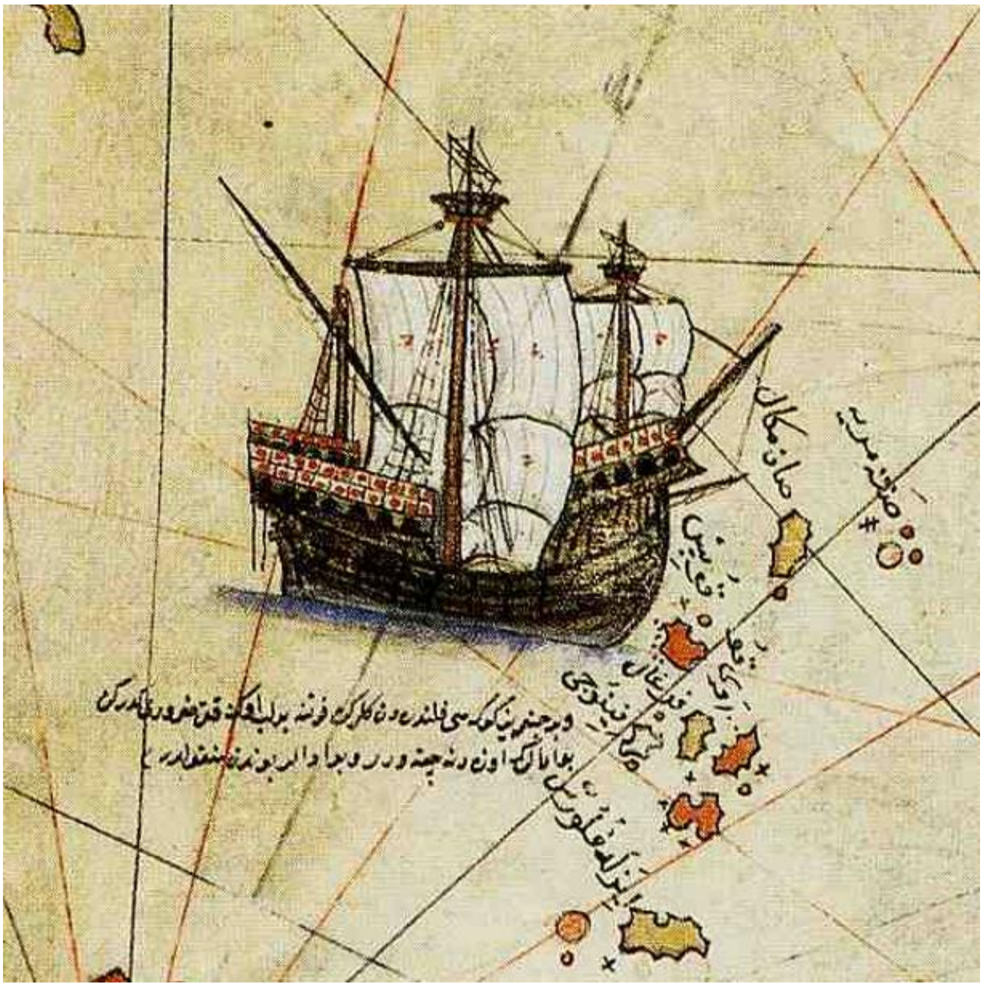

Figure 64. Galleon from Piri Reis' portolan chart, dated 1513, (Topkapi Palace Museum Library, Revan Mansion, nr. 1633), https://www.dzkk.tsk.tr/Genel/icerik/piri-reis-1465-1554.

Figure 65. Galleon from Matrakçı Nasuh's depiction of Istanbul in *Beyân-ı Menâzil-i Sefer-i Irakeyn-i Sultan Süleymân Han* (1537), Matrakçı Nasûh, Nasûh b. Karagöz Abdullah el-Priştinevî. *Beyân-ı Menâzil-i Sefer-i Irakeyn-i Sultan Süleymân Han*. Ankara: 1976. https://portal.yek.gov.tr/works/detail/409390.

Figure 66. Ottoman sailor in charge of the galleon. The galleon man, seen in the depiction, belongs to the class that does not have a permanent position in the navy. These people had recruited into the navy in a number determined by Kapudan Pasha and the shipyard officials, Mahmud Şevket Pasha, *Osmanlı Teşkilât ve Kıyâfet-i Askeriyyesi* (Ottoman Organization and Military Uniforms), 1902-1903, 37.5 x 48 cm, Istanbul University Library, nr. 9391, https://islamansiklopedisi.org.tr/kalyoncu.

4. 3. Galley, The Traditional Warship of the Mediterranean

Galleys, the traditional warship of the Mediterranean, with a background dating back to the Antiquity, were also the basis of the Ottoman navy.[494] The Ottomans, who were following their rivals, such as Spain and Venice, adopted the standard ship technology of the Mediterranean, and made the galley, the main ship of their navy.[495] These ships, which were widely used in the Ottoman navy, continued to be popular, until the Battle of Lepanto in 1571, which was considered the last galley war (Fig. 67). After this war, they continued to be used by the Ottomans for two more centuries.[496] Galley fleets were choice for sailing, in the spring and summer raid, lay siege, and engage in battle with another fleet. Operations, in the fall and winter, were the exception, usually carried out over shorter distances and with fewer ships.[497]

Figure 67. Battle of Lepanto**,** painting by an unknown artist, date made late 16th century. The Battle of Lepanto, October 7, 1571, in which the fleets of Spain, Venice, and the Papal States defeated the Turks, in the last great sea battle involving galleys; in the National Maritime Museum of London, https://cdn.britannica.com/68/122068-050-FACF29D2/Battle-of-Lepanto-fleets-galleys-Turks-Venice-October-7-1571.jpg.

[494] Uzunçarşılı, *Osmanlı Devleti'nin Merkez ve Bahriye Teşkilatı,* p. 462.
[495] Gabor Agoston, "Ottoman Military and Naval Power in Comparative Perspective: Before and After Lepanto," *Turkish Journal of History,* Vol. 76 (2022): 1-19, p. 11.
[496] Sütçüoğlu, *Piri Reis'in Gemileri*, p. 68.
[497] Guilmartin, *Kalyonlar ve Kadırgalar*, p. 45.

Political ideals of states fostered the early development of Mediterranean maritime trade and specialized warships. For, as Guilmartin points out, in his book, *Galleons and Galleys* (2010), there is credible evidence that from the outset the design of seaworthy ships, in Europe, tended towards two extremes: round ships for trade and long ships for war. In post-classical times, this trend found its final expression, in the Mediterranean war galley, a highly refined design that developed as an integral part of a system of warfare, and trade that was oddly adapted to the Mediterranean.[498] Pryor states that Ottoman and European galleys were, predominantly, divided into two. He said that Ottoman galleys had a reputation for being lighter and smaller, lower in the water and faster in sail, but slower under oars than European galleys.[499] The galleys are as low as tall, and almost resemble a giant swordfish. The main reason, why these ships were built in a low form, was the slope between the oars, and the impact surface of the sea. The cause that the galleys, were designed in proportion to this inclination, was to make maximum use of the kinetic propulsion energy gained by the landing of the oar.[500] They were not dependent on wind power and were not affect much by currents. The galleys, which could be used as attack ships with their high manoeuvrability, could be used, when soldiers landed on enemy galleys, and in amphibious operations, which the Ottomans were experts in. Lighter and faster galleys were the ships of choice for plunder, in the Mediterranean, and Black Seas, but the Ottomans also used hundreds of such vessels in their river fleets.[501] In Ottoman galleys, 196 oarsmen pulled each oar of the galley in four or five persons. The galley crew totalled 330, including the captain, sailors, and warriors.[502] We also see, in the picture, depicting the battle of Lepanto that many oars are used on the ships.

The Malta expedition of 1565 also provides an excellent case study for understanding the logistics of galley warfare. Galleys were narrow, low-lying vessels propelled by oars, with several bow-mounted cannons. This method of propulsion was both their strength and their weakness, because by rowing, the ship could still move, if

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[498] Guilmartin, *Kalyonlar ve Kadırgalar*, p. 45.
[499] Pryor, *Geography, Technology, and War: Studies in the Maritime History of the Mediterranean, 649-1571*, p. 68.
[500] Gürkan, *Sultanın Korsanları: Osmanlı Akdenizi'nde Gaza, Yağma ve Esaret, 1500-1700*, p. 110.
[501] Agoston, "Ottoman Military and Naval Power in Comparative Perspective: Before and After Lepanto," p. 11.
[502] Uzunçarşılı, *Osmanlı Devleti'nin Merkez ve Bahriye Teşkilatı,* p. 462.

there was no wind.[503] For example, in the battle of Preveza, Hayreddin's galley fleet succeeded in sinking the ships, with the cessation of wind, and the sailing ships were stopped at the entrance of the Gulf of Preveza. At the same time, the disadvantage outweighed this advantage by the large number of men on the oars, and the fact that these men took up most of the space in the galley. Therefore, the supply storage space was limited, and the need for supplies was very high, due to the large number of men.[504]

During the 16th century, the nature of galley warfare evolved, as the Ottomans and their Habsburg opponents fought for supremacy in the Mediterranean. Both the Ottomans and the Habsburgs continued to use the galleys, but they were less effective strategically in battle, that is, as they were modified to be more tactically effective, their range reduced.[505] Also, galleys began to carry more cannons and were slightly larger.[506] Guilmartin stated:

> The increase in the size of a galley, with the proportional increase in fighting manpower, led to a marked and direct increase in combat power, as the number of oarsmen grew disproportionately. In other words, more oarsmen were needed to propel this larger ship. This meant that the galleys increased slightly in size, but greatly increased the number of men on them. This has affected the galley fleets.[507]

Because there was less storage space per person for water and other supplies. Thus, fleets could not travel as far as in the past, as there was less room for their necessary supplies. This had always been a disadvantage of galley fleets. This affected even Barbarossa when he sailed to France in 1543.[508]

Before 1550, the average number of oarsmen per galley was 144, but at the battle of Lepanto, there were 200 oarsmen per galley on Spanish galleys. The flagships of the fleets carried enormous numbers of men. Don Juan's ship had 420 rowers and 400 arquebusiers.[509] The Ottoman admiral Müezzinzade Ali, who was brought to this

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503 Isom-Verhaaren, *The Sultan's Fleet*, chap. 5, para. 54.
504 Isom-Verhaaren, *The Sultan's Fleet,* chap. 5, para. 54-55.
505 Guilmartin, *Kalyonlar ve Kadırgalar*, p. 130.
506 Isom-Verhaaren, *The Sultan's Fleet*, chap. 5, para. 79.
507 Isom-Verhaaren, *The Sultan's Fleet*, chap. 5, para. 79.
508 Isom-Verhaaren, *The Sultan's Fleet*, chap. 5, para. 79.
509 Isom-Verhaaren, *The Sultan's Fleet*, chap. 5, para. 79.
The arquebus is a type of barrel-loading rifle used between the 15th and 17th centuries.

position with the influence of the palace rather than his expertise, had 300 janissaries and 100 arquebusiers on his ship. More men on sea voyages meant more biscuits to feed them. Biscuits had been problem, before in 1543 and 1565. More men meant more supplies, more balls, more money. Eventually, galleys would be replaced by sailing ships. This was not because they were better at war, sailing ships that did not need human muscle to propel them, could sail farther places, as the galleys' range continued to shrink. Also, sailing ships could carry much more artillery, and provided a more solid platform, on which to mount it.[510]

The galley had some advantages. It was fast and manoeuvrable, and because it was low on the freeboard, and had a shallow draft, it could operate close to the shore, and was not visible from very far away. These features made it very useful as a pirate ship. First, he did not trust the wind, and could move on calm days, when the galleons were still.[511] For instance, because of this benefit of galley, Barbarossa had the galleys black and low. Because, in this way, the galleys were waiting in the sea, without being seen from afar, for making sudden attacks.[512] In a mixed fleet, an oared galley can tow a stationary or crippled galleon. In this respect, the Armada galleys proved their worth, although they were not very useful as warriors.[513]

It was indeed the galley's shortcomings that determined the course of the war in the Mediterranean. With its long form and shallow draft, the galley could not withstand the storms. The sailing season was limited to the summer months, as a fleet could not sail safely in the winter.[514] The Ottoman imperial navy set sail on Nowruz, usually on the Iranian New Year's Day, which coincided with the vernal equinox, and returned to base in October or early November. Only a few patrol ships remained at sea, in the winter. This was standard practice for all Mediterranean galley fleets.[515]

Galley warfare had not only a limited season, but also a limited range. The crew of the galley was huge compared to the size of the ship. A standard ship had twenty-

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510 Isom-Verhaaren, *The Sultan's Fleet*, chap. 5, para. 79.
511 Imber, *Studies in Ottoman History and Law*, p. 5.
512 Nejat Tarakçı, *Deniz Gücünün Osmanlı Tarihi Üzerindeki Etkileri* (Istanbul: Deniz Basımevi, 2009), p. 34.
513 Imber, *Studies in Ottoman History and Law*, p. 5.
514 Imber, *Studies in Ottoman History and Law*, p. 5.
515 Imber, *Studies in Ottoman History and Law*, pp. 5-6.

five rowers on each side and three rowers at each obstacle, for a total of 150 rowers. The officers on board were much less, perhaps ten. In about 1560 the Ottoman galleys each seem to carry about sixty soldiers, but by 1572 the government was concerned that each galley was carrying 150 fighters.[516] Therefore, an average-sized ship could carry more than 200, and perhaps even 300, men. As a result, a fleet consumed an enormous number of supplies. The government had to plan to procure a fleet from land or separate supply ships acting with the fleet. These support ships could return to a predetermined point on the shore to collect supplies, if necessary, such as when a ship returned to load supplies at Lepanto, during the siege of Malta in 1565. However, a fleet of galleys could not be fed, if it was too far from its shore and the sea routes were unsafe.[517] Prior to the Djerba expedition in 1560, Ogier Ghislain de Busbecq reported the alarm the Ottoman galley crew felt, when they were operating this far from their home base against a daredevil enemy.[518] Under these circumstances, it is not surprising that the Ottoman Navy never dominated the western Mediterranean, and the Habsburg fleet never dominated the eastern part of this sea.[519]

The Ottoman navy was not much different from that of its Mediterranean rivals, and Ottoman shipbuilders faithfully followed the minor changes in galley design, in the 16th century. In the first decades of the century, Mediterranean galleys were vulnerable. So, each rower in an obstacle rowed a separate row. Normally there were three rowers in a barrier, so the rows of rows of three were arranged. From about 1540 the Venetians began to adopt the *Alla Scaloccio,* the galley in which all rowers at an obstacle shovel the same oar. In a galley of twenty-five barriers, there were seventy-five oars on each side.[520] There were twenty-five people in a similar galley at *Alla Scaloccio*. In 1543, the Ottomans continued to use galleys, also known as sensile, as the miniatures of Matrakçı Nasuh clearly demonstrate (Fig. 68).[521] By 1571 they were using *Alla Scaloccio* galleys, as various pictures of the battle of Lepanto show. The change occurred perhaps after 1560, when a Venetian envoy reported that the Ottomans

516 Imber, *Studies in Ottoman History and Law*, p. 6.
517 Imber, *Studies in Ottoman History and Law*, p. 6.
518 Imber, *Studies in Ottoman History and Law*, p. 6.
Ogier Ghiselin de Busbecq was a Dutch diplomat who served for the Austrian Monarchy. At the same time, he wrote ‘Turkish Letters’, one of the most authoritative sources about 16th century Istanbul.
519 Imber, *Studies in Ottoman History and Law*, p. 6.
520 Imber, *Studies in Ottoman History and Law*, p. 6.
521 Ottoman historian and mathematician (d. 1564).

were experimenting with various arrangements of oars. For most of the 16th century, the standard galley had a single mast. Around 1600, it usually had a pair of masts, and Ottoman shipbuilders did the same as needed.[522]

It can be said that the Venetian and Ottoman shipyards were similar, in terms of technology, due to the close attention that the Ottoman authorities showed to their finished products. Because galleys, which were still instrument in the Mediterranean war, until the mid-1600s, were relatively standardized. Once the most efficient ways, to manufacture them, were discovered, they quickly spread from one shipyard to the next.[523]

Figure 68. The type of galleys, used by the Ottoman navy, can be seen on the pages of Matrakçı Nasuh's book, *Târîh-i Sultan Bayezid* (1551), where the Lepanto Castle is depicted. Topkapı Palace Museum Library, Revan Mansion, nr. 1272, vr. 21b- 22a, https://islamansiklopedisi.org.tr/matrakci-nasuh.

[522] Imber, *Studies in Ottoman History and Law*, pp. 6-7.
[523] Faroqhi, "Artisans of Empire," Chap. 3, para. 1.

The galley, which the Venetians first added to their fleet in Lepanto, in 1571, was a novelty among Mediterranean warships (Fig. 66).[524] When Venice began to build a fleet to counter the Ottoman attack on Cyprus, the shipbuilders of arsenal converted ten commercial galleys into warships. It was an improvisation, but still quite successful. Merchant galleys were bulkier than war galleys, but they were wider. Shipbuilders could equip extra weapons, including cannons that could fire wide flanks. The extra height also allowed ships to prevail ordinary war galleys in battle.[525] Mark Antony Colonna, the Roman commander of the Allied navy, when he replied, in 1570, to objections to his plan to follow the Ottoman navy, he indicated the potential of these ships, that were rising above enemy, like fortresses. The battle of Lepanto, the following year, justified his optimism. The galleass played a momentous role in the victory of the Holy League. The galleass's technology was conservative, and it was a ship that the Ottomans could easily imitate. In the winter following the defeat at Lepanto, the imperial council instructed the arsenal's chief shipbuilder to build a ship that would have to "move with oars and fire cannons from behind, from the bow and from the sides" without harming the oarsmen.[526] When Admiral Uluj Ali approved the plans, the arsenal in Sinope built three new ships and the Istanbul arsenal one or two new ships. And from 1572, the galleass formed a regular part of the Ottoman navy (Fig. 69).[527]

[524] Imber, *Studies in Ottoman History and Law*, p. 7.
[525] Imber, *The Ottoman Empire*, p. 294.
[526] Imber, *The Ottoman Empire*, p. 294.
[527] Imber, *The Ottoman Empire*, p. 294.

Figure 69. Painting depicting an Ottoman galley from the Album of Hüsnü Tengüz, 1900s, Istanbul Maritime Museum, nr. 578, vr. 4a, https://islamansiklopedisi.org.tr/gemi.

Conclusions

After the 16th century, it is seen that major production activities were carried out in ship technology, the maritime tools of the early modern period. Although each ship has a certain history, it is seen that ship producing parties in the Mediterranean follow each other's ship technologies, that is, technology transfers, conceptually. To have their own ships and fleets, the Ottomans, like other nations, built shipyards and produced similar ships. The ships produced in the Ottoman navy in the 16th century were göke, barça, galleon, galley, and other small ships. Produced in the early modern period, these ships were made by the classes of artisans, mentioned above. It is made by artisans, who are experienced in carrying out these production activities. The contribution of the artisan to Ottoman technological production can be seen here. And most importantly, the artisanal pirates oversee these production activities and mechanisms.

Conclusions of Part 2

The conclusions that can be drawn from this part, the political aims of the states made it necessary for them to turn to technological developments. States needed nautical instruments to expand their borders in the seas, seek commercial markets, protect their ports, and sail to the seas. For these purposes, they turned to instruments of nautical science. When the states turned their faces to the seas, they first needed shipbuilding technology and artisans, who would produce these technologies. At this point, it can be said that the Ottoman empire developed and changed the scientific and technological improvements that it followed and incorporated into its structure by adding something from its identity.

When we look at Mehmed the Conqueror's period, we see that the interest in maritime technology forms a basis for the future periods. With Sultan Mehmed's interest, developments of the shipyards were a starting point and a light, in maritime, for in the Ottoman empire. It was a beginning in aiming the expansion of the empire's lands, in understanding the significance of the navy in trade.

It can say that the period of Sultan Bayezid II was a period of great progress in Ottoman maritime and ship technology. In particular, the expansion of the *Tersâne-i Âmire* had been an effective step in the increase of shipbuilding. This period was that the borders of the empire expanded mostly in the seas, and the Eastern Mediterranean sovereignty region began to be established. The Ottoman navy started to create a serious influence in the seas, as a value above the traditional land power, and started to form the core of the imperial navy to be established in the future.[528] This big step, in the Ottoman navy, was cooperation with Muslim pirates in the Mediterranean. Kemal Reis's captaincy and artisan, in the Ottoman navy, and there had been the production

[528] Brummett, *Osmanlı Denizgücü ve Doğu Akdeniz'de Diplomasi*, p. 138.

of ships by benefiting from his knowledge and experience, in ship technique and technology, made a great development in the Ottoman navy.

During the reign of Sultan Selim I, shipbuilding activities came to the fore, in technological developments. The most significant thing is that the Ottomans turned towards naval technologies, and increased the speed of shipbuilding, and the navy grew considerably. After the reign of Bayezid II, this large amount of shipbuilding was a great gain, and incentive for the Ottoman navy, for the following periods, especially, for the reign of Suleiman the Magnificent. It is now seen that the interest in technological production models has increased, and this is accepted as a need, for the political purposes of the state. This development is very substantial for the following periods.

Sultan Suleiman adopted a policy towards expanding the Ottoman borders. It became possible by bringing experienced and successful artisan sailors to the head of the Ottoman navy in technical matters. These artisanal pirates were sailors like Hayreddin Barbarossa, Dragut Reis, Piali Pasha, and Piri Reis. As seen above, these sailors had a great share in making the Ottoman navy successful. Thus, the Ottoman military organization developed not only relative to its Muslim predecessors, but also to its European contemporaries.[529]

British historian Geoffrey Parker argues that the Ottomans adopted and mastered Western technology with extraordinary speed and precision, and even by the late 17th century were clearly equal to all.[530] However, in the next period, that is, Selim II's period, the Ottoman navy suffered a great defeat in the Battle of Lepanto, due to the lack of experienced sailors and artisans, and the inability to train new ones. From this result, it can be understood that this is the most definitive proof of the importance of artisans in the early modern period, especially in the 16th century.

In the next section, the concept of piracy in the Ottoman empire, the artisanal pirates and their instruments will be explained in detail, in the next section. There are many sailors, such as Hayreddin Barbarossa Pasha, Piri Reis, Seydi Ali Reis, and Ali

[529] Streusand, *Islamic Gunpowder Empires*, p. 85.
[530] Streusand, *Islamic Gunpowder Empires*, pp. 89-90.

Macar Reis, who were master artisans, one of the successful sailors of the Ottoman empire. The reason, I mention these artisanal sailors, is some of them was the head of *Tersâne-i Âmire* and someone made portolan chart and atlases. These instruments are momentous for us, to see the knowledge of experienced artisanal pirates.

Part 3

Artisanal Pirates of the Ottoman Empire and Nautical Achievements: Portolan Charts and Atlases

The Role of "Superior Artisan"

This section will commence by elucidating the concept of "piracy" within the Ottoman empire. The primary focus will be on the skilled Ottoman artisanal pirates and their maritime instruments that they crafted. The spotlight will particularly be on portolan charts and atlases, which are predominantly associated with nautical cartography. Furthermore, this will provide an opportunity to delve deeper into the scientific knowledge possessed by these artisanal pirates and their contributions to Ottoman science.

Previously, the emphasis of chart historians on cartography as an activity exclusively pursued by the elite, such as princes, military commanders, and scientists, has obscured the fact that cartography is essentially a technology intertwined with other practical and industrial arts. However, shedding light on these practical instruments specifically designed for guiding sailors may help dispel any misconceptions surrounding this issue. This examination will primarily focus on nautical instruments crafted by experienced artisanal sailors, intended for active use by fellow sailors. The role of these artisans was intricately connected to the transformation of natural history into experimental philosophy and the shift from an organic worldview to a mechanistic one, as described by Hooykaas.[531]

Zilsel posits that these technologies not only influenced the development of natural philosophy in the 16th century but also played a role in the genesis of the "ideal of scientific progress". He refers to these technologists as "superior artisans", capable of documenting their personal and practical experiences and publishing them in manuals.[532] These artisans acquired a trade but were not constrained by its limitations. The impetus for technical advancement came from capitalism and economic competition.[533] Consequently, a wide range of individuals, both practical and knowledgeable, engaged in exchanges within this domain. It was within this discursive

[531] David Woodward, "Cartography and the Renaissance: Continuity and Change," in *Cartography in the European Renaissance*, ed. by David Woodward, Vol. 3, Part 1 of *The History of Cartography*, 3-24, (Chicago: The University of Chicago Press, 2007), p. 22.
[532] Edgar Zilsel, "The Sociological Roots of Science." *American Journal of Sociology*, 47, 4 (1942): 544–562, http://www.jstor.org/stable/2769053, pp. 554-555.
[533] Woodward, "Cartography and the Renaissance: Continuity and Change," p. 22.

practice that experimental and empirical methodologies emerged, including the practice of authorship.[534] By publishing portolan charts and atlases, these artisans openly declared their intention to promote the mastery of their peers. Surprisingly, the number of illiterate superior artisans in the 16th century was quite small, as their existence was often regarded as an anomaly.[535] However, as we shall discover in this section, the artisans under examination were highly skilled professionals in their craft. To comprehend their expertise, it is essential to utilize objects as resources and contemplate their role in the acquisition of knowledge during the early modern period.[536]

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[534] Pamela O. Long, *Openness, Secrecy, Authorship: Technical Arts and the Culture of Knowledge from Antiquity to the Renaissance* (Baltimore: Johns Hopkins University Press, 2001), p. 249.

[535] Woodward, "Cartography and the Renaissance: Continuity and Change," p. 22.

[536] Pamela H. Smith, "Making as Knowing: Craft as Natural Philosophy," in *Ways of making and knowing: the material culture of empirical knowledge* ed. by Pamela H. Smith, Amy R. W. Meyers and Harold J. Cook, 17-47, (New York: Bard Graduate Centre/University of Chicago Press, 2014), p. 20.

CHAPTER 5

The Concept of Piracy in the Ottoman World

The fact that the people of the shipyard consisted of a class of artisans, who were a turning point in Ottoman maritime, is very significant, in terms of Ottoman artisanal epistemology. The invitation of these pirates, whose work will be analysed one by one in the following sections, to the Shipyard and their appointment to the head, and to the management of the shipyard led to great strides in Ottoman maritime technology. And it can be said that even became a reform.

The most substantial feature, that marked the orientation to the maritime, in the Ottoman empire, was the prominence of piracy. The development of Ottoman piracy, in the Mediterranean, began in the late 15th century with the semi-official activities of most anonymous sea pirates.[537] An issue is needs to be clarified about the Ottoman pirates that acted in a system, unlike the pirates known in history.[538] It should be remembered that piracy, which is intended to be understood as banditry, is in fact to the raiders, who act in accordance with the principles of Islamic law. And they were fight as a leading force along at the land borders of the seas, as a requirement of the Islamic understanding of *jihad* (military action aimed at expanding Islam).[539]

It is understood that the word pirate entered Turkish through Arabic. The word *bâric*, which means "someone skilled in maritime" in Arabic, is also used to refer to pirate. In fact, piracy, which is carried out for purposes, such as dominating the seas, protecting the coasts and maritime trade, or eliminating possible danger from the sea in advance, is considered legitimate in the Western world, and is also seen as a part of *jihad* in the Islamic world.[540] Braudel defines piracy as a war justified by a formal declaration of war or by sealed letters, passports, missions, or instructions.[541] And he continues as follows;

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[537] Bostan, *Osmanlı Akdenizi*, p. 45.
[538] Bostan, *Kürekli ve Yelkenli Osmanlı Gemileri,* p. 47.
[539] Bostan, *Kürekli ve Yelkenli Osmanlı Gemileri,* p. 47.
[540] Nebi Bozkurt, "Korsan," accessed November 18, 2023, https://islamansiklopedisi.org.tr/korsan.
[541] Braudel, *II. Felipe Döneminde Akdeniz ve Akdeniz Dünyası*, Vol. II, p. 757.

> No matter how strange these qualities may seem to us, piracy has "laws, rules, customs and traditions". Indeed, it would be a mistake to believe that there was no international law with a certain sanction in the 16th century. Muslims and Christians send ambassadors to each other, sign agreements and mostly comply with their provisions. As the Mediterranean becomes a permanent arena of fratricidal conflict in a bordering universe, war emerges as a permanent reality, excusing and legitimizing corsair. However, legitimizing this means placing it in a category close to piracy, which is considered noble in its own way. For example, the Spanish would use two different languages in the 16th century: In the Mediterranean, they talked about Barbarossa piracy, and in the Atlantic, they talked about French, British or Dutch bandity.[542]

Ottoman historian Mustafa Cezar says that in the records in the Ottoman Mühimme registries, these sailors were referred to as *levends*, not pirates.[543] Ottoman bureaucrat and writer Mustafa Ali's work *Mevâ'idü'n-nefâ'is fî kava'idi'l-mecâlis*, written in 1599, is a review that deals with etiquette as well as various other issues of daily life and social groups of Ottoman empire. It also contains a lengthy description of the dangers of sea travel. Mustafa Ali also talks about pirates at length in his book (Fig. 70).[544] He refers to pirates as *levends*. And he defines the *levends* of the sea as the sailors of Tripoli, Tunisia, and Algeria.[545]

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[542] Braudel, *II. Felipe Döneminde Akdeniz ve Akdeniz Dünyası*, Vol. II, pp. 757-758.
This quote was translated into English by me from the Turkish version of Braudel's work "The Mediterranean and the Mediterranean World in the Time of Philip II".

[543] Mustafa Cezar, *Osmanlı Tarihinde Levendler* (Istanbul: Çelikcilt Matbaası, 1965), pp. 14-15. Janissary soldiers, serving in the navy, were called "*Levend*".

[544] Marinos Sariyannis, "Images of Piracy in Ottoman Literature, 1550-1750" in *Corsairs and Pirates in the Eastern Mediterranean, Fifteenth-Nineteenth Centuries*, ed. by G. Harlaftis-D. Dimitropoulos-D. Starkey (Athens: Adventure S.A, 2016), 129-140, pp. 131-132.

[545] Gelibolulu Mustafa Ali, *Mevâ'idü'n-nefâ'is fî kava'idi'l-mecâlis: 16. Yüzyıl Osmanlı Imparatorluğunda Gelenekler, Görenekler ve Sosyal Hayat* (Istanbul: Hünkâr Kitabevi, 1974), p. 38.

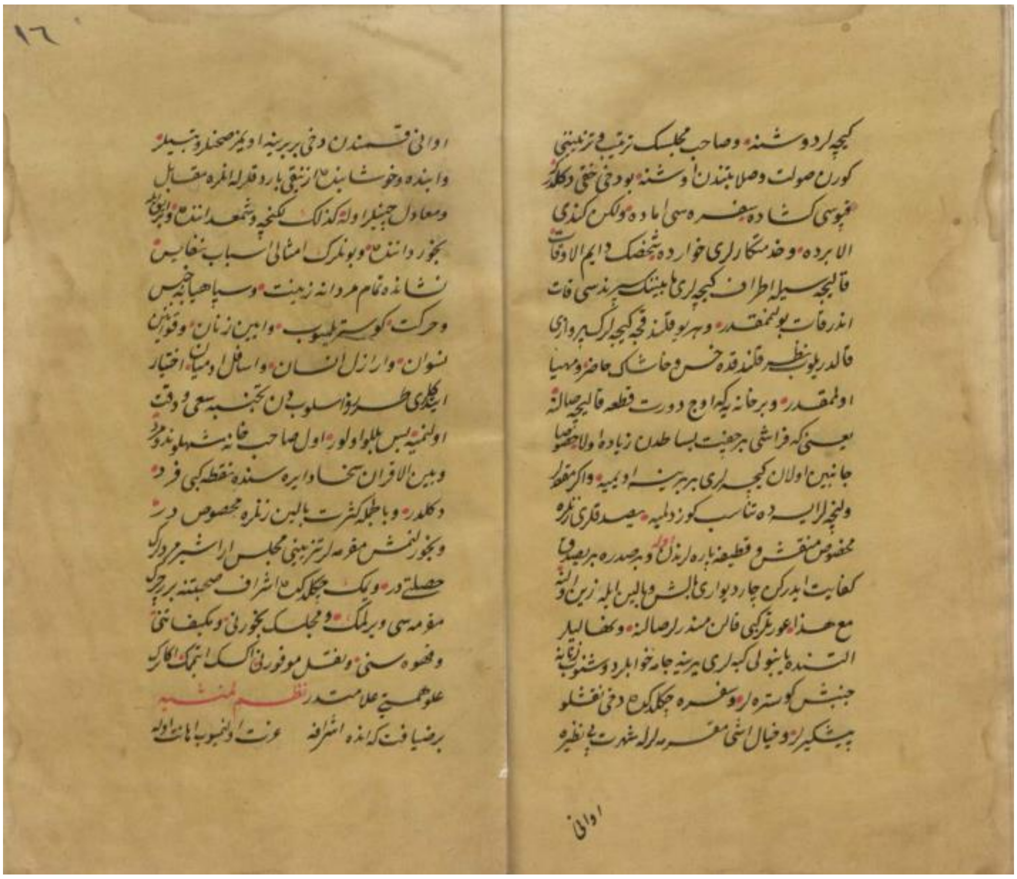

Figure 70. Mustafa Ali states that pirates gained experience in the seas, in wars and gaza, and in this way they rose to the top and became captains. He says that Hayreddin Barbarossa rose by gaining experience in this way.[546] Gelibolulu Mustafa Ali, *Mevâ'idü'n-nefâ'is fî kava'idi'l-mecâlis*, dated 1599, 193X115 mm., http://nek.istanbul.edu.tr:4444/ekos/TY/nekty03951.pdf.

Kâtip Çelebi advises non-pirate novice captains to communicate with pirates about the sea situation and naval warfare. His work, *Tuhfetü'l-kibâr fî esfâri'l-bihâr* (A Gift to the Great concerning Naval Expeditions, 1669), is a very substantial work from which we can learn the Ottoman perspective on pirates (Fig. 71 and 72).[547] In this work, Çelebi gave 40 pieces of suggestion to sailors, under the title "On Advice to Pirates regarding Sea and Naval Affairs".[548] A few of these stand out from which we can draw more inferences about pirates. The following are the recommendations from the pages

[546] Gelibolulu Mustafa Ali, *Mevâ'idü'n-nefâ'is fî kava'idi'l-mecâlis*, p. 40.
[547] Çelebi, *Deniz Savaşları Hakkında Büyüklere Armağan*, p. 191.
Tuhfetü'l-kibâr fî esfâri'l-bihâr was written on the occasion of the Cretan expedition that started in 1645 and lasted for years, describes the Ottoman naval wars that lasted until 1656. It is a momentous source for Ottoman maritime history.
[548] Çelebi, *Deniz Savaşları Hakkında Büyüklere Armağan*, p. 191.

of the copy in the archives of the Grand National Assembly of Turkey, the image of which I have provided below:[549]

Figure 71 and 72. Two pages with advice from Kâtip Çelebi's work titled *Tuhfetü'l-kibâr fî esfâri'l-bihâr*. Kâtip Çelebi, "*Tuhfetü'l-kibâr fî esfâri'l-bihâr*", Türkiye Büyük Millet Meclisi, CS. 301, 1669, https://acikerisim.tbmm.gov.tr/items/8709e022-69ff-42e3-b79c-b461b35765c6/full.

549 The images of this work of Kâtip Çelebi's *Tuhfetü'l-kibâr fî esfâri'l-bihâr*, dated 1669, are from the Turkish Grand National Assembly Library, Rare Works section. The manuscript was written in Ottoman Turkish with Arabic letters. The translation of the advice, in the work, was made by me from the copy translated into Latin alphabet by Kabalcı Publications. Kâtip Çelebi, Deniz Savaşları Hakkında Büyüklere Armağan (Istanbul: Kabalcı Yayınevi, 2007).

> First Advice; If captain is not a pirate himself, he should consult and listen to pirates in sea affairs and sea warfare. However, most of those, who went their own way, regretted it. Especially, if a mistake is made in this way, the damage is not only to himself.[550]
>
> Eighth Advice; Their captains must have spent many years, wandering around Algeria and at sea, and acting as pirates. Because the progress and survival of the navy depends on it.[551]
>
> Nineteenth Advice; Captain should attach strict importance to maritime science. They should not avoid learning about compass and maps. Great compliment should be given to those, who know, so that others, who do not know, will be enthusiastic and learn.[552]
>
> Twentieth Advice; Kapudan Pasha should test the sailors. In this way, those, who do not know, want to learn.[553]
>
> Fortieth Advice; What is told and written about the expeditions, conquests, and wars of the old Sultans and the Kapudans at sea, should be seen and lessons learned.[554]

Kâtip Çelebi's first advice started with the need to get information from pirates, and it seems that pirates were the first people to be consulted in navy-related matters and they were given value about navy.[555] In the eighth piece of advice, the emphasis is on being experienced at sea. In other words, an explanation of the craftsmanship, related topic covered in this thesis, can be seen here. Experience is the most significant point here, and at the same time, the prestige of craftsmanship is seen along with the necessity of knowledge.[556] Through the nineteenth advice, we see that it was important for captains in the Ottoman navy to have knowledge of navigation, that is, map and compass. However, as someone, who lived after the 16th century, Kâtip Çelebi reached this perception. We see that after artisanal pirates, such as Hayreddin Barbarossa and Kemal Reis, and Piri Reis, the understanding, that both experience and knowledge were necessary, was envisaged in the following centuries and this perception was formed. It seems that pirates, who are experienced and knowledgeable, are still being resorted to.[557] As in the 20th advice, it was now required that sailors be knowledgeable, and it is observed that sailors recruited to the navy began to be tested.[558] This work, written

[550] Çelebi, *Deniz Savaşları Hakkında Büyüklere Armağan*, p. 191.
[551] Çelebi, *Deniz Savaşları Hakkında Büyüklere Armağan*, p. 192.
[552] Çelebi, *Deniz Savaşları Hakkında Büyüklere Armağan*, p. 194.
[553] Çelebi, *Deniz Savaşları Hakkında Büyüklere Armağan*, p. 194.
[554] Çelebi, *Deniz Savaşları Hakkında Büyüklere Armağan*, p. 196.
[555] Çelebi, *Deniz Savaşları Hakkında Büyüklere Armağan*, p. 191.
[556] Çelebi, *Deniz Savaşları Hakkında Büyüklere Armağan*, p. 192.
[557] Çelebi, *Deniz Savaşları Hakkında Büyüklere Armağan*, p. 194.
[558] Çelebi, *Deniz Savaşları Hakkında Büyüklere Armağan*, p. 194.

in a later period, shows us that these people were at the basis of the perception that experience and knowledge should coexist in the Ottoman shipyards and navy, which was developed with experienced artisanal pirates in the early modern period of the 16th century. In fact, in the last, fortieth advice, Kâtip Çelebi says that from previous works should be read and lessons learned. This reveals the necessary of the works of sailors such as Piri Reis and Seydi Ali Reis for later sailors.[559]

Apart from this situation, where piracy is considered legitimate, the word also has a negative meaning as "attacks on merchant ships and beaches, mostly for the purpose of extortion".[560] While the Arabs used the term *lüsûsü'l-bahr* (sea thieves) for the perpetrators of such incidents that occurred from time to time in the Red Sea and the Persian Gulf, the Ottomans generally used the expression *harâmi* (bandit) for those who plundered merchant ships.[561] In this sense, pirates, also known as *levends* and understood as the naval equivalent of land raiders in Turkish history, would join the navy's expeditions when necessary.[562]

First, Kemal Reis (d. 1511), whom Piri Reis (between 1465 and 1470-1553) calls "our master", is one of them. Later, the great Ottoman sailors Barbarossa brothers and Dragut Reis (1485-1565), Seydi Ali Reis (1498-1562), Sinan Reis (1492-1546), Salih Reis (1488-1568), and Murad Reis (1534-1609) were also trained as pirates.[563] In the Ottoman empire, sea lords were also responsible for protecting the coasts within their territories, and the merchant ships passing close to the coast against pirates. In addition, joint protection against pirates and privileges to compensate for the damages caused by pirates were given in the treaties.[564]

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[559] Çelebi, *Deniz Savaşları Hakkında Büyüklere Armağan*, p. 196.
[560] Bozkurt, "Korsan."
[561] Bozkurt, "Korsan."
[562] Idris Bostan, *Adriyatik'te Korsanlık: Osmanlılar, Uskoklar, Venedikliler 1575-1620* (Istanbul: Timaş Yayınları, 2009), p. 21.
[563] Bozkurt, "Korsan."
Barbarossa brothers are three people. These are Hızır Reis, Ishak Reis and Ilyas Reis. Of these three brothers operating on the North African coasts of the Mediterranean, Hızır Reis, that is, Hayreddin Barbarossa, remains. Hayreddin Barbarossa was the Beg of Algeria and entered the Ottoman service.
[564] Bozkurt, "Korsan."

During the Middle Ages and early modern periods, when international relations were based on war and peace could only be established through special agreements, these activities, undertaken independently of regular navies for both defence and harming the enemy, were supported by states and played a momentous role in mutual relations. Although there are many examples that suggest that pirates have freedom of action, it is still seen that they are obliged to act in accordance with the legal rules of the state to which they belong.[565]

For example, if the Ottoman empire had an agreement with its enemies, who were likely to fight against it at sea, then Ottoman pirate ships were not allowed to attack ships belonging to that state or other targets. Attacks on the targets of the states with which the covenant was signed, were considered *harâmi.* As a matter of fact, although there was a peace agreement in 1588, it is known that some *harâmi* and *levend* boats were pursued because they plundered Venetian lands and captured their people, and were handed over to the Venetian consuls, where they were captured.[566]

In summary, the pirates, mentioned above, were influential in the struggle for Mediterranean dominance, during the Ottoman period, especially from the 16th century onwards, as pirate groups settled in bases on the North African coast, many of which operated under the state. It is seen that Ottoman *levends* or pirates started to advance in the Mediterranean, constituted a momentous support for the Ottoman navy, which would later develop. Because of this understanding, Ottoman maritime culture is dominated by piracy. This is not negative; this is very positive to control of the Mediterranean by Ottoman empire. So, the practical and artisanal knowledge, about maritime culture, was in the hand of pirates. That is, these pirates were brought to power because they were also artisans. Because they had the scientific, technological, and cosmographic knowledge to do these works.[567]

In the 15th and 16th centuries, the foundations of Ottoman domination, in the Mediterranean, were laid by Ottoman pirates. Ottoman sailors, whether sailing in a few ships or leading powerful navies, supported the Ottoman Sultans in their quest for

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[565] Bostan, *Adriyatik'te Korsanlık,* p. 19.
[566] Bostan, *Adriyatik'te Korsanlık,* pp. 20-21.
[567] Bostan, *Kürekli ve Yelkenli Osmanlı Gemileri,* p. 47.

dominance over their imperial rivals. Much of their rivalry was at sea. The Sultans' chances of naval dominance depended not only on powerful fleets financed by the empire's enormous resources, but also on the skilled leadership of their commanders, the most successful of whom had experience as pirates.[568] These pirate commanders and artisans, with great maritime skills, were seen as rivals by the Sultan's closest men, the rulers, who came as *devshirme*, and were appointed by Sultan.[569] The most promising soldiers were sent to the palace to be trained for the highest administrative and military positions in the empire. This training and service, at palace, encouraged these men to develop loyalty to the ruler. Thus, these *devshirme* soldiers were brought to the highest administrative and military positions of the empire, due to their ties with each other and especially with the Sultan, starting from the reign of Bayezid II. However, their lack of maritime experience undermined the maritime potential of the Ottomans. Thence, the Ottoman Sultans applied to the Mediterranean pirates. They asked these pirates, who had a good understanding of both the management of the Ottoman navy, the training of sailors and artisans, and the ship technology with their experience, to lead the production of the ships of the navy. Its effects were seen in the 16th century, when Ottoman naval power achieved its greatest successes in the Mediterranean, making it almost an "Ottoman Lake". But a battle lost by the Ottomans, Lepanto in 1571, revealed that this potential power could be wasted, if led by those without naval training.[570]

Initially, in the period leading up to the outbreak of hostilities, Bayezid had taken steps to improve his navy, increasing its size and, significantly, recruiting the corsairs Piri Reis, Burak Reis and Kemal Reis as navy commanders. These men were highly experienced in the waters of the eastern Mediterranean and brought with them not only their skill but also their ships and men. Kemal Reis's fame was such that his name was celebrated "throughout the world".[571]

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568 Isom-Verhaaren, *The Sultan's Fleet*, chap. 4, para. 4.
569 Isom-Verhaaren, *The Sultan's Fleet*, chap. 4, para. 4.
Devshirme was a tax levied on boys from peasant families, usually Christian, who, after being educated and converted to Islam, served the Sultan in the army or in the administration.
570 Isom-Verhaaren, *The Sultan's Fleet*, chap. 4, para. 4.
571 Kate Fleet, "Ottoman expansion in the Mediterranean," in *The Ottoman Empire as a World Power, 1453–1603*, *The Cambridge History of Turkey*, ed. by Suraiya N. Faroqhi and Kate Fleet, (New York: Cambridge University Press, 2013), Volume II, pp. 141-172, p. 149.

The use of corsairs, a rather unreliable term, for one man's corsair was another man's pirate, but who in essence were men who operated under the aegis of a state, was not new. However, Bayezid's initiative involved a greater, institutionalised corsair involvement within the naval structure. Clearly such a policy was not without risk, Nicolas Vatin arguing that by using pirates to re-construct his fleet Bayezid "opened Pandora's box".[572]

Moreover, power at sea, in the 16th century, meant control of places that could provide naval bases. The extent to which naval experts' advice was followed varied, according to the monarch and the priority, giving to maritime affairs. While the Sultans led their armies on land, they seldom boarded the ships themselves. Knowing, which areas to capture, required insight from people with vast maritime experience, especially if the naval bases were far from Istanbul. The most substantial thing that the Ottoman Sultans took into consideration, when choosing the people to lead their navy and shipyard might be that these people somehow made their names known, like Hayreddin Barbarossa, through their actions.[573] Therefore, the pirates, who were experienced in the strategy to be applied in naval wars and construction and using of devices, had a serious place in the Ottoman navy. For example, men, who knew the seas well, such as Kemal Reis, determined the key places, and encouraged the Sultans to seize these places by conquest.[574]

Piri Reis also noted in his navigational book, which I will talk about later, that Sultan Bayezid had listened to Kemal Reis's advice, regarding the most strategic objectives of a naval expedition against the Venetians. The Venetians followed Kemal Reis's career closely. Mariners, like Kemal Reis, leaded challenge, for the Ottomans able to compete effectively with Venetians, in naval battles.[575]

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[572] Fleet, "Ottoman expansion in the Mediterranean," p. 150.
Nicolas Vatin is a French epigrapher and historian, specializing in the study of the Ottoman Empire.

[573] Eric H. Ash, *Power, knowledge, and expertise in Elizabethan England* (Baltimore: The Johns Hopkins University Press, 2004), p. 11.

[574] Isom-Verhaaren, *The Sultan's Fleet*, chap. 4, para. 5.

[575] Isom-Verhaaren, *The Sultan's Fleet*, chap. 4, para. 38-39.

The primary breakthrough occurred when, in 1494 or 1495, Bayezid II pragmatically invited a pirate by the name of Kemal Reis to lead the Ottoman fleet to improve the Ottoman navy's military capacity.[576] The ruler was committed to *ghazawat* (religiously sanctioned raids) or *jihad* at sea against the Venetians.[577] The Ottoman navy entered a new phase, with Kemal Reis was taken into the service of the state, and the experience of this valuable sailor greatly benefit from him.[578] In other words, he served the Ottoman navy both in shipbuilding and in training sailors. With the ships under his command, he collided with Christian pirates and struck the coasts of Spain and Africa, around the Strait of Septe and the Balearic Islands.[579] The first duty of Kemal Reis, in the Ottoman navy, was to bring Muslims and Jews from Andalusia to the Ottoman empire.[580]

Kemal Reis' significant contribution to Ottoman naval power, during the reign of Sultan Bayezid, was to fight the Venetians in the Mediterranean, and to challenge Spain's Iberian powers and Portugal's naval expansion. During the Ottoman war with Venice from 1499 to 1503, he rendered very efficient services, overseeing the construction of the navy. By building new galleys, he conducted to the capture of Lepanto in 1499, Coron, Modon, and Navarino in 1500.[581]

Kemal Reis effectively reorganised the navy, building larger warships; as a result, in 1499 he was able to gain the first great naval victory near Lepanto.[582] Kemal Reis played a critical role in the capture of Lepanto from the Venetians in July 1499. During the campaign, he and Burak Reis were the first sailors to captain the new ships of Ottoman, the gökes (Fig. 73).[583] Kemal Reis was tasked with preventing Venetian support to Navarino by sea and with assisting with the governor-general of Rumeli.[584]

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576 Fleet, "Ottoman expansion in the Mediterranean," p. 304.
577 Idris Bostan, "Kemal Reis," in *The Encyclopaedia of Islam*, ed. by Kate Fleet, Gudrun Krämer, Denis Matringe, John Nawas, and Everett Rowson, (Leiden: Brill, 2021), Volume III, pp. 84-86, p. 84.
578 Bostan, *Osmanlı Akdenizi*, p. 45.
579 Uzunçarşılı, *Osmanlı Tarihi*, Vol. II, p. 203.
580 Uzunçarşılı, *Osmanlı Tarihi*, Vol. II, p. 201.
581 Isom-Verhaaren, *The Sultan's Fleet*, chap. 4, para. 16.
582 Fleet, "Ottoman expansion in the Mediterranean," p. 304.
583 Idris Bostan, "Kemal Reis," accessed October 10, 2021, https://islamansiklopedisi.org.tr/kemal-reis.
584 Bostan, "Kemal Reis," p. 85.

Following Lepanto's surrender, he participated in the Ottoman conquests of Modon, Koron, both on the southwestern coast of Greece, and Navarino in 1500. In 1501, while in command of twenty-two ships, he recaptured Navarino, which had been retaken by the Venetians earlier that year. Then, he returned to Istanbul with eight additional ships, which he had captured as loots. In 1502, Kemal Reis took part in the diplomacy that secured peace between the Ottomans and the Venetians and was involved with protecting merchant vessels in the Aegean. After receiving a defence for aid from the ruler of Tripoli in 1505, he sailed into the Mediterranean. In 1507, he commanded a fleet that transported artillery, military equipment, and technical personnel to the Mamluks for their struggle against the Portuguese in the Red Sea and Indian Ocean. He arrived in Cairo with fifty cannons, substantial copper for casting more artillery pieces, and artisans to construct a fleet at Suez.[585]

Kemal Reis sailed another fleet to Egypt in 1510, both as a guard for the Mamluk envoy in Istanbul and to deliver more Ottoman military aid. His twenty-five to thirty-five vessels, including eight galleys, were caught in a storm while on route to Alexandria. His ship sank, along with other ships in the fleet, and he drowned, in October 1510. In addition to his many accomplishments in naval campaigns, he is noted for introducing long-range cannon into the Ottoman navy.[586]

[585] Bostan, "Kemal Reis," p. 85.
[586] Bostan, "Kemal Reis," p. 85.

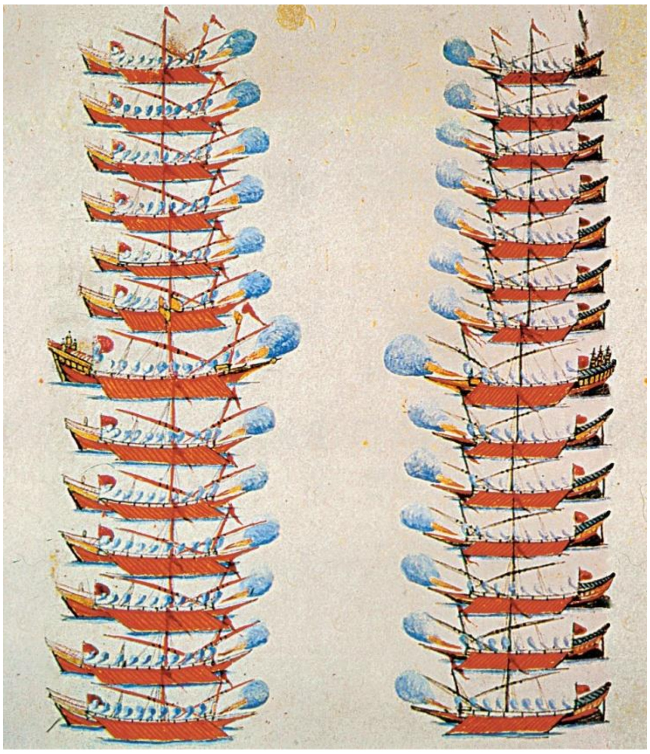

Figure 73. Miniature showing the Ottoman navy at the Port of Lepanto. In this depiction, the Ottoman ships on the left are galleys and there are 13 of them. There are 14 galleys in the European navy. (Kâtip Çelebi, *Tuhfetü'l-kibâr fî esfâri'l-bihâr*, 1669, TSMK, Revan Köşkü, nr. 1192, vr. 16b), https://islamansiklopedisi.org.tr/gemi.

The same situation continued, during the Sultan Suleiman period, and even got bigger. One of the most prominent developments, regarding maritime activities, during the reign of Suleiman the Magnificent, in the 16th century, was the inclusion of chiefs engaged in piracy, in the Mediterranean, into Ottoman service. Artisanal pirate, and one of the most reputable captains, was Hayreddin Barbarossa, who would be at the head of the Ottoman navy, for many years (Fig. 64).[587] The recruitment of Hayreddin Barbarossa, a turning point in Ottoman maritime, as a captain in the navy and his appointment as the head of *Tersâne-i Âmire*, has a very substantial place in the history of Ottoman maritime technology.

[587] Idris Bostan, *Istanbul'un 100 Denizcisi* (Istanbul: Istanbul Büyükşehir Belediyesi Kültür A.Ş. Yayınları, 2014), p. 46.

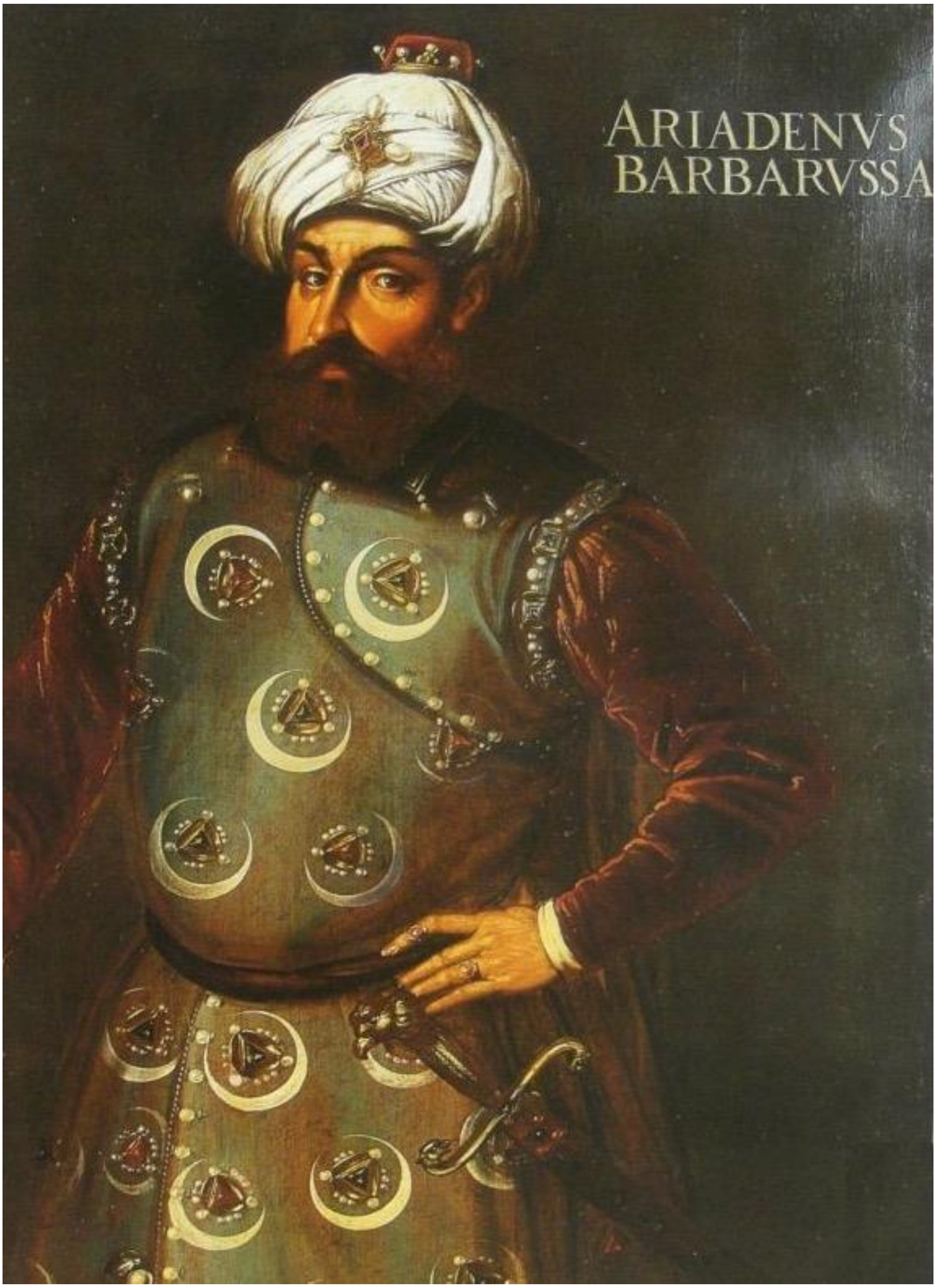

Figure 74. Hayreddin Barbarossa Pasha, made date: 16th century. He was a sailor and soldier, the first captain pasha and the 25th captain of the Ottoman Empire. Istanbul Naval Museum, Dem. Nr. 2327.

Hayreddin Barbarossa, who served as the captain of the Ottoman navy for many years, was a turning point for the Ottoman maritime history. In the inscription, dated 1519, of the mosque built by the Algerian Principality, Hayreddin Barbarossa, in Algeria, we see that he used the title '*es-Sultanü'l-mücahid fî sabil'lâhi Rabbi'l-âlemîn Mevlâna Hayreddin ibn emîrü'ş-şehir mujahid ebî Yusuf, Yakub et-Türkî*', ('Sultan Hayreddin, who fought in the way of Allah, son of the Turkish Emir Yakub').[588] We know from historical sources that Hayreddin Barbarossa, after rescuing his brother Hızır Reis, was captured by the Rhodes knights, came under the patronage of Shahzadeh (Prince) Korkud. With his brother, and rescued other captured Muslims, and he personally participated in events.[589] Upon these events, Oruç and Hızır brothers started to appear on the North African coasts, after 1504, heading towards the Western Mediterranean.[590]

Thereupon, Suleiman the Magnificent summoned Hayreddin Barbarossa to Istanbul, to bring him, to the command of the navy.[591] In the first years of the reign of Suleiman the Magnificent, after the Eastern Mediterranean came under Ottoman rule, the struggle moved to the Central and Western Mediterranean. At this time, when the Ottoman empire started a new struggle in the Mediterranean, Hayreddin Barbarossa was operating with his entourage, in the North African coasts, and was known as the Sultan of Algeria.[592]

The Ottoman state did not have the same success, in terms of naval forces, compared to land forces. This deficiency was not due to ships and weapons. It was mostly, due to the lack of an experienced naval commander to lead the navy. Because the Ottoman navy was greatly improved, in terms of ships and weapons, during the reigns of Bayezid II and Sultan Selim. In terms of military personnel, there were enough soldiers in the navy. For this reason, an experienced and successful commander

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588 Bostan, *Istanbul'un 100 Denizcisi*, p. 46.
589 Cezar, *Mufassal Osmanlı Tarihi*, Vol. II, p. 913.
590 Şerafettin Turan, "Barbaros Hayreddin Paşa," accessed September 18, https://islamansiklopedisi.org.tr/barbaros-hayreddin-pasa.
591 Turan, "Barbaros Hayreddin Paşa," accessed September 18, https://islamansiklopedisi.org.tr/barbaros-hayreddin-pasa.
592 Bostan, *Osmanlı Akdenizi*, p. 49.

was needed to command the Ottoman navy. Therefore, Suleiman the Magnificent invited the Algerian ruler Hayreddin Barbarossa to Istanbul (Fig. 75).[593]

Hayreddin Barbarossa came to Istanbul, in November 1533, upon the invitation, and was personally received by the Sultan. In February 1534, he was appointed to the Ottoman Kapudan Pasha, and the Algerian governorship. Hayreddin Barbarossa Pasha, who gave a new order to *Tersâne-i Âmire*, the central shipyard of the Ottoman empire, tried to eliminate the deficiencies, in ship engineering and construction. For he and his entourage were not only master sailors, but also specialized in shipbuilding, and repair work, during their years of sailing.[594] Hayreddin Pasha, who spent the winter of 1534, in the Istanbul shipyard, with intense work, reconstituted the Ottoman navy, as an imperial navy to the Mediterranean. Kapudan Pasha commissioned by Suleiman the Magnificent, and dressed in *hil'at*.[595] For this purpose, set out for Tunisia with his navy consisting of 100 ships, in May 1534, and made his first expedition.[596] Hayreddin Barbarossa Pasha had 14,975 rowers accompanying him.[597] He also seized ships from Algiers to form a fleet, and recruited several "volunteer" pirates. He gathered a fleet of eighty-four ships. And he launched an expedition to raid Messina in Sicily, and Reggio opposite him on the Italian coast. This first great expedition, in 1534, brought a great reward, such as the conquest of Tunis. This city provided a capital naval base on the North African coast east of Algeria.[598]

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[593] Cezar, *Mufassal Osmanlı Tarihi*, Vol. II, p. 922.
[594] Bostan, *Osmanlı Akdenizi*, p. 49.
[595] Bostan, *Osmanlı Akdenizi*, pp. 49-51.
It is the name given to the caftan made of high quality fur, which is made of high quality fabric, which the Sultans gave to those, who deserve it to win hearts or reward them.
[596] Bostan, *Osmanlı Akdenizi*, pp. 49-51.
[597] Bostan, *Osmanlı Akdenizi*, p. 194.
[598] Isom-Verhaaren, *The Sultan's Fleet*, chap. 5, para. 15.

Figure 75. A miniature showing Hayreddin Barbarossa Pasha in the presence of the Sultan Suleiman. Hayreddin Barbarossa was summoned to the palace by the Ottoman Sultan in 1533. *Süleymannâme,* 1558, Topkapi Palace Museum Library, Treasure, nr. 1517, vr. 360a, https://islamansiklopedisi.org.tr/barbaros-hayreddin-pasa.

More importantly, we see that Hayreddin Barbarossa Pasha, once again, showed his genius, when he gave the Ottoman navy, its first great victory, in the Preveza Naval War. The Battle of Preveza was a key point in Ottoman maritime. Because with the Preveza Victory, Turkish superiority was achieved in the Central Mediterranean region, after the Eastern Mediterranean.[599] In addition to the tactical genius of Barbarossa, the ship types, in the navy, had an impact, on their victory, against the Allied navies. The fact that there were only galleys, in the Ottoman navy, versus the large galleons, in the Allied navy, and the war resulted, in the superiority of the galleys, led to the preference of galley-type of ships in the Ottoman navy, for a long time. Barbarossa, who knew very well the Mediterranean coast and climate, preferred

[599] Uzunçarşılı, *Osmanlı Tarihi*, Vol. II, p. 377.

galleys, and that there was a fundamental distinction between a navy of sailing ships, moving with the wind and a navy of rowing galleys (Fig. 76). Especially, in the Central Mediterranean, stagnant weather would last for days, and sailing ships were not useful in bays, and small ports in those conditions. Even though the sailboats could not move rapidly, and had less manoeuvrability, the galleys, with a longer gun range, could move quickly, and navigate in shallow places.[600]

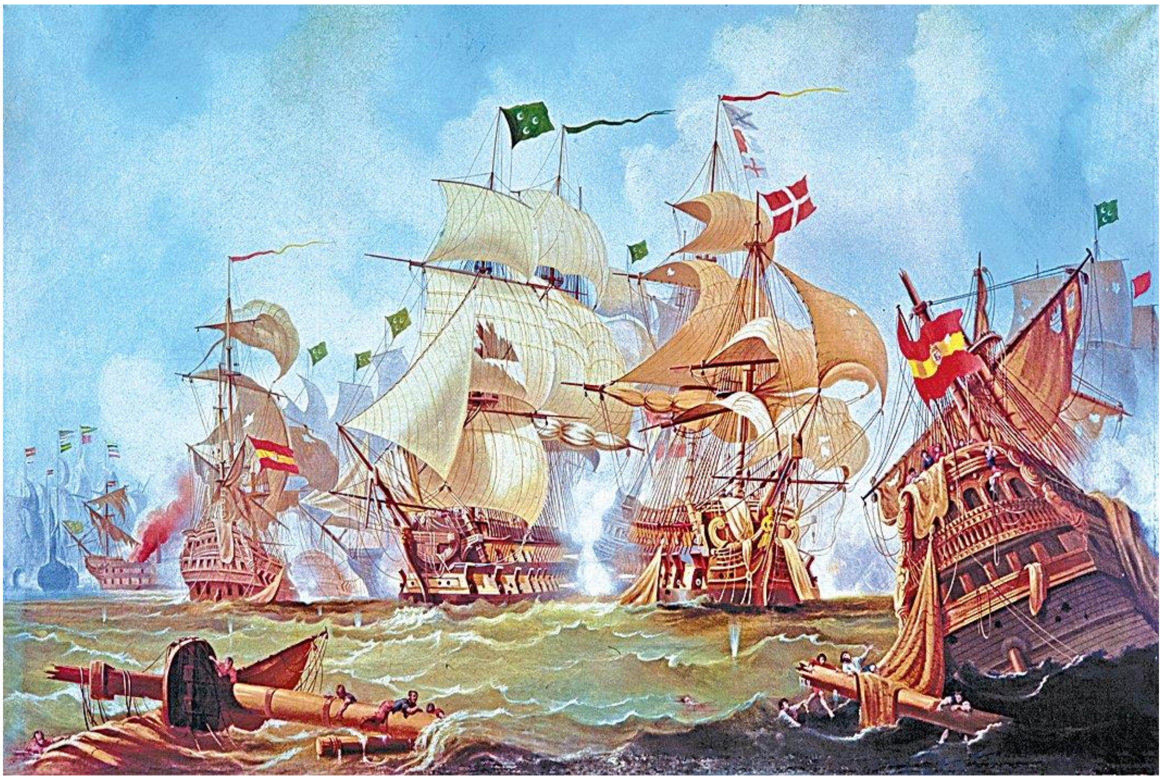

Figure 76. A painting, depicting the Battle of Preveza. The Battle of Preveza, which took place on 28 September 1538 between the Ottoman navy and the allied Crusader navy, is of great importance in terms of definitively determining Ottoman dominance in the Mediterranean. (Istanbul Naval Museum, Teşhir nr. 1753), https://islamansiklopedisi.org.tr/barbaros-hayreddin-pasa.

[600] Idris Bostan, "Preveze Deniz Zaferi ve Sonrasında Akdeniz Dünyası," in *Türk Denizcilik Tarihi*, ed. by İdris Bostan and Salih Özbaran, Volume 1, 173-184, (Istanbul: Boyut Yayıncılık, 2009), p. 176.

In a nutshell, a brand-new method was created, when Hayreddin Barbarossa Pasha became the head of the Ottoman navy. Barbarossa preferred his galleys black and low. Because in this way, their galleys could make sudden attacks without being seen from afar.[601] It is, for this reason, that until the end of the 16th century, the basis of the Ottoman navy was the galley class, which was the most advanced warship of the Ottomans. The length of a galley was between fifty-five and fifty-six zira, that is, forty-two meters, and had twenty-four seats. There were four rowers in each seat, and its rower was one hundred and ninety-six. With about a hundred warriors, captains, sailors, caulkers, helmsmen and other men of the sea, the galleys would find three hundred and thirty people. It had thirteen or fourteen cannons.[602] The barge was bigger than a galley, and it had seven oars each, one hundred and fifty warriors, and twenty-four cannons.[603] Galiot and retail, and others were smaller than a galley, and the *scampavia* was a messenger ship. [604] We need to open a parenthesis here. There may be some doubts about the dates, when the *scampavia* ship was used. Although *scampavia* is described as a ship, used in the 1800s, a work, written in the 16th century, shows us that it was used before.[605] This type of ship becomes clear from the description of the *scampavia* on page 401 of Tevârîh-i Âl-i Osmân (History of Ottoman Dynasties, 1553?), written by the 16th-century Ottoman vizier and historian Lutfi Pasha (Fig. 78).[606] I managed to read this knowledge from a copy made in 1922 in the

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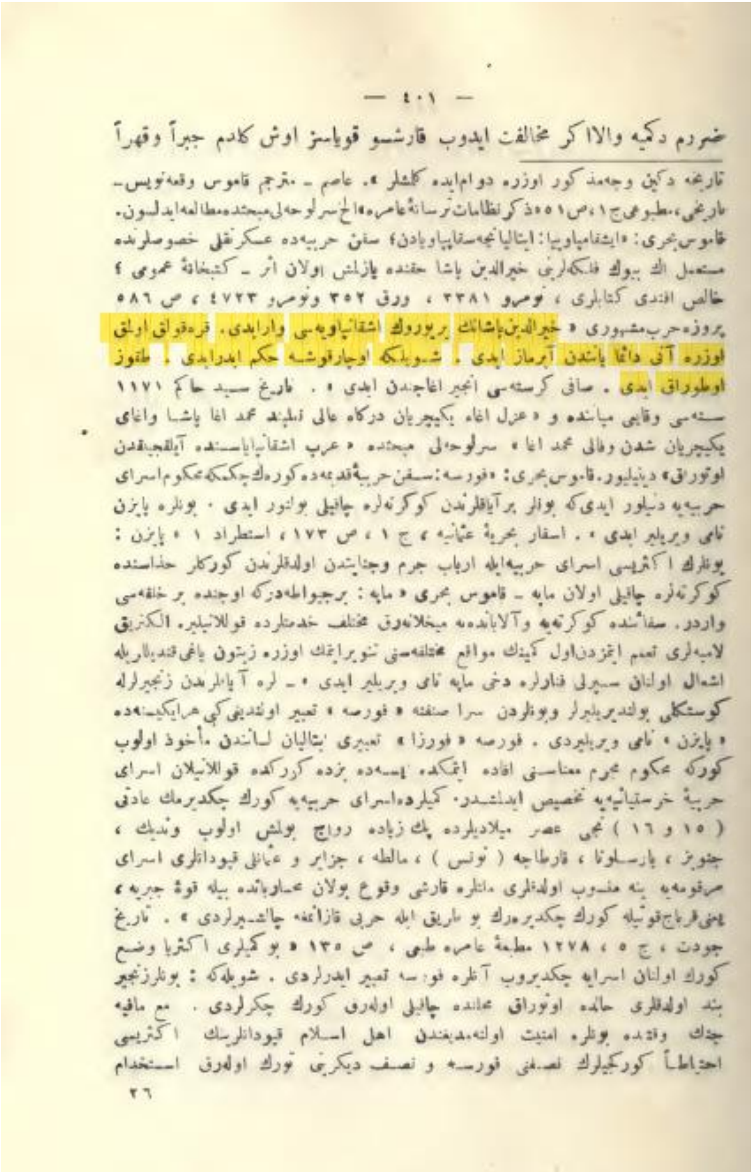
[601] Tarakçı, *Deniz Gücünün Osmanlı Tarihi Üzerindeki Etkileri*, p. 34.
[602] Uzunçarşılı*, Osmanlı Tarihi*, Vol. II, p. 577.
[603] It is known as the big lifeboat used to carry personnel on warships.
[604] Uzunçarşılı*, Osmanlı Tarihi*, Vol. II, pp. 577-578.
[605] The Oxford Reference defines *scampavia* as follows:
A type of small warship of the kingdom of the two Sicilies (Naples and Sicily), during the Napoleonic War (1803–15). It was basically a large rowing boat or galley of up to 46 metres (150 ft) in length, pulled by twenty oars or sweeps a side, with each rower having his bunk or sleeping place, under his rowing bench. They were very fast in the water, whether sailing or being pulled. ("Scampavia," Oxford Reference, accessed Dec 10, 2023, https://www.oxfordreference.com/display/10.1093/oi/authority.20110803100444366).
[606] Lutfi Paşa, *Tevârîh-i Âl-i Osmân*, 1st ed. (Istanbul: Matbaa-i Âmire, 1922), p. 401, https://archive.org/details/tevarihiliosma00lutfuoft/page/56/mode/2up.
I reached this knowledge from the footnote on the 458th page of Uzunçarşılı's work, titled *Osmanlı Devleti'nin Merkez ve Bahriye Teşkilatı* (Central and Naval Organization of the Ottoman Empire). (Uzunçarşılı, *Osmanlı Devleti'nin Merkez ve Bahriye Teşkilatı*, p. 458).
Later, I confirmed it by accessing the facsimile 1922 edition of the original manuscript. The part, I translated here, is the copy in the Robarts Library of the University of Toronto.

digital archives of University of Toronto's Robarts Library.[607] Where I marked in the Figure 77 as follows:



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ضرورم دکیه والاا کر مخالفت ایدوب قارشو قویلمز اوش کادم جبراً وقهراً

تاریخه دکین وجه‌مذ کور اوزره دوام ایده کلشلر ». عاصم ـ مترجم قاموس وقعه‌نویس ـ
تاریخی، مطبوعی ج ۱، ص ۱۰۵ ده ذکر لغات ترسانهٔ عامره‌ اخ سرلوحه‌لی مبحثده مطالعه ایدلسون.
قاموس بحری: «ایشقامپاویا: ایتالیانجه سقاپیاویادن» سفن حربیه‌ده عسکرلق خصوصلرنده
مستعمل الک بیوک فلکه‌لرینی خیرالدین پاشا حقنده یازلمش اولان اثر ـ کتبخانهٔ عمومی «
خالص افندی کتابلری، نومرو ۳۳۸۱، ورق ۳۵۲ ونومرو ۴۷۲۳، ص ۵۸۶
پروزه حرب مشهوری « خیرالدین پاشانک بریوروک اشقاپاویه‌سی وارایدی. قره‌قوللق اولق
اوزره آنی دائما یانندن آیرماز ایدی . شویله‌که اوجاقوشه حکم ایدرایدی . طقوز
اوطوراق ایدی . صاقی کرسته‌سی انجیر اغاجندن ایدی » . تاریخ سید حاکم ۱۱۷۱
سنه‌سی وقایعی میانده و « عزل اغاء یکیچریان درکاه عالی تملبند محمد اغا پاشا واغای
یکیچریان شدن وفاتی محمد اغا » سرلوحه‌لی مبحثده « عرب اشقاپایاسنده آیلقجیقدن
اوتوراق» دینیلیور. قاموس بحری: «فورسه: سفن حربیهٔ قدیمه‌ده کورکه چکمکه محکوم اسرای
حربیه‌یه دنیلور ایدی‌که بونلر برآیاقلرندن کوکرته‌لره چاتیل بولنور ایدی . بونلره یازن
نامی ویریلیر ایدی » . اسفار بحریهٔ عثمانیه، ج ۱، ص ۱۷۳، استطراد ۱ « یازن :
بونلرک اکثریسی اسرای حربیه‌ایله ارباب جرم وجنایتدن اولدقلرندن کورکلر حداسنده
کوکرته‌لره چاتیل اولان مابه ـ قاموس بحری « مابه : برجیواطه‌درکه اوجنده بر حلقه‌سی
واردر. سفائنده کوکرته‌یه وآلابانده‌یه میخلانه‌رق مختلف خدمتلرده قوللانیلیر. الکتریق
لامبه‌لری تعمم ایتمزدن اول کمینک مواقع مختلفه‌سنی تنویرایتمک اوزره زیتون یاغی قندیللریله
اشغال اولنان سپرلی فنارلره دخی مابه نامی ویریلیر ایدی » ـ لره آیاقلرندن زنجیرلرله
کوستکلی بولندیریلیرلر وبونلردن سرا صنفنه « فورصه » تعبیر اولندیغی کبی هرایکیسنه‌ده
« یازن » نامی ویریلیردی . فورصه « فورزا » تعبیری ایتالیان لساندن مأخوذ اولوب
کورکه محکوم مجرم معناسنی افاده ایتمکده یسه‌ده بزده کورکده قوللانیلان اسرای
حربیهٔ خرستیانیه‌یه تخصیص ایدلشدر. کیلرده اسرای حربیه‌یه کورک چکدیرمک عادتی
(۱۵ و ۱۶) نجی عصر میلادیلرده پک زیاده رواج بولمش اولوب ونديك ،
جنوىز ، بارسلونا ، قارطاجه (تونس) ، مالطه ، جزایر و عثمانلی قپودانلری اسرای
مرقومه‌یه یه منسوب اولدقلری ملتلره قارشی وقوع بولان محاربانده بیله قوهٔ جبریه «
یعنی قرباج قوتیله کورک چکدیرمرک بو طریق ایله حربی قازانغه چالشیرلردی » . تاریخ
جودت ، ج ۵ ، ۱۲۷۸ مطبعهٔ عامره طبعی ، ص ۱۳۵ « بو کمیلری اکثریا وضع
کورک اولنان اسرایه چکدیروب آنلره فورسه تعبیر ایدرلردی . شویله‌که : بونلر زنجیر
بند اولدقلری حالده اوتوراق محلنده چاتیل اولەرق کورک چکرلردی . مع مافیه
جنك وقتنده بونلره امنیت اولنه‌مدیغندن اهل اسلام قپودانلرینك اکثریسی
احتیاطاً کورکجیلرك نصفنی فورسه و نصف دیکرینی تورك اولەرق استخدام

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Figure 77. The fact that Lutfi Pasha was a vizier, during the most powerful period of the state (16th century), and that he included various opinions along with the events gave the work a different depth and reality. Lutfi Paşa, *Tevârîh-i Âl-i Osmân*, 1st ed. (Istanbul: Matbaa-i Âmire, 1922), p. 401, https://archive.org/details/tevarihiliosma00lutfuoft/page/56/mode/2up.

[607] Lutfi Paşa, *Tevârîh-i Âl-i Osmân*, 1st ed. (Istanbul: Matbaa-i Âmire, 1922), https://librarysearch.library.utoronto.ca/permalink/01UTORONTO_INST/14bjeso/alma991105873885906196.

Hayreddin Pasha had a yorouk scampavia. As Karakulak (Caracal), he always kept her with him. Namely, he ruled over flying birds and had nine seats.[608]

Figure 78. Lutfi Pasha (d. 1563) is a reputable witness about the events and details of his time, as he acted together with the navy captain Hayreddin Barbarossa Pasha in the Corfu expedition in 1537 and assumed command of the Ottoman naval forces. An engraving of Lutfi Pasha by the German painter Johann Theodor de Bry, 1590, https://islamansiklopedisi.org.tr/lutfi-pasa.

It can be seen here that scampavia was a ship, used by Hayreddin Barbarossa in 1500s. As for other ships, a larger galley, on which the Kapudan Pasha rode, was called a Galea bastarda (it is the name given to the warship, which is a large type of galley in the tow type). When the Kapudan pasha went out to sea, he used to board this galley, which had thirty-six seats, each seat had five to seven oarsmen. The presence of the Kapudan Pasha was about eight hundred, including the captain and five hundred

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[608] Lutfi Pasha, *Tevârîh-i Âl-i Osmân*, p. 401.
The Ottoman Turkish form of the quote is as follows:
"Hayreddin Paşa'nın bir yörük işkampavyesi vardı; karakulak olmak üzere onu daima yanından ayırmazdı; şöyle ki uçar kuşa hükmederdi, dokuz oturak idi." Uzunçarşılı, *Osmanlı Devleti'nin Merkez ve Bahriye Teşkilatı*, p. 458.
Yorouk (*Yörük*): a Turkic ethnic group.
Caracal (*Karakulak*): A long-legged wild cat with black tufted ears and a uniform brown coat, native to Africa and western Asia. At the same time, expression used for adjutant sergeant in the Ottoman empire.

oarsmen, two hundred and sixteen warriors, artillerymen and other sailors.[609] It can be listed the effects of Hayreddin Barbarossa, on the Ottoman navy, as follows: a good navy, a well-trained mass of sailors, and naval commanders, strategic bases, and ports were obtained.[610] During the time of him, Ottoman maritime power reached its peak, and this power continued for a while, thanks to the valuable sailors trained in his school and the organized shipyard (Fig. 79).[611]

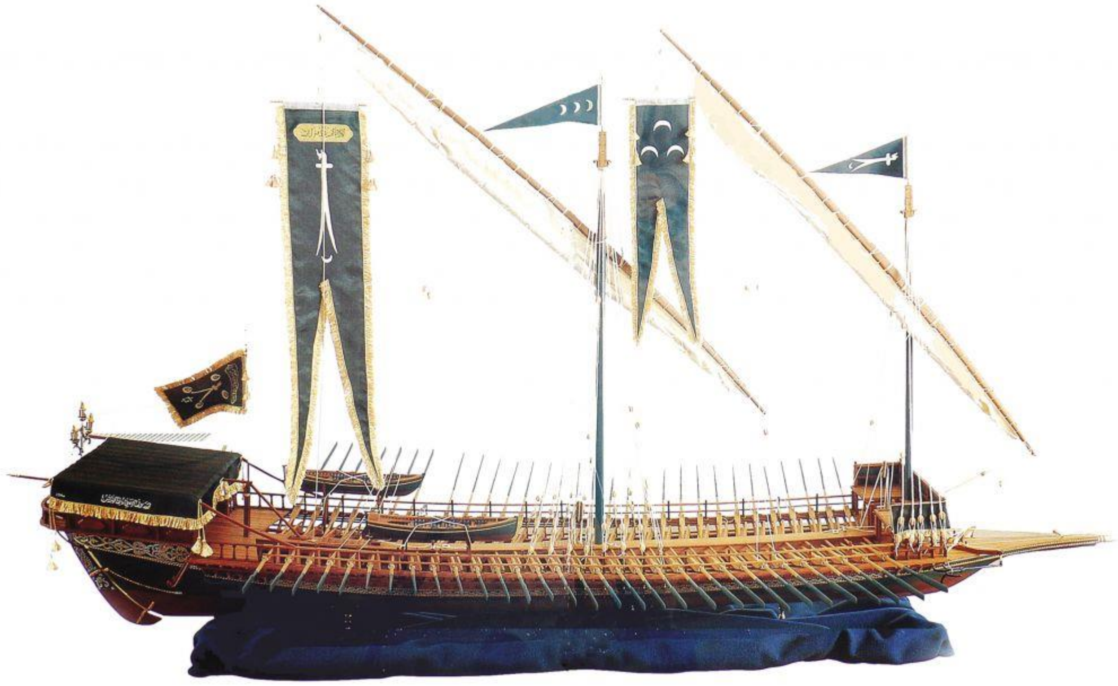

Figure 79. A model representing the galley of Hayreddin Barbarossa Pasha (Istanbul Naval Museum, Dem. Nr. 3783), https://denizmuzesi.dzkk.tsk.tr/tr/content/287.

609 Uzunçarşılı, *Osmanlı Tarihi*, Vol. II, pp. 577-578.
610 Tarakçı, *Deniz Gücünü Osmanlı Tarihi Üzerindeki Etkileri*, p. 34.
611 Turan, "Barbaros Hayreddin Paşa," accessed September 18, https://islamansiklopedisi.org.tr/barbaros-hayreddin-pasa.

Under the leadership of Piyale Pasha, another artisanal sailor of the Ottoman empire, and with the participation of Dragut Reis, a pirate who made his name in the Mediterranean, a final expedition was launched in Malta, in 1565. From the Malta expedition, unlike previous expeditions, many archival records have survived. These records provide rare information about the men, who served in the fleet as well as the admirals. While admirals, if they were skilled, were a crucial aspect of Ottoman naval power, skilled sailors at all levels were an essential component of an effective fleet. These men were the most difficult components for the navy to replace, after the loss of a major battle, like Lepanto, in 1571. Since there was no education system to train sailors, they learned sailing with experiencing, under a master artisan, like Piri Reis. If large numbers of masters or artisans were lost, before they could train their successors, these less experienced successors would also have less expertise to pass in the short run.[612]

Haji Khalifeh's insistence on seeking advice from "pirates" illustrates the value of the pirates, who functioned as a naval school for naval training.[613] The most famous of these is Hayreddin Barbarossa. The second was Uluj Ali, who was promoted to the navy, during the crisis that followed the Battle of Lepanto. He began his career, as an Algerian pirate. However, he arrived in Istanbul, in 1556, to serve as a captain in the Ottoman navy, on a salary that reflected his difference. Then, he returned to Algeria as viceroy, and fought as viceroy in Lepanto. Furthermore, Uluj Hasan Pasha, who was his successor in 1588, became his disciple and, like his patron, lived as a pirate, in Algeria.[614]

If the Ottomans were still able to take on their galley-powered adversaries, in the Mediterranean, after the battle of Lepanto, it was because, they continued to participate in the diffusion of new naval and military technology. In this process, renegades and Christian adventurers played significant roles, as well as the Barbary pirates, who were vassals of the Porte. The Spanish Diego de Haedo, who was

[612] Isom-Verhaaren, *The Sultan's Fleet*, chap. 5, para. 53.
[613] Imber, The Ottoman Empire, p. 302.
For Haji Khalifeh's book, you can refer to the publications: Kâtip Çelebi, *Deniz Savaşları Hakkında Büyüklere Armağan*, (Istanbul: Kabalcı Yayınevi, 2007), and for the English version; *The History of Maritime Wars of the Turks*, translated from Turkish of Haji Khalifeh by James Mitchell.
[614] Imber, The Ottoman Empire, p. 302.

imprisoned in Algiers, from 1579 to 1582, in his famous work on the history and geography of Algeria, listed thirty-five pirates, who owned galleons in Algeria, in 1581.[615] Of the thirty-five ship captains, three were sons of *devshirme* (renegade), and twenty-two were *devshirme*:[616]

> Six Genoese, three Greeks, two Spanish, two Venetian, two Albanian, one Hungarian, one French, one Jewish, one Corsican, one Calabrian, one Sicilian and one Neapolitan and only ten of them were Turkish.[617]

Given such a cultural diversity among Barbary captains, it is not surprising that pirates provided the Ottomans with an invaluable reservoir of naval experts. The employment of hundreds of these individuals, in the Mediterranean, facilitated military acculturation, and resulted in a shared military and maritime knowledge of the region.[618] The Turkish maritime dictionary of Italian and Greek origin reflects this "cultural unity" of the Mediterranean.[619]

Pirates like Kemal Reis and Barbarossa Hayreddin, whom I mentioned above, are sailors with scientific or technological knowledge. The knowledge they gained through many years of experience at sea has made them successful and good sailors. Again, the pirates I mentioned above were successful with their maritime knowledge, but we do not know that they produced any scientific and technological work. However, it is also a fact that these sailors had nautical instruments that they used during navigation. These have been given and analysed above. However, there were also some artisanal pirates, who produced maps and scientific navigational books, which were nautical instruments. Pirates, whose works have survived to this day as an example of practical knowledge, are Piri Reis, Seydi Ali Reis and Ali Macar Reis. Apart from these, there are two important atlases made in the same years, which are works that should be examined as instruments.

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[615] Agoston, *Guns for the Sultan*, pp. 54-55.
In 1632, Diego de Haedo published in Spain a book entitled Topographía e Historia General de Argel (Algiers).
[616] Agoston, *Guns for the Sultan*, pp. 54-55.
[617] Agoston, *Guns for the Sultan*, p. 55.
[618] Agoston, *Guns for the Sultan*, p. 55.
[619] Agoston, *Guns for the Sultan*, p. 55; and Kahane and Tietze, *The Lingua Franca in the Levant: Turkish Nautical Terms of Italian and Greek Origin*.

Conclusions

As mentioned above, it is very significant for Ottoman artisanal epistemology that the shipyard people consisted of a tradesman class that was a turning point in Ottoman maritime. The invitation of the pirates to the Dockyard, their appointment as commanders, and their appointment to the management of the shipyard led to great breakthroughs in Ottoman maritime technology, and it can be said that it was a reform. In the Ottoman Empire, the tendency towards experience-oriented knowledge contributed to the rapid development and growth of the navy. The navy developed and grew rapidly with production activities carried out, under the management of artisanal pirates. At the same time, the pirates, we call artisans, were state officials, who were recruited to serve the state in the sense. As seen above, these people have been influential in the acceleration and success of technological developments.

CHAPTER 6

Nautical Devices of Artisanal Pirates:

Portolan Charts and Nautical Atlases

In the early modern period, portolan charts and atlases, which are nautical instruments, were very significant in the Ottoman empire, as in the maritime states, such as Spain, Venice, and Portugal. Thus, although a Turkish school of cartographers corresponding to the European cartographic institutions did not arise, but special tradition took root among the Turks: portolan charts and atlases. These manuals of navigational instructions were written and drawn by Piri Reis, a Turkish pirate and captain in the Ottoman navy, like the most well-known *Kitâb-ı Bahriyye* or 1513 World Map.[620] Generally, nautical atlases are not nautical instruction manuals. However, in the case of Piri Reis, this book was written with the aim of being a practical instrument to guide sailors. He states this at the beginning of his book as follows:

> ...I have made this, so easy that those, who are masters of this profession, may by applying, which is written, in this book, and with the grace of God facilitate all their affairs, even if they have never seen or been acquainted with such places, and they will have no need of pilots....[621]
>
> ...My aim, thus, was to permit a desired place to be found, when needed without hesitation.[622]

Often a practical function, some of these charts and manuals were very artistically executed, gracefully drawn and elegantly coloured, never losing the original style of the portolan charts. New to the Ottoman tradition of portolan chart is their combination of text and charts, divided into a series of shorter segments covering the entire Mediterranean. In this type, which we call the Portolan Atlas, chapters usually

[620] Svat Soucek, "The 'Ali Macar Reis Atlas' and the Deniz Kitabi: Their Place in the Genre of Portolan Charts and Atlases," *Imago Mundi*, 25 (1971): 17–27, p. 26.
[621] Piri Reis, The Book of Bahriyye, p. 10.
[622] Piri Reis, The Book of Bahriyye, p. 10.

describe a small part of the coast or an island, and enlarged charts are correspondingly detailed.[623]

The portolan atlas and charts of Piri Reis, which we will see in this part, as well as the Nautical Atlas of Ali Macar Reis and the portolan charts are the products of the Mediterranean tradition.[624] In this section, we will analyse both these nautical and cosmographic artefacts and the craftsmanship behind their manufacture.

6. 1. Piri Reis: The Beginning of Ottoman Nautical Cartography

Piri Reis was a pirate, admiral, and captain, who left traces in Ottoman naval history (Fig. 19).[625] Navigator Piri Reis was probably born around 1465-1470, in Gallipoli. He drew the most comprehensive 'New World' portolan charts of the age of geographical discoveries, and is known for his book, *Kitâb-ı Bahriyye*, on the Mediterranean. He grew up with the pirate Kemal Reis. His father was al-Hac Mehmed from Gallipoli, and his grandfather was Ali Reis. This record shows that Piri Reis' family was also sailors.[626] Piri Reis started to learn with his uncle at the age of 12, and served for fourteen years, under the auspices of his uncle. Six of these years (1487-93) were spent on the coasts of North Africa, Italy, Spain, and the islands of the Western Mediterranean.[627] Piri Reis served as a naval veteran, in the entire Mediterranean, especially in the castles, and beaches of Spain and Venice, until he entered the service of the Ottoman empire, in 1495. It is known that during these activities, he conquered a castle near Majorca, besieged the island of Panthelaria, in the south of Malta, conquered the island of Pianosa around Corsica, and captured its people.[628]

In his book, Piri Reis talks about three merchant barcas (small warships of galleon type), near the southeast of Toulon (France), they captured seven barcas in front of Valencia, sold them in Tunisia, and similar events that lived, in the

[623] Soucek, "The 'Ali Macar Reis Atlas'," p. 26.
[624] Soucek, "The 'Ali Macar Reis Atlas'," p. 27.
[625] Özdemir, *Osmanlı Haritaları*, p. 49.
[626] Bostan, *Osmanlı Akdenizi*, pp. 171-172.
[627] McIntosh, *The Piri Reis Map of 1513*, pp. 5-6.
[628] Bostan, *Osmanlı Akdenizi*, pp. 171-172.

Mediterranean.[629] He describes Bayezid II's call and his entry into Ottoman service with his uncle Kemal Reis, in the *Kitâb-ı Bahriyye* as follows:

> Together we travelled the whole Mediterranean and roamed about all its capitals.
>
> Together we visited the lands of the Franks...
>
> One day, a firman graciously sent by Sultan Bayezid Han came to us.
>
> And it commanded, 'Let Kemal Reis come before me and serve in maritime matters at my court.'
>
> Good reader, in 900 (1494), the year of this order, we returned home.
>
> And after that, by order of the Sultan, we set out, on voyages, and won many victories at sea.[630]

Following the call of Bayezid II, Piri Reis entered the state service with Kemal Reis. And he participated in the Ottomans' Peloponnese expeditions with his galley, and showed many benefits, in the conquest of substantial castles between the years of 1499 and 1501, such as Lepanto, Moton, Koron, and Navarino.[631] Piri helped move the Muslim and Jewish populations of Granada from Spain to North Africa, during the reconquest of Spain by Ferdinand and Isabella.[632] He was the captain of his own ship in a fleet, under the command of Kemal Reis in the Venice War (1499-1502).[633] Upon the death of Kemal Reis, in 1510, Piri Reis withdrew to Gallipoli. The work to turn *Kitâb-ı Bahriyye* into a book started, in these years.[634]

In 1517, Piri Reis, who participated in the expedition of Sultan Selim to the city of Alexandria in Egypt for reinforcements from the sea with his galley, accompanied the Sultan to Cairo.[635] Piri Reis presented his chart of 1513, which he drew in Gallipoli,

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[629] Bostan, *Osmanlı Akdenizi,* pp. 171-172.
[630] Piri Reis, *Book of Bahriyye*, p. 11.
[631] Bostan*, Osmanlı Akdenizi*, p. 172.
[632] McIntosh, *The Piri Reis Map of 1513*, p. 6.
[633] McIntosh, *The Piri Reis Map of 1513*, pp. 5-6.
[634] Özdemir, *Osmanlı Haritaları*, p. 49.
[635] Bostan, *Osmanlı Akdenizi*, pp. 172-174.

to Sultan Selim in Egypt, in 1517.[636] During this trip, he carefully examined the distance, between Alexandria and Cairo, it is known that he drew a detailed portolan chart of the Nile River, and its tributaries for his book, and later retired to Gallipoli, and completed the first manuscript of *Kitâb-ı Bahriyye* in 1521.[637] As it is understood from what he wrote about his time in Egypt, in his book, it is seen that he took compass readings, while sailing on the Nile, and recorded them step by step.[638] And then, he recorded even more detailed information, as can be seen in his portolan charts. Thus, he had also the opportunity to make his own portolan chart by examining other charts.[639] Sultan Selim accepted this portolan chart. It was taken to Istanbul to be kept in the library, in the Topkapı Palace.[640]

Piri continued to traverse the Mediterranean from one end to the other, participating in some of the most important conflicts of the period.[641] Subsequently, he was present, in the navy, with his own galley, in the Belgrade (1521), and Rhodes (1522) campaigns of Sultan Suleiman.[642] He took Grand Vizier Ibrahim Pasha, who acted with the aim of reorganizing Egypt, as far as Rhodes with his galley, in 1524.[643] During his maritime career, Piri Reis collected charts of the islands and coasts, he visited, took notes and drew charts. In 1521, he collected these notes and charts in a book called *Kitâb-ı Bahriyye*. Piri Reis presented his book to Vizier İbrahim Pasha. When Pasha realized how valuable these notes could be for other Turkish sailors and the Ottoman empire, he encouraged Piri Reis to rewrite it to be presented to the Sultan.[644] With his encouragement, he submitted the second version of his book, which had been cleared, in 1526, and the second 'New World' chart, in 1528, to Suleiman the Magnificent.[645] This nautical book and work of art has been called "the greatest Ottoman geographic compendium of the time" and "a magnificently rich Renaissance table book".[646] At this time, the fact that he was mentioned as Piri *Kethüdâ*, suggests

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[636] Isom-Verhaaren, *The Sultan's Fleet*, chap. 4, para. 51.
[637] Bostan, *Osmanlı Akdenizi*, pp. 172-174.
[638] Piri Reis, *Kitâb-ı Bahriyye: Denizcilik Kitabı*, Volume 2, p. 227.
[639] Isom-Verhaaren, *The Sultan's Fleet*, chap. 4, para. 51-52.
[640] Idris Bostan, "Piri Reis," in *Türkiye Diyanet Vakfı İslâm Ansiklopedisi, 34, 283-285,* (İstanbul: Türkiye Diyanet Vakfı Yayınları, 2007), p. 284.
[641] Isom-Verhaaren, *The Sultan's Fleet*, chap. 4, para. 52.
[642] Bostan, *Osmanlı Akdenizi*, p. 173.
[643] Bostan, *Osmanlı Akdenizi*, pp. 172-174.
[644] McIntosh, *The Piri Reis Map of 1513*, p. 6.
[645] Bostan, *Osmanlı Akdenizi*, pp. 172-174.
[646] McIntosh, *The Piri Reis Map of 1513*, p. 6.

that he was in charge of the Gallipoli shipyard. Later, he joined the navy that was re-established by Hayreddin Barbarossa Pasha.[647]

In 1528, Piri Reis made another portolan chart, which he presented to the Sultan. As with the 1513 portolan chart, the only surviving part was the Atlantic Ocean depiction. This second chart is based on a later model than the 1513 chart. Piri Reis, who was appointed to the Indian Ocean navy in 1547, commanded the Red Sea and Arabian Sea ships in Suez.[648] On September 19, 1552, with 24 galleys, 4 barca navy and 850 soldiers, under the command of Piri Reis, he besieged Hormuz, which was the Portuguese's. Although he took almost the whole of the island, in the continued bombardment, and successive attacks, he could not capture the inner castle. Meanwhile, there is no doubt that the long duration of the fighting discouraged the Ottoman forces. The biggest concern of Piri Reis, while the siege was continuing, was the support of the Portuguese navy. In the face of the possibility that a Portuguese navy would come to help Hormuz, Piri Reis lifted the siege. And he moved to the nearby island of Kish (currently an island connected to Iran in the Persian Gulf) and obtained a large booty from the island.[649] There were disagreements between Piri Reis, who was moving towards Basra, and Kubad Pasha, the governor of Basra. The rumours broke out that Piri Reis lifted the siege, because of the loot, and, in case, the Persian Gulf was closed by the Portuguese navy, Piri Reis moved to Suez, and one of the ships ran aground, on the way. He could only return to Suez with two galleys, which led to accusations against Piri Reis. After Kubad Pasha wrote letters to the palace against him, Piri Reis was executed, in Egypt, by the order of Suleiman the Magnificent (November-December 1553).[650] He was over eighty years old, when he died.[651]

[647] Bostan, *Osmanlı Akdenizi*, pp. 172-174.
[648] McIntosh, *The Piri Reis Map of 1513*, p. 6.
[649] Bostan, *Osmanlı Akdenizi*, p. 180.
[650] Bostan, *Osmanlı Akdenizi*, pp. 180-181.
[651] Özdemir, *Osmanlı Haritaları*, p. 50.

Figure 80. Nautical chart showing Alexandria in Piri Reis’s *Kitâb-ı Bahriyye*, 1521, Piri Reis can easily be distinguished from other cartographers thanks to the unique style of his maps. Istanbul University Library, TY, nr. 6605, vr. 295a, 24 cm x 34 cm, https://islamansiklopedisi.org.tr/iskenderiye.

Although Piri Reis is a big name in Turkish maritime history, he is best known for his two ‘New World’ charts, he drew, in 1513, and 1528, and his book *Kitâb-ı Bahriyye* (Fig. 80).[652] It may be accurate to describe Piri Reis, who seems to have been following the new geographical discoveries closely, as a ‘cartographer of the age of discoveries’. Because his first portolan chart, dated 1513, shows Spain, Portugal, and West Africa, and places discovered, as the eastern coast of Central and South America, mostly the southern part of the Atlantic Ocean. On portolan charts, his long writings, in which explains how the discoveries took place, provide detailed information that can be found in books. This also reveals that Piri Reis’s aim is not only to draw portolan charts, but to announce new developments in geographical discoveries.[653] Therefore, Piri Reis’s works, besides being an instrument, constitute the contemporary corpus of maritime literature and cartography. And these works provide a rare glimpse into what European overseas voyages and explorations.[654]

[652] McIntosh, *The Piri Reis Map of 1513*, p. 7.
[653] Bostan, *Osmanlı Akdenizi*, pp. 182-183.
[654] Svat Soucek, *Piri Reis and Turkish Mapmaking After Columbus* (Istanbul, Boyut Publishing Ltd., 2013), p. 47.

Apart from these, it can be said that Piri Reis was an artisan, who produced scientific works. And considering the subject on which this thesis was written, Piri Reis's works are extremely striking works that need to be studied in terms of the history of Ottoman science. First, the knowledge about nautical instruments, given by Piri Reis in his *Kitâb-ı Bahriyye,* attracts attention because it is the first work, in the history of Ottoman science, that gives us data about the compass. Apart from this, he provides with his experience and knowledge, while providing information about astronomy, navigation and maps that they need to know, gives us the chance to see the scientific knowledge, he had as a sailor. That is, examination of these scientific works of Piri Reis, who is generally remembered for his services in the Ottoman navy, reveals that he had more scientific knowledge and allows us to see him as an artisanal pirate and a scientist at the same time. It is possible to see these in two world maps, made by Piri Reis in 1513 and 1528, and in a navigational book, called *Kitâb-ı Bahriyye*, which he presented to Sultan Suleiman in 1520.

6. 2. The First World Map of Piri Reis (1513)

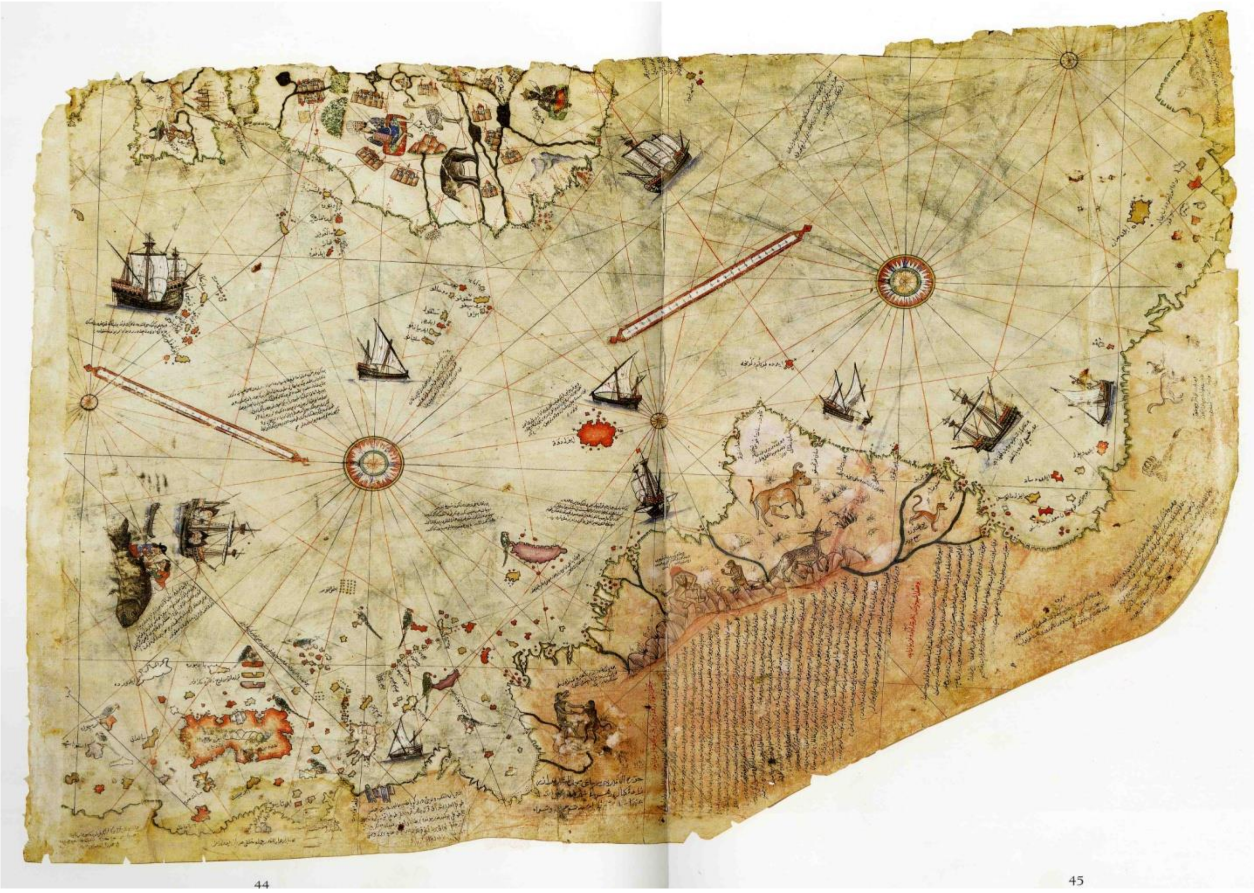

Figure 81. World Map presented by Piri Reis to Sultan Selim I, dated 1513. Parchment, 650 x 900 mm (TSMK, Revan K., nr. 1633), https://www.dzkk.tsk.tr/Genel/icerik/piri-reis-1465-1554.

The Director of National Museums, Halil Edhem (Eldem), revealed Piri Reis' First World Map, one of the unique treasures of Topkapı Palace, in 1929 (Fig 81). The chart was analysed, by the German orientalist Paul Kahle, who was doing research, in Istanbul, at that time, and presented to the world scientific community, at the 18th Congress of Oriental Studies held in Leiden, in 1931. The chart, which is called the 'First World Map', has portolan chart feature, drawn on camel skin, painted and illustrated in nine colours, is 86 cm tall. Its width is 61 cm on the upper side, and 41 cm on the lower side.[655] The mountains are in relief, the rivers are marked with thick lines, the stony places are black, the sandy places are with red dots, the stony places that are not visible in the seas are determined by the cross. And it decorated with

[655] Özdemir, *Osmanlı Haritaları*, p. 50.

characteristic plant and animal pictures, and notes on the regions have been added.[656] While cream tones dominate the chart, green, red, white, and brown tones are also used.[657] We get this knowledge, according to Piri Reis's explanation about "the Markings on Maps" in his *Kitâb-ı Bahriyye* (Fig. 82).[658] He gives these informations, as follows;[659]

Figure 82. Section about "the Markings on Maps" in Piri Reis's *Kitâb-ı Bahriyye* (Book on Navigation, 1521), https://www.loc.gov/item/2021667235/.

[656] Sevim Tekeli, *İlk Japon Haritasını Çizen Türk Kaşgarlı Mahmud ve Kristof Kolomb'un Haritasına Dayanarak En Eski Amerika Haritasını Çizen Türk Amirali Piri Reis* (Ankara: Atatürk Kültür Merkezi Yayınları, 1985), p. 12.

[657] Şehnaz Biçer Özcan, "The Pattern Analysis of the Ornament of Piri Reis World Map," *Idil Journal of Art and Language*, 8, 55, 421- 426 (Ankara: Idil Journal of Art and Language, 2019), doi: 10.7816/idil-08-55-16, p. 423.

[658] Inan, *Piri Reis'in Hayatı ve Eserleri*, p. 34.

[659] I revised the English translation of this chapter in Piri Reis's *Kitab-ı Bahriye* by taking it from the work published by Boyut Publications as Piri Reis, "The Book of Bahriye", translated by Ertuğrul Zekai Ökte and Tülay Duran from TTT: The Historical Research Foundation Istanbul Research Center.

> Now listen carefully to the circumstances of the map. Not many have written of this before.
>
> For this reason, if you have given your attention, I will explain it to you in detail.
>
> Now, then there are a number of names on maps that if you will attend, you will see what they are.
>
> The names of towns and citadels are in red, while uninhabited places are in black.
>
> You have learned the science of the map. There is, but one more thing to say, and I will do so at once.
>
> There are a few reefs: these are shown by black dots.
>
> Shallows that are entirely sandy are shown with red dots.
>
> Hidden reefs in the sea since ancient times have been shown by means of crosses.
>
> If one wishes to show tiny islets, points are marked equal to their number.
>
> Now if you can remember all this, I have told you all about the markings of maps.
>
> Young man, if you can put this knowledge to work, you will always be considered a master seaman.
>
> You may make you might know in the lands of the Franks, for I have shown you the way.
>
> And be you young or old, if new doors open as a result, both you, and I will have performed a good deed.[660]

The Piri Reis chart, dated 1513, is one of the most fantastic, interesting, and mysterious charts that have survived from the Age of Great Discoveries. Yet, it is one of the least understood charts of this important and remarkable period in the history of cartography and geographical discoveries. Many different opinions have been put forward about this chart. Someone claimed that it contains a copy of a chart, made by Christopher Columbus in 1498, that it is the oldest chart of the Americas. Some thought that it is the most accurate chart, made in the 16th century. Some people have argued that there was evidence of the cartographer's ability to measure and perform spherical trigonometry calculations centuries ahead of time. And they believed that this provides evidence that a world-class maritime civilization existed tens of thousands of years ago.[661]

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[660] Piri Reis, *The Book of Bahriyye*, p. 15.

[661] Gregory McIntosh, *The Piri Reis Map of 1513* [Edition unavailable], (Reprint, University of Georgia Press, 2012), https://www.perlego.com/book/839607/the-piri-reis-map-of-1513-pdf, pp. 1-2.

If we look carefully, the chart had been severed on the right side. The short width of the lower part is due to the usual structure of the skin. Because of the rupture, only the part, showing the two sides of the Atlantic Ocean, remained from the World Map that has survived to the present day.[662] Although there are those, who claim that this is the whole chart, we understand from the half-split view of the depictions, that the chart was damaged. That is, this is only a part of the chart. Another argument to support this situation is that, as can be seen from the ruptures of the chart, the drawings are incomplete. It should be considered that he must have added the Mediterranean, a region that Piri Reis knew very well, to his portolan chart. It does not seem possible that he did not add all places to the chart. On the chart, Spain, France, the eastern parts of America, and the coasts of Florida, the Antilla, the eastern part of South America were drawn with accuracy close to today's charts.[663]

The chart is a typical portolan. Instead of lines of latitude and longitude, it is decorated with a weathervane, and direction lines, mythical, and realistic pictures. Many pictures of ships appear, on the chart, most of them Portuguese caravels. There are more than ten pictures of parrots, 'tuti birds' in Piri Reis's words, on the islands, in the Antilla. In addition to the names of places, there are notes about the history of discovery, legendary information, and the formation of the chart.[664] The portolan chart, at a scale of approximately 1:12,000,000, is uniquely picturesque. The fact that the visuality is so prominent, is due to the work will be presented to the Ottoman Sultan.[665]

The Piri Reis' portolan chart has two large compass roses, three small compass roses, and a partial network of rhumb lines. The positions of these roses and lines indicate that there were originally sixteen successive compass roses, large and small, in a large circle around a central compass rose in northeast Africa. This was a common design in the portolan charts of 16th century. The circle of compass roses is approximately 113 cm (45 inches) in diameter. The two large decorative compass roses

[662] Özdemir, *Osmanlı Haritaları*, p. 50.
[663] Özdemir, *Osmanlı Haritaları*, p. 50.
[664] Özdemir, *Osmanlı Haritaları*, p. 50.
[665] Özdemir, *Osmanlı Haritaları*, p. 52.

each have a black arrowhead to indicate north. This practice is, first used in the *Catalan Atlas* (1380), then continued by later cartographers and into the present day.[666]

This portolan chart that is also a World Map, can also be proved by the number of wind roses. The number of these wind roses should have been 17, as in the standard portolan chart drawings. Only 5 of them can be seen on the chart.[667] If we assume, there are 17 wind roses, in the entire chart, it can be concluded that it is a *mappa mundi* (world map). The diversity of sources also confirms this opinion. In the north-western part of South America, the signature of Piri Reis is clearly read (Fig. 83):

> Piri, son of Hacı Ahmed, famous as Kemal Reis's brother, wrote this, in the city of Gallipoli, in *Muharremü'l-harâm*, it is the first month of the Hijri lunar calendar of 919 (1513), may God forgive them both.[668]

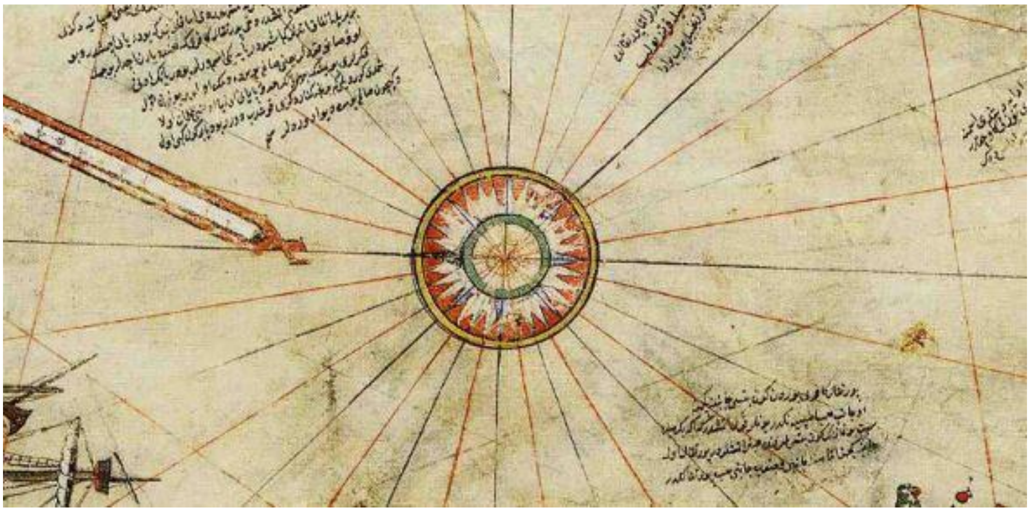

Figure 83. One of the two large wind roses found on the chart, 1513, (TSMK, Revan K., nr. 1633), https://www.dzkk.tsk.tr/Genel/icerik/piri-reis-1465-1554.

[666] McIntosh, *The Piri Reis Map of 1513*, pp. 9-10.
[667] Özdemir, *Osmanlı Haritaları*, p. 52.
[668] Özdemir, *Osmanlı Haritaları*, p. 52.

After the chart was found in Topkapı Palace, which was described as 'Columbus's chart of America', and attracted great attention, led to the emergence of many theses. The common point of these views is that the chart contains the whole world with newly discovered places, therefore, it was torn on the right side. On the other hand, it was torn from the part to which, it was pasted and consisted of several layouts. Because generally, portolan charts, showing large areas, were made in one piece. All the Mediterranean portolan charts, such as the portolan chart of El Hacc Ebu'l Hasan, in the Topkapı Palace Museum Library, the portolan chart of İbrahim el-Mursi, in the archives of Istanbul Naval Museum, were in one piece.[669] Gregory C. McIntosh, in his book *Piri Reis Chart of 1513*, says the following about this subject:

> The original world map probably measured about 140 cm (55 in.) high, and at least 165 cm (65 in.) wide, and most likely included the British Isles, Iceland, Greenland, and Newfoundland, the remaining portions of Europe and Africa, and all of Asia eastward to China, and the East Indies.[670]

The right side of the chart clearly shows the coasts of the Iberian and France's British Peninsulas, the West African ridge, the Azores, Madeira, the Canarian, and the Cape Verde Islands. The left side of the chart shows a mixed depiction of the coastline and ledge of South America, the Lesser Antilla, Puerto Rico and Hispaniola, Cuba, the Bahamas, and the northwest corner of Central America. At the bottom of the chart is a large continental landmass, connected to South America. Presumably, the missing eastern part of the chart stretched from Africa and Europe to China and the east coast of Asia. It seems that the British Isles, Iceland, Greenland, and Newfoundland were removed from the surviving portion of the chart. And the blank strip, with another piece of parchment attached along the top edge of the chart, indicates that the parchment, containing these northern regions, was also lost.[671] The other two-thirds of the chart,

[669] Özdemir, *Osmanlı Haritaları*, p. 52.

[670] Gregory McIntosh, "The Piri Reis Map of 1513: Art and Literature in the Service of Science," in *Seapower, Technology and Trade* eds. Dejanirah Couto, Feza Günergün, Maria Pia Pedani, 367-379, (Istanbul, Denizler Kitabevi, 2014), p. 10. https://www.researchgate.net/publication/286455909_The_Piri_Reis_Map_of_1513_Art_and_Literaturein_the_Service_of_Science.

[671] McIntosh, *The Piri Reis Map of 1513*, pp. 9-10.

possibly showing the eastern hemisphere, were of more immediate practical value, and so that part did not remain in the palace library.[672]

6. 2. 1. Inscriptions on the World Map of Piri Reis

At the beginning of the 16th century, seeing the increasing relations of the Ottoman empire, in the Mediterranean, Piri Reis thought that a chart, was needed to assist his colleagues, who would travel. From the first note written in Piri Reis' handwriting, we understand that he made the chart, and he was in Gallipoli, in March-April 1513.[673] Piri Reis added extremely interesting and informative notes on the chart. Among these notes, he mentions legends, myths, and most excitingly, the charts, he used, while drawing his portolan. Among these, there is a very interesting note, in which he tells about the discovery of Christopher Columbus, and mentions the chart drawn by Columbus, in this discovery, and says that he made use of this chart, while drawing the America part of his portolan. We see that another feature of the chart is that it is not a copy, but an original work that was created by making use of various charts, and the information of the captains.[674] The notes, on the portolan chart of Piri Reis, can be examined closely. First, it would be useful to do this by numbering the notes and proceeding systematically (Fig. 84). After giving the Latin alphabet translation of the notes in the original text, which are in Ottoman Turkish, I will also give the English versions.[675]

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[672] Isom-Verhaaren, *The Sultan's Fleet*, chap. 4, para. 51-52.
[673] Inan, *Piri Reis'in Hayatı ve Eserleri*, pp. 26-27.
[674] Yusuf Akçura, *Piri Reis Haritası* (Istanbul: Deniz Kuvvetleri Komutanlığı Hidrografi Yayını, 1981), p. 4.
[675] I am making Latinized and English-translated versions of these texts from the version made in 1935 by Yusuf Akçura, historian, writer and President of the Turkish Historical Society. See also Yusuf Akçura, *Piri Reis Haritası*, Istanbul: Deniz Kuvvetleri Komutanlığı Hidrografi Yayını, 1981. I provide revisions of the translation of the names of people and places in the English version. For example, Piri Reis wrote the name of Christopher Columbus as Kolonbo in the text. There are several more examples like this. This is due to language. I restored these to their original state.

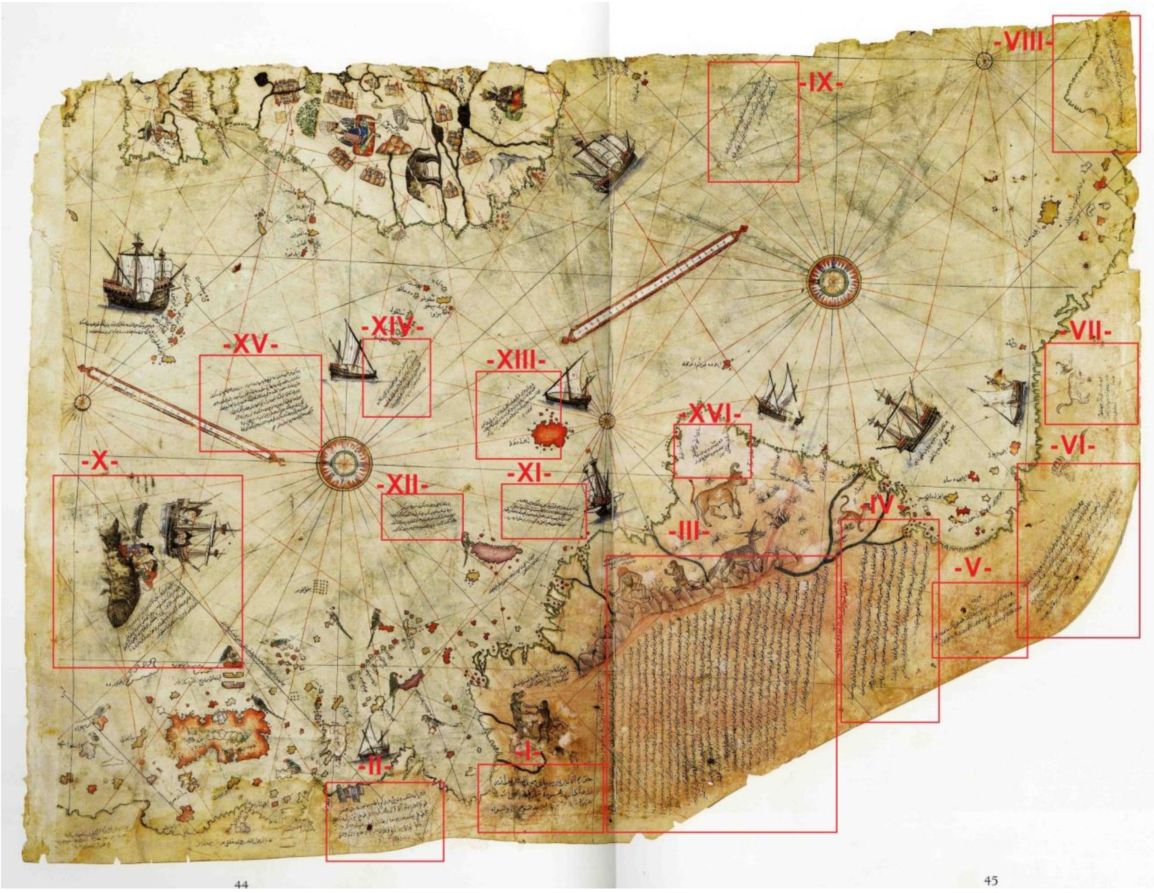

Figure 84. Portolan chart presented by Piri Reis to Sultan Selim I, dated 1513 (Topkapi Palace Museum Library, Revan Mansion, nr. 1633), https://www.dzkk.tsk.tr/Genel/icerik/piri-reis-1465-1554.

Note Number I.

> This chart was drawn by Piri Ibn Haji Mehmed, known as the nephew of Kemal Reis, in Gallipoli, in the month of Muharrem of the year 919 (that is, between the 9th of March and the 7th of April of the year 1513).[676]

It is very significant that Piri Reis introduces himself, in the way, as Kemal Reis' nephew Piri Reis, on the chart, because the absence of a signature on such charts, has led to many misconceptions (Fig. 84.-1). It is momentous, in distinguishing it, from the charts, like Piri Reis's portolans. For example, the work of the 17th century Ottoman historian and scholar Haji Khalifeh, *Müntehab-ı Bahriyye* (Selected Sea) was

[676] Akçura, *Piri Reis Haritası*, p. 33. Below is a transcription of the original Turkish version of the note in Latin alphabet; "İş bu haritayı Kemal Reis'in biraderzadesi ünvanile müştehir Piri ibni Hacı Mehmet 919 senesi muharreminde (yani 1513 senesi 9 Mart ile 7 Nisan arasında) Gelibolu'da tahrir eylemiştir". I will follow the same procedure in all other cases.

known as one of the copies of Piri Reis' *Kitâb-ı Bahriyye*. Detailed examinations revealed that the work was made in a later period.

Figure 84.-1. Signature of Piri Reis from his portolan chart of 1513.

Note Number II.

> This region is known as the territory of Antilla. It is on the side where the sun sets. They say that there are four kinds of parrots, white, red, green, and black. The people eat the flesh of parrots, and their headdress is made entirely of parrots' feathers. There is a stone here. It looks like a black touchstone. The people use it instead of the ax. That it is very hard (illegible). We saw that stone.[677]

In his note, number II, Piri Reis said that this place is known as the Antilla region, there are four kinds of parrots in white, red, green, and black colours, and there is a stone, like a black touchstone (Fig. 84.-2). In addition, Piri Reis defines, in the *Bahriyye*, that he saw them, on an enemy ship, they captured, as follows:

[677] Akçura, *Piri Reis Haritası*, p. 33.
"Bu diyara Antilya vilayeti derler. Gün batısı canibidir. Dört cins tuti olur imiş: ak, kızıl, yeşil, kara. Halkı tuti etini yerler ve taçları cümle tuti yünündendir. Bunda bir taş olur, siyah mehenk taşına benzer, halkı nacak yerine anı kullanırlar imiş. Gayette berk taş olduğunu...... biz ol taşı gördük." Akçura, *Piri Reis Haritası*, p. 5.

On the enemy ships, which we captured, in the Mediterranean, we found a headdress, made of these parrot feathers, and a stone, resembling a touchstone.[678]

Figure 84.-2. Note number two on the chart of Piri Reis, giving information on Antilla (Cuba).

Note Number III.

In this note, Number III, Piri Reis explains how the coasts of Antilla, were found. He states that Christopher Columbus discovered these shores, in 1490-1491, and that this discovery was made through a book that Columbus found (Fig. 84.-3). He says that this book reports that, at the end of the West Sea (Atlantic) i.e., the western side, there are coasts, islands, and all kinds of metals, and precious stones. Examining the book thoroughly, he states that Columbus, first, went to Genoa, and asked for two ships, but was refused. He says that Columbus, who went to the King of Spain, after that, persuaded the King, and took two well-equipped ships. Piri says that when the King gave the ship to Columbus, that if everything was found, as Columbus said, coasts, islands, and precious stones, he would make Columbus, the governor of the place. Here, we hear from whom Piri Reis learned this information. Piri Reis talks that a Spanish slave was found on the ship of his uncle, Kemal Reis. Piri Reis reports that

[678] Akçura, *Piri Reis Haritası*, p. 33.
"Akdenizde elde ettiğimiz düşman gemilerinde hem bu tuti yününden olan külâhlardan bir tanesini ve mehenk taşına benzeyen taşı bulmuştuk." Akçura, *Piri Reis Haritası*, p. 5.

this person told Kemal Reis that he went to explore these new places three times with Columbus.[679] Moreover, he recounts what this person said:

> This section tells how these shores and these islands were found.
>
> These coasts are named the shores of Antilla. They were discovered in the year 896 of the Arabian calendar. But it is reported that a Genoese sailor, his name was Columbus, discovered these places. For instance, a book fell into the hands of the said Columbus, and he found said in this book that at the end of the Western Sea (Atlantic) i.e. on its western side, there were coasts and islands and all kinds of metals and precious stones. This man, having studied this book thoroughly, explained these matters one by one to the grandees of Genoa and said: "Come, give me two ships, let me go and find these places". They said: "Foolish man, can an end or a limit be found to the Western Sea? Its vapour is full of darkness". The above-mentioned Columbus saw that no help was forthcoming from the Genoese, he sped forth, went to the Bey of Spain (king), and told his story in detail. He too answered like the Genoese. In brief, Columbus talked the king for a long time, and finally the Bey of Spain gave him two ships, saw that they were well equipped, and said:
>
> "Columbus, if it happens as you say, let us make you kapudan to that country". Having said this, he sent the said Columbus to the Western Sea. The late Gazi (veteran) Kemal had a Spanish slave. This slave said to Kemal Reis, that he had been three times to that land with Columbus. He said:
>
> First, we reached the Strait of Gibraltar, then from there straight south and west between the two... (illegible). Having advanced straight four thousand miles, we saw an island facing us, but gradually the waves of the sea became foamless. And the North Star, little by little, became veiled and invisible, and he also said that the stars, in that region, are not arranged as here. They are seen in a different arrangement. They anchored at the island, which they had seen earlier across the way. The population of that island came, shot arrows at them, and did not allow them to land and get information. The males and the females shot hand arrows. The tips of these arrows were made of fishbones, and the whole population went naked and very... (illegible). Seeing that they could not land on that island, they sailed to the other side of the island, where they saw a boat. On seeing them, the boat fled, and they (the people in the boat) dashed out on land. They (the Spaniards) took the boat. They saw that inside of it, there was human flesh. It happened that these people were of that nation, which went from island-to-island hunting, men and eating them. Columbus saw yet another island, they neared it, and they saw that on that island, there were great snakes. They avoided landing on this island, and remained on anchor, for seventeen days. The people of this island saw that no harm came to them from this ship, so they caught fish, and brought them, in their small canoes. These (Spaniards) were pleased and gave them glass beads. It appears that he (Columbus) had read it in a book that in that region, glass beads were prized. Seeing the beads, they brought still more fish. Spaniards continued to give glass beads to them. One day, they saw gold around the arm of a woman, they took the gold, and gave her beads. They told her, bring more gold, we will give you more beads. They (the natives) went and brought them much gold. It appears that, in their mountains, there were gold mines. One day, also, they saw pearls, in the hands of a person. They saw that, when they gave beads many more pearls, were brought to them. Pearls were found on the shore of this island, in a spot one or two fathoms deep. Also, loading their ship with many logwood trees, and taking two natives along, they took them within that year to the King of Spain. However, Columbus not knowing the language of these people, they traded by

[679] Akçura, *Piri Reis Haritası*, p. 33.

signs, and after this trip, the Spanish King sent priests and barley to this new place. The Spaniards taught the natives how to sow and reap and converted them to their own religion. The natives had no religion of any sort. They walked naked and lay there like animals. Now these regions have been opened to all and have become famous. The names, which mark the places on the said islands and coasts, were given by Columbus, that these places may be known by them. And also, Columbus was a great astronomer. The coasts and islands on this map are taken from Columbus's map.[680]

[680] Akçura, *Piri Reis Haritası*, pp. 33-34.
"Bu fasıl işbu kenarların vedahi cezairin nice bulunduğunu beyan eder. İşbu kenarlara Antilya kıyıları derler. Arap tarihinin sekiz yüz doksan altı yılında bulunmuştur. Amma şöyle rivayet ederler kim Cinevizden bir kafir adına Kolonbo derler imiş, bu yerleri ol bulmuştur. Meselâ mezbur Kolonbonun eline bir kitap girmiş ki Magrip Denizinin nihayeti yani gark (garp) tarafında kenarlar ve cezireler ve türlü türlü madenler ve dahi cevahir dağı vardır deyu bu kitapta bulur. Mezbur kitabı taman mütalea ederek Cineviz ulularına bu kaziyeleri bir bir şerh edip eydür gelin, bana iki pare gemi verin, varayım, ol yerleri bulayım, der. Bunlar eydürler: ey epter, Mağrip deryasının nihayeti payanı ve haddi (mi) bulunur? Buharı zulmetle doludur, derler. Mezbur Kolonbo görür ki Cinevizlerden çare yok, sürer. İspanya Beyine varır, hikâyeyi bir bir arzeder Anlar dahi Cinevizli gibi cevap verirler. Velhasıl bunlara Kolonbo hayli ibram eder. Ahir İspanya beyi iki gemi verip bunun muhkem yarağın görüp eydür: ey Kolonbo, eger senin dediğin gibi olursa, seni ol diyara kapudan ideyin, deyip mezbur Kolonboyu Bahri Magribe gönderdi. Merhum Gazi Kemalin İspanyalı bir kulu vardı, mezbur kul Kalonbo ile üç defa ol diyara vardım. Deyu merhum Kemal Reis'e hikâye edip eydür: evvel Septe Boğazına vardık, dahi oradan gün batısı lodosun ikisinin ortasına rast dört bia mil yürü dükten sonra karşımızda bir ada gördük; amma gittikçe deryanın mevci köpüklenmez olmuş, yani deniz sakin olup düzelmis; ve Şimal yıldızı dahi bâhriler puslalarında gene yıldız derler ol yıldız gide gide dolunmuş görünmez olmuş: ve dahi eydür ki, bu tertipçe yıldızlar ol diyarda görünmez, gayri tertipçe görünür, der. Andan evvel karşıda gördükleri adaya demir korlar, ol adanın halkı gelir, bunlara ok vurur, komazlarki dışarı çıkıp haber soralar. Erkeği ve dişisi el okun atarlarmış. Ol okun demreni balık sağüğünden, ve cümlesi üryan yürürlermiş ve hem gayret... Görürler kim ol adaya çıkamazlar, adanın öte yüzüne geçmişler. Bir sandal görürler, bunları görücek sandal kaçıp karaya dökülürler. Bunlar sandalı almağa varırlar, görürler ki içinde adam eti var. Meğer bunlar bu tayfa imişki adadan adaya çıkıp adam şikar edip yerler imiş. Mezbur Kolonbo bir ada dahi görüp ana varırlar, görürler kim ol adada ulu yılanlar var. Ol yere çıkmadan hazer edip bir gayri adaya dahi varırlar. Demir korlar, on yedi gün onda yatarlar. Bu adanın halkı görürler ki kendilerine bu gemiden ziyan yok, varırlar, balık avlayıp filikasile bunlara getirirler. Bunlar da hoş görüp anlara sırça boncuk verirler. Meğer kim sırça boncuk ol diyarda muteber idiyin kitapta bulmuş imiş. Anlar boncuğu görüp dahi ziyade balık getirirler. Bunlar daim anlara sırça boncuk verirler. Bir gün bir avretin kolunda altın görürler. Altın alıp boncuk verirler. Bunlar eydür: varın, dahi altın getirin, size dahi ziyade boncuk verelim, derler. Anlar varıp dahi vafir altın getirirler. Meğer bunların dağlarında altın madeni varmış. Bir gün dahi birinin elinde inci görürler. Inciyi alıp boncuk verirler. Bunlar görürler ki boncuk verirler dahi vafir inci getirirler. İnci bu adanın kenarında bir iki kulaç yerde bulunurmuş ve dahi ol diyardan vafir bakkam ağacını yükleyip mezbur halktan ikisini alıp ol yıl içinde İspanya Beyine getirirler. Amma mezbur Kolonbo ol kişilerin dilin bilmeyip işaretle alış-veriş ederlermis. Ve bu seferden sonra Ispanya Beyi papaz ve arpa gönderip ekin biçim öğredip kendi tarikine koymuş; bunların bir vecle mezhepleri yoğmus, hayvan gibi üryan yürüyüp anda yatarlarmış. Şimdi ol diyarlar tamam açılıp meşhur olmuştur. Bu isimler ki mezbur cezairde ve kenarlarda kim vardır. Kolonbo komuştur ki anında malûm oluna. Ve hem Kolonbo ulu müneccim imiş. Mezbur hartide olan bu kenarlar ve cezireler kim vardır. Kolonbonun hartisinden yazılmıştır." Akçura, *Piri Reis Haritası*, pp. 5-6.

It is surprising that Piri Reis has so much information about Columbus' discoveries. Only someone, who follows the discoveries carefully, can access these knowledges. As we can see in other notes on the map, we can say that Piri Reis has a very wide opportunity or chance to access resources, people, objects, and instruments. Of course, this primarily stems from his own curiosity and desire to research. We can also get the following information from the explanation here. As can be understood from Piri Reis' writings, he speaks Greek, Italian, Spanish and even Portuguese, in addition to his native Turkish. Because he noted that he used works in these languages to draw the world map, in the next notes. At the same time, his observations and narratives, in his book, testify that he can easily talk to the people of those places.[681]

If we evaluate the life story of Piri Reis that we already have, Piri Reis is a person with a desire to learn, and it is known that he joined his uncle Kemal Reis's ship in the Mediterranean, as a crew member. And it can be estimated that there were many different nationalities among the crew on this ship. Because we know, from the previous chapter about pirates, that there were people from many nationalities among the Ottoman sailors. It is possible that Piri Reis learned many languages from these people. Moreover, the fact that Piri Reis mentioned all these details here, makes him a complete scientist. In terms of history of science and nautical knowledge, it is very significant and valuable that a first witness, like Piri Reis as a person, who listened and learned, and wrote, conveys these details.

[681] Inan, *Piri Reis'in Hayatı ve Eserleri*, p. 17.

Figure 84.-3. Note number three on the chart of Piri Reis. He explains how the coasts of Antilla were discovered.

Note Number IV.

> This section shows in what way this map was drawn. In this century, there is no map, like this map, in anyone's possession. The hand of this poor man has drawn it and now it is completed. From about twenty charts and Mappae Mundi (medieval European maps of the world) - these are charts drawn in the days of Alexander, Lord of the Two Horns, which show the inhabited quarter of the world: the Arabs name these charts Jaferiye (geography) - from eight Jaferiyes of that kind and one Arabic map of Hind, and from the maps just drawn by four Portuguese, which show the countries of Hind, Sind and China geometrically drawn, and also from a map drawn by Columbus in the western region, I have extracted it. By reducing all these maps to one scale this final form was arrived at. So that the present map is as correct and reliable for the Seven Seas as the map of our countries is considered correct and reliable by seamen.[682]

In note IV, he gives information about which charts he used, while drawing his portolan chart (Fig. 84.-4). Piri Reis mentions about 34 charts, in the note, he wrote here. Since he said that he made use of charts from the period of Alexander the Great, it can be concluded that he benefited from Ptolemy's *Geographia*, which was also found in Topkapı Palace and was widely used by the cartographers of the period.[683] Twenty of these charts are old, and undated. However, eight of them were made by Muslims, two of which are in Istanbul. One of them was a portolan chart by Ahmad b. Suleiman et-Tanci, in 1413, and is in the library of the Topkapı Palace Museum. The other one is Ibrahim el-Mursi' portolan chart, dated 1460, and located in the Istanbul Naval Museum. Four charts were the Portuguese portolan, one in Arabic showing parts of the West Indian, and Chinese seas and parts of Africa, and one is an exploration chart of Christopher Columbus. For example, as proof that Piri Reis made use of Portuguese portolans, in the African coast section of his chart, it can be shown that the place names, on the African coasts consist of an interesting mixture of Portuguese and Turkish.[684]

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[682] Akçura, *Piri Reis Haritası*, p. 34.
"Bu fasıl işbu hartinin ne tarikle telif olduğunu beyan eder.Işbu harti misalinde harti asır içinde kimesnede yoktur. Bu fakirin elinde telif olup şimdi bünyat oldu. Hususan yirmi miktar hartiler ve Yappamondolardan yani Iskenderi Zülkarneyn zamanında telif olmuş hartidir ki rubu meskün anın içinde malûmdur. Arap tayfası ol hartiya Caferiye derler anın gibi sekiz Caferiyeden ve bir Arabi Hint hartisinden ve dört Portukalın şimdi telif olmuş hartilerinden kim Sint ve Hint ve Çin diyarları hendese tariki üzerine ol hartilerin içinde mesturdur, ve bir dahi Kolonbonun garp tarafında yazdığı hartiden bir kıyas üzerine istihraç edip bu şekil hâsıl oldu; söyle ki bu diyarın hartisi bahriler içinde nice sahih ve muteber ise, mezbur harti de dahi yedi derya ile sahih ve muteberdir." Akçura, *Piri Reis Haritası*, p. 6.

[683] Akçura, *Piri Reis Haritası*, p. 34.

[684] Soucek, "Islamic Charting in the Mediterranean," p. 271.

Figure 84.-4. Note number four, on the chart of Piri Reis, gives information on what way this map was drawn.

Here, it can be opened a parenthesis about the maps that Piri Reis might have benefited from. The aim is to examine which he used maps and geography works while drawing his portolan chart.[685] The Islamic geography works that Piri Reis mentioned among the sources of the portolan and that he was likely to see or own that day can be researched through the maps, atlases, and sources in the Topkapı Palace archives. From here, a few maps that Piri Reis might have seen can be guessed with the clues he gave.[686]

First, it may be the map of the Abbasid Caliph al-Ma'mun (813-833), (Fig. 73). Caliph Ma'mun patronized many scholars, engineers, and artisans in the institution he founded, which was a science and research centre and named "*Bayt al-Hikma*" or House of Wisdom. In this centre, a group of astronomers and geographers prepared a

[685] Mustafa Kaçar, *Piri Reis ve Kristof Kolomb Öncesi Islam Haritaları* (Istanbul: Boyut Yayıncılık, 2013), p. 6.
[686] Kaçar, *Piri Reis*, p. 9.

large world map by order of Caliph Ma'mun.[687] This map has not survived to the present day. However, this map, which has a political effect as well as a scientific aspect, was copied and used by contemporary states such as the Fatimids, Sassanids and Normans. A copy of map was found in the work, titled *Mesâlikü'l-Ebsâr fî Memâliki'l Ensâr*, written by Ibn Fazlullah el-Ömerî in 1340, in the Topkapı Palace Library.[688] The map draws attention primarily in terms of seas. Major rivers, mountains, deserts, and countries are located according to meridians and parallels. The Mediterranean, Black Sea, Caspian Sea, Indian Sea, Red Sea and the coasts and seas surrounding the continents had been determined.[689]

[687] Fuat Sezgin, *Islam Uygarlığında Astronomi, Coğrafya ve Denizcilik* (Istanbul: Boyut Yayıncılık, 2009), p. 191.
[688] Kaçar, *Piri Reis*, p. 10.
[689] Kaçar, *Piri Reis*, p. 13.

Figure 84.-4.1. World Map prepared by the order of Caliph Ma'mun in the 9th century. Persian scientist Hârizmî was among those assigned to prepare the map.[690] el-Ömerî, *Mesâlikü'l-Ebsâr fî Memâliki'l Ensâr*, dated 1340. Leather, paper, ink and watercolour. 29 x 42.3 cm. Topkapı Palace Museum Library, III. Ahmed, Nr. 2797/1, vr. 293b-394a, https://www.facebook.com/topkapi.sarayi.muzesi/photos/a.931524166888008/2496772150363194/?type=3&paipv=0&eav=Afa3E_BWGxkS4PwZJux-FwkVyLcwhyzzGY_3TY6hBXCm16Q36P04o8deROod4QY0c&_rdr.

Another is the map of al-Istakhrî. Ibrahim ibn Muhammad al-Farisî al-Istakhrî is one of the most effective representatives of the Caliph Ma'mun and Balkh school of geography.[691] The date of Istakhrî's atlas, named *Kitâbü'l-Mesâlik ve'l-memâlik* (Book of Roads and Kingdoms), has been determined as the 10th century, according to the informations in the book (Fig. 84.-4.1). The work was written in the form of maps and texts related to maps, like *Kitâb-ı Bahriyye*, which I will talk about in the next section. Istakhrî divides the world into regions under the name of *Iklim* (climate), (Fig. 84.-4.2). The work includes a world map and maps of the regions that he divided into climates (Fig. 84.-4.3). In the texts, for each climate, cities are first introduced, then information

[690] Hârizmî, or with his full name Ebû Ca'fer Muhammed bin Mûsâ al-Hârizmî (780-850), was a Persian scientist, who worked in the fields of mathematics, astronomy, geography and algorithms.

[691] Kaçar, *Piri Reis*, p. 46.
In the first half of the 10th century, a regional geography school was founded by Ebû Zeyd Ahmed b. Sehl el-Belhî (d. 934) in the city of Balkh, which is today within the borders of Afghanistan. The Balkh school, which divided Islamic countries into climatic regions, gave a new direction to human geography and laid the foundations of the universal understanding of human geography.

is given about rivers, mountains, population, and ranges.[692] The new information obtained is placed in the text, according to this plan, and official documents and historical information are added to them. The definition of regions is made in a broad and comprehensive manner in the work, while the topographic details of cities and towns are also examined. Istakhrî gives precise road routes and distances between locations. The work is like a mixture of physical geography, Hellenistic mythologies and Islamic tradition.[693] It can be seeing the legends, he heard from sailors and mythological drawings about the places drawn on Piri Reis' chart. Likewise, in his navigational book, it is seen that the charts of the places are drawn one by one and detailed information is given (84.-4.4 and 84.-4.5).

[692] Kaçar, *Piri Reis*, p. 46.
[693] Kaçar, *Piri Reis*, p. 46.

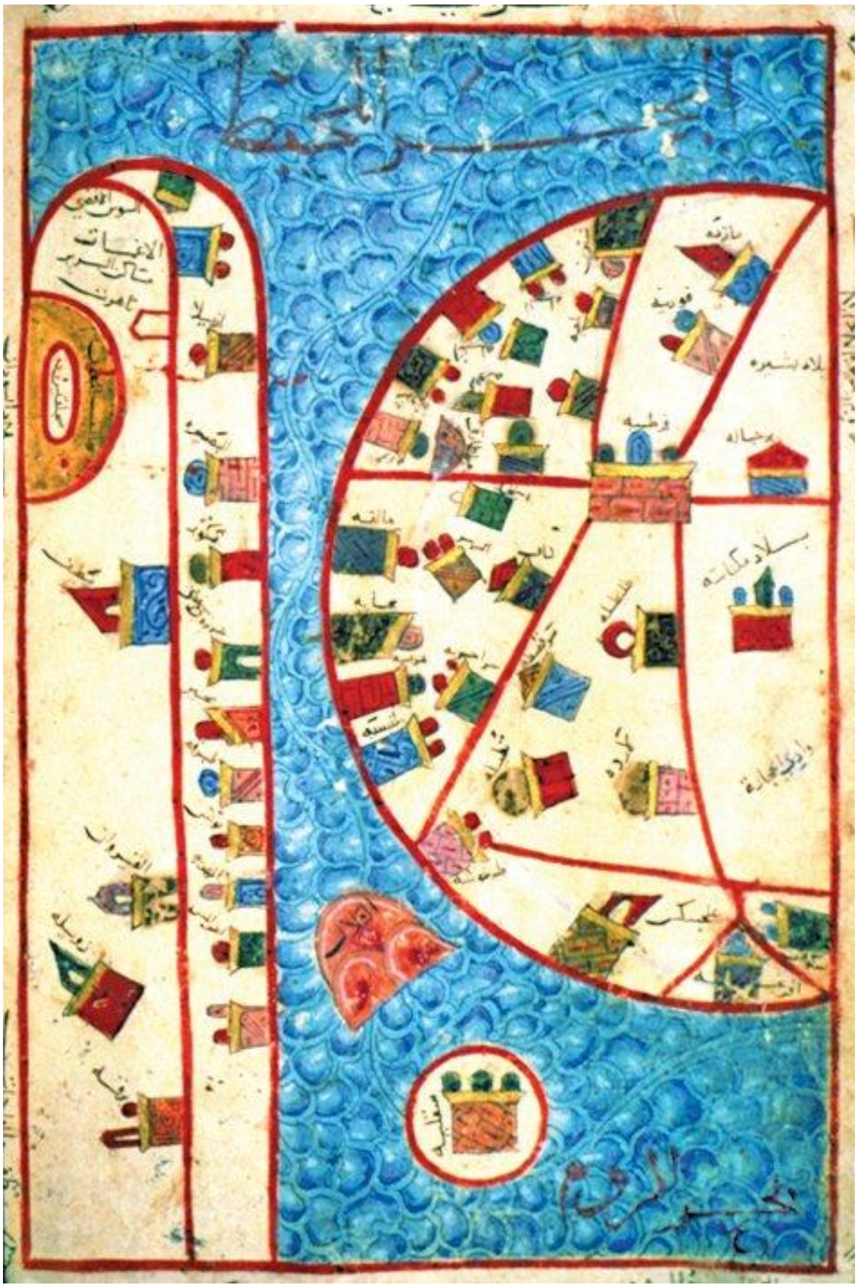

Figure 84.-4.2. Map showing Spain and Africa in Istakhrî's work titled, *Kitâbü'l-Mesâlik ve'l-memâlik*, dated 10th century. In the Spain section, cities, such as Cordoba, Malaga, and Valencia, are shown. Topkapi Palace Museum Library, Ahmed III, nr. 3348, vr. 40a, https://islamansiklopedisi.org.tr/cografya.

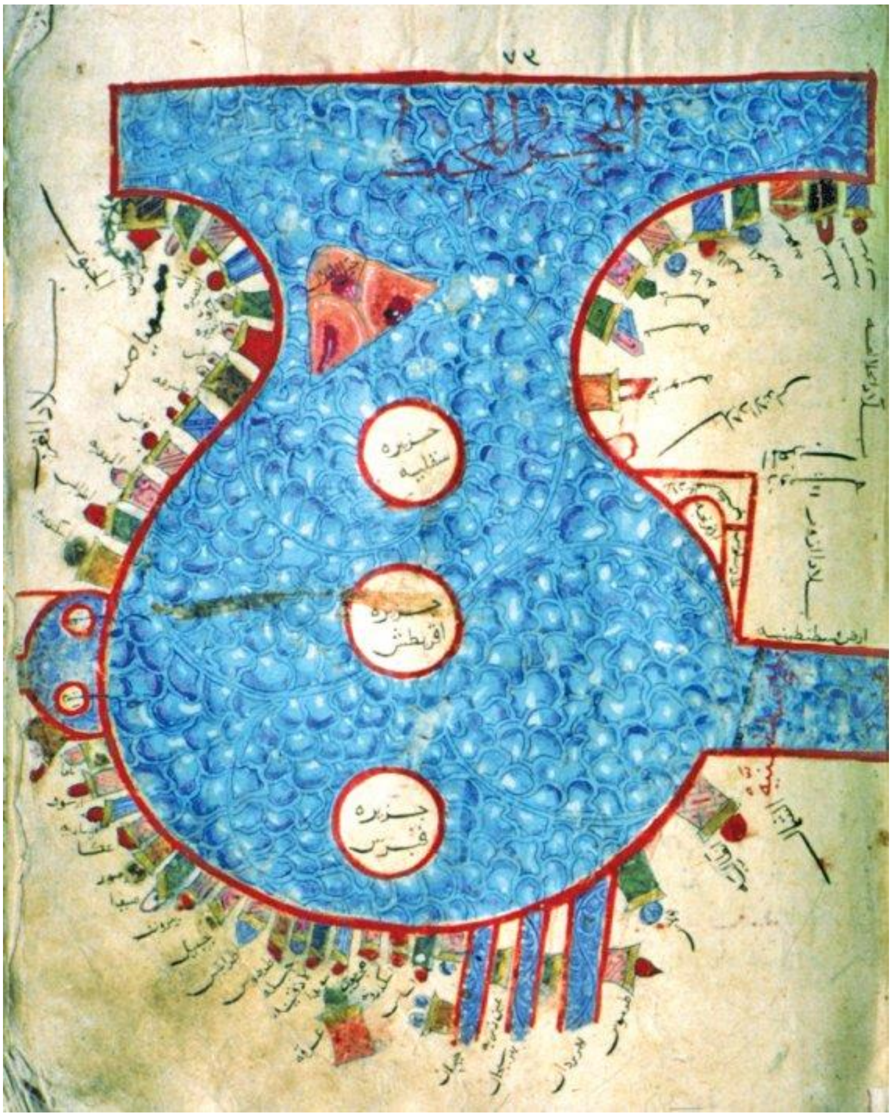

Figure 84.-4.3. Map showing the Eastern Mediterranean in Istakhrî's work titled, *Kitâbü'l-Mesâlik ve'l-memâlik*, dated 10th century. This map was made, according to the Belhi Islamic cartography tradition. Topkapi Palace Museum Library, Ahmed III, nr. 3348, vr. 73a, https://islamansiklopedisi.org.tr/cografya.

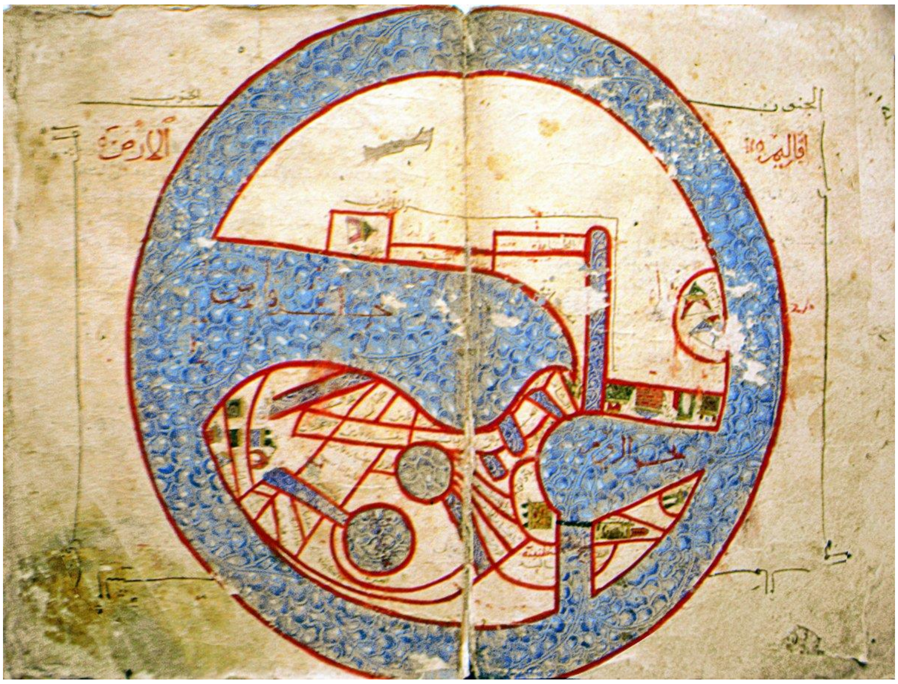

Figure 84.-4.4. The world map in Istakhrî's work, titled *Mesâlikü'l-Memâlik*, dated 10th century. This world map was made like the style of Istakhrî's other maps. Topkapi Palace Museum Library, Ahmed III, nr. 3348, vr. 2b-3a, https://islamansiklopedisi.org.tr/istahri.

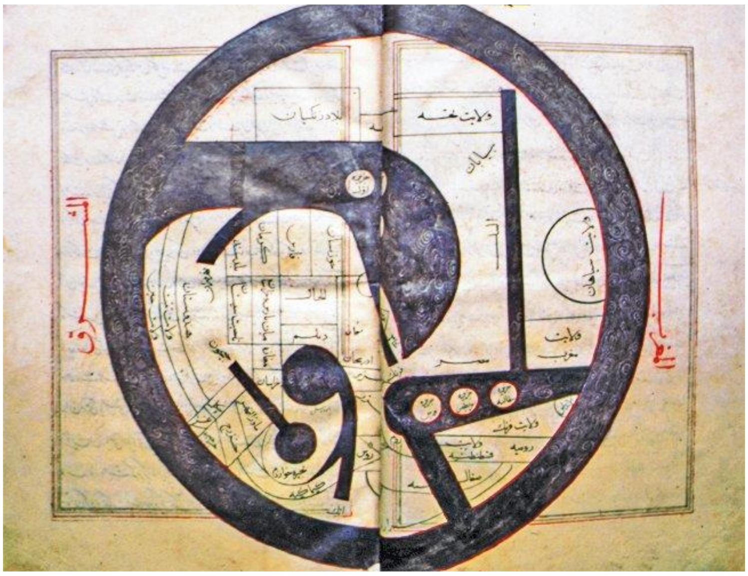

Figure 84.-4.5. Another world map in distinct copy of Istakhrî's work titled, *Kitâbü'l-Mesâlik ve'l-memâlik*, dated 10th century. The centre of the map, which includes the climates dominated by Islamic states, is the Arabian Peninsula and the Iraq region. Topkapi Palace Museum Library, Revan Mansion, nr. 1646, vr. 2b-3a, https://islamansiklopedisi.org.tr/cografya.

Apart from these that Piri Reis might have seen is the maps of Ibni Hawqal. He spent most of his life, from 15 May 943 to 973, traveling in Islamic Africa, Persian land, and Turkestan, and was last in Sicily.[694] He most likely made these travels for commercial purposes. Influenced by Istakhrî, İbni Hawqal's work, named *Sûretü'l-arz* (also known as *Kitâbü'l-Mesâlik ve'l-Memâlik*, Map of Earth) influenced the Eastern and Western geographers, who came after him (Fig. 84.-4.6).[695]

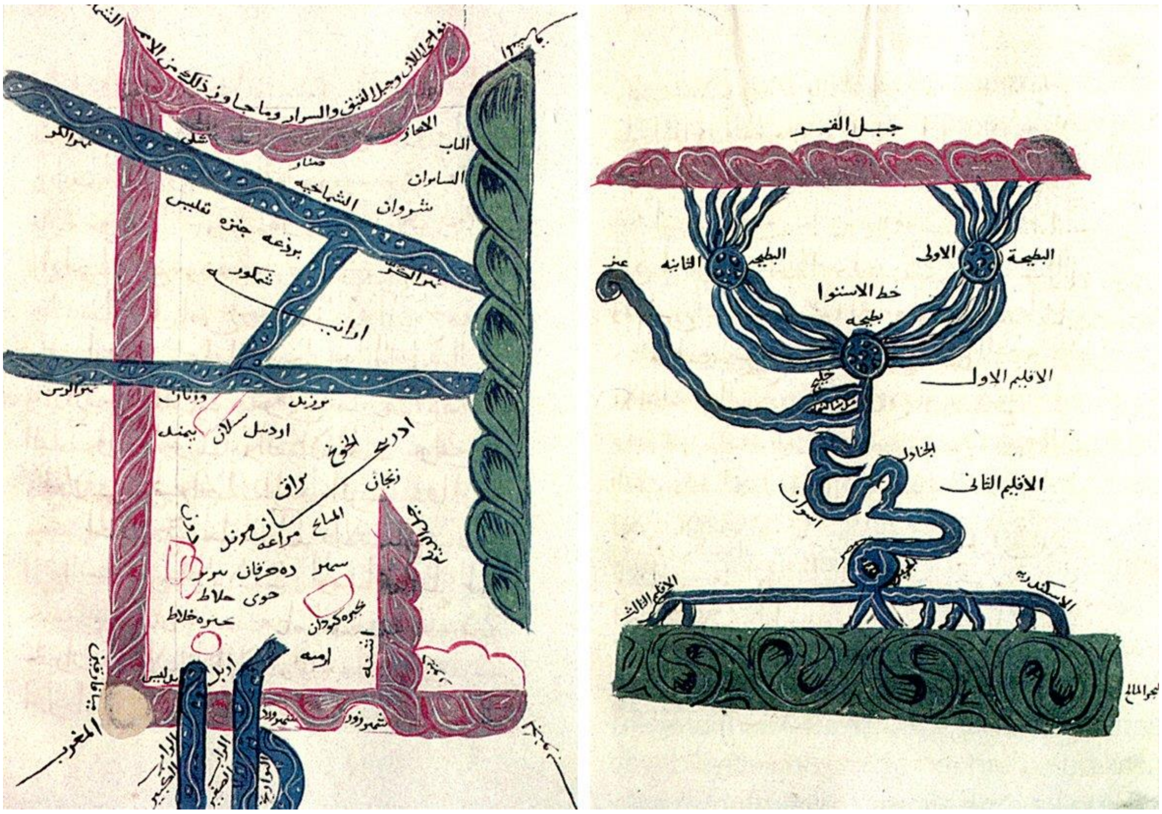

Figure 84.-4.6. Two pages from Ibn Hawqal's work called *Sûretü'l-arz*, Suleymaniye Library, Hagia Sophia, nr. 2934, vr. 25b, 69b, https://islamansiklopedisi.org.tr/ibn-havkal.

On Ibn Hawqal's oval world map, climates are positioned as seven climates, starting from the Equator, and moving towards the North (Fig. 84.-4.7). There are 12 zodiac signs around the map. The mountains are arranged in an idealized way, as hollow, random shapes made of simple, red lines, but not as geometric lines. While the

[694] Kaçar, *Piri Reis*, p. 28.
[695] Gerald R. Tibbetts, "The Balkhi School of Geographers," in *The Cartography in the Traditional Islamic and South Asian Societies*, *The History of Cartography*, Volume II/I, ed. by J. B. Harley and David Woodward, (Chicago: the Universiy of Chicago Press, 1992), pp. 108-136, p. 108.

Mediterranean Sea is shown in light blue as *Bahr-î Rum*, that is, the Roman Sea, other seas are shown in dark green and wavy, and unknown seas are shown in lighter blue.[696]

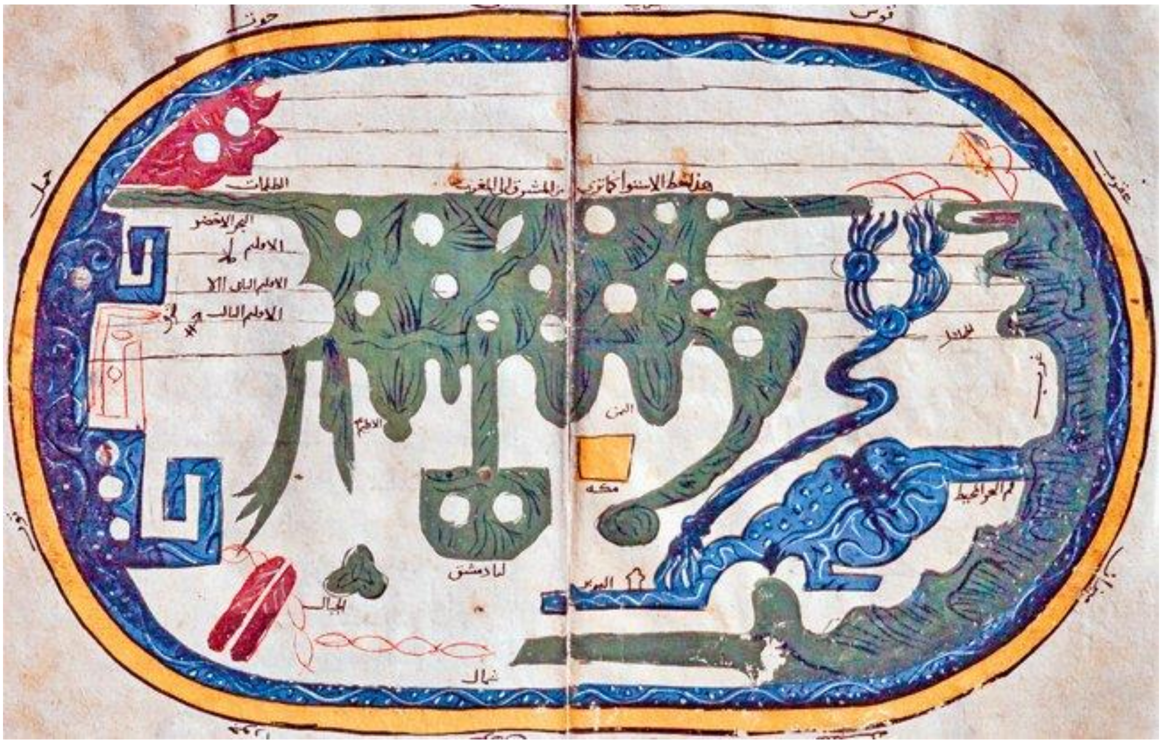

Figure 84.-4.7. World map showing Mecca and the equator in Ibn Hawqal's *Sûretü'l-arz*, Suleymaniye Lib., Hagia Sophia, nr. 2934, vr. 4b-5a, https://islamansiklopedisi.org.tr/cografya.

Another source of Piri Reis may be the world map of the Moroccan geographer Muhammad al-Idrîsî (Fig. 84.-4.8). Idrisi travelled throughout the Mediterranean, from Lisbon to Damascus. In 1138, King Roger II of Sicily hosted al-Idrîsî in his Palermo palace. The king established an academy and put Idrîsî in charge of geography studies. He worked with 12 geographers, 10 of whom were Muslims.[697] In addition to the traditional Islamic atlas of Islamic geographers, he drew a world map in his book, *Nüzhetü'l-müştâḳ fi'ḥtirâḳı'l-âfâḳ* (1154).[698] This book includes recent travels and new experiences used by sailors in practice.[699] This detail is very important. Because the

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696 Kaçar, *Piri Reis*, pp. 30-31.
697 Kaçar, *Piri Reis*, p. 34.
698 Kaçar, *Piri Reis*, p. 34.
The title has been translated as 'The book of pleasant journeys into faraway lands' or 'The pleasure of him who longs to cross the horizons'.
699 Kaçar, *Piri Reis*, p. 34.

portolan charts and navigational atlas, drawn by Piri Reis, are instruments for sailors, made for practical use.

Figure 84.-4.8. Idrîsî's world map is in his work, *Kitâbü'l Nüzheti'l-müştâḳ*, Köprülü Lib., nr. 955, vr. 2b-3a, https://islamansiklopedisi.org.tr/cografya.

As can be understood from these maps, it is seen that Piri Reis benefited greatly from the Islamic tradition. It can be said that the works are similar in aim of construction. Among the purposes of creating these works, the use of sailors in practice and the giving of descriptions of places along with their maps are also seen in the navigational book of Piri Reis, which will be mentioned later. However, we see from the notes, he obtained and wrote with the information that benefited from

Western maps. And it is understood (from the explanations in the following notes) that some of these were written with the information obtained from European sailors.

Additionally, we see that if Piri Reis is aware of Columbus' exploration chart and can get information about the newly found places and draw on his chart. This shows that Piri Reis has either the original or a copy of Christopher Columbus' chart, but if he had a copy, we could see many reproduced versions. From this, it can be deduced that Piri Reis had the original one. Portolan charts were one of the most needed instruments, which were followed competitively by states and sailors. And how did Piri Reis capture Columbus's chart, perhaps the most important of these charts? It can be speculated from the notes, he wrote on his chart, and what he wrote in the *Kitâb-ı Bahriyye*. It can be considered the possibility that he may have acquired Christopher Columbus's discovery chart, when he was on the coast of Spain, in the Mediterranean, with Kemal Reis. Because, while he was talking about the Spanish coast, in his book, 'Once with the late Kemal Reis, we captured seven bargias at this place. It is seventy miles northeast to the Colombia island...'[700] He writes that they bought seven ships from the Spaniards in a war. While reporting that in *Bahriyye*, had heard about the clothes of the Antillean natives, he recorded that he obtained a cone with a parrot feather, and a hatchet made of black hard stone. On the other hand, in one of the notes, written on the chart we have, it is remarkable that a Spaniard, who participated in three of Christopher Columbus's four voyages (1492, 1493, 1499, and 1502), and was later captured by Kemal Reis. It is possible that he captured this Spaniard, in the war, in which the belongings of the Antilla requisition.[701]

According to another idea, Kemal Reis and Piri Reis fought against the Spaniards, in 1501, then Columbus chart fell into the hands of Piri Reis in this war. As it is known, Christopher Columbus sent a chart to Spain, in 1498, and many sailors used copies of it as a guide. However, these charts were lost. As far as we know today, the only original document is this portolan chart, made by Piri Reis.[702] Although Piri Reis has created a world map, based on the resources he has, unfortunately, what we have is a part of Europe and Africa that partially covers the western coasts, the Atlantic

[700] Piri Reis, *The Book of Bahriyye*, p. 183.
[701] Inan, *Piri Reis'in Hayatı ve Eserleri*, pp. 26-28.
[702] Inan, *Piri Reis'in Hayatı ve Eserleri*, p. 26.

Sea, and Central America, and South America. At the same time, Piri Reis's saying that he used charts of all these regions, shows us that his portolan includes more places than the remaining part. Therefore, the whole chart is not only this piece, but this conclusion can also be an explanatory answer for those, who say 'this is the whole chart'.[703]

I think that, with this note, he wrote on the Piri Reis chart, he was extremely honest and reliable in this regard. Because this courteous behaviour is a befitting a scientist, and Piri Reis has proven it. If the remaining parts of Piri Reis' world map, dated 1513, were found in a manuscript, in one of the libraries, who knows what more this wonderful discovery would tell us There are those, who claim that the chart of Columbus is in Kilitbahir castle in Gallipoli. Because Piri Reis drew his chart in this castle, and they can be right, because after he drew the chart, we do not know what Piri Reis did with these charts. If he had the opportunity to examine these charts by making use of the libraries, or archives, due to its location, perhaps the possibility of donating the Columbus chart, he obtained to these archives, can be taken into consideration. Because he presented his own portolan to the Ottoman Sultan. My wish is that the rest of Piri Reis' charts of the world and perhaps Columbus' chart can be found.

Note Number V.

> It is related by the Portuguese sailor that on this spot night and day are, at their shortest period, of two-hour duration, and at their longest phase, of twenty-two hours. But the day is very warm and, in the night, there is much dew.[704]

In number V, Piri Reis conveys that, the Portuguese tells that at this point, the shortest periods of day, and night are two hours, and the longest is twenty-two hours. In addition, he indicates that the day is very hot, and there is very dew at night (Fig. 84.-5).[705] It is understood that Piri Reis either heard this knowledge from a Portuguese

[703] Inan, *Piri Reis'in Hayatı ve Eserleri*, pp. 27-28.
[704] Akçura, *Piri Reis Haritası*, p. 34.
"Portukal kafiri rivayet eder kim bu yerde gece ve gündüz kısalıcak iki saat olur uzayıcak yirmi iki saat olur. Amma gündüzü gayet ıssı olup ve gecede gayet çiy düşer derler." Akçura, *Piri Reis Haritası*, p. 6.
[705] Akçura, *Piri Reis Haritası*, p. 34.

sailor, or obtained it from a newly drawn map, belonging to a Portuguese cartographer. Therewithal, it can be concluded that, since this part of the map provides information about newly discovered places, this data is very new, compared to Piri Reis's time. And Piri Reis's map contains very up-to-date knowledges for his time.

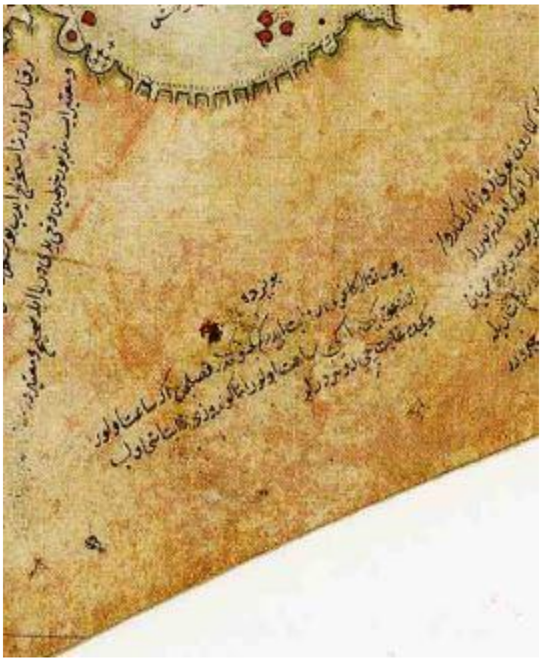

Figure 84.-5. Note number five on the chart of Piri Reis. Piri Reis tells the information he received from a Portuguese sailor.

Note Number VI.

> On the way to the shire of Hind a Portuguese ship encountered a contrary wind (blowing) from the shore. The wind from the shore... (illegible) it (the ship). After being driven by a storm in a southernly direction, they saw a shore facing them. They advanced towards it (illegible). They saw that these places were good anchorages. They threw anchor and went to the shore in boats. They saw people walking, all of them naked. But they shot arrows, their tips made of fish-bone. They stayed there eight days. They traded with these people by signs. That barka saw these lands and wrote about them which... The said barka without going to Hind, returned to Portugal, where, upon arrival they gave information...[706] They described these shores in detail... They have discovered them.[707]

Piri Reis, in this note, number VI, described the discoveries, made by the Portuguese, in Indian lands. He said that the Portuguese saw the coasts to anchor their ships, traded with the Indian natives, and gave information about these coasts (Fig. 84.-6).[708]

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[706] Akçura, *Piri Reis Haritası*, p. 34.
A barque or bark is a type of sailing ship with three or more masts, having a square sail on the fore and main masts and a longitudinal sail only on the mizenmast. It is also described as a large boat.
[707] Akçura, *Piri Reis Haritası*, p. 34.
"Portukal gemisi Hint vilâyetine giderken muhalif rüzgâra duş gelir kenardan; bunu rüzgâr kenardan....... ken fırtınayile kıble canibine gittikten sora karşılarında bir kenar görürler, anın üzerine yürürler... görmüşler ki hûp demir yerlerdir. Demir korlar sandalla kenara çıkarlar, görürler kim adamlar yürür, herbirisi üryan; ve lâkin el okun atarlar, demrenleri balık süğüğünden. Bunlar anda sekiz gün yatarlar, o halkla satı pazar ederler işaretile. Bu diyarları ol barça görüp yazmıştır ki... çekip durur. Mezbur barça Hinde gitmeyip döner, Portukala varıp haber verir... Bu kenarları tafsilile yazarlar; anlar bulmus (?) oldu." Akçura, *Piri Reis Haritası*, p. 6.
[708] Akçura, *Piri Reis Haritası*, p. 34.

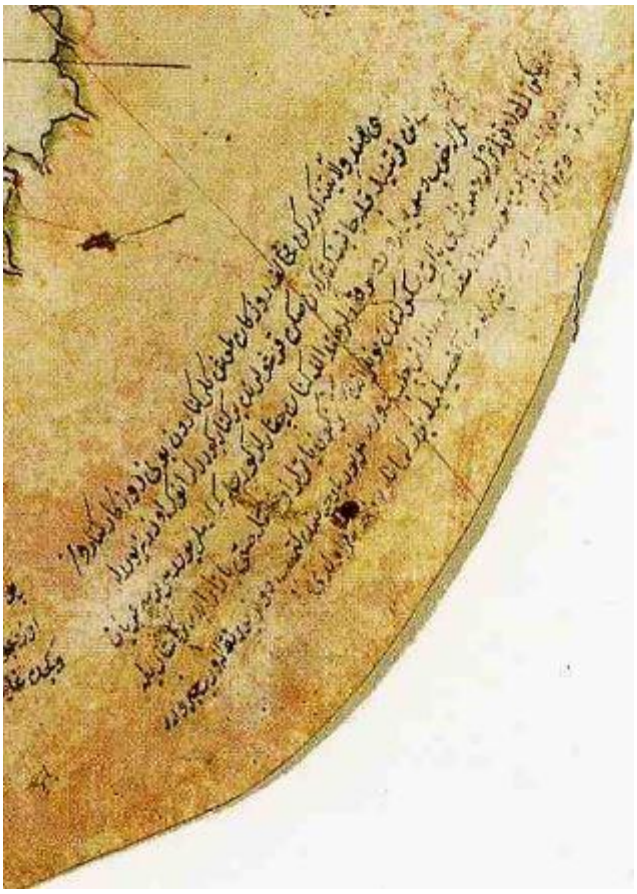

Figure 84.-6. Note number six, on the chart of Piri Reis, the discoveries, made by the Portuguese, in Indian lands.

We come to this note by Piri Reis with guidance from the note, he left next to the depiction of a Portuguese ship (Fig. 84.-7). Here it states:

> This is the barka from Portugal, which encountered a storm and came to this land. The details are written on the edge of this map.[709]

[709] Akçura, *Piri Reis Haritası*, p. 35.

Figure 84.-7. With this note, written next to the depiction of the Portuguese ship, Piri Reis guides the reader to the note above about the Portuguese ship, going to the Indian province.

Note Number VII.

> And in this country, it seems that there are white-haired monsters in this shape, and six-horned oxen. The Portuguese sailors have written it on their maps.[710]

Piri Reis wrote that there were white-haired monsters in this country, which he drew, and that six-horned oxen were seen, and that he indicated them on the charts of the Portuguese. We see that Piri Reis used a Portuguese chart, while drawing this part (Fig. 84.-8).[711]

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[710] Akçura, *Piri Reis Haritası*, p. 35.
"Ve bu diyarda ak kıllı ve bu şekilli canavar ve dahi altı boynuzlu kâvlar olurmuş; Portukal kafiri hartilerinde yazmışlar." Akçura, *Piri Reis Haritası*, p. 6.

[711] Akçura, *Piri Reis Haritası*, p. 35.

Figure 84.-8. Note number seven on the chart of Piri Reis. It contains information that Piri Reis took from a Portuguese chart.

Note Number VIII.

> This country is barren. Everything is in ruins and, it is said that large snakes are found here. For this reason, the Portuguese sailors did not land on these shores, and these are also said to be very hot.[712]

Piri Reis said that the Portuguese described these places, as very hot, and in a dilapidated condition, and that they did not go down to the shores, because there were large snakes here (Fig. 84.-9). Again, we see that Piri Reis used a Portuguese chart, while drawing these coasts.[713]

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[712] Akçura, *Piri Reis Haritası*, p. 35.
"Bu doyarda imaretlik yoktur, cümle haraptır ve ulu yılanlar olurmuş; ol sebepten Portukal kâfiri bu kenarlara çıkmazlar imiş; ve hem gayret ıssırlar olur imiş." Akçura, *Piri Reis Haritası*, p. 7.
[713] Akçura, *Piri Reis Haritası*, p. 35.

Figure 84.-9. Note number eight on the chart of Piri Reis. Piri Reis shows the snakes, he mentioned, with drawings.

Note Number IX.

> And these four ships are Portuguese ships. Their shape is written down. They travelled from the western land to the point of Abyssinia to reach India. They sailed towards Shuluk. The distance across this gulf is 4200 miles.[714]

Piri Reis said that four Portuguese ships travelled from the west to Abyssinia, to reach India, and set out for Shuluk (South Sudan) (Fig. 84.-10). It also gives details that this distance is 4200 miles from the bay. It is possible to understand from the distance units, Piri Reis gave, which is a proof of his meticulous work on these charts and calculations.[715] Piri Reis mentioned the Portuguese ships in this note, are in various parts of the map. The figures below 84.-10-1, 10-2, 10-3, and 10-4 are Portuguese ships. And it will be examined, under the title "Ship Depictions on the Works of Piri Reis" in the next sections.

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[714] Akçura, *Piri Reis Haritası*, p. 35.
"Ve bu dört pare gemi Portukal gemisidir. Hem şekli yazılmıştır. Mağrip diyarından Habeş burnuna geçerler kim Hinde giderler. Şuluk üzerine yürürler. Bu körfezi arkırı geçmeğe dört bin iki yüz mildir." Akçura, *Piri Reis Haritası*, p. 7.
[715] Akçura, *Piri Reis Haritası*, p. 35.

Figure 84.-10. In this note, Piri Reis talks about the journey of four Portuguese ships.

Figure 84.-10-1. The first of the Portuguese ships, mentioned by Piri Reis in his note.

Figure 84.-10-2. Depiction of a Portuguese caravel caught in a storm.

Figure 84.-10-3. Piri Reis states that the master of this caravel is called Messire Anton the Genoese.

Figure 84.-10-4. A Portuguese barka caught in a storm.

Note Number X.

> It is said that in ancient times a priest by the name of Sanvolrandan (Santo Brandan) travelled on the Seven Seas and landed on this fish. They thought it were dry land and lit a fire on this fish. When the back of the fish began to burn it plunged into the sea, they reembarked in their boats and fled to the ship. This event is not mentioned by the Portuguese sailors. It is taken from the ancient Mappae Mundi.[716]

Piri Reis talks about the legend of St. Brandan, which is found in almost every chart of his period (Fig. 84.-11). He says that a priest named St. Brandan, had travelled to the Seven Seas, that a reef they had climbed out to make a fire, thinking it was land, was a fish. And he adds that when they lit the fire, they realized that the fish moved. He states that he tried to catch the men, who climbed on top of the fish, but the men reached the ship by diving into the sea. Piri Reis also says that he conveyed this event from the Portuguese, and he got this information from an old *Mappa Mundi*.[717]

[716] Akçura, *Piri Reis Haritası*, p. 35.
"Rivayet ederler kim zamanı evvelde Sanvolrandan (Santo Brandan) derler bir papaz yedi deryayı gezmiş derler. Mezbur bu baluğun üzerine uğramış kuru yer sanıp baluk üzerine ot yakmışlar; baluğun sırtı kızıcak denize dalmış, bunlar sandala koyulmuşlar, gemiye kaçmışlar. Bu ahval Portukal kâfirinden zikrolunmaz. Kadîm Pappa Mondalardan mankuldür." Akçura, *Piri Reis Haritası*, p. 7.
[717] Akçura, *Piri Reis Haritası*, p. 35.

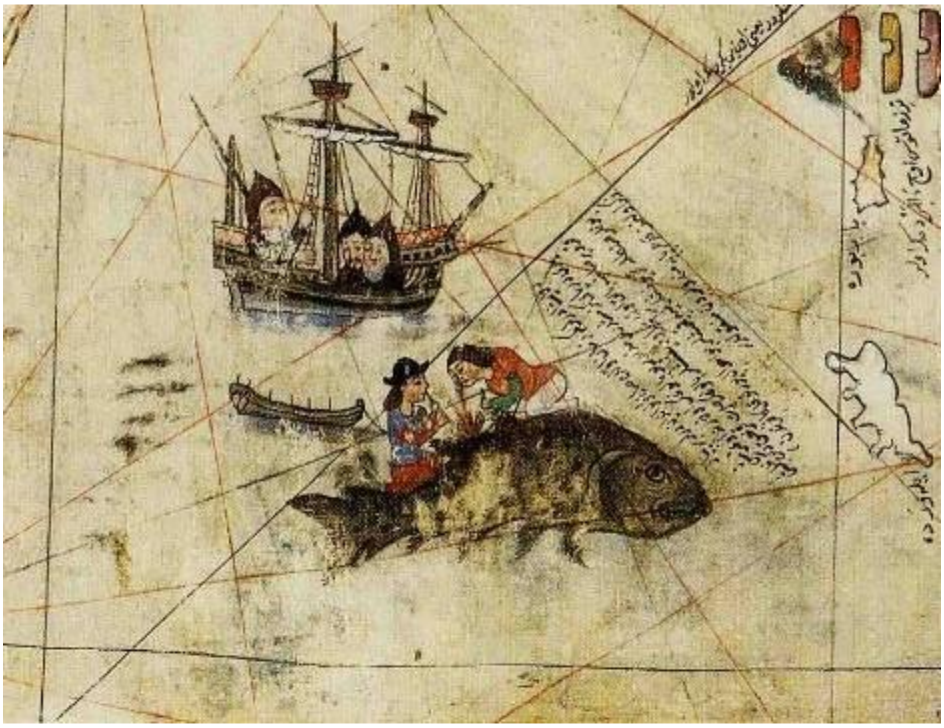

Figure 84.-11. Piri Reis both talked about the legend of St. Brandan and gave a drawing here.

Note Number XI.

> This barka was driven upon these shores by a storm and remained where it fell... Its name was Nicola Giuvan. On his map, it is written that these rivers, which can be seen, have for the most part gold (in their beds). When the water had gone, they collected much gold (dust) from the sand. On their map...[718]

Although part of this note can be read, it is understood that Piri Reis is talking about a sailor, named Nicola Giuvan (Fig. 84.-12). He says this sailor's ship drifted ashore, due to a storm, and stayed there. He said that this person wrote that the rivers that can be seen, in his chart, contain mostly gold in their beds. He says that when the waters are gone, more gold dust than sand is seen. Along with this interesting information, Piri Reis also included the ship of this person, named Nicola Giuvan, and the place, he described on his chart. This detail is observed in the South American parts of Piri Reis' chart.[719]

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[718] Akçura, *Piri Reis Haritası*, p. 35.
"Bu kenarları bu barça fırtına ile gelip düştükte........ Adına Nikola di Cuvan derler. Hartisine yazmış ki bu ırmaklar kim görünür ekseri hep altın toprağıdır. Suyu kaçtıktan sonra kum içinde altın toprağını vafir devşırlermiş; hartisinde…" Akçura, *Piri Reis Haritası*, p. 7.
[719] Akçura, *Piri Reis Haritası*, p. 35.

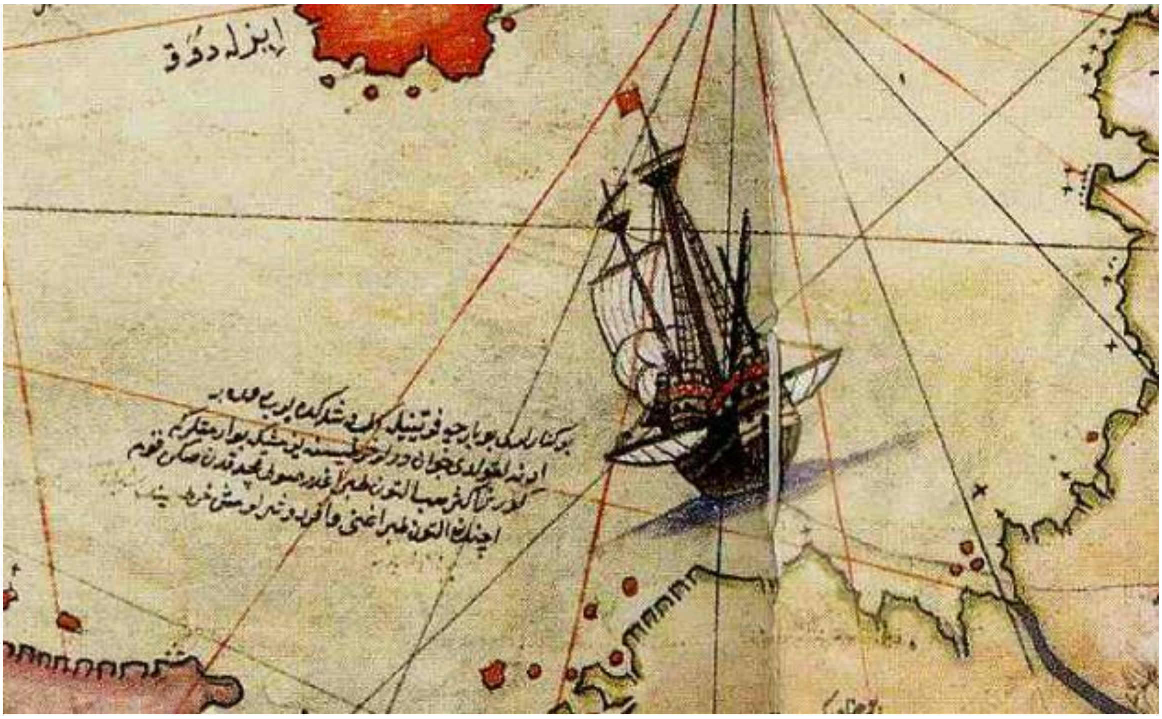

Figure 84.-12. Piri Reis talks about a barka that was washed ashore by a storm.

Note Number XII.

> The Portuguese sailors do not go west of here. All that side belongs entirely to Spain. They have made an agreement that a line drawn two thousand miles to the western side of the Strait of Ceuta (Gibraltar) should be taken as a boundary. The Portuguese do not cross to that side, but the Hind side and the southern side belong to the Portuguese.[720]

Piri Reis states that the Portuguese sailors did not go to the west of this point, because it completely belongs to the Kingdom of Spain (Fig. 84.-13). Although he did not give the name, we understand that Piri Reis was talking about the Treaty of Tordesillas (1494) from the information, he gave. Because it tells that, a borderline drawn two thousand miles from the West side of the Strait of Gibraltar, was determined as the limit.[721]

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[720] Akçura, *Piri Reis Haritası*, p. 36.
"Portukal kâfiri burdan gün batısı canibine geçmez. O canip hep İspanyanındır. Bunlar kavil etmiştir ki iki bin mil Septe Boğazının günbatısı tarafında sınır etmişlerdir. Portukal ol canibe geçmez, amma Hint canibi ve cenup canibi hep Portukalındır." Akçura, *Piri Reis Haritası*, p. 7.

[721] Akçura, *Piri Reis Haritası*, p. 36.

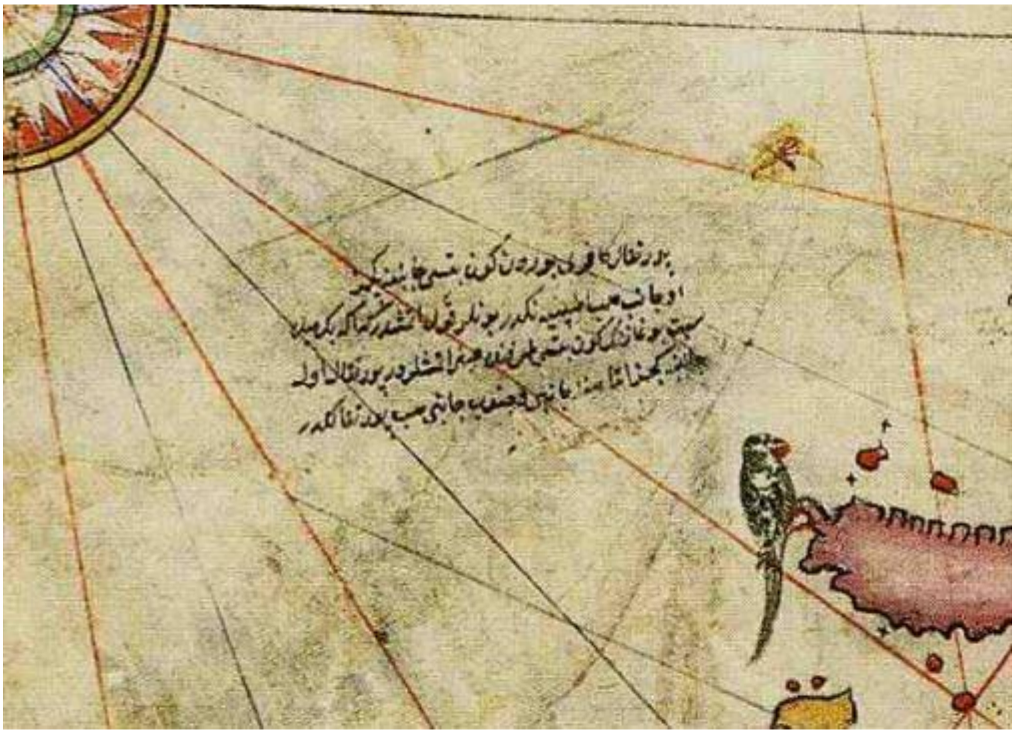

Figure 84.-13. Piri Reis said, in this note, that the Portuguese did not go further than here because the rest belonged to Spain.

Note Number XIII.

> And this caravel having encountered a storm was driven upon this island. Its name was Nicola Giuvan. And, on this island, there are many oxen with one horn. For this reason, they call this island, Isola de Vacca, which means Ox Island.[722]

Piri Reis continues to talk about Nicola Giuvan (Fig. 84.-14). In this place, he says that unicorn oxen were seen. For this reason, he states that this island was named *Isola de Vacca* (Cow Island).[723]

[722] Akçura, *Piri Reis Haritası*, p. 36.
"Ve bu karaveleyi fırtına bulup geldi, bu adaya düştü; ismine Nikola Cuvan derler. Ve bu adada vafir birer boynuzlu kâv çoktur. Ol sebepten bu cezirenin İzle (de) aka derler, yani sığır adası demek olur." Akçura, *Piri Reis Haritası*, p. 7.
[723] Akçura, *Piri Reis Haritası*, p. 36.

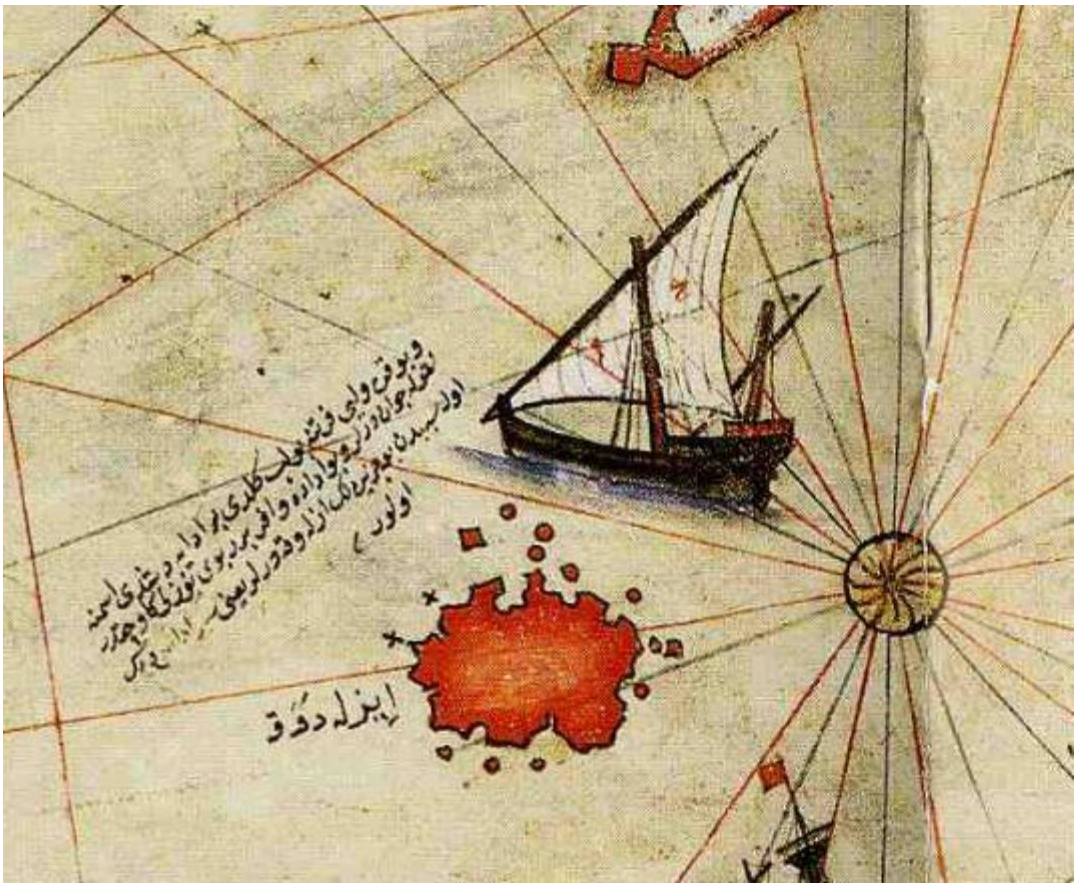

Figure 84.-14. Piri Reis introduces this island as Isola de Vacca, which means Ox Island.

Note Number XIV.

> The master of this caravel is called Messire Anton the Genoese, but he was brought up in Portugal. One day this caravel encountered a storm and was driven upon this island. He (he master) found much ginger here and wrote about these islands.[724]

He states that the master of this caravel, which he drew, at this point, on his chart, was Messire Anton the Genoese, but he was raised in Portugal (Fig. 84.-15).

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724 Akçura, *Piri Reis Haritası*, p. 36.
"Bu Karavelenin reisine Mesir Antin Cineviz derler, amma Portukalda büyümüştür. Bir ün mezbur karavelesile fırtına bulup gelmiş, bu cezirelere düşmüş; vafir zencebil bulup bu adaları ol yazdı." Akçura, *Piri Reis Haritası*, p. 8.

He tells that one day, when he encountered a storm, his ship drifted to this island, and he found a large amount of ginger, on the island, and wrote about these islands.[725]

Figure 84.-15. In this note, Piri Reis mentions a sailor, named Messire Anton the Genoese.

Note Number XV.

This sea is called the Western Sea, but Frank sailors call it, the Mare d'Espana, which means the Sea of Spain. Up to now, it was known by these names, but Columbus, who opened up this sea and made these islands known, and also the Portuguese sailors, who have opened up the region of Hind, have agreed together to give this sea a new name. They have given it the name of Ovo Sano (Oceano) that is to say, sound egg. Before this, it was believed that the sea had no end or limit, that at its other extremity darkness prevailed. Now they have seen that this sea is girded by a coast, and because it is like a lake, they called it, Ovo Sano.[726]

[725] Akçura, *Piri Reis Haritası*, p. 36.
[726] Akçura, *Piri Reis Haritası*, p. 36.
"Bu denize Bahri Mağrip derler, amma Efrenç tayfası Mar de İspanya derlerdi, yani İspanya Denizi demek olur. Şimdidek bu isimlerle meşhurdu. Amma kolonbo ki bu deryayı açmıştır ve bu cezairi ol malûmetmiştir, dahi Portukal kafiri ki Hint diyarın açtılar, bu cümle birbirile ittifak ettiler kim işbu deryaya yeni isim vereler. Bu deryanın adını Ovosano (Oseano) kodular, yani Sağ yumurta demek olur. Bundan evvel fikirleri bu imiş ki bu deryanın haddü payanı olmaya, ötesi zulemat ola. Şimdi gördüler kim bunca kenar denizi kuşadıp durur; bu derya bir göl gibi olduğu için Sağ yumurta deyu ad verdiler. Sah." Akçura, *Piri Reis Haritası*, p. 8.

Piri Reis gives information about the name of the region (Fig. 84.-16). He says, it was called the West Sea, but French sailors named it, *Mare d'Espana*, meaning the Spanish Sea. However, he explains that later the Portuguese and Spaniards agreed to give it, the name *Ovo Sano* (Ocean).[727]

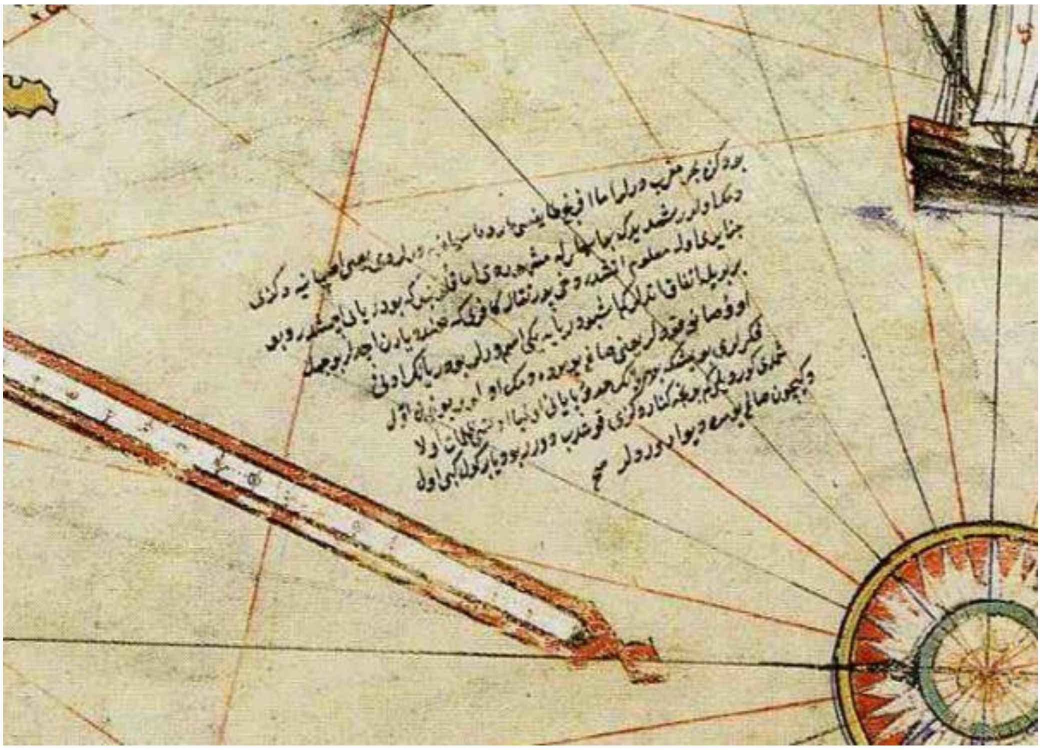

Figure 84.-16. Piri Reis gives knowledge about the name of this region.

When we examine the part of the chart, we have, we see how faithful Piri Reis was to his sources. At the end of the bibliography, he gave for the chart, he notes that "the more accurate and reliable map of the Mediterranean that the sailors had in their hands, the more correct the map, they created was for the seven seas". It is understood that while Piri Reis was drawing the African coast, he benefited from the knowledge of the Turkish sailors, who travelled on the African coast, as well as from the new Portuguese charts, he had.[728] Place names are interesting because he determined the names of many places in Turkish, such as Babadağı, Akburun, Yeşilburun, Kızılburun,

[727] Akçura, *Piri Reis Haritası*, p. 36.
[728] Inan, *Piri Reis'in Hayatı ve Eserleri*, p. 34.

Altın River, Güzel Gulf, Kozlukburnu, and Harmanlık Cape, etc.[729] We see remarkable accuracy in the drawing of these coasts, and the determination of the locations of the places.[730]

If we move on to the part of the map showing South America, we see that Piri Reis used not only the Christopher Columbus (1451-1506) map, but also the new Portuguese maps. We see that Piri Reis had access to the knowledge that Italian explorer and navigator Amerigo Vespucci (1451-1512), Spanish mariner, shipbuilder, navigator and explorer Martín Alonso Pinzón (1441-1493), and Portuguese navigator and explorer Juan Díaz de Solís (1470-1516) had obtained on the South American coast until 1508. In addition, although the locations of the major rivers in South America are shown on the map, their names are not written. And regarding this part, Afet Inan states the following; "It is very noteworthy that the La Plata River (*Río de la Plata*), which Pinzón and Solís passed by in 1508, but which is thought to have not attracted their attention, is marked on the map."[731]

On the other hand, the most remarkable part in terms of the history of geographical discoveries is the part of Central America. According to the studies carried out on America, especially the Central American part, it is understood that the map that Christopher Columbus drew and sent to Europe in 1498, contains the same information as in Toscanelli's map, which Columbus had, when he first set out on his journey (Fig. 85).[732] This can be understood by comparing the Toscanelli map with the Piri Reis map. Assuming that the knowledge about America on Piri Reis's map is data, taken from Columbus, this conclusion can be reached.

[729] Inan, *Piri Reis'in Hayatı ve Eserleri*, p. 34.
All these places are in modern-day Turkey. What is important here is that the names of these places were determined by Piri Reis in the 1500s. For example, present-day, Babadağ is a mountain and located in near Fethiye, in Muğla Province, southwest Turkey. Its previous name was Ancient Mount Anticragus, used in Ancient Greek. It was called Babadağ in the 1500s, as determined by Piri Reis, and is still referred to as Babadağ today.
[730] Inan, *Piri Reis'in Hayatı ve Eserleri*, p. 34.
[731] Inan, *Piri Reis'in Hayatı ve Eserleri*, p. 35.
[732] Inan, *Piri Reis'in Hayatı ve Eserleri*, p. 35.

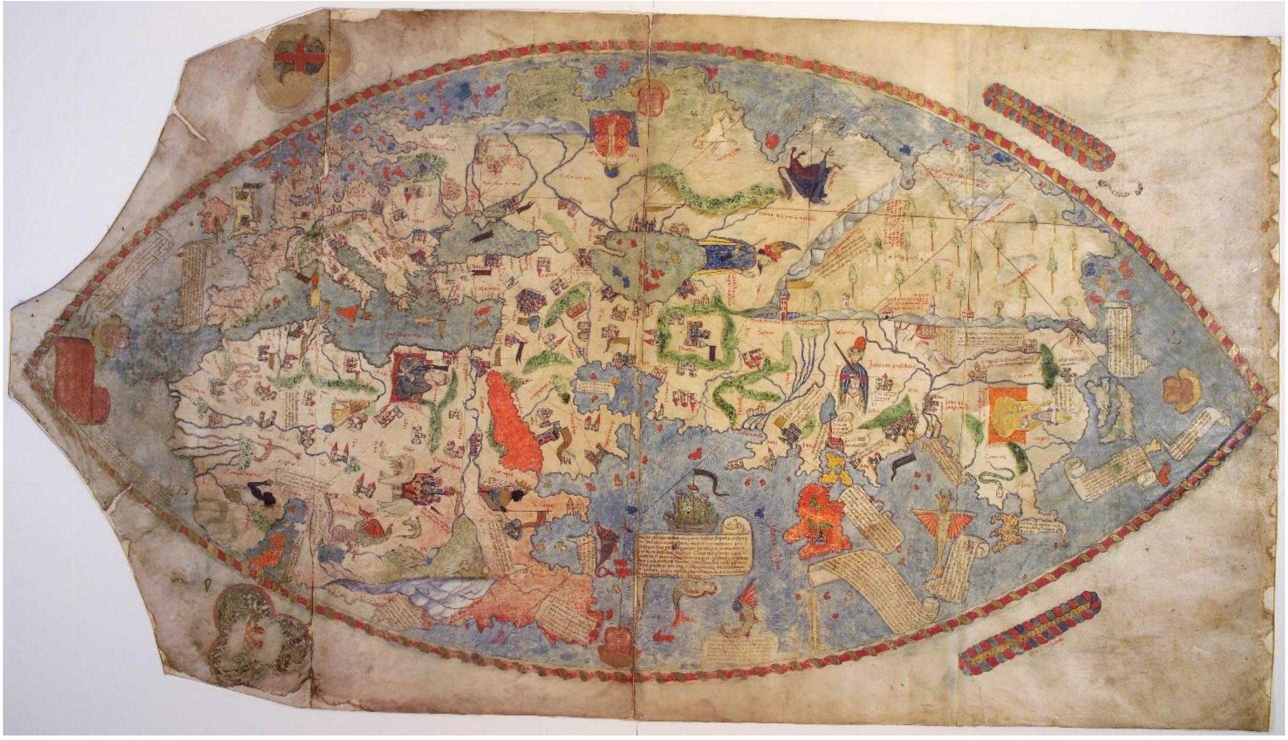

Figure 85. The Genoese map, is also dedicated to Paolo dal Pozzo Toscanelli, is a 1457 world map. The map relied extensively on the account of the traveller to Asia, Niccolò de' Conti, rather than the usual source of Marco Polo. It is taken by Columbus on his journey to find the route. Genoese map, 1457, Parchment, National and Central Library of Florence (*Biblioteca Nazionale Centrale di Firenze*), Port. N.01, https://medea.fc.ul.pt/view/chart/5909.

While comparing Piri Reis's map notes with other maps, I realized that the person, he mentioned as "Nicola Giuvan" in the 13th note, might be Niccolò de' Conti (1385–1469). This is possible, given linguistic differences. This can be concluded from this, first, it is said that Columbus took the Toscanelli map with him, when he set out on his journey (1492), and used it, during his explorations. It is known that Columbus corresponded with Toscanelli. It is thought that the person "coming from Cathay (China)", mentioned by Toscanelli in his letter to Christopher Columbus in 1474, was Niccolò de' Conti.[733]

It can be said that Toscanelli, who benefited from this person's travels, used them in his map, and Columbus's map also used them in his map, too.[734] And through this, he may have been instrumental in Piri Reis accessing this information and processing it on his map. In other words, "Nicola Giuvan", who has been researched

[733] Henry Vignaud, *Toscanelli and Columbus* (London: Sands & Co., 1902), p. 285.
[734] Vignaud, *Toscanelli and Columbus*, p. 285.

so far and has not reached a conclusion, may be Niccolò de' Conti. If I must repeat it again, the difference here may be due to linguistic and alphabetic distinctions. The sound differences heard in the pronunciation of the language may show differences, when voicing or conveying the names that Piri Reis heard from sailors or read from a map. For this reason, the name that Piri Reis transferred to his map as Nicolo di Cuvan (Giuvan), which is still not determined with certainty, may be Niccolò de' Conti. Perhaps this may also indirectly confirm the claims in the Toscanelli letter that the person, who met with the Pope in Florence, was Niccolò de' Conti.

In addition, Antilla, which is an island, is not shown as an island on the map, but as a continent in accordance with Columbus' idea. In his chart, Piri Reis calls that Central America is the Antilla province, and the South American coasts are the Antilla coasts. However, there is also the island of Antilla on Piri Reis' chart. It is understood that this island represents the legendary Antilla island, which was rich and prosperous, when Columbus started his voyage. However, in the article, he wrote next to this island, Piri Reis states that the island was not lived.[735] He stated on the map as follows (Fig. 86):

> And this island, they call the Island of Antilla. There are many monsters and parrots, and much logwood. It is not inhabited.[736]

[735] Inan, *Piri Reis'in Hayatı ve Eserleri*, pp. 36-37.
[736] Akçura, *Piri Reis Haritası*, p. 35.
"Ve bu adaya Antilya adası derler. Canavar ve tuti ve bakkam gayet çoktur, veli imaret değildir." Akçura, *Piri Reis Haritası*, p. 7.

Figure 86. Antilla island from Piri Reis' world map, dated 1513, https://medea.fc.ul.pt/view/chart/283/viewer.

Moreover, while Columbus was on the Cuban coast, he believed that Cuba was a continent, not an island. Cuba is also shown as a continent on the Piri Reis map. This shows that Piri Reis saw Columbus's map and quoted these places from the Columbus map. The fact that Cuba is shown as a continent in Ruysch's map (Fig. 87), dated 1507, and Waldseemüller's map (Fig. 88), dated 1507, in addition to Piri Reis's map, raises the possibility that he may have seen these maps as well.[737] Here, we see not only an experienced pirate, but also a strict investigative cartographer. The fact that a pirate and artisan, like Piri Reis, had scientific knowledge, and did research enabled him to produce scientific works. So, here we are talking about the scientific works, produced by an artisan, and his contributions to the history of science.

[737] Inan, *Piri Reis'in Hayatı ve Eserleri*, p. 37.

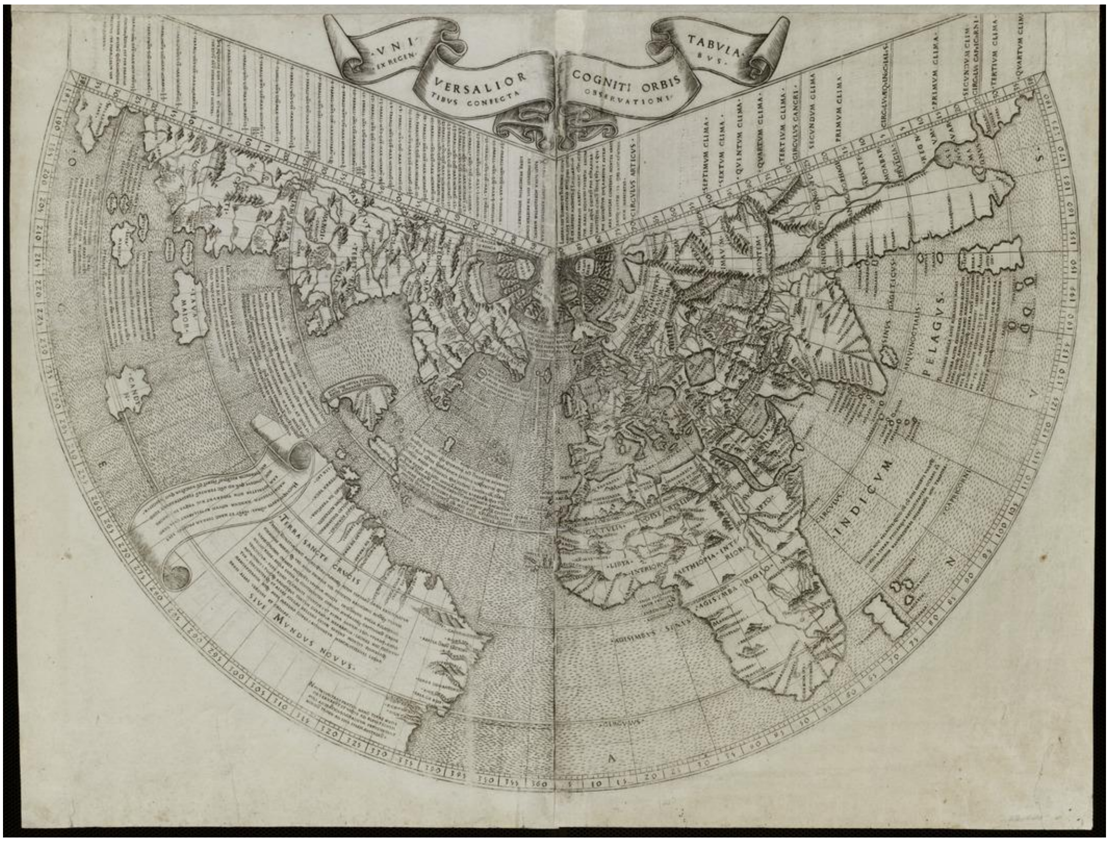

Figure 87. On this map by Ruysch in 1507, Cuba is shown as a continent. Johannes Ruysch, printed map of the world, "Uniuersalior cogniti orbis tabula ex recentibus confecta obseruationibus," 1507, Norman B. Leventhal Map & Education Center, https://collections.leventhalmap.org/search/commonwealth:3f462s18s.

Figure 88. Cuba is also shown as a continent on Waldseemüller's map in 1507. Martin Waldseemüller, Printed Geographical map of the World, 1507, Library of Congress, https://medea.fc.ul.pt/view/chart/104.

As you can see, there is a lot of information on the first portolan chart of Piri Reis. It is very valuable to read these data from a chart, made by someone, who lived at that time in the first degree. From these knowledges, it is possible to deduce that Piri Reis closely tracked the European cartography, the stories, and news of the travels and discoveries. And he also followed closely the cartography techniques, the place, and the distance data. From this point of view, it can be concluded that the Ottoman sailors had the opportunity to access information of maritime and exploration. Based on this, I think that Piri Reis took on the role of master artisan, which I mentioned at the beginning of the chapter, asserted by Zilsel. Because, as we have seen, Piri Reis, who can be considered as one of these people, whom Zilsel also calls a technologist, is an artisan, who can write and detailed his personal and practical experiences together with the knowledge he has gained as a guide. He took influential steps in the development of scientific cartography, such as triangulation method, latitude, and navigational method with the help of his portolans, as an experienced artisan.

Piri Reis made a second portolan chart in Gallipoli, in 1528, fifteen years after the first world map. It has his signature, as in the first one. There is a great difference between the first chart, he presented to the Sultan, and the second one. As will be seen, in the next section, the second portolan chart does not contain footnotes, information, and legends, as much as the first one. However, it can be concluded that with new developments, it is seen that second chart is closer to the truth.

6. 3. The Second World Map of Piri Reis (1528)

During the search for the missing pieces of Piri Reis' first portolan chart, Tahsin Öz, the Director of Topkapı Palace, found a new chart (Fig. 89). The fact that the frame is only on the north and west edges, and the margins are incomplete, shows that it is also a piece.[738] However, the part of this map we have is a corner from the top and left part of the entire map.[739] It seems more accurate to have a top and left part because the compass roses are placed with a north direction. The chart has dimensions of 69 x 68 cm.[740] This fragment, from a parchment of portolan chart, showing Yucatán, Cuba, Haiti, Florida, and North America, is signed, and dated:

> 'Piri Reis ibn el-Hacc Mehmed el-müştehir biraderzâde-i merhum Reis Gazi Kemal in Gelibolu 935 AH', Piri Reis, the son of Hacc Mehmed, and known as the nephew of the late Gazi Kemal Reis, Gallipoli 1528.[741]

[738] Özdemir, *Osmanlı Haritaları*, p. 56.
[739] Inan, *Piri Reis'in Hayatı ve Eserleri*, p. 39.
[740] Özdemir, *Osmanlı Haritaları*, p. 56.
[741] Inan, *Piri Reis'in Hayatı ve Eserleri*, p. 41.

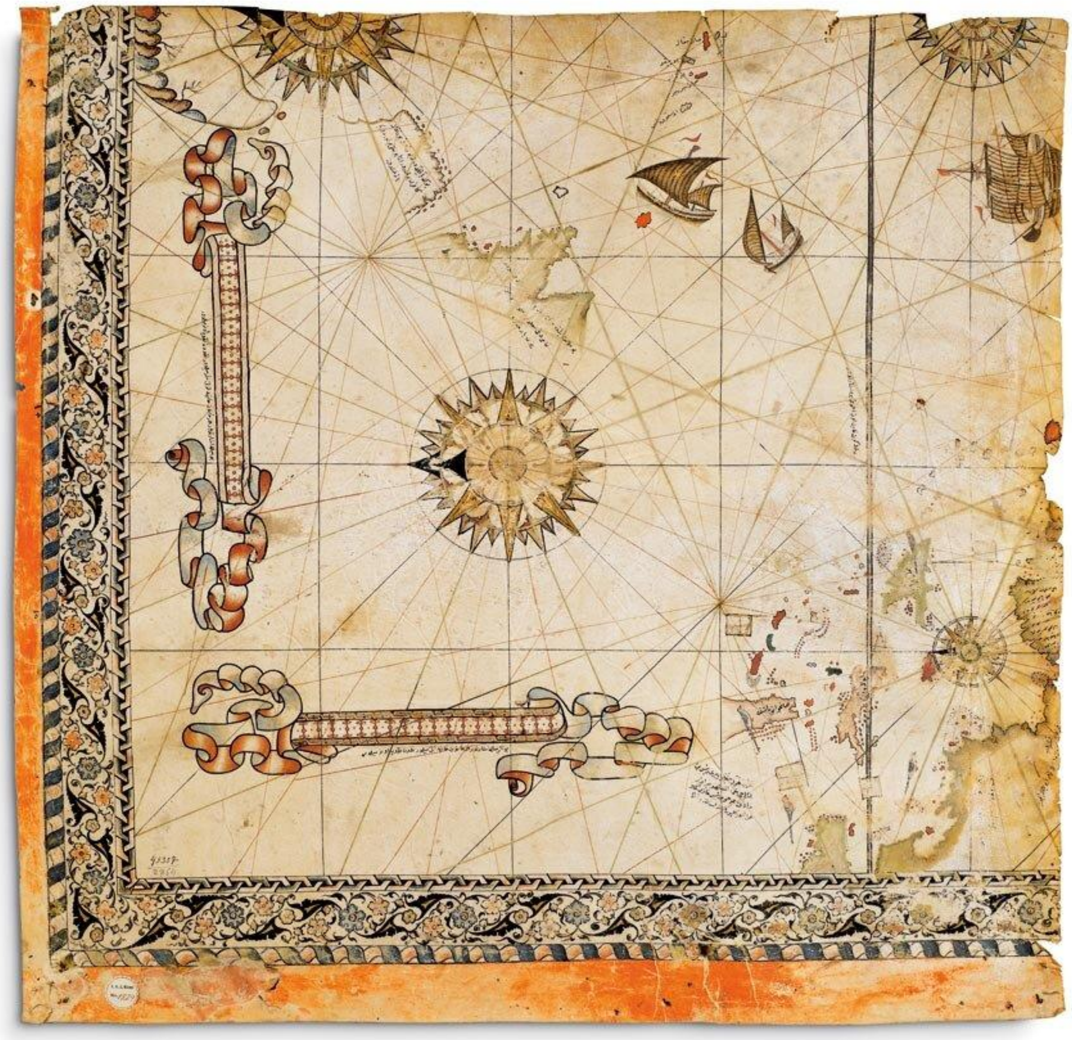

Figure 89. Surviving fragment of the Piri Reis' Portolan Chart dated 1528. This map of Piri Reis has less notes than 1513 map. Topkapi Palace Museum Library, Treasure Library, nr. 1824, https://www.atlasdergisi.com/kesfet/bilim-haberleri/piri-reis-ve-haritasi.html?doing_wp_cron=1637777662.9063079357147216796875.

The part, covered by this map, is the northern part of the Atlantic Ocean and the newly discovered coasts of North and Central America at that time.[742] Wind roses and their directions are frequently drawn in the work. There are four compass roses, two of which are large, and two small decorated, divided into 32.[743] There are also two scales on the map that show mile calculations.[744] The size of this map is larger than the

[742] Inan, *Piri Reis'in Hayatı ve Eserleri*, p. 39.
[743] Inan, *Piri Reis'in Hayatı ve Eserleri*, p. 39.
[744] Inan, *Piri Reis'in Hayatı ve Eserleri*, p. 41.

previous map, dated 1513.[745] Below the scale bars is the following explanation (Fig. 90):

> “These measures are in miles. Each section represents fifthy miles. There are ten miles between each point”.[746]

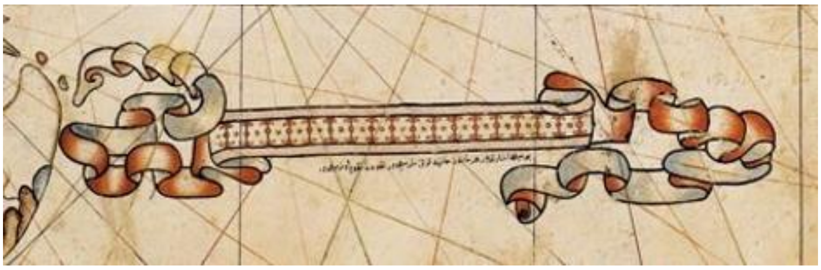

Figure 90. One of scales, given in miles, on Piri Reis’s world map, dated 1528.

The outer edge of the map starts from the coast of northern Greenland. The southern line passes over the Azorean islands. One of the Azorean islands is shown with São Miguel, Santa Maria, Pico, and São Jorge islands.[747] Two large land masses stand out from Greenland to the southwest. The northern one is called “Bakala”, and it was written that it was discovered by the Portuguese. At points on the edge of the Labrador coast; “It is a ‘bakala’ which was discovered by the Portuguese. Its entirety is unknown yet. Only the discovered places are written down”.[748] These places are the Terre Neuve beaches, according to the situation on the map.[749]

In this second map, coastal shapes are drawn more accurately. Signs were carefully placed, especially on stony places and rocks. Further down, Florida stands out in a style very close to its present form. Piri Reis gives name Florida, as San Juan Bautista. In the previous map, dated 1513, this name was given to Puerto Rico. Unlike the first map made, according to Christopher Columbus’s map, the islands of Cuba and

[745] Inan, *Piri Reis’in Hayatı ve Eserleri*, p. 40.
[746] Inan, *Piri Reis’in Hayatı ve Eserleri*, p. 41.
[747] Inan, *Piri Reis’in Hayatı ve Eserleri*, p. 40.
[748] Inan, *Piri Reis’in Hayatı ve Eserleri*, p. 41.
[749] Inan, *Piri Reis’in Hayatı ve Eserleri*, p. 40.
In present day, Newfoundland and Labrador is located in the Eastern Canadian region of Canada.

Haiti, as well as Bahamas and Antilla, were drawn completely in accordance with today's shape.[750]

Ships are depicted in the Atlantic Ocean, birds, and standards on islands, while crosses mark rocks. On this chart, which thought to be one quarter section of a large portolan chart, some of the imaginary islands shown, on the previous one, are not included, and the Tropic of Cancer is drawn. And the coasts of America are more accurate than the first chart, showing that Piri Reis was keeping track of current developments by navigators, after Columbus. Evidently, he was closely following the exploratory voyages of the American coasts and, arranged them in his chart. The north and west edges of the chart are surrounded by an illuminated border. The mountain ranges and a dry tree depicted on the land, on the northeast side, are in the same style, as in *Kitâb-ı Bahriyye*, and reflect the art of miniature, in the period 1520-1530.[751]

The fact that we only have certain parts of both maps may not be due to coincidence or erosion over time. This needs to be taken into consideration because both pieces point to America. Either these places were being explored by someone from the palace, and in this way certain parts separated from the rest, or the remaining parts were taken by someone to be used for practical purposes.

Besides, as Piri Reis showed the discovered places, on this chart, he never drew the side, which was not discovered at that time. And after leaving these places white on the chart, he explains that these places were not drawn, because they were not known. In this way, he proved once again, that he acted, according to the rules of scientific methods, while drawing his chart.[752] In addition, there is a very valuable geographical work, written by Piri Reis, which is *Kitâb-ı Bahriyye*. Piri Reis said that only charts were not enough, when showing and describing a place, and a book was needed to give detailed information about the places. That is why he explains that wrote this navigational book. In the diffusion of knowledge, this type of instruments, which were common, was used a lot, especially in the 16th century.

[750] Inan, *Piri Reis'in Hayatı ve Eserleri*, p. 40.
[751] Kültür ve Turizm Bakanlığı Kültür Varlıkları ve Müzeler Genel Müdürlüğü, P*iri Reis'ten Önce ve Sonra Topkapı Sarayı'nda Haritalar*, p. 105.
[752] Inan, *Piri Reis'in Hayatı ve Eserleri*, p. 42.

6. 4. *Kitâb-ı Bahriyye* (The Book of Navigation) (1520)

> I hope our brothers, who will walk through this path, and read this book, would remember this humble man.[753]

At the beginning of his treatise, Piri Reis explains the reason, for writing *Kitâb-ı Bahriyye,* as follows:

> As, for the reason, why this book written, scholars, during the reign of the Sultan of the World (Suleyman I), brought forth works on various branches of the sciences, for his exalted state, and felicitous court, so that they might come into possession of the infinite favour of that fortunate sovereign as well as of repute and honour. In that hope, I, Piri Reis, the weakest and most powerless of God's servants, the son of Haji Muhammed, the brother of the late Kemal Reis, have written a book to place, before the divine door of his majesty the Sultan. I though done to the best of my powers will be but a poor keepsake of the science of navigation, and of the mariner's art, for to date, no one has left behind so valuable a work.
>
> That being the situation, I investigated the prosperous and ruined places, the harbours, the springs, the reefs in the sea, and the shallow places along the shores, and around the islands of the Mediterranean, seeing and becoming acquainted with them first together, with the late Kemal Reis, and then with other champions of the Faith. I have fully explained them all here, for the matters discussed, in this book, cannot be shown on charts, which are much too brief. Those, who know the business using dividers, and calculating miles, and then it is all inscribed on leather produce that which we call a chart. In this way, however, a distance measuring ten miles can be shown with, but three dots on a chart, yet there are places, where the distances are less than ten miles. Similarly, a place, where the measured distance, is thirty miles, can only be represented, in nine dots. Thus, it is impossible, in such places to include within a chart the built up, and ruined places of shores, and islands, their harbours, their springs, the reefs and shallow places in the sea. And there are which side the harbours are located on, which winds they are exposed to, and which they are not, how wide or how narrow they are, and how many vessels they may shelter, as well as a great many more matters like these. If one were to ask whether the chart could be inscribed on thinner leather, the answer would be that it is not possible to make use of such a large chart on board a ship. It is, because of this, that master mariners draw on large skins to show lengthy coasts, and big islands. For smaller places, however, there is a definite need for a sailor.
>
> Before, I, your humble servant, made charts in which I was able to show twice the number of things, contained in the charts of our day. Having made use of new charts of the Chinese and Indian Seas, which no one in the Ottoman lands, had hitherto seen or known, I presented them to the late, and deceased Sultan Selim Han (may he rest in peace and reside in Paradise), while he was in Egypt, and received his favour. In the same way, the chart presented, here, was a summary.
>
> By means of these charts, now, employed, one may operate along the extensive shores of the seas, and around the major islands. Nevertheless, even in such broad places as these, the representation of several significant markings goes

[753] Piri Reis, *The Book of Bahriyye*, p. 3.

unnoticed for they are abbreviated. However, I have made this, so easy that those, who are masters of this profession, may by applying, which is written, in this book, and with the grace of God facilitate all their affairs, even if they have never before seen or been acquainted with such places, and they will have no need of pilots.

As has been explained, I have written in full concerning the matters, made mention of. In the year 932 (1525) of the Hegira of the Holy Prophet, I compiled information, while in Gallipoli concerning the places, mentioned above. The result was this book. In composing the book, I began, first, with the castles, known as *Sultaniye* and *Kilidü'l-bahr* located near Gallipoli, proceeding step by step, distance by distance, explaining this sea, in full as we move about, and in the end returning, again, to these castles, where I make an end of it. My aim, thus, was to permit a desired place to be found, when needed without hesitation.

Nevertheless, the submission of this book, before the felicitous door of the Sultan, in whom the wise, take refuge, was impossibly beyond our powers, and thus, a fair copy of the work was not produced. It was just, at this point, that your poor and humble servant received an order that could not go unfulfilled.

It was his Excellency Ibrahim Pasha, vizier and grand vizier, the sun of the state and the light of happiness (may God facilitate his affairs), who ordered me to have the drafts of this work copied out and made into a book. Complying with this decree, which it would be incumbent upon the whole world to obey, and with this decision, to which one needs be subject, and displaying, due diligence, I produced a clean copy of this book from beginning to end. I beg Almighty God that his Excellency the Sultan may enjoy this work. Amen.[754]

[754] Piri Reis, *The Book of Bahriyye*, p. 10.

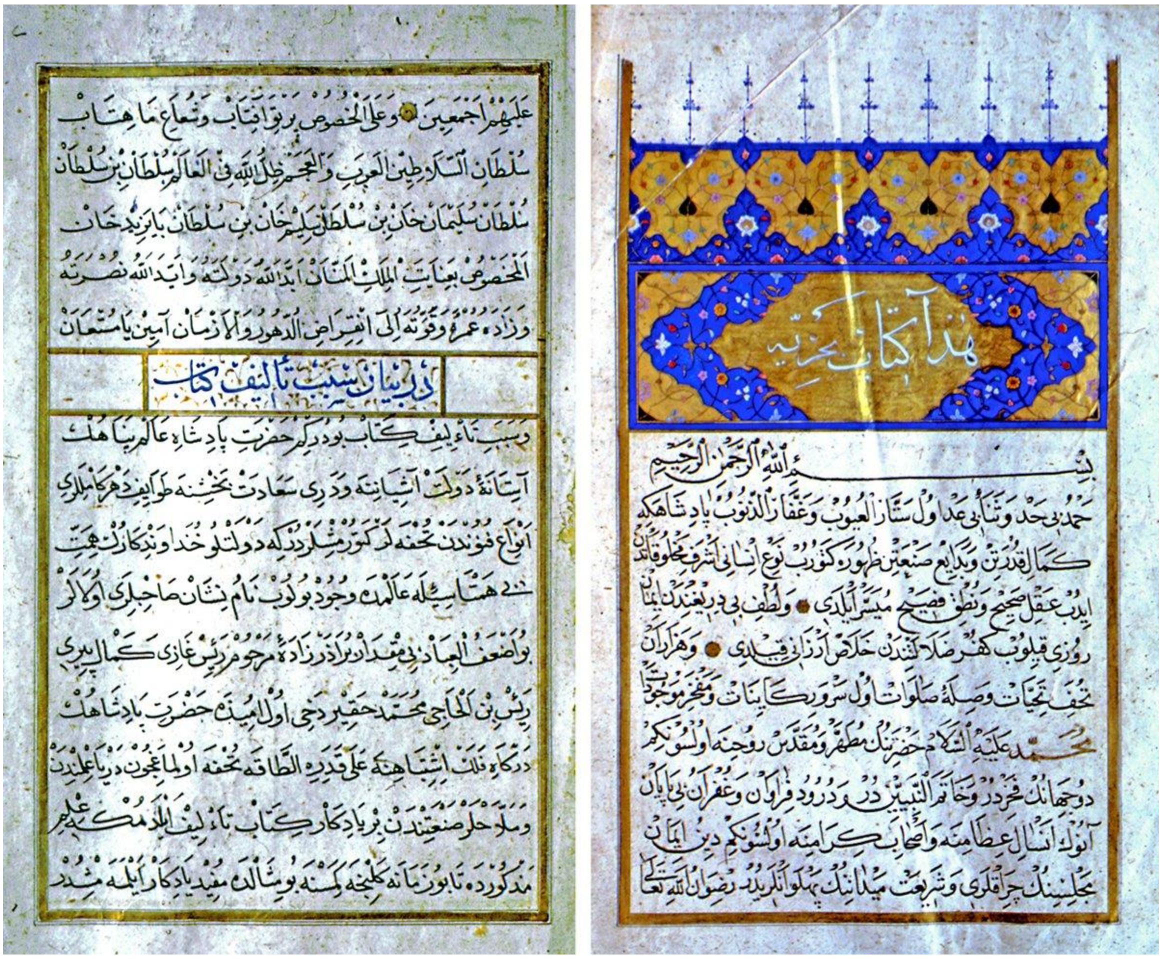

Figure 91. The first two pages of *Kitâb-ı Bahriyye*. Piri Reis begins his book with praises to the Ottoman Sultan, Sultan Suleiman. Süleymaniye Library, Hagia Sophia, nr. 2612, https://islamansiklopedisi.org.tr/kitab-i-bahriyye.

Undoubtedly, the most valuable work of Piri Reis is *Kitâb-ı Bahriyye* (Fig. 91). This treatise was written for the first time, in 1521, and expanded in the second time, in 1525. And it was presented to Sultan Suleiman through Grand Vizier Ibrahim Pasha.[755] *Kitâb-ı Bahriyye* is a book of texts and charts. It covers the entire Mediterranean, covering the subject in parts, and each is accompanied by one, sometimes two, or rarely three charts. Piri Reis divided his book, into 214 chapters.[756] The copy presented to Sultan Suleiman has 215 charts and is in the Topkapı Palace Museum Library (Hazine, nr. 642).[757] Piri Reis's depictions of the Mediterranean

755 Fikret Sarıcaoğlu, "Kitâb-ı Bahriyye," accessed December 2, 2021, https://islamansiklopedisi.org.tr/kitab-i-bahriyye.
756 Pınar Emiralioğlu, "Cartography and the Ottoman Imperial Project," p. 77.
757 Sarıcaoğlu, "Kitâb-ı Bahriyye," accessed December 2, 2021, https://islamansiklopedisi.org.tr/kitab-i-bahriyye.

mainly focused on the objectives of the Ottoman navy in the first half of the 16th century. Of the 214 charts in the second version of the book, only 32 show locations in the central and western Mediterranean, primarily the islands (Malta, Corsica, Majorca, etc.). About 85 percent of the tables (182 tables) show the Eastern Mediterranean and North Africa.[758]

Piri Reis's *Kitâb-ı Bahriyye* is essentially two-dated. It is dated 1521 and 1525. The first written copy was in demand among sailors at that time and was copied for use in the navy. The other is the copy that was presented to Sultan Suleiman upon the request of Ibrahim Pasha, with new additions made. The ones registered in libraries are copied from these ones with various dates. There are many examples of *Kitâb-ı Bahriyye*. These are 20 copies in Istanbul, one in Dresden, two in Bologna, two in Berlin, and one in Paris, Vienna, and London.[759]

The treatise begins and ends with a verse from the *Holy Quran*. If the preface is read, carefully, it is understood that the author, with strong research and fine observation power, studied the geographical works of his time, and the situation of every place, he visited, and wrote his work in that way. It is, in the first prose part of this foreword, that there is a need for nautical guides in the west, called portolan chart, and describing coasts, islands, ports, dangerous rocks, and places for transportation. Because it is not necessary to compress all this information into charts to be made at a certain scale, no matter how large.[760]

Piri tells that Ibrahim Pasha, who saw this work, during his trip to Egypt, told him to prepare it to present to the Sultan. After that, he tells, in the prologue, in verse, before mentioning his own maritime life and that, his uncle, the mariner Kemal Reis, entered the service of state, in 1494, in the time of Bayezid II. Then, he says that it is necessary to know the tide, the shallow, and anchoring locations of the ports to emphasize the difficulty, and significance of seafaring tells what it is. After, he deals

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[758] Tarek Kahlaoui, "The Imperial Ottoman Mediterranean and the Transmission of the Tenth-/Sixteenth-Century Mapping of the Mediterranean," *Creating the Mediterranean* (Handbook of Oriental Studies. Section 1: The Near and Middle East) (Leiden, The Netherlands: Brill, 2018), Vol. 119, Chap. 7, pp. 240-262, doi: https://doi.org/10.1163/9789004347380_009, p. 241.

[759] Inan, *Piri Reis'in Hayatı ve Eserleri*, pp. 72-73.

[760] Sarıcaoğlu, "Kitâb-ı Bahriyye," accessed December 2, 2021, https://islamansiklopedisi.org.tr/kitab-i-bahriyye.

with the description and explanation of the storm, the types of winds, the description of the compass, and the portolan chart, and the situation of the *'rub-i meskûn'* (the land quarter of the world) seas.[761] The part of the preface that will interest us, the most is that, he insists everywhere that the earth is spherical, and that he sees a globe made by a Portuguese priest, in particular. This globe, which the author describes well, is most likely be a model of the globe, made by Martin Behaim of Nuremberg, in 1492 (Fig. 92).[762]

[761] "Rub-ı Meskûn," accessed December 5, 2021, https://www.luggat.com/index.php#ceviri.
[762] Adıvar, *Osmanlı Türklerinde İlim*, pp. 78-79.

Figure 92. The Behaim's Globe of the Germanisches National Museum is one of the most striking cultural artifacts in the history of cartography, as the oldest surviving spherical representation of the world. It was created in the eve of Columbus's first voyage to America between 1492 and 1494, the map images and labels were produced after the great discoveries. With its 110 miniatures, nearly 2,000 toponyms (place and field names) and numerous short and long texts, it has an encyclopaedic dimension and contains information about the non-European world. The Behaim globe, also called "Erdapfel". The Erdapfel is a terrestrial globe produced by Martin Behaim from 1490 to 1492. The Erdapfel is the oldest surviving terrestrial globe. Behaim Globe, Martin Behaim, Georg Glockendon, around 1491-1494, Germanisches National Museum, Nuremberg. The concept and content come from the well-travelled Nuremberg cloth merchant and sailor Martin Behaim (1459–1507), and the work was carried out by the illuminator and illuminist Georg Glockendon, the painter Hans Storch and the scribe Petrus Gagenhart as well as other Nuremberg specialist artisans. Later additions, frame added to the horizon ring in 1510. Material/Technique: Glued fabrics, parchment, painted paper; forged iron, painted; cast brass, hallmarked, engraved. Dimensions: H. 133 cm; D. 51 cm.[763]

[763] "Behaim-Globe," Germanisches Nationalmuseum, accessed Aralık 8, 2023, https://www.gnm.de/forschung/archiv/digitalisierung-behaim-globus.

A closer comparison of the literary expressions, in *Kitâb-ı Bahriyye*, with those in European portals reveals considerable originality, and often a much greater amount of information distinguishes the work from others. Piri Reis may have read and used some of the specialized European literature, but once again, his own personal experience and vision helped him to create a work, like no other. The originality of *Kitâb-ı Bahriyye* begins with the structure and scope of the book. Dividing the subject into chapters, covering specific parts, each chapter accompanied by a large-scale painting of that chapter, is a method otherwise unknown in portolan literature.[764] However, the related genre of *isolarii* may have also provided some of the original inspiration.[765]

In the research, on the sources of *Kitâb-ı Bahriyye,* it is suggested that some Italian, Catalan, and Portuguese portolan charts, and Italian island books (*isolario*), belonging to the middle of the 15th century, may have been used (Fig. 82). Bartolommeo's *isolarios* (Venice 1484-1486), for the Aegean Sea islands, the studies started by C. Boundelmonti, and developed by B. Bartolommeo dalli Sonetti, and B. Bordone, due to their style similarities, were mentioned among these sources with a probable recording. Here, especially the Adriatic Sea, the Italian peninsula, the coasts of Sicily, and France are in question.[766]

> Whoever reads this book, will increase his knowledge among mariners.
> Know you then that complete knowledge of one science, is preferable to knowing a little about many.
> One should read and understand the nature of the world, and of oneself.[767]

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[764] Soucek, *Piri Reis and Turkish Mapmaking After Columbus*, p. 102.
[765] Soucek, *Piri Reis and Turkish Mapmaking After Columbus*, p. 102.
Isolarii or the conventional term '*isolario'* is used to denote manuscript or printed atlases that—regardless of title, format, or structure, and of whether a work contained text—consist of maps, mostly of islands, but also of coastal areas of the mainland, arranged in the form of a thematic encyclopedia. Their authors, in the early period, called their works "books of islands, island chorographies, or island navigations." And it is used specifically for navigational books of the Mediterranean islands. Benedetto Bordoni's *Isolario: nel qual si ragiona de tutte l'isole del mondo, con li lor nomi antichi & moderni, historie, fauole, & modi del loro uiuere, & in qual parte del mare stanno, & in qual parallelo & clima giacciono* (*Isolarii*: in which we reason of all the islands of the world, with their ancient & modern names, histories, fables, & ways of life, & in which part of the sea they are, & in what parallel & climate), published in Venice in 1534, is the most famous example.
[766] Sarıcaoğlu, "Kitâb-ı Bahriyye," accessed December 2, 2021, https://islamansiklopedisi.org.tr/kitab-i-bahriyye.
[767] Piri Reis, *The Book of Bahriyye*, p. 27.

Piri Reis travelled, almost, all the Aegean and Mediterranean coasts with Kemal Reis' ships. And he had the opportunity to explore the ports of the Adriatic, Italy, France, Spain, and Tunisia, and gathered his notes (Fig. 93). Piri Reis collected information about the historical, geographical, and maritime conditions of these regions, noted down his own observations, and then, wrote his book based on them. For each chapter, he drew the portolan chart of every region, which he described.[768]

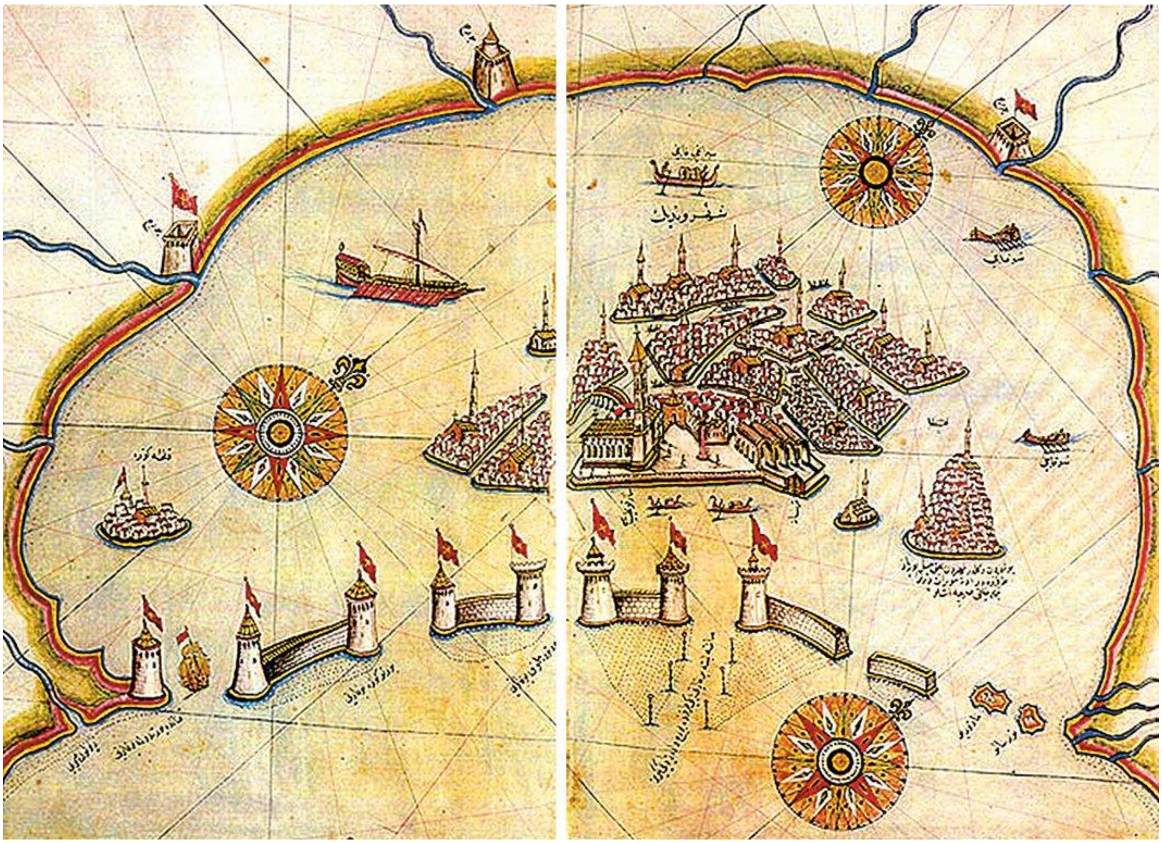

Figure 93. The Portolan chart showing the city of Venice in Piri Reis's *Kitâb-ı Bahriyye*, 1513. In the drawing of the city of Venice, which Piri Reis may have visited and seen firsthand, the depictions of different types of ships are particularly noteworthy. Süleymaniye Library, Hagia Sophia, nr. 3161, vr. 17b-18a, https://islamansiklopedisi.org.tr/venedik.

[768] Inan, *Piri Reis'in Hayatı ve Eserleri*, p. 17.

The most distinguishing feature of the *Kitâb-ı Bahriyye* is to make the information that cannot be fit on the portolan charts, give the texts and charts together for being useful to sailors. The main subject of the treatise is the Aegean and Mediterranean coasts, and the islands, after the first 85 pages of preface, and general information in verse. Piri Reis wrote the first part of his book, in verse, that is, like the language of poetry.[769] While giving information about the islands, and coasts together with his portolan charts, it was transformed into prose. It can be summarized Piri Reis's writings in the prose and verse section of his book.

Chapters 1 and 2 described his purpose, in writing this book, and his activities on the seas with Kemal Reis. It points to the advantages of observations, and experiments at sea. He says that his uncle lost his life, due to such a deficiency.[770] Chapters 3, 4, and 5 give information about the storm and wind directions, and compass.[771] He describes the winds as follows:

> Heed, now, and I will explain the winds so that each one may be known.
>
> Know you that there are four principal winds and all of them, are great ones.
>
> These are the east, north, west, and south winds.
>
> These are the four main winds of the world, and they define all others.
>
> This is the reason for marking the four winds, on the compass, with black lines.
>
> For black is the foremost of all colours: all other hues are its complement.
>
> Similarly, there are four winds, marked in red, on the compass: northwesterly, southeasterly, southwesterly, and northeasterly.
>
> These are the types of winds, and they number eight in all.
>
> These define eight, another eight, and thus, the number of winds becomes sixteen.

[769] Inan, *Piri Reis'in Hayatı ve Eserleri*, p. 18.
[770] Inan, *Piri Reis'in Hayatı ve Eserleri*, p. 19.
[771] Inan, *Piri Reis'in Hayatı ve Eserleri*, p. 19.

> In addition to these sixteen, there are also another sixteen,
>
> However, these are not the same: they are directions and not winds.
>
> Thus, there are thirty-two points, and this lead everywhere.[772]

The definitions of the compass and the portolan chart, which are two of the most prominent nautical instruments in the early modern period, are the most striking point here. Because, especially in the Ottoman empire, *Kitâb-ı Bahriyye* is the first source, where the definition of the compass is made among the scientific works (Fig. 94). It is not known exactly when the compass was first used in the Ottoman empire, but it is clearly seen that it was used in the early sixteenth century. Piri Reis mentioned the magnetic compass for the first time in this manuscript. Therefore, it can be assumed with certainty that Piri Reis used the sailor's compass.[773]

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[772] Reis, *The Book of Bahriyye*, p. 13.

[773] Ferhat Özçep, "Terrestrial magnetism in the Ottoman empire: Documents and measurements" *Earth Sciences History*, 37, no. 1, (January 2018): 1-24, p. 8.

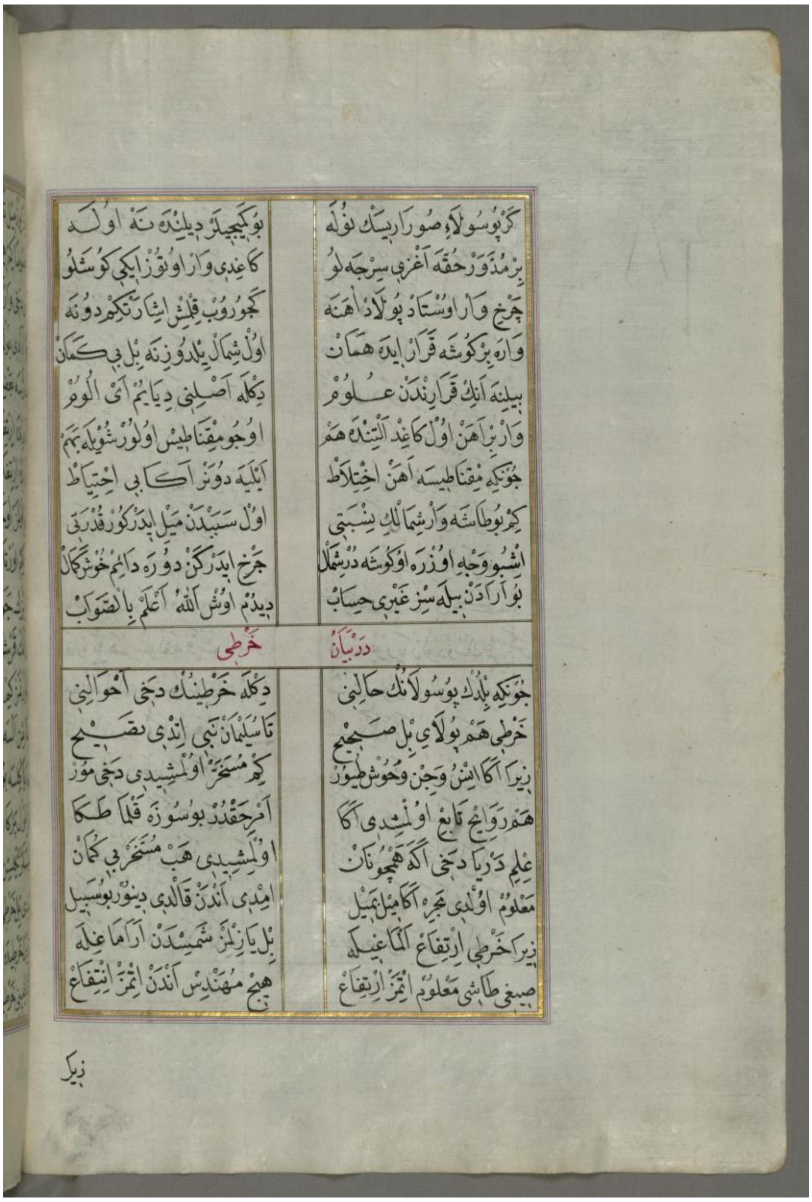

Figure 94. Description of the compass in *Kitâb-ı Bahriyye*, 1513, https://www.loc.gov/item/2021667235/.

If you would know what a compass is, and how it is used in the seafarer’s trade, it is a round box, sealed in glass, containing a piece of paper with thirty-two corners.

Its maker has placed this paper on a shaft of steel, and having marked, it permits it to rotate, like the world.
When it turns and comes to a halt, you may be sure that it points to the North Star.

May Great God let this be known by science, so that I may explain it to you.

Below that, paper is a bar of iron, whose ends, are round, and has been magnetized.

> For when loadstone and iron come together, the iron turns towards it on its own. This stone is northward looking.
>
> Behold the power of God, for the stone turns that way.
>
> This corner, then, is the north, and even if it turns, it always points north.
>
> More than this, you need not know, for only God knows the truth.[774]

Chapters 6 and 7 refer to charts, and illustrations on charts, and describe ship compasses. After that, Piri Reis gives very long information with portolan charts (Fig. 95, 96, and 97).[775] While defining the chart, he also states that drawing should not only be determined by astrolabe, compass, or geometry, but also by people seeing the shallows and coasts. Here, the necessity of experienced people, that is the necessity of being an artisanal sailor is seen. It is understood from here that Piri Reis wants to explain that calculations made with compass or other instruments, regarding shallows and shores are not sufficient. Experience is required for these. In other words, he says that these places should be seen and researched. It seems that a sailor needs experience as well as scientific knowledge. In other words, it is seen that these artisans need to add their experience to this information, in addition to the scientific knowledge, they must know while sailing at sea.

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[774] Piri Reis, *The Book of Bahriyye*, p. 14.
[775] Inan, *Piri Reis'in Hayatı ve Eserleri*, p. 19.

Figure 95. In these pages, Piri Reis explains the necessity of knowing the map information by sailors, in *Kitâb-ı Bahriyye*. https://www.loc.gov/item/2021667235/.

Figure 96. Piri Reis gives knowledges to sailors about how maps should be used, and he talks about the signs on the map, in *Kitâb-ı Bahriyye*. https://www.loc.gov/item/2021667235/.

Figure 97. When talking about the map, Piri Reis states that a compass should be used along with the map, in *Kitâb-ı Bahriyye*. https://www.loc.gov/item/2021667235/.

Now that you know what a compass is, listen to the nature of charts. Truly know both compass and chart.

Charts cannot be drawn by taking elevations and peering about.

Latitudes, on charts, do not show shallows or reefs. Geometers derive no benefit from them. Within a hundred miles, there may be many reefs and who can know them for sure?

Particularly, since none of them can be seen, most are four to five fathoms deep.

Some are even ten fathoms deep. Not even an astrolabe is of use here. Who has ever searched for them or discovered them? Who knows what is in the middle of the sea?

If knowledgeable men have discovered some of them, it was because, they happened to pass that way one day.

And they marked its elevation down. Do not suppose that they found it by searching for it. However, even if they marked down the elevation, while right upon it, whether they err by so much as a hair, that chart will be worth nothing. Listen now and you will see why. Imagine a place in the middle of the sea with five or six miles of water around.

Good friend, the shores of this sea will extend for many hundreds of miles.

No geometer can determine truly the distances between its opposite shores.

One needs to indicate their compass headings and thus bring together places that cannot be seen.

Know you that if you measure the elevation and write it down, but err by so much as a hair, that is, whether the points are wrong by so much as a hair, then all the capes will be wrong.

This work cannot be done with dividers either. If one tries to, the results will be mistaken.

Whether they but once discover a mariner's mistake, no one will ever again heed his word.[776]

[776] Reis, *The Book of Bahriyye*, p. 14.

In the eighth chapter, he records that there are continents in a quarter of the seas that cover the world, and the seven seas with their names (Fig. 98).[777] This is reminded of the information, given in the books of people, such as Istakhri, Ibn Hawqal and Idrisî, whom I mentioned in the previous section. *Kitâb-ı Bahriyye* also has the same features. It has the feature of being both a practical navigational book, and a book that includes geographical knowledge. The distinction between Piri Reis and these writers is that he is an artisanal pirate, who experienced them firsthand.

The most substantial innovation in this book is that it has made the knowledge that do not be contained on portolans useful to sailors, creating large comparative maps, and completing them with the writings in the text.[778] And the most striking feature of Piri Reis's works is that he both added his experience and benefited from different works while creating these works. And he clearly stated most of the works, he benefited from.

Figure 98. Description of a quarter of the seas that cover the world, and the seven seas with their names, in *Kitâb-ı Bahriyye,* 1513, https://www.loc.gov/item/2021667235/.

[777] Inan, *Piri Reis'in Hayatı ve Eserleri*, p. 20.
[778] Inan, *Piri Reis'in Hayatı ve Eserleri*, p. 18.

Good friend, this science, then, will be easy for you. May you remember me by these words.

Zealous one, they call these the "Seven Seas," here now their names.

One, if these is known as the Chinese Sea, and another is the Indian Sea.

The third is the *Bahr-i Pars* (Strait of Hormuz), while the Sea of *Bahr-i Zenc* (Red Sea) lies off Habesh.

Surely, one is the *Bahr-i Mağrib* (the Atlantic Ocean): a vast ocean without end.

Beloved one, another is the *Bahr-i Rum* (Mediterrenian); and with the *Bahr-i Kulzum* (Caspian Sea), they number seven in all.

The *Bahr-i Kulzum*, however, is a different sort: for it is like a lake surrounded by land.

The length of all these seas, as measured in miles, are calculated at four thousand miles.

No other seas join with these seven, nor do they join with any others.

All the others are united with the *Bahr-i Azam* (Pacific Ocean).

The Ocean is the sea into which they all are collected. It encircles the world.

It is the head of all the seas: from it, all seas emerge, and to it all return.

As I have told you, the fact is that all the other seas are but gulfs of the Ocean.

The sea is like a tree that spreads everywhere left and right.[779]

In chapter 9, Piri Reis wrote, at length, about the geographical discoveries of the Portuguese and how they went to the Indian Sea. In the 10th chapter, he extended the Abyssinian country to the Cape of Good Hope and wrote that the Dutch and Portuguese came to Jeddah from the Red Sea, and that the Turks had to drive them

[779] Piri Reis, *The Book of Bahriyye*, p. 15.

away. In the 11th chapter, Piri Reis wrote the Poles, tropics, equator, and the information of the Portuguese about them, in the embodied sphere, which he calls the 'globe'. In chapter 12, he describes, very usefully, how the Portuguese made voyages from their homeland to India, according to the appropriate seasons. In chapters 13 and 14, he tells stories of sailors, often giving knowledge about the seas. At the same time, he talks about the Chinese sea, and gave data about the Chinese people, their customs and the art of tile making, by considering it the end of the east. In chapter 15, he explains the condition of the Indian sea, and the seasonal winds therein, in a manner entirely, in accord with what is now known. He also tells the wind situation in the Mediterranean and Aegean. He gives news about the Pole Star, by describing astrolabe.[780] It is clear that Piri Reis reached this information through his research. It is possible to find data on more than one field and subject here. In these chapters, Piri Reis explains the discoveries and journeys made by the Portuguese, their knowledge about the poles, the equator, and the tropics. Also, he gives information about China and the Chinese people, their traditions, and arts. That is, there are scientific, historical, and geographical knowledges, and this make his *Kitâb-ı Bahriyye* valuable resource in many respects.

> Now we return to our previous subject, let me tell you what this science of navigation is.
>
> Indian navigation is exactly this, attend whoever knows it takes a rod in his hand,
>
> Holds it up to the north and brings it to the horizon between the sea and sky.
>
> For, at night, the sea is dark, but the sky is bright.
>
> When it is exactly on the horizon, they measure the lower part of the rod.
>
> Looking at it straight upwards, they observe the North Star, but if it appears not, see what they do.
>
> They put the rod down, and take up another and by such reckoning, they draw chart their course.

[780] Inan, *Piri Reis'in Hayatı ve Eserleri*, p. 20.

> Good friend, this, then, is the science of proportional navigation. It is the result of hundreds of trials on the routes to India.
>
> By their experience, they know, where they are going, and even if the sea is raging, they return.
>
> This method is used only in the Indian Ocean, for the North Star, is clearly visible there.
>
> The North Star is always their target with it, they perform their tasks.
>
> Nevertheless, in some places, the North Star is not visible, but wise men have discovered a remedy for that too.
>
> Companion, they draw chart that course with the astrolabe, by taking elevations.
>
> Hear, now, the places, where the North Star, is not visible.
>
> They are all in the south, wherever it is visible, is on the other side of the equator.
>
> These places are located at latitudes above the equator, but others are just below it.
>
> Thus, these latitudes block the North Star for them, as well. Because they are on the underside of the earth.
>
> For this reason, the North Star does not appear, and this is the reason for these words.[781]

In chapter 16, he writes what he heard about the Persian Gulf. Because, at that time, Piri Reis had not yet gone to the Persian Gulf. He informs about the pearl mining, and how these works are done on which islands. In chapters 17, 18, 19, and 20th, he refers to the coast and its islands, calling the Indian Ocean, *Bahr-i Zence*. In chapters 21, 22, and 23rd, he deals with the Atlantic Ocean in two parts, by saying *Bahrü'l-Mağrib*, and *Bahr-i A'zam*. Piri Reis, who recorded the Maghreb Sea, as a great sea four thousand miles to the west from the Ceuta Strait, states that the continent of Antilla is at the other end of this sea. Thus, Piri Reis wrote that sailors found the continent,

[781] Reis, *The Book of Bahriyye*, pp. 21-22.

called Antilla, in 1465. Here, it can be also read what was known, at the time, about the discovery of America (Fig. 99).[782]

Figure 99. This page describes what led to the discovery of the Antilla, in *Kitâb-ı Bahriyye*. https://www.loc.gov/item/2021667235/.

[782] Inan, *Piri Reis'in Hayatı ve Eserleri*, p. 20.

They call that country, Antilla. If you listen, I will tell you of it.

Hear, also, how that land was discovered. Let me explain, so that it will be clear.

In Genoa, there was a stargazer, whose name was Christopher Columbus.

A curious book, came into his possession, which without doubt, was from the time of Alexander.

In that book they had collected and written down all that was known about navigation.

That book, ultimately, reached the land of the Franks, but they knew not what was in it.

Columbus found this book, and read it, whereupon he took it to the King of Spain.

When he told the King, all that was written therein, King gave him ships.

Good friend, employing that book Columbus sailed, and reached Antilla.

After that, he ceased not, but explored those lands. Thus, all have known the route.

His portolan chart, too, has reached us. That is the situation, and I have told it all to you.

We have come, however, now to point at which I must summarize the rest.[783]

With his description, Piri Reis means that the portolan chart used by Christopher Columbus, was in his hands. These are very significant expressions for us to see the maps, used by Piri Reis. And the fact that he included this in his book makes him a true scientist as well as an artisanal sailor. This means that Piri Reis, as an experienced sailor with scientific knowledge, synthesized all these sources and produced a very valuable work for the history of science. Because Piri Reis has gained many years of experience at sea and believes in the necessity of scientific instructions in maritime with these experiences, creating a work that brings these together makes him a scientist as well as an artisan. From this, it can be concluded that Piri Reis had wide range of resources regarding maps and that he saw, used and even had many

[783] Piri Reis, *The Book of Bahriyye*, p. 26.

maps, made in the period before him and in his own time. While he talks about cosmography, he explains as follows:

> In Portugal, an influential priest, who was, thoroughly, versed in all things.
>
> Skilled in theoretical and practical knowledge, he had attained perfection. Through constant effort, he had become a philosopher.
>
> He created a ball, shaped like an apple, on which he marked the lands and the seas.
>
> On that globe, he indicated all the distances, and calculated its size to be twenty-four thousand miles.
>
> He marked the various countries and wrote their names on the globe.
>
> At the same time, he recorded on it, the islands in the seas, and countless numbers of castles.
>
> Using this globe, one can travel the whole world, across the Ocean, as far as China.
>
> Thus, when this globe was made their faces, were no longer beset with sorrow.
>
> For, before this, many were lost, and many perished in distress.
>
> However, since this astronomical globe, began to be used, they have suffered no loss at sea.[784]

Thus, in these 84 pages section, Piri Reis gathered information about all the seas known, in his time. The original text of the book is 743 pages with charts, divided into 209 chapters. These chapters were written, in prose, so that sailors can easily use them. These articles are about geographical, historical, and sometimes lost castles on the Aegean Sea coast and islands, the coasts of Adriatic Sea and the western coasts of Italy, the south of France, and the eastern coasts of Spain, starting from the Dardanelles and *Kilitbahir Castle*, where the book was written. He followed the African coasts from the Strait of Gibraltar to Egypt, giving information about from there, it follows the Palestinian and Syrian coasts, Cyprus, and Anatolian coasts, and ends the entire

[784] Piri Reis, *The Book of Bahriyye*, p. 17.

Mediterranean basin in Marmaris.[785] The last part of *Kitâb-ı Bahriyye* talks about Piri Reis' thoughts on the sea, and his efforts to increase the knowledge of the sea to his followers.

> Hearken to the secrets, I reveal and from them know and discern my aim,
>
> And with these words let me explain one by one what I hoped to do.
>
> I speak to those, who would know how this book was finished.
>
> It was with God's guidance that it became my habit to roam the seas.
>
> And if I lived forever, I would always be at sea.
>
> If ever I were unable to go to sea, I would by much pained by inactivity,
>
> For I love it with all my heart, and so derived pleasure from my work.
>
> So much could be said so make an end of it: it was God's divine wisdom.
>
> My heart was the captive of this science, on which I have written so much.
>
> I have described the Mediterranean, in all its details and at great length.
>
> I have concealed not a thing and related only the truth.
>
> For I have always been an eager and willing lover of the sea.[786]

Piri Reis's love for the Mediterranean and his devotion to the science of cartography are manifested in his diligence in sailing, researching, and presenting his detailed, and beautiful cartographic works. The portolan charts remained in the library of Topkapı Palace, and only a part of them has survived. On the other hand, there are

[785] Inan, *Piri Reis'in Hayatı ve Eserleri*, p. 23.
[786] Piri Reis, *The Book of Bahriyye*, p. 275.

more than one, copy of *Kitâb-ı Bahriyye*, and reproduced and used by sailors, even though it did not bring him grace and fame, during his lifetime. In 2013, UNESCO declared the year of Piri Reis, celebrating the 500th anniversary of the creation of the world map showing the coasts of South America. Also, UNESCO said “the Piri Reis World Map, dated 1513, a rare chart of the 15th and 16th centuries, is an invaluable part of the world documentary heritage, as it sheds light on the history of the period. It is therefore part of the Memory of the World and should be better promoted.” Piri Reis’s contribution to cartography was finally accepted, when his chart entered the Memory of the World Registry.[787] From all these, we see that Piri Reis’s *Kitâb-ı Bahriyye* is a very rich work that gives information about scientific, geographical, ethnographic, and many other things in the 16th century. However, although this valuable work and instrument was a valuable manuscript, written in the 16th century, the scientific world cannot find the opportunity to fully benefit from it. Nevertheless, no matter what the valuable works that were written maintain their value, even after centuries.[788]

Piri Reis’s book, *Kitâb-ı Bahriyye*, which we reviewed above, is one of the rarest works, written in the Ottoman empire. Here, as I mentioned at the beginning of the part, Piri Reis openly demonstrates that he is “a superior artisan” in Zilselian terms. This work, which he wrote as a guide to sailors, is also seen to have been written to advance sailors in their profession. Because Piri Reis talks about winds, astronomy, the science of navigation, compass and directions, portolan charts, the names and characteristics of the seas, the state of the coasts and the astrolabe, compass, and its use in the book. At the same time, he talks about the people and sources, he reached, the purpose of the Portuguese to go to the Indian seas, the countries, the ocean as far as he knows and heard, how the Portuguese applied cosmography in the oceans. In short, it talks about everything a sailor needs to know and presents a work that is almost like a textbook. It is seen from this that an artisanal sailor aims to train other artisans with a scientific work, based on experience and knowledge. This is one of the cases, in this thesis, that supports my hypothesis that artisanal pirates contributed and improved to science in the Ottoman empire.

[787] Isom-Verhaaren, *The Sultan’s Fleet,* chap. 4, para. 69-70-71-72.
[788] Inan, *Piri Reis’in Hayatı ve Eserleri*, p. 26.

Maps are also very informative about ships, which are nautical instruments. If we examine the ship details, I mentioned above in Piri Reis's works, it is possible to reach detailed descriptions of many types of ships belonging to the Ottoman, Spanish, Venetian, and Portuguese. These are necessary because in maritime, which was very momentous for the states in the early modern period, shipbuilding technology were very popular and states, especially in the Mediterranean, followed each other in shipbuilding. This can be a very useful analysis to see the knowledge exchange between states, even if they are in competition.

6. 5. Ship Depictions on the Works of Piri Reis

It is possible to identify ships, which are among instrument of the early modern period that I analysed in the previous sections, on the Piri Reis' works. He made his portolans and book, realistically, including traditional, stylized inner cities and ruler figures. Therefore, it is also valuable for documenting the types of ships, used in its era. For example, there are 10 ship drawings on the 1513 portolan chart. Five of these drawings show carracks, and the rest are caravels. Heading counterclockwise from the top right corner of the chart (west of the Iberian Peninsula), the first ship is a carrack, lying next to a group of islands (Fig. 100). [789] The accompanying legend is as follows:

> A Genoese ship, returning from Flanders, is caught in a storm and drifted all the way to these islands. And in this way, these islands became known.[790]

[789] Soucek, *Piri Reis and Turkish Mapmaking After Columbus*, p. 68.
[790] Akçura, *Piri Reis Haritası*, p. 35.

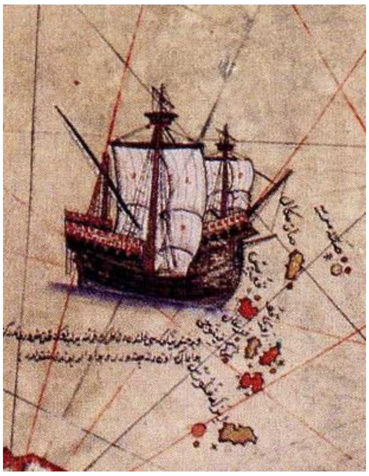

Figure 100. A Genoese carrack on the chart of Piri Reis (1513). The ship depictions on the Piri Reis map are very informative as they are extremely detailed.

The next ship is a carrack, also to the west of the Azores group, accompanied by a picture of a large fish (Fig. 101). In addition, mentioned in the description of the notes, is the carrack in the section, where the Irish monk Saint Brendan recounts an event from his semi-legendary journeys, which was interpreted in Latin, as *Navigatio Brendani*, and was in great fashion in many medieval translations. This legend confirms Piri Reis' claim that he collected all kinds of cartographic material he could find.[791] The other ship, depicting in St. Brendan legend, is a caravel located in the Caribbean archipelago, near the coast of the southern part of Central America (Fig. 102). Then, following the northern coast of South America, we see the next ship, belonged to a sailor named Nicola Giuvan, is a barka (Fig. 103).[792]

[791] Soucek, *Piri Reis and Turkish Mapmaking After Columbus*, p. 68; and Akçura, *Piri Reis Haritası*, p. 35.

[792] Soucek, *Piri Reis and Turkish Mapmaking After* Columbus, pp. 68-69; and Akçura, *Piri Reis Haritası*, p. 35.

Figure 101. A caravel in depicting of St. Brendan legend in Piri Reis's world map (1513). There are five people in the depiction, and two people light a fire on the fish.

Figure 102. Piri Reis depicted this caravel on the coast of Antilla in his map, dated 1513. There are no notes regarding this ship.

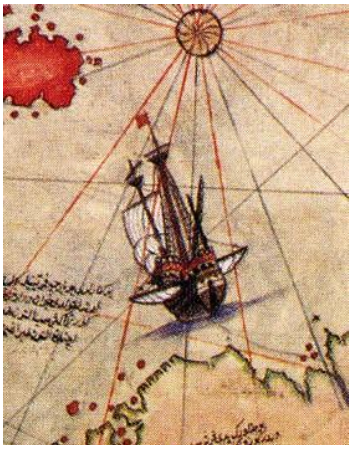

Figure 103. Piri Reis depicted this barka, on his 1513 map, which he said belonged to a sailor named Nicola Giuvan.

The ship, landed on this island, because of the storm, is a caravel, located further east in the Atlantic, next to a large island. Piri Reis states that the captain of this ship is Nicola Giovan (Fig. 104). The ship, a caravel is located near the coast of Brazil, just beyond the easternmost ridge of the continent (Fig. 105). No notes were written next to this ship, but the next ship's note makes up for this. Farther south, a barca is located near the coast, drifting to these shores by storms (Fig. 106). It is further stated that the ship, bound for India, returned to Portugal to report on the accidental discovery. This may be a reference to one of Cabral's 14 ships that he sent back to Portugal to report the discovery of Brazil in April 1500, unaware that Pinzón had arrived two months, before him.[793]

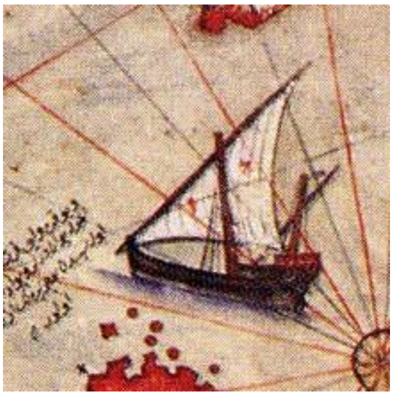

Figure 104. Piri Reis says, on his 1513 map, that this caravel landed on this island, because of the storm.

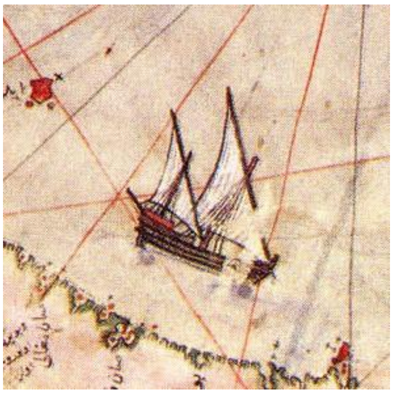

Figure 105. A caravel, depicted by Piri Reis on his 1513 world map, near the coast of Brazil.

[793] Soucek, *Piri Reis and Turkish Mapmaking After Columbus*, p. 69.

Figure 106. It is a Portuguese barka, caught in a storm, depicted by Piri Reis on his map, dated 1513.

The ship is a caravel, located near the coastline of Brazil (Fig. 107). There is no accompanying legend. The depiction of the coast at this point does not reflect reality, of course, but may be based on the Ptolemaic concept of Asia being connected to an Australian continent. We must cross the entire width of the south Atlantic to reach penultimate ship, a beautiful carrack located near Liberia (Fig. 108). Again, there is no accompanying legend. The ship clearly has nothing to do with the legend, wrote to a distance to the east, which refers to the depiction of four Portuguese ships clearly visible. The final ship is a fabulous caravel, depicted next to a group of islands off the westernmost coast of Africa, the Cape Verde Islands (Fig. 109). The reference here is to the Genoese Antoniotto Usodimare (1416-1462?), one of the two commanders of the caravel fleet that settled in Portugal and was driven to the islands by a storm in 1456.[794]

Figure 107. This ship is a caravel, located near the coastline of Brazil, on Piri Reis 1513 world map. Piri Reis did not write a note about this ship.

[794] Soucek, *Piri Reis and Turkish Mapmaking After Columbus*, p. 69.

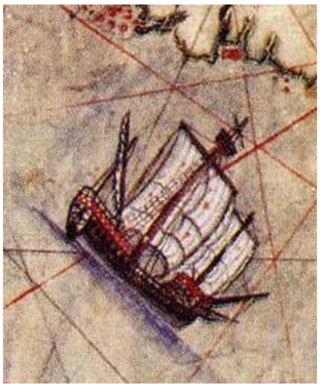

Figure 108. This carrack is located near Liberia, on Piri Reis's 1513 world map.

Figure 109. This caravel is depicted next to a group of islands off the westernmost coast of Africa, the Cape Verde Islands, on Piri Reis' world map of 1513.

Although the carrack, one of these ship types seen on the chart, was a distinctive ship type of the 16th century Mediterranean, its use as a name in the Ottoman empire was problematic. Basically, the Ottomans did not give much space to such large sailboats in their fleet, and used them for transportation and logistics stock, in small numbers in the fleet. Since they were not directly involved in the war, it was not possible for them to be intensively manufactured or developed in Ottoman shipyards.[795] Since many merchant ships, which were no varied from carracks, were captured in the Mediterranean in this century by both the Ottoman state fleets and the Turkish pirate front, these were enough as logistics ships.[796] Moreover, the Venetian shipyard masters who also manufactured the carracks were making them similar to their own merchant ships, called barças.[797] The carrack drawing, depicted by Piri Reis

[795] Sütçüoğlu, *Piri Reis'in Gemileri*, p. 47.
[796] Uzunçarşılı, *Osmanlı Devleti'nin Merkez ve Bahriye Teşkilâtı,* p. 469.
[797] Soucek, *Piri Reis and Turkish Mapmaking After Columbus*, p. 20.

on the shore of the Rovine Castle chart in the Gulf of Venice, is not a coincidence (Fig. 110). Because this situation is clearly seen, when the texts in the book are read, and compared with the positions of the ships. Many ship depictions were designed to support some expressions in the content of the text and were carefully drawn to make some information visible.[798]

[798] Sütçüoğlu, *Piri Reis'in Gemileri*, p. 76.

Figure 110. Piri Reis gives the depiction of carrack in detail, in the chart of Rovine Castle in the Gulf of Venice, in his *Kitâb-ı Bahriyye*. Piri Reis, *Kitâb-ı Bahriyye*, 1521, https://www.loc.gov/item/2021667235/.

It is possible to say that caravels, another ship frequently seen on Piri Reis' portolan, dated 1513, are type of the *göke*, just like the carrack. However, ships, such as caravels, not only benefited from the advantages of being adapted to open sea conditions, but also could recklessly enter enemy waters, and stay away to protect themselves from the threat of galley fleets, or to move the conflict area towards the open sea (Fig. 111-112). The only reason for this was not their physical scale, therewithal the opportunity to stay at sea for a long time without needing water or food. Because the holds of the caravels could keep enough provisions for the sailors for months.[799]

The root of Sultan Selim's orientation towards Egypt, in 1517, was the Portuguese presence, which disrupted the maritime trade coming through India with caravels. Ottoman galleys were not sufficient to fight Portuguese caravels because they could cruise the open sea for long periods of time. In this region, which also cost Piri Reis' life, the Ottoman fleets were constantly trying to control the region with rowing galleys and galiots. These ships were not suitable for the open sea. Therefore, every time they went out from the southern isthmus of the Red Sea, even if they stayed as close to the shore as possible, they were always damaged without even having to battle.[800]

[799] Sütçüoğlu, *Piri Reis'in Gemileri*, p. 41.
[800] Sütçüoğlu, *Piri Reis'in Gemileri*, p. 41.

Figure 111. Depiction of caravel from the castle of known as Crotone (Italy) in Piri Reis's *Kitâb-ı Bahriyye*. Here, the caravel is drawn further away than the galley. Even the locations where the ships are depicted on Piri Reis' maps are informative. Piri Reis, *Kitâb-ı Bahriyye*, 1521, https://www.loc.gov/item/2021667235/.

Figure 112. Depiction of caravel from The Castle of Known as Crotone (Italy). And caravel, sailing towards the open sea, is depicted here. This is a considerable detail, according to the characteristics of the caravel, given above. Piri Reis, *Kitâb-ı Bahriyye*, 1521.

Piri Reis depicted many similar galley-type ships in different parts of the Mediterranean on his charts (Fig. 113). To distinguish them from each other, it is necessary to focus on their height, number of poles and oars. The drawings, in the book, have been detailed, and very valuable data has been processed to understand this type of ships (Fig. 114, 115 and 116).[801] The scaling of the ships was done based on the idea that the largest ship should be a galley. The galley is slung on the oars on one side and its sails are hoisted on the other. When you look at the original picture, it is understood that the ships are leaving the shore, and the cruising movement has just begun. Galleys use oars to control manoeuvring and speed, when entering or leaving the harbour. This situation is given correctly here.[802] Piri Reis explains this depiction as follows:

[801] Sütçüoğlu, *Piri Reis'in Gemileri*, p. 71.
[802] Sütçüoğlu, *Piri Reis'in Gemileri*, p. 73.

In the old days, these islands used to be monasteries, but they are now uninhabited. The island that we call Hurşid (Corsae) is called Hirsu by seamen. The island located to the west they also call Fornoz (Fournoi). East of the island located on the east of this Hirsu is a small, dark island. The sea between this little island and Hirsu is deep. When calling here, the cove on the small island makes a good shelter and is a place where large ships may lie. The best haven on Hirsu however is a cove that faces northwest as the landmark for this cove: when one arrives at these islands from the north, Hirsu island looks like a double-pronged mountain from Susam island. After reaching this split mountain, a stubby, dark headland appears on the island while still two miles from shore. The end of this stubby cape between the two islands is a good harbour and large galleys may lie here.[803]

[803] Piri Reis, *The Book of Bahriye*, p. 53.

Figure 113. Depiction of galley from the Islands called Corsae and Fournoi in Piri Reis's *Kitâb-ı Bahriyye*. Since galleys were the most preferred ship type in the Mediterranean in the early modern period, galleys are often seen in the Piri Reis's works. Piri Reis, *Kitâb-ı Bahriyye*, 1521, https://www.loc.gov/item/2021667235/.

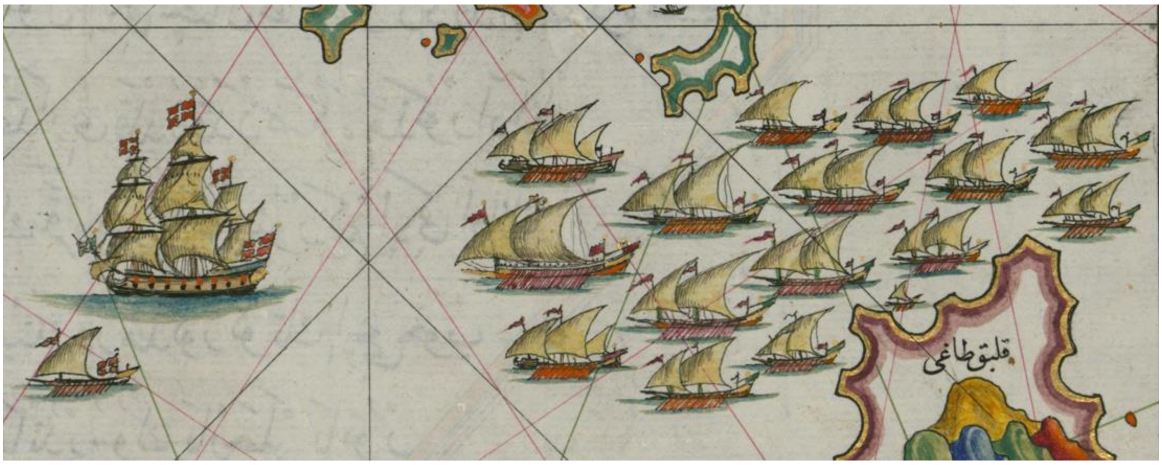

Figure 114. Galley fleet detail from the map of islands, called Corsae and Fournoi. The fleet is not described anywhere else in Piri Reis's book. Generally, ships are showed separately from each other. But the depiction of the galley fleet here can give us knowledge that these types of fleets are in the majority.

Figure 115. Galley detail from the map of Venice in Piri Reis's *Kitâb-ı Bahriyye*. Piri Reis, *Kitâb-ı Bahriyye*, 1521, https://www.loc.gov/item/2021667235/.

Figure 116. Depiction of a galley from Piri Reis' portolan, dated 1528. A varied type of galley can be seen on the world map, drawn much later by Piri Reis. TSMK, Hazine K., nr. 1824.

As can be seen, in Piri Reis's works, there is a lot of opportunity to find information about the scientific and technological developments of the period in which he lived (16th century). It is possible to access ship technology, astronomical and geographical knowledge, and everything that sailors need to know while sailing from his works. Therefore, his works are influential instruments and scientific works that shed light on the period in which they were written and today.

Conclusions

As can be seen, in Piri Reis's works, there is a lot of opportunity to find information about the scientific and technological developments of the period in which he lived (16th century). It is possible to access ship technology, astronomical and geographical knowledge, and everything that sailors need to know while sailing from his works. Therefore, his works are influential instruments and scientific works that shed light on the period in which they were written and today. At the same time, it is very momentous for Piri Reis, as an experienced artisan, to convey his scientific knowledge, and produce a scientific work. The most important reason for analysing such works is to see the scientific knowledge possessed by an experienced artisan.

CHAPTER 7

The Artisanal Scientist Seydi Ali Reis (*Kâtibî*)

Seydi Ali bin Hüseyin (1498-1562) also known as *Kâtib-i Rumi* (the Anatolian author), Galatalı (from Galata), Seydi Ali Reis (the Admiral), Seydi Ali Kapudan (the Captain) or Seydi Ali Çelebi was an Ottoman mariner and artisan, who wrote extensively on astronomy, geography and navigation.[804] He came from a wealthy sailor family, who settled here, after the conquest of Constantinople.[805] His grandfather and father were superintendents (*kethüdâ*) in Galata shipyard (*Tersâne-i Âmire*). For this reason, Seydi Ali Reis served in the naval arsenal from an early age and became *Azaplar Kâtibi* (Undersecretary of the Naval Forces), and then *Tersâne Kethüdâsı* (Naval Arsenal Inspector).[806] Seydi Ali Reis gives this information and more in his book *Miratü'l Memalik* as follows:

> I have always been interested in maritime and was willing to complete my maritime education. I was with our blessed Sultan, during the conquest of Rhodes. Since then, I have provided many services with the late and honoured Hayreddin Reis, Sinan Pasha and other captains in all the wars fought in the Mediterranean and in all the conquered castles. I have travelled to every nook and cranny of the Mediterranean. I strengthened my knowledge of maritime and learned all the sciences on this subject by writing. I have written books on astronomy and other nautical subjects, and on the state of the stars. My maternal and paternal ancestors had been shipyard clerks in Galata, especially since the conquest of Istanbul. Each of them was a skilled person in maritime science, and their skills were clearly seen. That is why maritime art was inherited from my ancestors. Considering all these, as a man who has a thorough knowledge of naval science, I was given the service of captaining Egypt as a gift.[807]

[804] Gaye Danışan Polat, "A Sixteenth-Century Ottoman Compendium of Astronomical Instruments," in *Scientific Instruments between East and West,* ed. Neil Brown, Silke Ackermann and Feza Günergun (Leiden: Brill, 2019), 1-15, p. 1.

[805] Mehmet Kiremit, *Seydi Ali Reis: Mir'atü'l- Memalik* (İnceleme-Metin-İndeks) (Ankara: Türk Dil Kurumu Yayınları, 1999), p. 13.

[806] Danışan Polat, "A Sixteenth-Century Ottoman Compendium of Astronomical Instruments," p. 1.

[807] Seydi Ali Reis, *Miratü'l Memalik,* trans. Necdet Akyıldız (Istanbul: Tercüman 1001 Temel Eser, 1975), pp. 33-34.

Here we see an artisan, who learned and inherited astronomy, maritime and navigation knowledge from his family. And it is very significant for an artisan and a scientist, who later produces scientific works to explain clearly, where he learned these knowledges. Seydi Ali would now and then mention his interest in the science of the configuration of the heavens (*ilm-i heye*), mathematical sciences (*ulum-i riyaziye*) and the science of the stars (*ilm-i nücum*) in his treatises. Moreover, he associated the art of navigation with these sciences, and considered that his knowledge in astronomy was important for his assignment as Admiral of the Ottoman fleet in the Indian Ocean in 1553.[808] Seydi Ali learned navigation in the Mediterranean, while sailing alongside Hayreddin Barbarossa Pasha, the chief admiral of the Ottoman navy in the early sixteenth century.[809] It is said that Seydi Ali was one of the most trusted man of Barbarossa.[810]

Seydi Ali Reis conquered Rhodes with Suleiman the Magnificent. He sailed alongside Hayreddin Barbarossa Pasha and took part in the left arm of the Ottoman navy at the Battle of Preveza.[811] Seydi Ali was appointed Egyptian Captain, in 1553, and was tasked with taking the Indian seas fleet from Basra to Egypt. This task will also enable him to produce a very rare work in the field of geography. He sailed with the fleet from Basra, in 1554, crossing the Strait of Hormuz, and colliding with Portuguese ships, he encountered on the shores of Oman and Muscat. His ships, which were dragged by the storms, hit the Gujarat coast of India, and he remained under the Muslim Gujarat Reign for a while.[812]

Seydi Ali Reis, who could not return to Egypt, due to the damage to his ships, embarked on a difficult journey to reach Istanbul by land with his fifty men. He crossed Sind (a historical region in the India) continent and a province in present day Pakistan, Afghanistan, Transoxiana, Khorasan, and Azerbaijan, reaching Baghdad, and reaching Istanbul, in early May 1557. Seydi Ali presented eighteen letters from

[808] Danışan Polat, "A Sixteenth-Century Ottoman Compendium of Astronomical Instruments," pp. 2-3.
[809] Danışan Polat, "A Sixteenth-Century Ottoman Compendium of Astronomical Instruments," p. 1.
[810] Mehmet Kiremit, *Seydi Ali Reis: Mir'atü'l- Memalik*, p. 13.
[811] Christine Isom-Verhaaren, "Was there Room in Rum for Corsairs?: Who Was an Ottoman in the Naval Forces of the Ottoman Empire in the 15th and 16th Centuries?," *Osmanlı Araştırmaları,* 44 (2014): 235-264, p. 250.
[812] Kemal Özdemir, *Osmanlı Deniz Haritaları ve Ali Macar Reis Atlası* (Istanbul: Creative Yayıncılık, 1992), p. 86.

the rulers of the places, he passed through, during his journey, before Sultan Suleiman. Seydi Ali Reis described the journey that lasted three years, and seven months, in his work *Miratü'l Memalik* (Mirror of Countries) that he wrote in Istanbul. Seydi Ali dedicated this work to the Sultan. In this work, which he started in Baghdad upon the insistence of his friends on his return to India and completed in Istanbul, in January 1557, Seydi Ali Reis told what had happened to him in a literary and semi-story style since his Indian appointment. In the work, the countries that the author visited, the rulers he met, the events he saw, the tombs he visited were handled in a style that would carry the character of a travelogue.[813] The most remarkable feature of this work is that it talks about Seydi Ali Reis's position at the beginning of his book, starting with his being deemed worthy of Indian captaincy.[814]

Seydi Ali probably had time to study astronomy in Aleppo, where Sultan Suleiman spent the winter after the Eastern Expedition (1548-1549).[815] During this period, Mevlânâ Hamdullah bin Sheikh Cemaleddin, who had knowledge about Euclid's Elements, Ptolemy's Almagest and Aristotle's works, encouraged him to translate Ali Qushji's (d. 1473) *el-Fethiyye* from Arabic to Turkish. Seydi Ali translated the text and added sections on geography. He titled it, *Hulâsatü'l-hey'e* (The Summary of Astronomy), and presented it to Sultan Suleiman at an unknown date, but probably before his appointment as Admiral of the Ottoman fleet in the Indian Ocean in 1553.[816]

A year later, in 1554, he completed *Kitabü'l-Muhit fi İlm el-Eflak ve'l-Ebhur* (Oceanic Book on the Science of the Spheres (Heavens) and the Seas). The book, known as *Kitabü'l-Muhit* or simply *el-Muhit*, aimed to provide practical knowledge about navigation in the Indian Ocean, and was written for Ottoman sailors, who did not have much experience in the open sea. Just as there are stylistic distinctions between the texts of *Hülasatü'l-Hey'e* and *el-Muhit*, there are also distinctions in the purposes for which they were written. The reason for these variations may be Seydi

[813] Ak, "Seydi Ali Reis," accessed May 20, 2023, https://islamansiklopedisi.org.tr/seydi-ali-reis.
[814] Seydi Ali Reis, *Mir'âtü'l-memâlik* (Istanbul: Tercüman 1001 Temel Eser, 1978-1981), s. 28.
[815] Danışan Polat, "A Sixteenth-Century Ottoman Compendium of Astronomical Instruments," p. 3. Sultan Suleiman organized a great expedition on Iran in 1548-1549 with the aim of proving that Eastern Anatolia was an integral territory of the Ottoman Empire, preventing Shiite propaganda in Anatolia, ensuring the independence of the Shirvanshahs again, and placing *Elkâs Mirzâ* on the Iranian throne.
[816] Danışan Polat, "A Sixteenth-Century Ottoman Compendium of Astronomical Instruments," p. 3.

Ali’s experience in the open sea. In *el-Muhit*, which he wrote after 1553, he is interested in practical methods rather than the theoretical issues of astronomy, which he discussed in *Hülasatü’l-Hey’e*. Equally momentous, in *Hülasatü’l-Hey’e*, he mentions instruments, such as the equatorial circle and the astrolabe, but they are not included in the maritime context. In contrast, in *al-Muhit*, he advises sailors to use the astrolabe, the sine quadrant, and the equatorial circle.[817]

The text, *Mir’atü’l-Memalik* (Mirror of Countries, 1557), in which he describes his adventures, while traveling from India to Istanbul, gives clues about his knowledge of instruments. When he and his crew got lost in the Indian Ocean, he applied the same maritime techniques, he had used in sailing in the Mediterranean. However, he soon realized that Mediterranean seafaring techniques were not suitable, while sailing in the Indian Ocean. This may have been why he began writing *al-Muhit*, a guide to the ocean.[818]

Additionally, in *Mir’atü’l-Memalik* mentions that the astrolabe and the equatorial circle were used on land, and states that he compiled treatises on astronomy, physics (science of wisdom), navigation and the location of the stars, but they were not used at sea. *Mir’ât-ı Kâinât*, he gave the titles of the department, which contains knowledge on the construction and use of five portable astronomy instruments, astrolabe (*usturlab*), sine quadrant (*rub’-ı müceyyeb*), astrolabe quadrant (*rub‘-ı mukantara*), terrestrial sphere (*zatü’l-kürsi*) and equator (*da‘ire-i muaddil*). It is the most interesting among Seydi Ali’s treatises. The original copy presented to Suleiman does not exist, and the date of its compilation is uncertain. However, based on the dates of other works in Seydi Ali’s collection, it is likely that they were written after 1554.[819] There are many copies of *Mir’ât-ı Kâinât* (Fig. 117). The oldest copy of Mir'ât-ı Kâinât, which has 22 copies, is the one copied by Ibnülemin Ahmed b. Yahya in 1573.[820]

[817] Danışan Polat, “A Sixteenth-Century Ottoman Compendium of Astronomical Instruments,” p. 3.
[818] Danışan Polat, “A Sixteenth-Century Ottoman Compendium of Astronomical Instruments,” pp. 3-4.
[819] Danışan Polat, “A Sixteenth-Century Ottoman Compendium of Astronomical Instruments,” p. 4.
[820] Cevat Izgi, *Osmanlı Medreselerinde Ilim* (Istanbul: Iz Yayıncılık, 1997), Volume I, pp. 449-450.

Figure 117. As a tradition in the Ottoman Empire, authors begin their books with praise to the Sultan. Seydi Ali Reis also begins his book with praise for Sultan Suleiman. First two pages from *Miratü'l Memalik,* Seydi Ali Reis b. Hüseyin el- Kâtibi, 1557, 249X160 mm., Istanbul University Rare Books Library, http://nek.istanbul.edu.tr:4444/ekos/TY/nekty02426.pdf.

Another valuable and scientific works of Seydi Ali Reis survived to these times. These are *Hulâsatü'l-hey'e* (1549)*, Mir'ât-ı Kâinât* (1550s)*, Kitâbü'l-Muhît fî ilmi'l-eflâk ve'l-ebhur* (1554), and *Risâle-i Zâtü'l-Kürsî* (1550s). Since Seydi Ali Reis was a sailor trained in *Tersâne-i Âmire*, he and his surviving works have a very momentous place in the production of practical knowledge by artisans. The following is an analysis of each of these works.

7. 1. Kitâbü'l-Muhît (The Book of Ocean, 1554)

Kitâbü'l-Muhit, which he wrote in Ahmedabad (city in the Indian state of Gujarat), in 1554, is a work that he said would provide sailors sailing, in the Indian seas with the opportunity to sail without a guide.[821] While Seydi Ali Reis was writing *Muhit*, especially, the works of previous writers, such as Ibn Majid was also used extensively.[822] And he added his own knowledge and experience to the book, as well as benefiting from the sailors, who sailed in these waters (Fig. 118).[823] In addition, Ihsanoğlu indicates the possibility that he may have benefited from the knowledge of the Portuguese.[824]

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[821] The full name of the book is *Kitabü'l Muhit fî İlmi'l-Eflak ve'l-Ebhur*.
[822] Özdemir, *Osmanlı Deniz Haritaları Ali Macar Reis Atlası*, p. 86.
Ibn Majid is an Arab sailor, who has long maritime experience as well as the knowledge heritage of his ancestors. At the same time, he did not remain just a sailor and wrote down, what he knew. His works guided Red Sea and Indian Ocean sailors for a long time. His best-known work is *Kitâbü'l-Fevâʾid fî uṣûli ʿilmi'l-baḥr ve'l-ḳavâʿid* (The Book of the Benefits of the Principles and Foundations of Seamanship, 1490). His book includes topics, such as the prerequisites for sailing, the stars corresponding to the thirty-two divisions of the compass, winds, sea seasons, basic knowledge and tools required for captains, latitude and longitude. Also see; Sayyid Maqbul Ahmad, "Mâcid," accessed Dec 19, 2023, https://islamansiklopedisi.org.tr/ibn-macid.
[823] Özdemir, *Osmanlı Deniz Haritaları Ali Macar Reis Atlası*, p. 86.
[824] Ihsanoğlu, *Osmanlı Bilim Mirası*, Vol. II, p. 166.

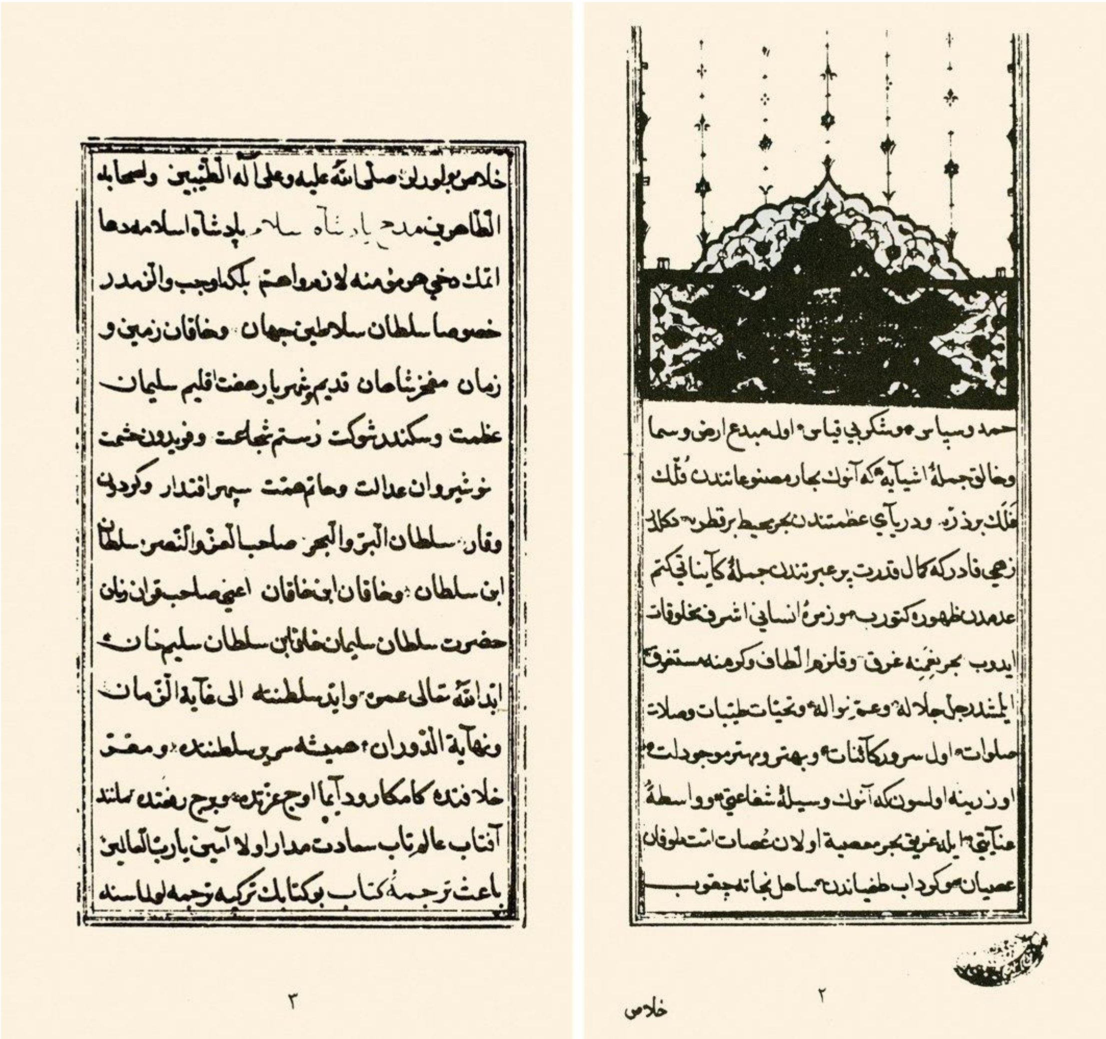

Figure 118. The first two pages of Seydi Ali Reis' *Kitâbü'l-Muhit* (the Book of Ocean, 1554). The book contains knowledge that will enable sailors on a voyage in the Indian Ocean to continue their journey without a guide. Topkapı Palace Museum Library, Revan Mansion, nr. 1643, https://islamansiklopedisi.org.tr/seydi-ali-reis.

The book is divided into 10 parts and 50 chapters.[825] The contents of the work are as follows, in summary: finding the way, in the 1st part; in the 2nd part, time calculation, calendar, sun, and moon; compass sections in the 3rd section. In chapter 4th, the names, and locations of some substantial stars for maritime. In chapter 5th, the elevations of some momentous islands in maritime, up to the pole star; in the 6th chapter, the elevations of the harbours and islands relative to the pole star; in chapters 7 and 8th, knowledge on astronomy, and the distances between some ports. In the 9th chapter, the expedition routes, and in the 10th chapter, the great storms that he called

[825] Cevat Izgi, *Osmanlı Medreselerinde Ilim*, p. 614.

the flood, and the measures to be taken, during these times.[826] Seydi Ali Reis also drew some charts in addition to his book, thus making his work also a striking and safe portolan for the Indian Ocean.[827] As its subjects show, *Muhit* is indeed a scientifically beneficial work and instrument.[828]

Seydi Ali Reis, who explained in detail how compasses are manufactured in his book, *Muhit*, also explained the reasons that would prevent the device from working and the ways to eliminate its malfunctions.[829] He mentioned that the compass was used in Portugal and other parts of Europe.[830] Seydi Ali Reis was the first to mention the magnetic variation (declination) of the magnetic compass in the *Muhit*:

> It is known that difference between direction of magnetic needle and the geographic North is 7 degree east.[831]

Turkish academician Ferhat Özçep explains this situation as follows:

> In those days, mariner's compasses imported from Germany were widespread throughout the Ottoman empire. The German compasses were manufactured with a magnetic variation of 7 degrees to the east, the same declination that had been determined for Portugal. Although the instrument makers knew about declination, they were not yet aware that declination varied with time and geographic position.[832]

Seydi Ali Reis is the first person to talk about this subject in his book. Because there are instructions on how to use compasses in the *Kitâb-ı Bahriyye* of Piri Reis, and in other books, but there is no information about magnetic declination.[833] Therewithal, practical knowledges, about sailors' latitude determination methods, is also obtained from this book. Since he detailed data on marine astronomy techniques in this work, he explains the methods of finding latitude by taking both the Sun and the pole star altitude. The most significant thing is that these recipes are given not only for cruising the Indian Ocean, but also for use in open sea areas in the

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[826] Kazancıgil, *Osmanlı'da Bilim ve Teknoloji*, pp. 191-192.
[827] Şerafettin Turan, "*Kitâbü'l-Muhît,*" accessed May 19, 2023, https://islamansiklopedisi.org.tr/kitabul-muhit.
[828] Kazancıgil, *Osmanlı'da Bilim ve Teknoloji*, pp. 191-192.
[829] Ihsanoğlu, *Osmanlılar ve Batı Teknolojisi*, p. 137.
[830] Özçep, "Terrestrial magnetism in the Ottoman empire: Documents and Measurements," p. 10.
[831] Özçep, "Terrestrial magnetism in the Ottoman empire," p. 10.
[832] Özçep, "Terrestrial magnetism in the Ottoman empire," pp. 10-11.
[833] Özçep, "Terrestrial magnetism in the Ottoman empire," p. 11.

Mediterranean. Seydi Ali Reis is of the opinion that sailors should have knowledge of nautical astronomy.[834] This situation can be seen in Seydi Ali Reis's suggestion in the section about the charts, that the route followed with the portolan and compass should be checked by observation in the routes, where cruising times are extended, that is, in the open sea regions of the Mediterranean.[835]

The section describes the tasks that a sailor must do in situations, where the shore or island cannot be seen, or when navigation is required day and night. Seydi Ali Reis states that it is necessary to measure how many miles are travelled every hour, depending on the suitable wind. This process corresponds to the longline navigation method. In addition, the sailor should take bearings once or twice a day. While performing these operations, it is important to follow the route on the chart.[836] For example, if the ship is traveling at 100 miles per hour, then two compasses are required and the ship's route, on the chart, must be followed with the help of these compasses. However, Seydi Ali Reis states that this process is not sufficient and knowledge of the current direction is essential.[837]

Another situation that Seydi Ali Reis draws attention to is that the sailor does not know where he is, even though the shore or cape is visible in the sea. He explains what should be done in such situations with an example for a ship sailing in the Mediterranean. Here, he describes what a ship sailing at sea will do if it proceeds from the shore, but does not know where it is, that is, if a ship going from Alexandria to Anatolia does not know which coast it is sailing on.[838] The fact that he chose the place names, he gives here, especially from the Mediterranean, allows us to obtain knowledge about the navigation conditions in the Mediterranean, and the situations that sailors may encounter. A sailor in such a condition aims with a compass at the visible land or island and determines which winds he is in and records it. Then, using compasses, he tries to determine where these places are on the chart. If the distance, between the bearing points and the places assumed to be found on the chart, are

[834] Gaye Danışan Polat, "16. Yüzyılda Osmanlılarda Deniz Astronomisi ve Astronomi Aletleri" (PhD diss., Istanbul: Istanbul Üniversitesi, 2016), p. 207.
[835] Danışan Polat, "16. Yüzyılda Osmanlılarda Deniz Astronomisi ve Astronomi Aletleri," p. 207.
[836] Danışan Polat, "16. Yüzyılda Osmanlılarda Deniz Astronomisi ve Astronomi Aletleri," pp. 207-208.
[837] Danışan Polat, "16. Yüzyılda Osmanlılarda Deniz Astronomisi ve Astronomi Aletleri," p. 208.
[838] Danışan Polat, "16. Yüzyılda Osmanlılarda Deniz Astronomisi ve Astronomi Aletleri," p. 208.

greater or less than the distance, the assumed places are not real places. If the sailor knows where the land or islands are located, but wants to measure the distance between them, he can make this measurement using a chart.[839]

We understand from the knowledge, given in the chapters, that the book is a rare scientific manuscript, prepared for the Indian seas, and the Mediterranean. In addition, the fourth chapter of *Muhit* contains knowledge about the Americas. He says that Portuguese sailors found a continent by going about twenty degrees to the west from the Canary Islands, and that this continent extended to ninety degrees longitude in the west, and ten degrees latitude in the south. Seydi Ali Reis writes that, on reaching the 'Land of Darkness', especially in the southernmost part, it was passed through the Strait of Magellan, named after its discoverer Magellan. It is understood, from these writings that he collected the latest data about the history of the discovery of the Americas.[840] Among the information he gave about the new continent, the fact that he told different forms of people and 18 fingers in length informs that he believed in the legends. And he says that learned news about the new world from a Portuguese sailor, who went around the world through the Strait of Magellan, that he received information from the crew of a French ship that brought bakkam (tree used for paint) from the new world. And he must have heard the legends information from these crews.[841] Accordingly, *Muhit* is the second written source of knowledge about the New World, after *Kitâb-ı Bahriyye*. In addition, there are portolan charts in *Muhit*. It is thought that the work was presented to Sultan Suleiman, who was in the Ottoman city of Edirne, together with the portolan charts.[842]

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[839] Danışan Polat, "16. Yüzyılda Osmanlılarda Deniz Astronomisi ve Astronomi Aletleri," p. 208.
[840] Özdemir, *Osmanlı Deniz Haritaları Ali Macar Reis Atlası*, p. 86.
[841] Adıvar, *Osmanlı Türklerinde İlim*, p. 88.
[842] Özdemir, *Osmanlı Deniz Haritaları Ali Macar Reis Atlası*, p. 87.

7. 2. Hulâsatü'l-hey'e (The Summary of Astronomy, 1549)

The book, *Hulâsatü'l-hey'e,* is an additional translation of Ali Qushji's famous astronomical work, *er-Risâletü'l-fetḥiyye,* prepared by Seydi Ali Reis.[843] It was completed in Aleppo at the end of January 1549.[844] The oldest of the twenty-seven existing copies of the work, presented to Suleiman the Magnificent, was copied in Galata, in 1550.[845] It was presented to Suleiman the Magnificent.[846] The author states that he decided to translate this work, after Mevlânâ Hamdullah bin Sheikh Cemaleddin, whom he was educated in, said that there were few Turkish sources on astronomy.[847] The work consists of an introduction and two chapters. The introductory part, which describes what needs to be known before starting the science of astronomy, consists of the first part, where the situations related to geometry are explained, and the concepts, are defined. And the second part, where the situations related to nature, are described.[848]

The first chapter in which the states of the celestial bodies are explained, consists of six chapters on subjects, such as sphere, zodiac sign, star, and planet (Fig. 119). The sixth chapter is also divided into four parts.[849] In this chapter, Seydi Ali Reis explains the number, qualities, and arrangement of spheres. Accordingly, the universe is spherical in shape, and its centre is the middle of the earth. The spheres are nine in number, they are all spherical and go around in circles. These globes surround each other, like onion layers. At the same time, this section explains the situations that occur on planets. It has four parts: the first part is about the situations that occur on planets, depending on longitude. This is called the star's longitude and calendar. The second

843 Cengiz Orhonlu, "Seydi Ali Reis," *Istanbul Üniversitesi Edebiyat Fakültesi Tarih Enstitüsü Dergisi*, no. 1 (1970): 39-56, p. 54.
Er-Risâletü'l-fetḥiyye is an astronomy book written in Arabic.
844 Orhonlu, "Seydi Ali Reis," p. 54.
845 Izgi, *Osmanlı Medreselerinde Ilim*, p. 394.
846 Bursalı Mehmed Tahir, *Osmanlı Müellifleri*, ed. M. A. Yekta Saraç, Vol. 3, (Ankara: Türkiye Bilimler Akademisi Yayınları, 2016), p. 1262.
847 Mikail Cengiz, "*Hülâsatü'l-hey'e* (Giriş, Notlar, Metin, Dizin)" (Master diss., Ankara: Hacettepe Üniversitesi, 2010), p. 9.
848 Aslı Adaklı, "*Hülâsatü'l-hey'et, Seydi Ali Reis* (Giriş-İncelem-Metin-Dizin)" (Master diss., Sakarya, Sakarya Üniversitesi, 2020), p. 18.
Cengiz, "*Hülâsatü'l-hey'e,*" p. 10.
Tuba Uymaz, "Seydi Ali Reis'in *Hülâsa el-hey'e (Astronominin Özeti) Adlı Eseri Üzerine Bir İnceleme*" (Master diss., Ankara: Ankara Üniversitesi, 2009), p. 27.
849 Adaklı, "*Hülâsatü'l-hey'et*," p. 18.
Cengiz, "*Hülâsatü'l-hey'e,*" pp. 11-17.
Uymaz, "Seydî Ali Reis'in *Hülâsa el-hey'e*," pp. 28-43.

part explains the positions of the planets in latitude. He says the sun has no latitude. Its concentric and eccentric sphere are each in the plane of the ecliptic. However, other planets tend towards the ecliptic, sometimes to the north and sometimes to the south. Because the belts of their carrier spheres intersect with the ecliptic at two points. The third part explains the situations that occur, when planets are close to the Earth in longitude and latitude. In particular, the real location of the moon is different from its apparent place. In the fourth part, solar and lunar eclipses are described, as well as the positions of the planets relative to each other.[850]

[850] Fatma Zehra Pattabanoğlu and Tuba Uymaz, "15. ve 16. Yüzyıl Osmanlı Astronomisi Bağlamında Ali Kuşçu'nun "Fethiyye" ve Seydî Ali Reis'in "Hülâsatü'l-Hey'e" Adlı Eseri", *Dört Öge*, no. 20 (2021): 115-139, p. 128.

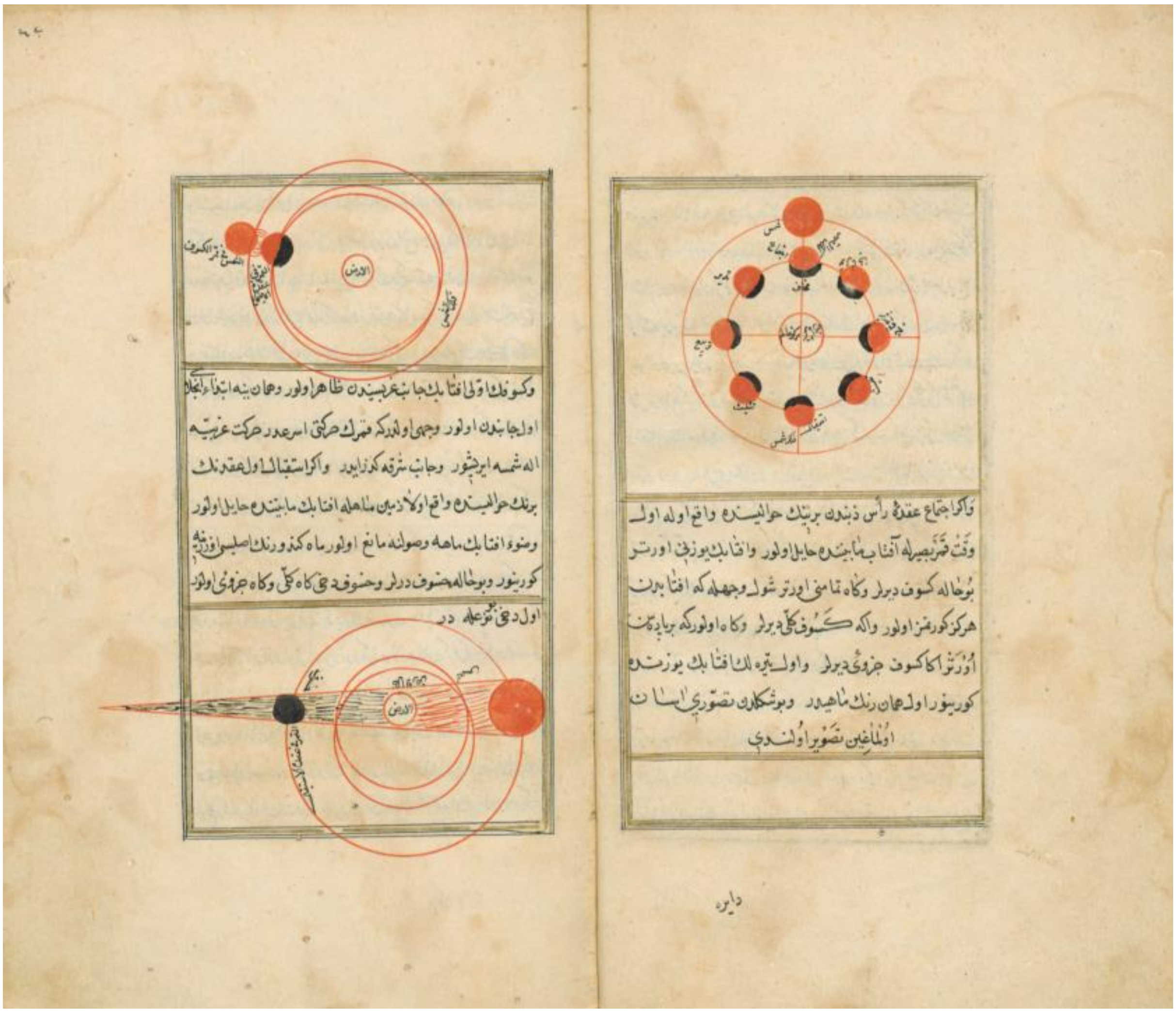

Figure 119. Two pages describing the movements of the sun and moon from the version of *Hülâsatü'l-hey'e*. Explanations made with such drawings show the knowledge that Seydi Ali Reis had together with the accumulation, he obtained from other sources. *Hülâsatü'l-hey'e*, dated 1563, Seydi Ali Reis b. Hüseyin el- Kâtibi, 237x138 mm., Istanbul University Rare Books Library, http://nek.istanbul.edu.tr:4444/ekos/TY/nekty01613.pdf.

The second chapter is that the shape of the Earth, its division into climates and the differences in the states of the "Sky" and the necessary conditions in the "Earth", are explained. And it consists of twelve sections, which are the structure of the world, features of the equator, landforms, climate characteristics, the position of the world with respect to the sun and the time concepts determined, accordingly, the birth of the zodiac signs, the meridian line.[851] In addition, there are drawings related to the astronomical events described, both inside of the work and at the end of the work.[852]

Additionally, there are drawings about the astronomical events described in the work, both within and at the end of the work. Seydî Ali Reis was not content with just translating, he also improved additions to his work regarding astronomy and geography. However, the study is not a direct translation, but has been enriched with additions from various books, especially Kadızâde's *Şerḥu'l-Mülaḫḫaṣ fi'l-hey'e* (1412), and Kutbüddîn-i Şîrâzî's *Nihâyetü'l-idrâk* (1281).[853]

It is not a literal translation of *Hülâsatü'l-Hey*, but it is a work in which some additions are made to sections and sections related to astronomy and geography, when necessary. Among these, it is seen that additions related to geography have a large place. The reason for this is that Seydi Ali Reis was a sailor, and he wanted to add information about mathematical geography to the translation that would be useful to a sailor during the voyage.[854]

As seen in this work, Ottoman sailors created scientific works, considering the necessity of mathematical geography and astronomy for a sailor. These scientific works, which he produced by synthesizing both his experience and scientific studies as

[851] Mikail Cengiz, "*Hülâsatü'l-hey'e* (Giriş, Notlar, Metin, Dizin)" (Master diss., Ankara: Hacettepe Üniversitesi, 2010), pp. 19-26.
Uymaz, "Seydi Ali Reis'in *Hülâsa el-hey'e*," pp. 43-58.

[852] Adaklı, "*Hülâsatü'l-hey'et*," p. 18.

[853] Gül Yılmaz Çal, "*Hulâsatü'l-hey'e* (*Kâtibî*)," accessed May 19, 2023, http://tees.yesevi.edu.tr/madde-detay/hulasatu-l-hey-e-katibi.
Kadızâde's *Şerḥu'l-Mülaḫḫaṣ fi'l-hey'e* (1412) is a commentary by the physician Çağmînî (d. 1221), an astronomy and mathematics scholar, and was written in 1412, and presented to Ulugh Beg (Süleymaniye Library, Hagia Sophia, nr. 2662; copied from the author's copy). It is the most important work written by Kadızâde in the field of theoretical astronomy. More than 300 copies of the work, which was taught as a secondary level textbook in Ottoman madrasahs, have survived to our time, and various editions have been made. Also see; Ihsan Fazlıoğlu, "Kadızâde-i Rûmî," accessed Dec 20, 2023, https://islamansiklopedisi.org.tr/kadizade-i-rumi.
Kutbüddîn-i Şîrâzî's *Nihâyetü'l-idrâk* (1281) is the diary work on astronomy completed by the Iranian philosopher, astronomy, mathematics, medicine and religion scholar Şîrâzî, while he was working as a judge in Sivas (1281) (Bibliothèque Nationale, nr. 2517/8; British Museum, nr. ADD 7482). The author responded to the calls made by his teacher, Iranian scholar and philosopher Nasîrüddîn-i Tûsî, in his *Risâle Müteʿalliḳa bi-baʿżı ebhâs̱i Nihâyeti'l-idrâk* (Süleymaniye Library, Fâtih, nr. 5396), on some subjects of *Nihâyetü'l-idrâk*. Also see; Azmi Şerbetçi, "Kutbüddîn-i Şîrâzî," accessed Dec 20, 2023, https://islamansiklopedisi.org.tr/kutbuddin-i-sirazi.

[854] Pattabanoğlu and Uymaz, "15. ve 16. Yüzyıl Osmanlı Astronomisi Bağlamında Ali Kuşçu'nun "Fethiyye" ve Seydî Ali Reis'in "Hülâsatü'l-Hey'e" Adlı Eseri", p. 137.

a sailor in Seydi Ali Reis, are an indication that he, as an artisan, benefited from a scientific work, and produced a scientific book.

7. 3. Mir'ât-ı Kâinât (The Mirror of the Universe, 1555s)

Mir'ât-ı Kâinât is a prose work on nautical astronomy, written by Seydi Ali Reis. Its full name is *Risâle-i Mir'ât-ı Kâinât min Âlât-ı İrtifa'* and it is known as *Mir'ât-ı Kâinât* (Fig. 120). It was prepared, after *Hümâyun Shah* (Bâbur ruler, d. 1556) wanted from Seydi Ali Reis to write "lunar eclipse from the astrolabe calculation".[855] Thus, Seydi Ali Reis states that he wrote this book to explain the science of stars (*ilm-i nücum*).[856] The exact date of writing of the work, which consists of 5 parts and 120 chapters, is not known. Seydi Ali Reis says that since there is no such work in Turkish, this work that he compiled from Arabic and Persian works, would be useful everywhere.[857]

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[855] Ak, "Seydi Ali Reis," accessed May 20, 2023, https://islamansiklopedisi.org.tr/seydi-ali-reis.
[856] Danışan Polat, "A Sixteenth-Century Ottoman Compendium of Astronomical Instruments," p. 5.
[857] Adnan, *Osmanlı Türklerinde Ilim*, p. 89.

Figure 120. Seydi Ali Reis's work contains very rich knowledge, regarding navigational instruments. Two pages from *Mir'ât-ı Kâinât*, Seydi Ali Reis b. Hüseyin el- Kâtibi, 1555s, 225X123 mm., Istanbul University Rare Books Library, http://nek.istanbul.edu.tr:4444/ekos/TY/nekty01804.pdf.

He includes astronomical and nautical instruments and their uses.[858] In the preface, it is stated that the construction and use of the astrolabe, the altitude of the sun and the distance of the stars, the determination of the qibla and the noon time, the construction and use of the sine quadrant, the finding of the sinuses, beams and tangents of the circles, the measurement of the width of a river that cannot be crossed to the opposite side are explained. In each of the five articles of *Mir'ât-ı Kâinât*, knowledge is given about an astronomical instrument used to determine direction and time at sea: astrolabe, *rub'-ı müceyyeb*, *rub'-ı mukantara*, *zatü'l-kürsi* ve *da'ire-i*

[858] Ihsanoğlu, *Osmanlı Bilim Mirası*, Vol. II, p. 165.

muaddil.[859] The oldest of the twenty-two known copies was copied by Ibnulemin Ahmed b. Yahya in 1573.[860]

The manuscript of *Mir'ât-ı Kâinât* consists of an introduction, five parts and 120 chapters. In the introduction, Seydi Ali's purpose and content of compiling the treatise are explained. Each of the five parts deals with the structure and use of one of the tools. The first part is about the planispheric astrolabe (Fig. 121). This astrolabe is like the astrolabe described by Mustafa bin Ali al-Muvaqqit (d. 1571) in his treatise on the astrolabe. According to al-Muvaqqit, this was the most well-known astrolabe among experts. This statement implies that Seydi Ali chose to describe the type of astrolabe most commonly used in the Ottoman empire.[861]

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[859] Ayfer Aytaç, "*Mir'ât-ı Kâinât / Risâle-i Mir'ât-ı Kâinât min Âlât-ı İrtifa' (Kâtibî)*," accessed May 19, 2023, http://tees.yesevi.edu.tr/madde-detay/mir-at-i-kiinat-risale-i-mir-at-i-kainat-min-alat-i-irtifa-katibi.

Rub'ul-mujayyeb consists of a 90 degree scale drawn on an arc with a sine chart drawn parallel to the two sides at intervals of one or two degrees and dividing the radius into 60 degree scales.

On the other side of the sine quadrant instrument, there is a stereographic projection of the shape of the celestial sphere scaled with imaginary circles, called *mukantarâ*, from a certain latitude, based on the south pole point, and this face is called *rub' al-mukantarât*.

(Taha Yasin Arslan, "Vakti Fethetmek: Mîkât İlmi Geleneğinde *Rub'u'l-mukantarât* Yapım Kılavuzu Örneği Olarak Muhammed Konevî'nin *Hediyyetü'l-mülûk*'u," *Nazariyat İslâm Felsefe ve Bilim Tarihi Araştırmaları Dergisi*, 2/4 (2016): 103-148, dx.doi.org/10.12658/Nazariyat.2.4.M0026, pp. 105-106).

Seydi Ali Reis suggested measuring the 7° deviation between geographical north and magnetic north by means of the *Da'ire-i muaddil*. Seydi Ali Reis states that the instrument is known as semi-circle or full circle in the first chapter in his work *Mir'ât-ı Kâinât*, where he describes the nature of the circle, its parts and the names of these parts. (Danışan Polat, "16. Yüzyılda Osmanlılarda Deniz Astronomisi ve Astronomi Aletleri," pp. 290-291).

[860] Izgi, *Osmanlı Medreselerinde İlim,* p. 450.

[861] Danışan Polat, "A Sixteenth-Century Ottoman Compendium of Astronomical Instruments," p. 5.

Figure 121. Seydi Ali Reis may have received data about instruments from various regions, during his travels. Planispheric Astrolabe, Muhammad Zaman al-Munajjim al-Asturlabi (Iranian, active 1643–1689), 1654–1655, New York: Metropolitan Museum of Art, Harris Brisbane Dick Fund, 1963, 63.166a–j, https://www.metmuseum.org/art/collection/search/451699.

In the second chapter, Seydi Ali explains the sine quadrant and explains how to use the observations made with it. The third chapter is about the astrolabe quadrant, which bears arcs and lines for performing astronomical calculations. Tiny headless nails are used for marking important points. Generally, Ottoman quadrants have an astrolabe quadrant on one side and a sine quadrant on the other, but Seydi Ali did not mention this arrangement.[862]

The fourth and fifth chapters deal respectively with the celestial globe and the equatorial circle, instruments that appear less frequently in Ottoman astronomical literature than the other three tools. In these chapters, there are the first being confusion about the meaning of the term *Zâtü'l-Kürsî*. For example, Turkish academician Gaye Danışan Polat says that in *Cihânnümâ* (View of the World), by

[862] Danışan Polat, "A Sixteenth-Century Ottoman Compendium of Astronomical Instruments," pp. 6-7.

Kâtip Çelebi (1609-1657), *Zâtü'l-Kürsî* is illustrated as an armillary sphere with the Earth inside, but the instrument described by Seydi Ali is a celestial globe. The term *Zâtü'l-Kürsî* alone means a stand. If Seydi Ali had used the term *el-küre* in *Zâtü'l-Kürsî*, he would mean a globe with a stand. Seydi Ali mentions various traditions in the construction of Islamic celestial globes. He portrays two types of meridian ring, which passes through the north and south poles, and observer's zenith. One of them is divided in 360° bearing abjad numerals, and the globe can turn within ring, pivoting on the celestial poles. The second type of meridian ring is graduated in 180° and is attached to the horizon circle. In this model, the globe rotates within the stand (*Kürsî*) and can be set for the observer's latitude. He mentions that the globes have 48 constellations, but some of them are engraved with figures, while others just have the names written on the globe.[863] In a seventeenth-century copy of *Mir'at-ı Kâinat*, there is a figure of *Zâtü'l-Kürsî* which has been added by the copyist (Fig. 122). The globe is made with the north pole up for use in northern latitude.[864]

[863] Danışan Polat, "A Sixteenth-Century Ottoman Compendium of Astronomical Instruments," pp. 7-8.
[864] Danışan Polat, "A Sixteenth-Century Ottoman Compendium of Astronomical Instruments," p. 8.

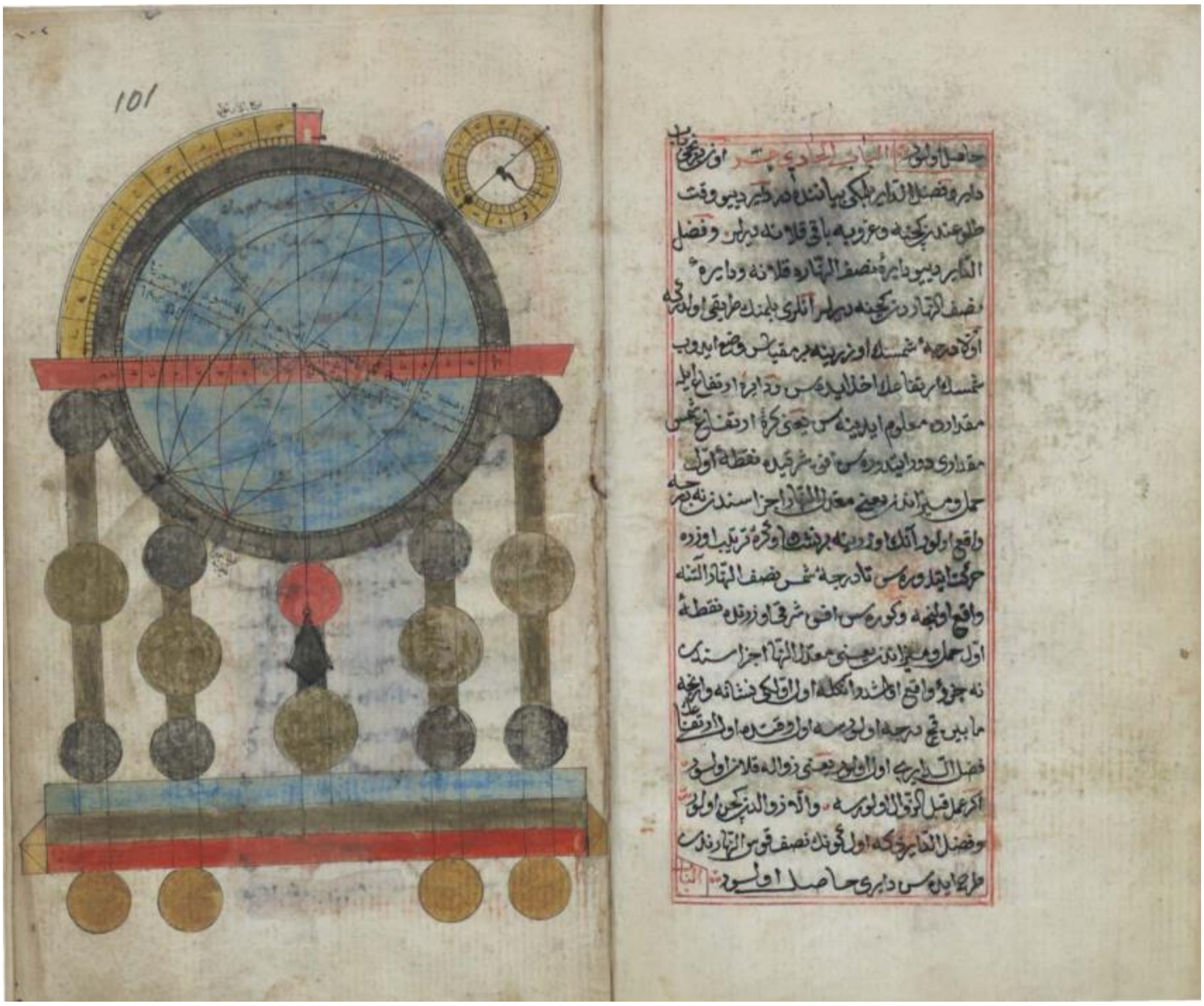

Figure 122. Seydi Ali Reis may have made the drawing of *Zâtü'l-Kürsî* from a model or book that he saw personally. *Zâtü'l-Kürsî* (Terrestrial Globe) from Seydi Ali Reis b. Hüseyin el- Kâtibi, *Mir'ât-ı Kâinât*, 1555s, 225X123 mm, Istanbul University Rare Books Library, http://nek.istanbul.edu.tr:4444/ekos/TY/nekty01804.pdf.

One of the most significant types of knowledge given by Seydi Ali Reis in this book is that he did give detailed information about the 7º declination between true north and magnetic north in his *Kitabü'l-Muhit*, and advised navigators to measure declination with the equatorial circle. Moreover, he noted that this variation was known in Portugal and other regions of Europe (France or Western countries), and that the qiblanuma (qibla indicators) made in "German lands" and imported into Anatolia (*Diyar-ı Rum*) were calibrated to work correctly with a magnetic declination of 7º east.[865] And Polat explains it as follows;

[865] Danışan Polat, "A Sixteenth-Century Ottoman Compendium of Astronomical Instruments," p. 11.

> The declination of 7° would not pose a problem, when navigating in the Black Sea and the Mediterranean, but could do so when sailing in the Indian Ocean. If navigators were unaware that magnetic declination changed from place to place, they would suppose that navigational errors were caused by currents. Seydi Ali did point out the various requirements of navigators, astronomers and timekeepers. He noted that some authors, who were engaged in the science of the stars did not need to use a compass, therefore they did not mention it in their treatises. As he had recourse to various Arabic, Persian and Turkish sources he probably learned about the 7º declination from Islamic texts, but he was also aware that some compasses and qibla indicators, produced in Europe took the 7º declination into account.[866]

In the sixteenth century, Ottoman *munejjims* (astronomers/astrologers) and *muwaqqits* (timekeepers) used the astrolabe, sine quadrant and astrolabe quadrant extensively. The popularity of these instruments led to the compilation of many treatises describing them and their use. Seydi Ali's *Mir'at-ı Kâinat* follows this tradition of Ottoman literary: it describes the parts of the instrument, and then describes how to use it. These treatises are seldom illustrated, but several portable astronomical instruments were indicated in the miniature of the Istanbul observatory, where Taqi ad-Din (d. 1585) and his staff made observations in late sixteenth century (Fig. 123).

Mir'at-ı Kâinat is not the only treatise written by Seydi Ali on practical astronomical instruments. There are also works attributed to him: *Risale-i Da'ire-i Muaddil* (Equator Circle Treatise), *Risale-i Usturlab* (Astrolabe Treatise), *Risale-i Rub-ı Müceyyeb* (Sine Quadrant Treatise), *Risale-i Zatü'l-Kursi* (Treatise on the Sky).[867]

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866 Danışan Polat, "A Sixteenth-Century Ottoman Compendium of Astronomical Instruments," p. 11.
867 Danışan Polat, "A Sixteenth-Century Ottoman Compendium of Astronomical Instruments," p. 4.

Figure 123. Miniature showing Ottoman astronomer Taqi ad-Din working with the astronomers in his entourage in Murad III’s *Şehinşahnâme*. In this depiction, various instruments, such as an astrolabe, a quadrant, a terrestrial globe, a sine quadrant can be seen. And also, manuscripts and the library are depicted. Miniature of Istanbul observatory (between 1574-1595), 1581, Istanbul University Library, nr. 1404, vr. 57a, https://islamansiklopedisi.org.tr/takiyyuddin-er-rasid.

7. 4. Risâle-i Zâtü'l-Kürsî

Risâle-i Zâtü'l-Kürsî is a work, which contains information about *zâtü'l-kürsî*, an astronomic instrument. *Zâtü'l-kürsî* is a portable instrument that can be used at any latitude. It allows to see the movement of a star or sun above and below the horizon, for any latitude and for any date (Fig. 124).[868]

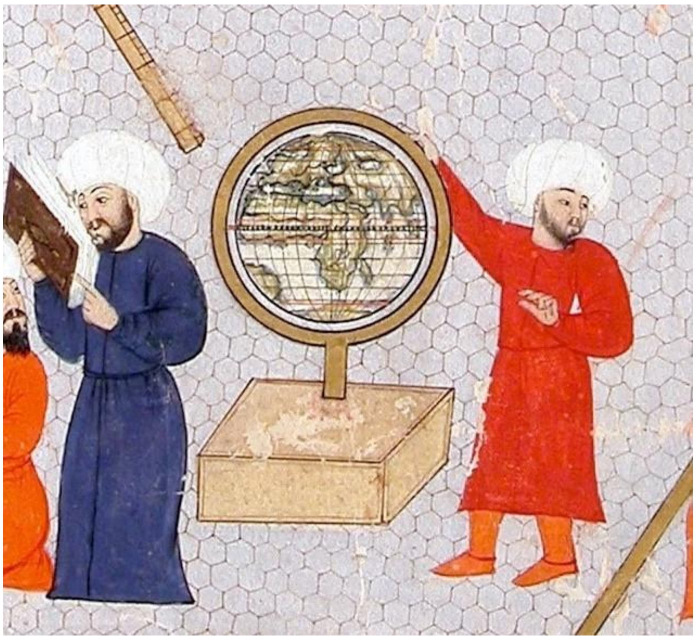

Figure 124. *Zâtü'l-Kürsî*, apart from the miniature showing Taqi ad-Din working with the astronomers in his entourage in the *Şehinşahnâme* of Murad III (1581). Istanbul University Library, FY, nr. 1404, vr. 57a, https://islamansiklopedisi.org.tr/takiyyuddin-er-rasid.

The observer can follow the celestial sphere from outside, not from the centre. Thus, instead of just observing the semi-dome on the horizon of its latitude, it follows its movement across the entire celestial sphere. In this respect, it is the three-dimensional form of the sky atlas. *Zâtü'l-kürsî* is a term meaning a footed globe. Here, the term *kürsî* may mean only the feet holding the globe, or this term may also be used for a mechanism set up with the horizon plane and feet. There are two main types of *zâtü'l-kürsî*. At the centre of the first is a small sphere representing Earth, and around

[868] Danışan Polat, "16. Yüzyılda Osmanlılarda Deniz Astronomisi ve Astronomi Aletleri," p. 280.

this sphere there are fixed or moving rings representing the celestial meridian, the horizon, the tropics, etc.[869]

In the other, the ecliptic, the tropics and other circles that allow us to learn about the positions of the celestial bodies are drawn on a sphere. This globe represents the celestial sphere. Fixed stars are also located on this sphere. This globe is placed within a pillar consisting of the celestial meridian and the horizon. It is also possible to come across examples of this instrument in European sources (Fig. 125).[870]

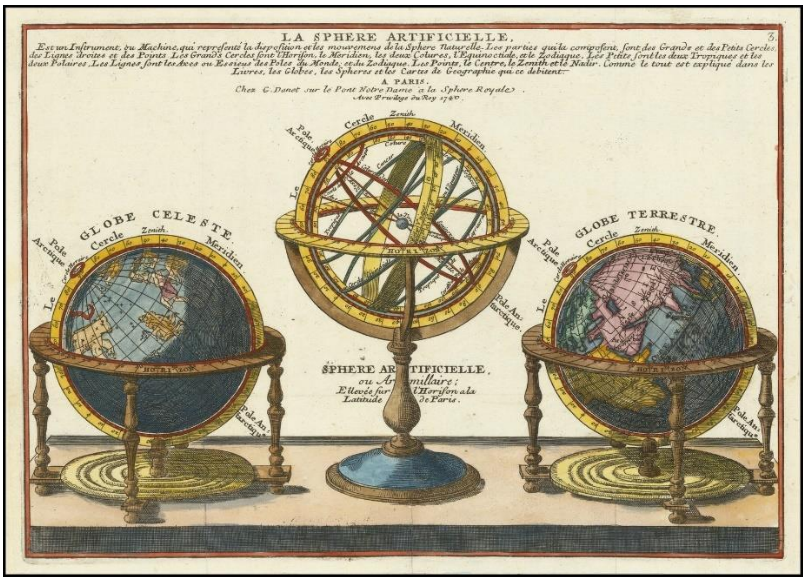

Figure 125. We also see the terrestrial globe, one of the types of globes, terrestrial, celestial and armillary, used in Europe, in Taqi ad-Din's observatory. Terrestrial, Celestial and Armillary Globes, Nicolas de Fer and Guillaume Danet, La Sphere Artificielle, 13 x 9 inches, Paris, 1740. https://www.raremaps.com/gallery/detail/80300/la-sphere-artificielle-1740-terrestrial-celestial-de-fer-danet.

Seydi Ali Reis states that epistles about this astronomical instrument could not be reached, when needed, and that these works were not found in many cities. He says that he created a useful Turkish treatise in summary form by compiling works on the subject, since not everyone can benefit from them, because the existing ones are Arabic

[869] Danışan Polat, “16. Yüzyılda Osmanlılarda Deniz Astronomisi ve Astronomi Aletleri,” p. 280.
[870] Danışan Polat, “16. Yüzyılda Osmanlılarda Deniz Astronomisi ve Astronomi Aletleri,” pp. 280-281.

and Persian.[871] One of the five chapters of his work *Mir'ât-ı Kâinât*, which he wrote for the same purpose, is devoted to information about the *zâtü'l-kürsî*.[872]

Apart from these works, there are three books containing treatises on practical astronomic instruments, attributed to Seydi Ali. The first of these includes three studies on the astrolabe, the equatorial circle, and the celestial sphere. These show that texts were copied from *Mir'ât-ı Kâinât*, with a comparison made by copyist Mustafa b. Muhammed in 1581-1582.[873] The second journal, which is attributed to Seydi Ali and contains treatises on the celestial sphere and the sine quadrant, is different. It begins with a dissertation called *Risale-i Zatü'l-Kürsi*. Its text is almost identical to the chapter on *Zatü'l-Kürsi* in the *Mir'ât-ı Kâinât*: the scribe copied this chapter together with its preface. On the contrary, the text of the treatise *Risale-i Rub-i Müceyyeb,* which is included in the same journal, is not the same as the section, titled "Rub-ı Müceyyeb" of *Mir'ât-ı Kâinât*. Book has 25 chapters, and the chapters, in *Mir'ât-ı Kâinât,* are 20.[874]

These extra chapters explain how to perform trigonometric multiplication, division, and square root calculations with the sine quadrant. *Risale-i Rub-i Müceyyeb* also has an introduction section explaining the author's purpose, but it is varied from the introduction of *Mir'ât-ı Kâinât*. The third magazine consists of two treatises, *Risale-i Ceyb* and *Risale-i Mukantara*. These were probably copied in 1861-1862. The copies that have survived to this day begin with a different introduction than *Mir'ât-ı Kâinât,* but the comparison shows that the knowledge, in the treatise, is taken from the sections of *Mir'ât-ı Kâinât*.[875]

The following momentous conclusion can be drawn in this chapter: Seydi Ali Reis is an artisanal seaman, who grew up in *Tersâne-i Âmire*, gained experience in maritime affairs, and took lessons from knowledgeable people and had a wealth of knowledge in scientific subjects. And the fact that on this occasion, as I mentioned above, produced important scientific works, is proof that artisans have a great influence on science. The reason why I am explaining the works of Seydi Ali Reis one by one,

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[871] Izgi, *Osmanlı Medreselerinde Ilim,* p. 306.
[872] Ayfer Aytaç, "*Risâle-i Zâtü'l-Kürsî* (*Kâtibî*)," accessed May 18, 2023, http://tees.yesevi.edu.tr/madde-detay/risale-i-zatu-l-kursi-katibi.
[873] Danışan Polat, "A Sixteenth-Century Ottoman Compendium of Astronomical Instruments," p. 4.
[874] Danışan Polat, "A Sixteenth-Century Ottoman Compendium of Astronomical Instruments," pp. 4-5.
[875] Danışan Polat, "A Sixteenth-Century Ottoman Compendium of Astronomical Instruments," p. 5.

together with their subjects, is to show the scientific works, produced by an artisanal sailor. The fact that Seydi Ali Reis produced works, such as books and treatises, is enough for him to be seen as an effective artisan in early modern Ottoman science. Because his surviving works contain valuable knowledge about the nautical instruments of the period. These studies can only be written by someone, who knows and uses these tools very well and who does very good calculations. With these scientific works, Seydi Ali Reis proved himself as an experienced, knowledgeable, and well-trained artisanal sailor. At the same time, he was the author of the work *Gazavat-ı Hayrettin Pasha* (1541), which tells about the memories that Hayreddin Barbarossa Pasha had personally told and dictated. He died in 1562, in Istanbul.[876]

Conclusions

The reason why *Hulâsatü'l-hey'e* (1549s), *Mir'ât-ı Kâinât* (1550s), *Kitâbü'l-Muhît fî ilmi'l-eflâk ve'l-ebhur* (1554), and *Risâle-i Zâtü'l-Kürsî* (1550s) works of Seydi Ali Reis are examined here is that it is significant to see the scientific knowledge, and work of a sailor, and an artisan, trained in *Tersâne-i Âmire*. As mentioned above, Seydi Ali Reis had maritime knowledge, due to the knowledge, he received from his sailor family, and his upbringing in the shipyard. He also had experience in the Ottoman navy, as he was trained and captained in Hayreddin Barbarossa's navy. In addition to all this, since he is a sailor with scientific knowledge and, as we have seen, curiosity to develop this, it can be thought that in the shipyard, he may have acquired the infrastructure of this knowledge. Because if he did not have this background, it would have been more difficult to produce these works. Here, we see a scholar, who is knowledgeable on the subject. Because of this, as seen above, Seydi Ali Reis, who had knowledge of astronomy, geography, and navigation, produced valuable works on marine instruments and astronomy. While producing these, he collected information from the places, he visited during his travels, as seen especially in *Kitâbü'l-Muhît*, and

876 "Seydi Ali Reis," accessed December 20, 2021, https://www.dzkk.tsk.tr/Genel/icerik/seydi-ali-reis-1498-1562.

produced works by synthesizing them with the knowledge and experiences, he had. This shows us that Seydi Ali Reis was an artisan sailor, who produced scientific works.

CHAPTER 8

The *Nautical Atlas* of Ali Macar (Hungarian) Reis (1567): between 'Ottoman portolan style' and Ottoman binding art

Ali Macar Reis grew up as a pirate and became a volunteer chief of *levend* in the Ottoman navy. It is thought that he belonged to a family of Hungarian origin.[877] He is known to have participated in the Conquest of Cyprus (1570) and the Battle of Lepanto (1571). Ali Macar Reis, who was also a cartographer, wrote a *Nautical Atlas*. It is in Treasury of Topkapı Palace Museum. He completed his *Atlas* in 1567. He mentions his name, at the end of the fourth portolan chart, in *Atlas*. In a note, on November 14, 1565, in the Travelogue of the Turkish traveller Evliya Çelebi stated that he was a pirate, near the island of Crete.[878]

However still, aside from his name, nothing is known for sure about the author, Ali Macar Reis. The name itself suggests that on the one hand, he was a Hungarian renegade, Ali is a Muslim name, while *Macar* means Hungarian in Turkish; on the other, that he was a ship's captain, as the third part of the name, *Reis* means captain, suggests. No other chart or atlas made by him is known. Thus, the first impression might be that this atlas was made by an Ottoman seaman based on his maritime experience.[879]

There are seven charts in his atlas, which is significant in terms of Ottoman period cartography. Cities, castles, islands, and capes are carefully drawn on the portolan charts, in the nautical atlas. All nautical charts are in portolan style. On the first portolan chart, there is the north of Spain, the British Isles, and the English Channel. And the second portolan chart is showing Tripoli, Tunisia, and the south of Italy. The third portolan chart is the Eastern Mediterranean and the Aegean Sea. The fourth portolan chart is the Black Sea, and the Marmara Sea basin. The naval battles of Dragut Reis, Piali Pasha, Sinan Pasha, and Lutfi Pasha are marked in this chart. Some

[877] Italyan Kültür Merkez, *XIV.-XVIII. Yüzyıl Portolan ve Deniz Haritaları*, p. 94.
[878] Sarıcaoğlu, *Osmanlı Tarihi Haritaları ve Tarihi Coğrafya Eserleri*, p. 65.
[879] Soucek, "The 'Ali Macar Reis Atlas'," p. 18.

Turkish place names are the same, as in Piri Reis's *Kitâb-ı Bahriyye*.[880] The fifth chart includes the British Isles and Europe's Atlantic Coasts. The sixth chart includes Aegean Sea, Western Anatolia, and Greece; and the seventh chart covers the whole world.

Some of the portolan charts, in the *Nautical Atlas*, which were made on nine gazelle skin sheets, were incorrectly bound. The fact that Ali Macar Reis' signature is only seen on the fourth piece, the Western Mediterranean portolan chart, has led to the suggestion that the others may have been added later. On the other hand, it has been claimed that the *Nautical Atlas* was prepared by Italian portolan cartographers, due to its compliance, with the Italian and Catalan portolan technique and order, reached the Ottomans with the place names neglected, and that Ali Macar Reis completed the incomplete writings.[881] Giancarlo Casale stated that Ali Macar Reis made his charts in a style, which can be called the 'Ottoman portolan style'. This style is a cartography school combining the traditions of Piri Reis, and the traditions of Italian portolan charts.[882] In addition, Svat Soucek argues that it is undeniable that Atlas of Ali Macar Reis follows the cartographic style of the Italian school, particularly the small atlases of Ottomano Freducci and Battista Agnese.[883] It is also certain that the painting technique, in the *Nautical Atlas,* shows a style familiar to the Ottoman muralist. From the portolan chart, indirect information is obtained about the places, where Turkish sailors, such as Turgud Reis, Sinan Pasha, and Piali Pasha fought. The *Nautical Atlas* of Ali Macar Reis, which contains very valuable information, in terms of place names, and positioning in the Sea of Islands, the old name of the Aegean Sea, is among the most interesting of the Ottoman nautical charts.[884]

The *Nautical Atlas* of Ali Macar Reis, which is registered at number 644, in the Treasury Department of Topkapı Palace Museum Library, has brown skin, like other from his period. In the middle of the front and back covers, there is a *şemse,* the ornamental element of Ottoman binding art. Gold gilding also surrounds the edges of the caps. With the effect of years, these gildings tend to be erased. On the upper edge

[880] Ihsanoğlu*, Osmanlı Bilim Mirası*, Vol. II, p. 180.
[881] Sarıcaoğlu, *Osmanlı Tarihi Haritaları ve Tarihi Coğrafya Eserleri*, p. 65.
[882] Giancarlo Casale, "From Hungary to Southeast Asia: The Ali Macar Reis Atlas in a Global Context," *Osmanlı Araştırmaları,* 39 (2012): 54-62, p. 61.
[883] Soucek, "Islamic Charting in the Mediterranean," p. 280.
[884] Sarıcaoğlu, *Osmanlı Tarihi Haritaları ve Tarihi Coğrafya Eserleri*, p. 65.

of the marbling on the inside of the front cover, there is a note that reads: ‘This portolan chart belongs to Ali Macar, do not be heedless’. It is thought that this note was written, during the sorting of the library. In the atlas consisting of 18 pages, the dimensions of charts, in the plane, on which they are drawn cover an area of 31 x 43 cm on seven double pages, scratched on leather parchment. The first six nautical charts, in the atlas, are an example of the 16th century Ottoman nautical charts. The last one is a world map. Only black lines were drawn with a ruler, on the edges of the next two pages, and they were left blank.[885]

The first six charts, in the atlas, have features of portolans, and all have seventeen wind roses. Thirty-two direction lines, departing from the wind roses, are in certain colours: eight cardinal directions were drawn in black, the middle of the cardinal directions in red, and the intermediate directions, called *kerte*, were drawn in green. All these portolan charts have a mile scale at the bottom.[886] Ports were shown with exaggerated indentations, and protrusions. This feature, which had been present in all portolans from the beginning, arose from the need to give ship captains, detailed information about ports. The places, where the land meets the sea, were shaded with navy blue, so that the shores were aimed to catch the eye immediately.[887]

The islands, in the portolans, were painted in striking colours, such as gold gilding, yellow, green, pink, and red. The colours are the same, on the two Aegean portolan charts. Colouring the islands, with the same colours, suggests that the colours carry a certain meaning. Shallow places are shown with red dots, and hidden cliffs with plus (+), as usually the case in portolans. The rivers were coloured in gold gilding. The deltas of some of the major rivers were exaggerated, and strikingly painted. Apart from the world map and the second Aegean nautical chart, significant cities, and castles were shown with simple coloured miniatures. The names of the cities were written in black, thus, breaking the rule of writing, the momentous ports in red, in the portolans. All portolan charts were oriented to the north, and no information about political borders

[885] Özdemir, *Osmanlı Deniz Haritaları ve Ali Macar Reis Atlası*, p. 127.
[886] Özdemir, *Osmanlı Deniz Haritaları ve Ali Macar Reis Atlası*, p. 127.
Rhumb is the angle equal to 1/32 of 360 degrees. It is used in maritime.
[887] Özdemir, *Osmanlı Deniz Haritaları ve Ali Macar Reis Atlası*, p. 127.

is given.[888] The seven portolan charts and one world map, found in *Nautical Atlas*, are as follows:

1. Black Sea: It is a portolan chart covering the Black Sea, the Sea of Marmara and Azov, as well as their ports and the lands surrounding these seas (Fig. 126). More than fifty cities and castles are depicted in stylized miniatures. The frequency of stylized miniatures, along the Danube, are immediately striking. The delta of the Dnieper River is the most spectacular on the chart and was artfully rendered in vibrant colours. In the north of the Caucasus is the largest miniature on nautical atlas. The steep mountains and forest image are demonstrated very realistically. The settlements, on the Anatolian and Thrace coasts, bear current names. Also, the names of cities, such as Kerş (Kerç), Soğdak (Sudak), and Batun (Batum), from the Black Sea ports are compatible with today's pronunciation. The names of cities and castles, on the Caucasian, coast is different from today.[889] Red, green, blue, and gold gilding was used on the chart, and place names were written in black. 17 wind roses, one of which is the centre, are undecorated. Scale indicators were not used. The shores are painted blue, the rivers gilded, the seas white, the land green.[890]

[888] Özdemir, *Osmanlı Deniz Haritaları ve Ali Macar Reis Atlası*, p. 127.
[889] Özdemir, *Osmanlı Deniz Haritaları ve Ali Macar Reis Atlası*, p. 127.
[890] Kültür ve Turizm Bakanlığı Kültür Varlıkları ve Müzeler Genel Müdürlüğü, P*iri Reis'ten Önce ve Sonra Topkapı Sarayı'nda Haritalar*, p. 132.

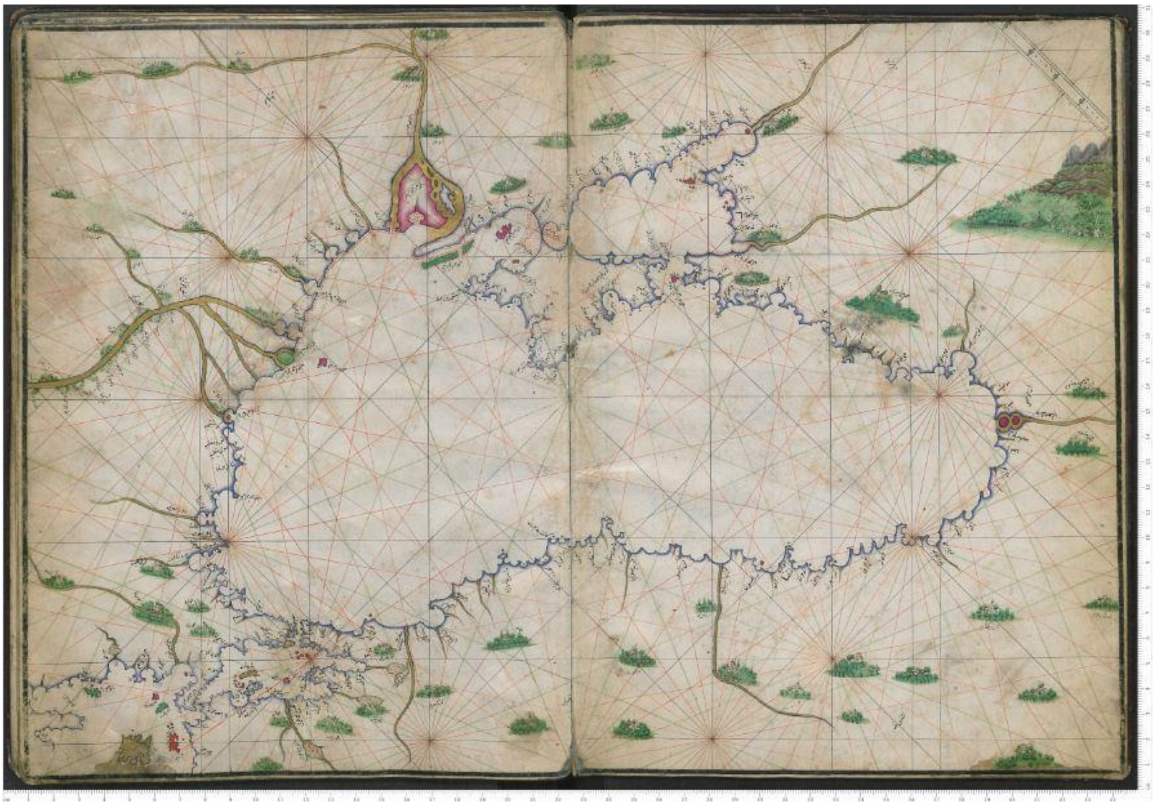

Figure 126. The Black Sea in the *Nautical Atlas* of Ali Macar Reis, dated 1567. Ali Macar Reis' maps are extremely simple and contain city depictions. Topkapi Palace Museum Library, Treasure, nr. 644.

2. Eastern Mediterranean and Aegean: This portolan chart covers the Aegean Sea, Greece, the southwestern and southern coasts of Anatolia, Cyprus, Syria, Palestine, and Egypt (Fig. 127). About thirty cities, especially Anatolia, were shown with stylized miniatures. Cities, with miniatures, in Anatolia, are Sis (Kozan), Adana, Karaman, Konya, Ankara, Kütahya, Karahisar, Manisa, Bergama, Akhisar, Tire, Bursa, Iznik, Bandırma, and Manyas. Painting the islands, with blue, red, pink, yellow, and gold gilding, added a unique beauty to the portolan chart. The Nile Delta is made with vivid colours, and care. The portolan chart is an invaluable guide, for sailors, traveling from Istanbul to the momentous ports of Egypt, Cyprus, and Syria.[891]

This nautical chart of Ali Macar Reis differs from the other five nautical charts of the Mediterranean basin, at least in terms of scale. As it is known, the scale, depending on the projection type, in small-scale portolan charts varies from point to point. Assuming that no projection type is used in the drawing of the portolan chart, and therefore, there is no length deformation in any direction, measurements were

[891] Özdemir, *Osmanlı Deniz Haritaları ve Ali Macar Reis Atlası*, p. 127.

made between well-detectable points. According to these measurements, the scale of the portolan chart was determined as approximately 1: 3,000,000.[892]

Figure 127. The Eastern Mediterranean and Aegean Sea in the *Nautical Atlas* of Ali Macar Reis, dated 1567 On the map, the islands in the Aegean are given in detail, different colours are used on the coasts, and city depictions are also included. Topkapi Palace Museum Library, Treasure, nr. 644.

3. Italy: This portolan chart, showing Benghazi, Tunisia, Sicily, Italy, and the Adriatic Gulf, is in detail so that Turkish ships, departing from any port in Anatolia, can easily travel to and from the Tunisian and Algerian ports (Fig. 128). When compared with today's charts, it is seen that it has been drawn very successfully. On the portolan chart, it can be found evidence of the dominance of Turkish sailors in the Mediterranean. Turkish names and notes take memories of Turkish sea voyages. Such information is generally seen on Ottoman nautical charts. In front of the Djerba Island off the coast of Tunisia, the inscription reads: "This is the place, where Dragut Bey broke through". This note reminds one of the Turkish sailors of the period, Dragut Reis,

[892] Özdemir, *Osmanlı Deniz Haritaları ve Ali Macar Reis Atlası*, p. 127.

being saved from enemy ships. Another note, near of Cerbe Island is the inscription reads: “Places, where Piali Pasha took ships”. It refers to the naval battle of Djerba, in which Piali Pasha defeated the Spanish, Genoese and Papal navies, in 1560. The Ottomans captured this island of great strategic significance, in the Mediterranean, and constantly fought to keep it.[893]

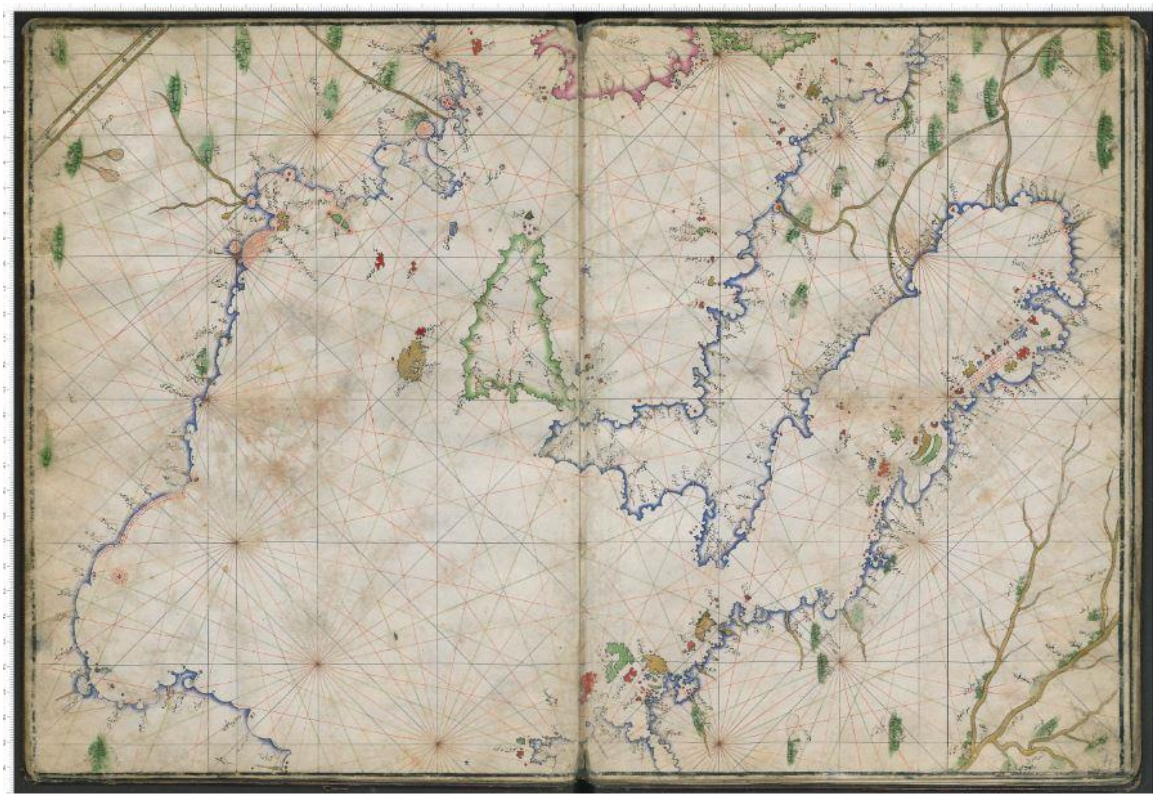

Figure 128. The Italy in the *Nautical Atlas* of Ali Macar Reis, dated 1567. Different regions are tried to be distinguished by colouring the coasts on the map. Topkapi Palace Museum Library, Treasure, nr. 644.

4. Western Mediterranean and the Iberian Peninsula: It is a very close to the original and perfect drawing of the Western Mediterranean, from Corsica and Sardinia Islands to the Atlantic Ocean (Fig. 129). Small miniatures of thirty-five cities and castles, in Algeria, Spain, and France, stand out. The Turkish names, on the portolan charts, are a clear indication of the activities of Turkish sailors, in this part of the Mediterranean.[894] *Karamanlı* Island off the Strait of Gibraltar, *Koyunluca* Island in the south of Ibiza from the Balearic Archipelago, *Üçadalar* off the city of Toulon in France, Caprera, Asinera between Corsica and Sardinia Island, San Pietro in the south-

[893] Özdemir, *Osmanlı Deniz Haritaları ve Ali Macar Reis Atlası*, p. 129.
[894] Özdemir, *Osmanlı Deniz Haritaları ve Ali Macar Reis Atlası*, p. 129.

west of Sardinia, are some of the Turkish place names on the portolan chart. The islands were painted in vibrant colours. The coast of Corsica was coloured green, Sardinia pink. The Rhone River delta also gives a very beautiful view. The biggest feature of the portolan chart is undoubtedly that it carries the identity of the cartographer. On the Atlantic Ocean, there is the signature of Ali Macar Reis and the note 7 August- 4 September 1567, which is the date of the portolan chart.[895] In addition, in the 16th century, North African coasts, such as Algeria, Tunisia and Morocco were under Ottoman rule. There are two portolan charts that seem likely to be sources from this region for Ali Macar Reis' Nautical Chart. The Tunisian *Suleiman el-Kâtibî*'s portolan, dated 1421, and *el-Hacc Ebul Hasan*' portolan chart, dated 15th century, which is understood to have been made, during the Sultan Suleiman period, cover these areas.[896]

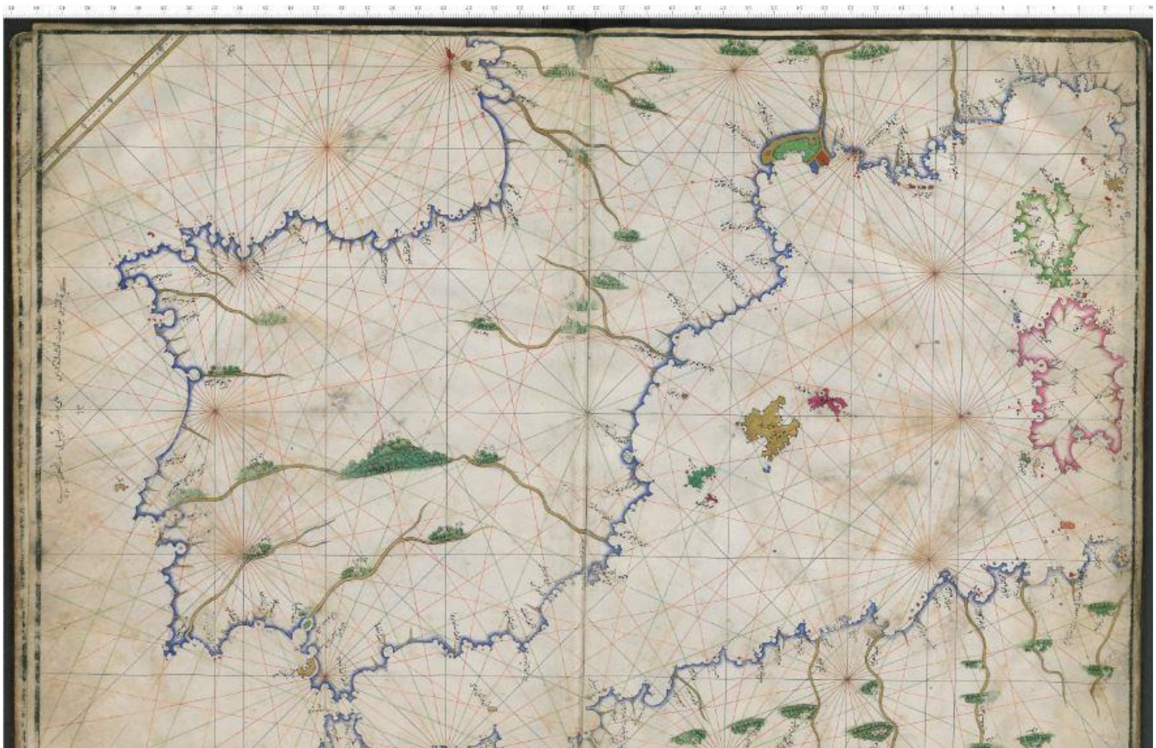

Figure 129. The Western Mediterranean and the Iberian Peninsula in the *Nautical Atlas* of Ali Macar Reis, dated 1567. In this map, the coasts are coloured and there are city depictions. Topkapi Palace Museum Library, Treasure, nr. 644.

[895] Özdemir, *Osmanlı Deniz Haritaları ve Ali Macar Reis Atlası*, p. 129.
[896] Özdemir, *Osmanlı Deniz Haritaları ve Ali Macar Reis Atlası*, p. 98.

5. British Isles and Europe's Atlantic Coasts: Compared to other portolan charts of the atlas, this one of the western part of Europe and the British Isles is not very successful (Fig. 130). However, features found on other nautical charts are also found on this chart. The lack of information about these coasts, where Ottoman sailors were rarely seen, shows itself. The names of some cities are not similar to those, used today.[897] One of the reasons for this is the lack of Turkish names of the ports in distant waters, which are misread from foreign nautical charts, and put on the portolan chart. Again, there are some familiar city names on the nautical chart. These cities are Santander, Nantes, Dieppe, Calais, Dublin, London, and Bristol. Stylized drawings of about twenty cities can be seen in portolan. A wide waterway stands out between Edinburgh-Glasgow-Greenock, in the north of England. This was common in 15th and 16th century' portolan charts. The northern part of England is very colourful, and attractive.[898]

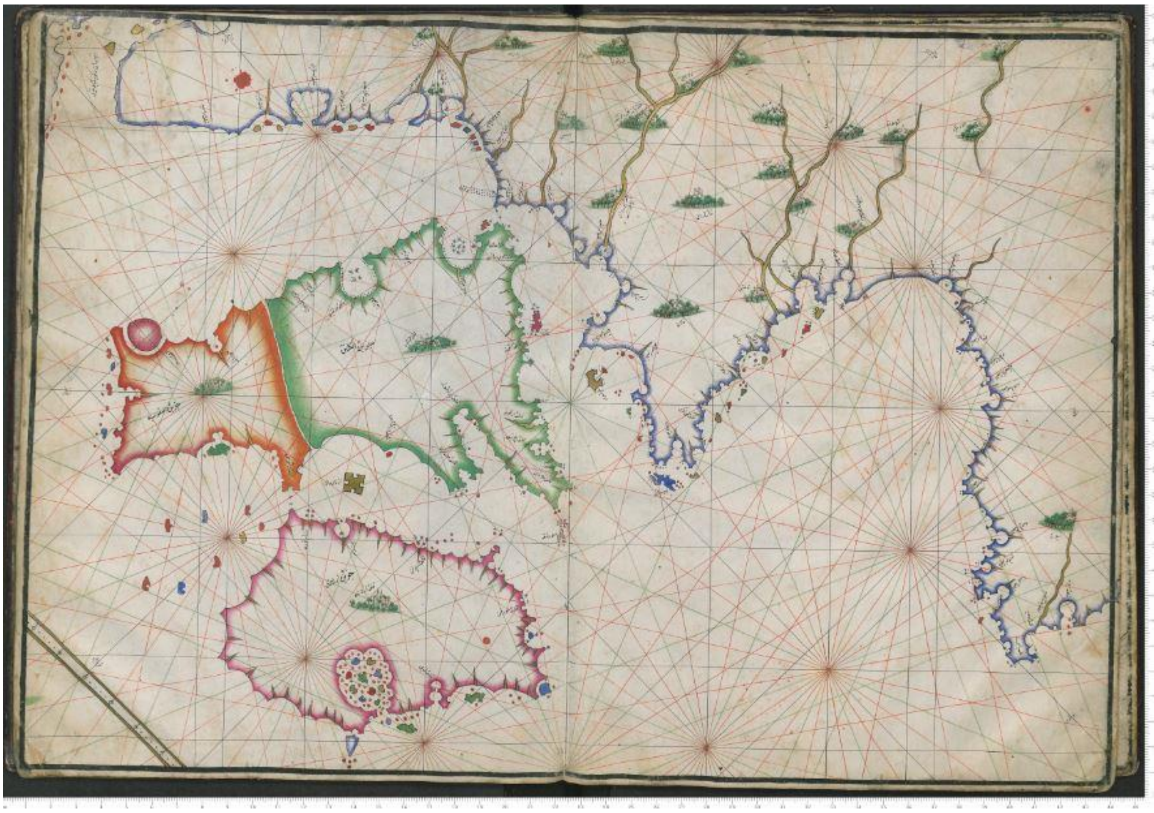

Figure 130. British Isles and Europe's Atlantic Coasts in the *Nautical Atlas* of Ali Macar Reis, 1567. Islands and shallow places are indicated on the map. Topkapi Palace Museum Library, Treasure, nr. 644.

[897] Özdemir, *Osmanlı Deniz Haritaları ve Ali Macar Reis Atlası*, p. 131.
[898] Özdemir, *Osmanlı Deniz Haritaları ve Ali Macar Reis Atlası*, p. 131.

6. Aegean Sea, Western Anatolia, and Greece: This portolan chart is the most beautiful portolan chart of the *Nautical Atlas* (Fig. 131). Ali Macar Reis achieves great success in the drawing of this area, where he sailed and wandered many times. The portolan chart has taken on a pleasing quality with the vivid colours used. Most of the islands are painted in the same colours, as nautical chart number 2.[899] The names of 32 directions are written on the wind rose that comes over Anatolia. The places, shown on the nautical chart, are indicated by the Turkish names, used at that time. In the *Kitâb-ı Bahriyye* of Piri Reis, most of these ports and islands were shown and described. Some of these islands are Limnos, Jura, Pontigo, Mulari, Salamin, Elefonisi, Karavi, Spedza, Karpatho, Paro, Sipheno, Levitno, Nisyro, Hydra, Polinos, Giura, Anydro, Charki, Denos, Arki, Gaydafonis, Forni, Jerpho, and Stapodia. Another feature seen is the absence of stylized miniatures of significant cities and castles, as in other portolan charts. This shortcoming suggests the assumption that the cartographer was not Ali Macar Reis. Even if such a thought is correct, there is no doubt that the source is portolan chart number 2. In addition, the tones of the colours used eliminate such an assumption.[900]

[899] Özdemir, *Osmanlı Deniz Haritaları ve Ali Macar Reis Atlası*, p. 131.
[900] Özdemir, *Osmanlı Deniz Haritaları ve Ali Macar Reis Atlası*, p. 131.

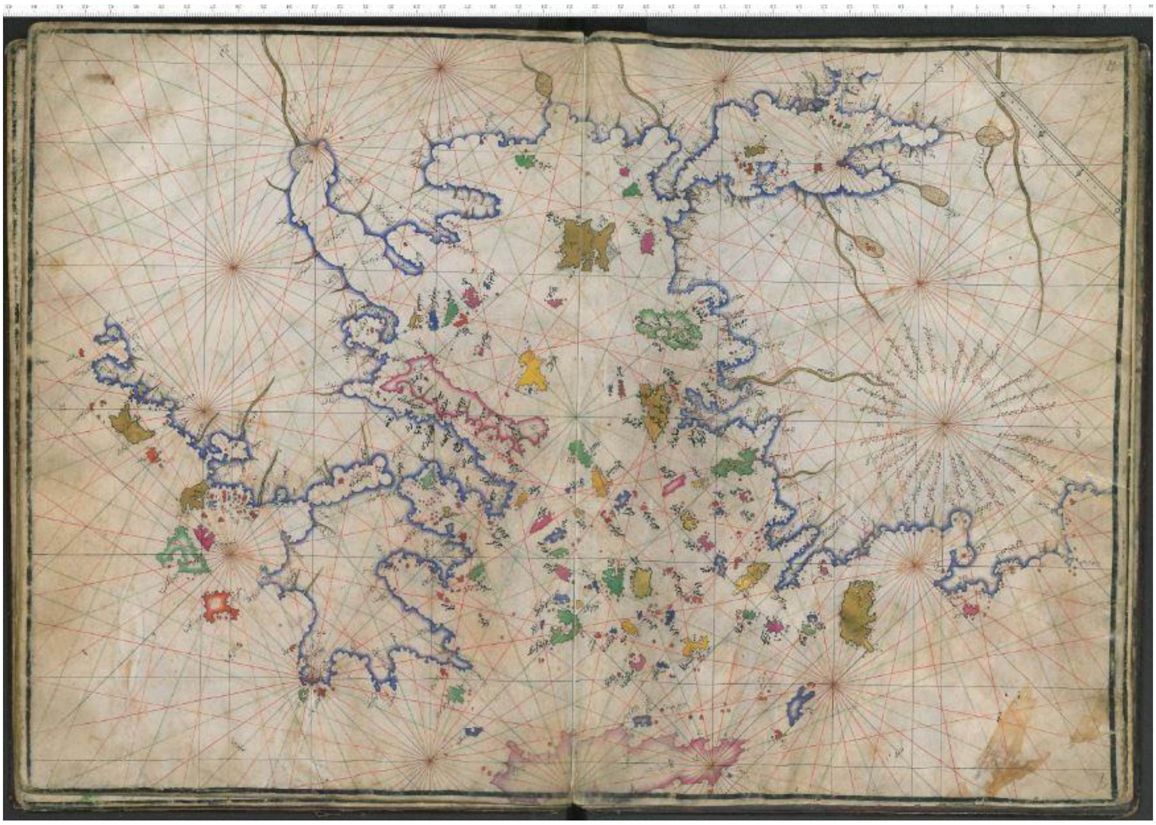

Figure 131. Aegean Sea-Western Anatolia and Greece in the *Nautical Atlas* of Ali Macar Reis, dated 1567. Here, the islands in the Aegean are seen in more detail. Topkapi Palace Museum Library, Treasure, nr. 644.

7. World Map: Usually world maps are placed on the first pages of nautical atlases, before other charts. However, this chart, include all places of world, is located at the end of Ali Macar Reis' *Nautical Atlas* (Fig. 132). It is a *mappa mundi* (world map), which raises suspicion that it was made, during Ali Macar Reis's lifetime. All lands and islands are painted green. It is immediately striking that the rivers were clearly drawn, but most of them were not named. With the Equator line that cuts the globe in the middle, a line is drawn to the east and southwest with an inclination of 23.5 degrees around Cape Verde.[901] It is written on words, denoting the zodiac. The lines, showing the equator and the South and North Pole circles, are coloured in red. The drawings of the continents of Europe, Africa, and America are successful. Australia and Antarctica are constructed, as a very large continent occupying the south of the chart. Most charts of the 16th century show this error, due to the paucity of exploration. *Berr-i Beyâbân* (Continent of Desert) was inscribed on it. In the Asian

[901] Özdemir, *Osmanlı Deniz Haritaları ve Ali Macar Reis Atlası*, p. 131.

continent, Arabia, India, and Indochina are not well drawn, in terms of size and shape. '*Tatar*' is written in five places, in the north of Asia. The Red Sea is drawn very wide. The words *Vilayet-i Yeni Dünya* (New World), *Maden-i Dür* (Gold Mine) are read on South America. Portugal pier is inscribed on Panama, and the Strait of Magellan are shown.[902]

Figure 132. World Map of Ali Macar Reis' *Nautical Atlas*, in the *Nautical Atlas* of Ali Macar Reis, dated 1567. All details are available on the world map, but place names were not written. That's why the map seems incomplete. Topkapi Palace Museum Library, Treasure, nr. 644.

There is a mile scale at the bottom of the chart. On this scale, it is written: "The points are floating, and it is five hundred miles, the whole is 2000 miles". The chart is equipped with a geographical chart network, consisting of 15-degree meridians and parallel circles. The opinion that this chart includes information, after its own age, and that it was not made in that period, is a subject, open to discussion. The assumptions, which the projection system belonged to later centuries, disappeared with the discovery of the same type of charts, which is from the 16th century. It is also a fact that Ottoman

[902] Özdemir, *Osmanlı Deniz Haritaları ve Ali Macar Reis Atlası*, p. 131.

sailors follow the innovations and geographical discoveries in the west, and constantly reflect these on their charts.[903]

Svat Soucek interprets the *Nautical Atlas* of Ali Macar Reis, as follows: “As a work of art, this atlas is among the most successful. It is an example that competes in quality with the best works of famous Italian schools, such as Angelo of Ancona Freducci or Battista Agnese. Indeed, the charts, in this Ottoman *Nautical Atlas*, are entirely made in the style of Italian schools. The shape of the depicted areas, the character and placement of the rhumb line grids, the stylized shape of rivers, deltas and towns, the colouring, all this is so integrated into the Italian tradition. If it were not for the Ottoman captain and the author’s name, one would immediately look for the Italian author and find him or her with internal evidence.”[904]

An Ottoman nautical atlas, like this one, which is significant in terms of world maritime geography, is in Baltimore Walters Art Gallery. Another similar one is preserved, in the Istanbul Archaeological Museums Library. Ali Macar Reis is considered one of the foremost cartographers of the 16th century with his nautical atlas, because of the close resemblance of Giacomo Gastaldi’s (1500-1566) portolan chart, made at the same time, and other naval atlases (Fig. 133 and 134). In 1561, the opinion that the Ottoman sailors, who prepared these nautical atlases, followed European cartography closely has been reinforced.[905]

[903] Özdemir, *Osmanlı Deniz Haritaları ve Ali Macar Reis Atlası*, p. 131.
[904] Soucek, “The ‘Ali Macar Reis Atlas’,” pp. 17-19.
[905] Özdemir, *Osmanlı Deniz Haritaları ve Ali Macar Reis Atlası*, p. 131.

Figure 133. Giacomo Gastaldi, Printed map of the world, 1565, Paper, 750 x 410 mm, Library of Congress, https://medea.fc.ul.pt/view/chart/6160.

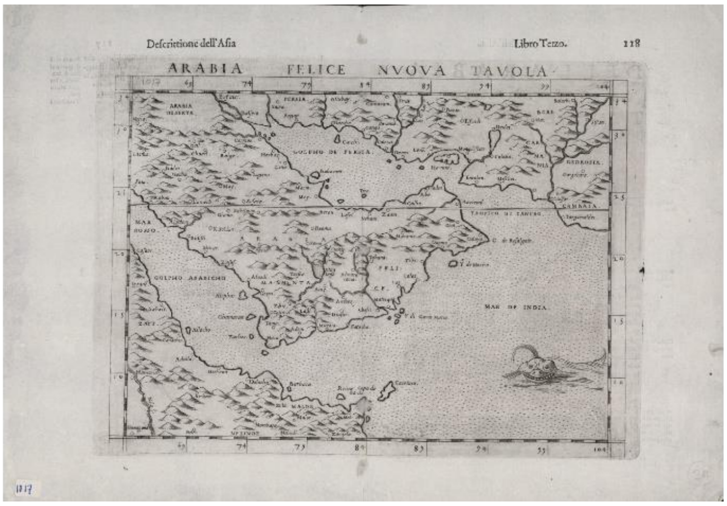

Figure 134. Giacomo Gastaldi, New Chart of the Arabia Felix (South-Eastern Arabian Peninsula, dated 1561, black and white map, 23x28 cm., https://www.loc.gov/resource/gdcwdl.wdl_16197/?sp=1&r=-0.315,0.078,1.542,0.574,0. Contributor Names Gastaldi, Giacomo, 1500?-1565?. Contributor Ruscelli, Girolamo, died approximately 1565 Creator. Created / Published Venice, Italy: Vincenzo Valgrisi.

From the rhumb lines on the charts in Ali Macar Reis' *Atlas*, it can be deduced that he drew these charts by making calculations. As can be seen, he drew charts of many regions in the Mediterranean, including a world map. And he made these charts very close to reality. The following conclusion can be drawn from the *Nautical Atlas* of Ali Macar Reis, which liken to Italian cartography; a sailor, who was in charge of the Ottoman navy and had a high probability of going on many expeditions, can see many charts in Italian style. And he is even likely to have these portolans. However, it can be deduced that Ali Macar Reis, whom we consider as an artisan, has a good knowledge of navigation and calculations from his charts, although there is no text in his atlas.

Conclusions

The maps in the Ali Hungarian Reis Atlas, analysed in detail above, are works of art drawn with superior artisan. According to the information available, Ali Macar Reis is an experienced sailor, who served in the Ottoman navy. The places, drawn by Ali Macar Reis, on his maps, and the small notes and rhumb lines, he made on some places, seem to have been made by calculations. This shows the navigational knowledge that Ali Macar has. At the same time, his unique style of description in his maps makes him an artisan with a certain knowledge. This conclusion, we draw, can include Ali Macar Reis in the class of superior artisan, asserted by Zilsel. The reason for this is that Ali Macar Reis is both an experienced sailor and a navigator, who draws maps, using his knowledge and experience.

Another reason that makes Ali Macar Reis' *Nautical Atlas* valuable in terms of artisanal epistemology is that it serves as a model for atlases, produced in the Ottoman Empire. It seems that two atlases were produced in *Nakkaşhâne*, an artisanal institution, founded at the same time, as *Tersâne-i Âmire* in the Ottoman Empire (after the conquest of Constantinople in 1453), starting from the second half of the 16th century. Traces of Piri Reis and especially Ali Macar Reis' *Nautical Atlas* can be seen in the production of these atlases. The most significant point, in the preparation of these instruments, is to take the maps, navigational books, and atlases of the artisanal pirates, Piri Reis and Ali Macar Reis as models and create a common traditional Ottoman model. As can be seen in the 9th chapter, the similarities of the *Atlas-ı Hümayûn* (Imperial Atlas, 1570) and *Walters Sea Atlas* (1560-1570), especially with the Ali Macar Reis' *Nautical Atlas*, have begun to form a common tradition. In other words, the most momentous feature of these atlases, made by artisans in *Nakkaşhâne* is that, as will be seen later, they are taken as a model from the *Nautical Atlas* of Ali Macar Reis, and they also bear traces of Piri Reis' maps and *Kitâb-ı Bahriyye*. These artisans worked in this institution with models, taken from the works of artisanal pirates, and that these sailors influenced the Ottoman traditional map model that started to be produced in the Ottoman *Nakkaşhâne*.

CHAPTER 9

Putting maps in their place of production: two cartographic artefacts from *Nakkaşhâne*

The first organized palace, writing *Nakkaşhâne* (scriptorium), where expert artisans worked collectively to prepare beautiful manuscripts, was place, belonging to the Timurid Ruler, Bay Sungur, in Herat in the 1420s. We do not know exactly to what extent this workshop provided a model for the organization of other court artisans, such as armorers and swordsmiths, jewelers, and goldsmiths, but it is certain that artisans began to have their own workshops in Tabriz at the end of the fifteenth century, during the rule of the early Safavid dynasty. After the victory against Akkoyunlu Uzun Hasan in Battle of Otlukbeli in 1473, some of these artisans were probably brought to Istanbul by Mehmed II. Possibly, these formed the core of the palace *Nakkaşhâne*, established by Bayezid (Fig. 135).[906]

Figure 135. The assembly of writers, muralists, scribes, and scholars, from *Şehnâme-i Selîm Hân*, 1581, Topkapi Palace Museum Library, no. 3595, vr. 9a, https://istanbultarihi.ist/275-istanbul-sarayinin-resim-hazinesunu-osmanli-sanatinda-minyatur#gallery-2.

[906] M. J. Rogers and R. M. Ward, Topkapı Sarayı Hazineleri: Muhteşem Süleyman'ın Çağı (Berlin: Staaliche Museen Preufischer Kulturbesitz, 1988), p. 137.

The term *nakkaş* includes many types of artists and artisans: those who paint and decorate surfaces, those who embroider clothes, manuscript miniaturists and wall painters. In the shipyards of Istanbul, the same term is used for the painters of wooden and metal surfaces as well for the painters of a ship's sails. As for *nakkaş* as a painter, there are also many distinct expertises: *kattâ* (engraver), *nakkaş* (color painter), *musavvir* (portrait painter), *tarrâh* (decorator or landscape painter), *ressam* (draughtsman). Those painter-miniaturists drew the world maps that participated the classical Arabic geographies as well as the topographical maps and plans of the Islamic holy sites.[907]

In other words, painters, hand-drawn artists, book decorators, draftsmen, illuminators, bookbinders, precious stone carvers, embroiderers, stonemasons, and glaziers worked in the *Nakkaşhâne*.[908] It was one of the most efficient and effective branches within the *Ehl-i Hiref* organization.[909] As an institution, its influence on Ottoman visual arts was significant. Because it was the main unit of coding a unique Ottoman visual and aesthetic repertoire.[910] The period between 1450 and 1550 was an experimental period for the *Nakkaşhâne*, both structurally and stylistically. Towards the end of the reign of Sultan Suleiman (1520-1566), the "classical" synthesis of Ottoman imperial art and architecture reached its zenith, and from this development a sense of unity and standardization emerged. According to the general opinion, it matured and developed fully in the 1550s, and then, like many branches of the Ottoman Empire, the *Nakkaşhâne* reached its "classical synthesis".[911]

Thus, the classical style of Ottoman painting emerged from the tradition of pictorial history that was firmly established in the 1500s. This tradition, in which the people and places of the events are visually recreated with documentary realism, was started not by palace artists, but by members of the administration, such as Piri Reis

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907 Dimitris Loupis, "Ottoman Nautical Charting and Miniature Painting: Technology and Aesthetics" in *M. Uğur Derman 65th Birthday Festschrift / 65 Yaş Armağanı*, ed. by Irvin Cemil Schick (Istanbul: Sabancı Üniversitesi, 2000), 369-397, p. 384.
908 Zeren Tanındı, "*Nakkaşhâne*," accessed Dec 19, 2023, https://islamansiklopedisi.org.tr/nakkashane.
909 Sinem Erdoğan, "The *Nakkaşhâne*," *Tarih* 1, no. 1 (2009): 37-69, p. 37.
Ehl-i Hiref means tradesman, artisan, and craftsman.
910 Erdoğan, "The *Nakkaşhâne*," pp. 37-38.
911 Erdoğan, "The *Nakkaşhâne*," p. 38.
In historiography, the age of Suleiman is often referred to as the "classical age" of Ottoman history.

and Matrakçı Nasuh. However, it was adapted, and taken to its highest point by the *Nakkaşhâne* painters.[912]

The Suleiman period is the most creative period in Ottoman art, when a unique ornamentation vocabulary was formed. Undoubtedly, the extraordinary burst of energy seen in the artistic production of the age owes much to the efforts of the members of the *Nakkaşhâne*, who formulated the themes and concepts that characterized the Ottoman decorative arts and set the standards of their high technical and aesthetic achievements. All arts and crafts, required by the state, were undertaken by the *Ehl-i Hiref*, which consisted of several societies representing various professions, such as calligraphers, painters, bookbinders, goldsmiths, goldsmiths, woodworkers, weavers, tailors, and milliners (Fig. 136).[913]

[912] Esin Atıl, *The Age of Sultan Süleyman the Magnificent* (New York: Harry N. Abrams, 1988), p. 78.
[913] Atıl, *The Age of Sultan Süleyman the Magnificent*, p. 29.

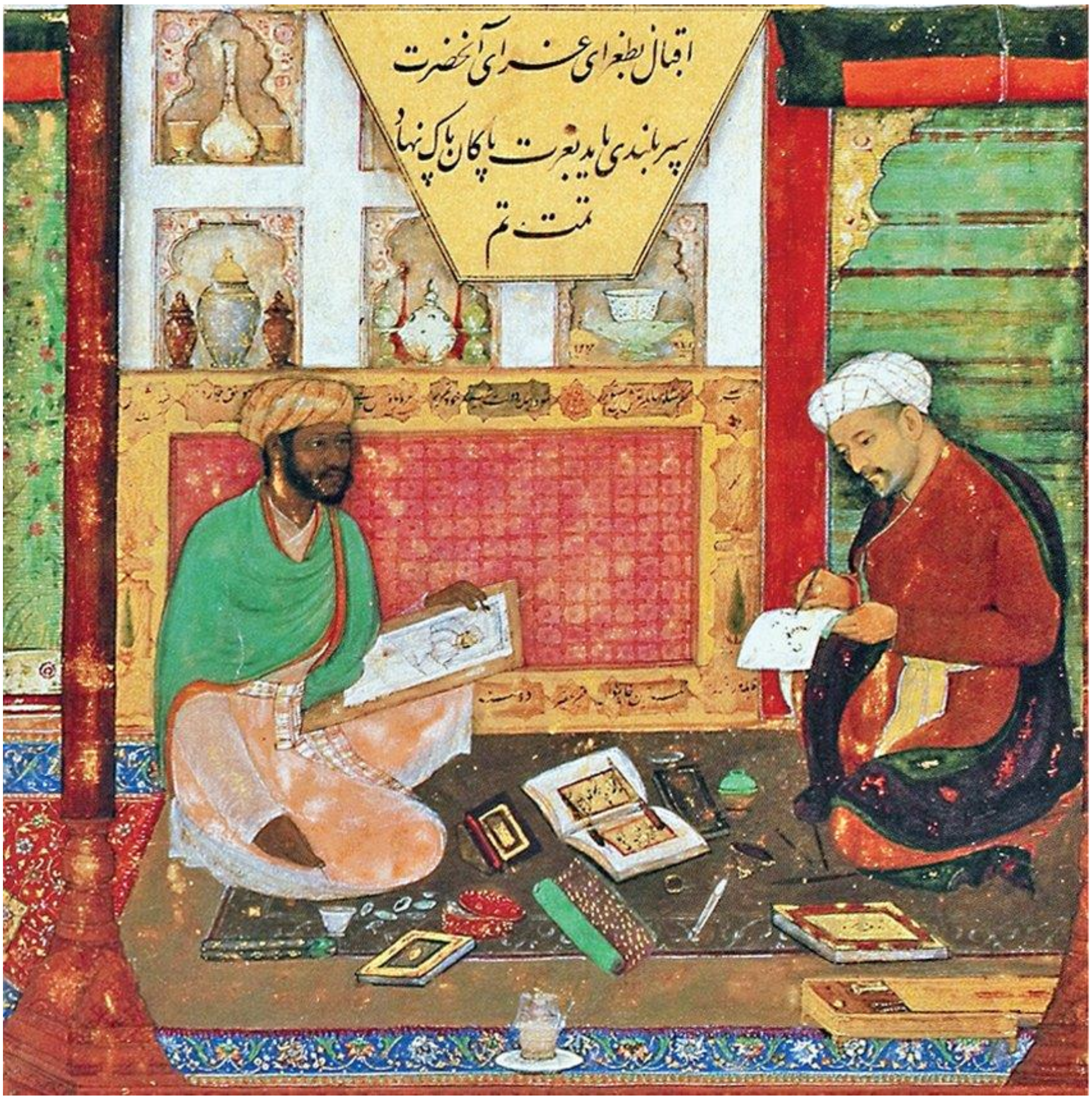

Figure 136. Miniature showing miniaturists at work, from Ḫamse, 17th century, London British Library, MS, Or., nr. 12208, vr. 325b, https://islamansiklopedisi.org.tr/nakkas.

In the Ottoman state palace, artists were organized as part of the palace administration and as salaried officials, called *Ehl-i Hiref*. It was divided into branches; bookbinder, *Nakkaşhâne* and workshop. Each branch had its own infrastructure with its own hierarchy of masters and apprentices. *Ehl-i Hiref* artists were officers and members of the imperial guard (*Kapıkulu*) and were subordinate to the imperial army (*Ordu-yu Hümayun*, Ottoman mint).[914] Members who were officially considered soldiers were asked to participate in the Sultan's campaigns and departures from the capital. The most famous of these were sea captain Piri Reis and Matrakçı Nasuh, who oversaw the Enderun (Fig. 137 and 138). Both contributed to the tradition of

[914] Erdoğan, "The *Nakkaşhâne*," p. 39.

documentary painting with topographic illustrations and nautical atlases. This tradition not only affected the future of the workshop, but also became one of the characteristic features of Ottoman art.[915]

Members of *Ehl-i Hiref* were generally selected from *Devsirme* units, according to their special talents in art.[916] However, when the projects required more artists, artists would come from other regions of the Ottoman empire. Sometimes, people, who worked outside the *Nakkaşhâne* organization, such as Piri Reis and Matrakçı Nasuh, could be quite effective in their inspiring work. Among the members of *Ehl-i Hiref* were invited artists, immigrants and prisoners.[917]

One of the groups in the *Ehl-i Hiref* was called *Cemaat-i Nakkân* (Society of Painters) and consisted of artists, whose job it, was to decorate manuscripts commissioned for the imperial libraries. They produced tens of thousands of books on religious, historical, literary, and scientific subjects, the best of which were kept in the palace treasury, and some were distributed to various departments and foundations or presented to the educational institutions of the foundations. These artists also provided designs used by other artisans, such as weavers, potters, stone carvers, and mural painters. The term, muralist, was all-encompassing and applied to men, who created decorative themes. They could use their skills in the illumination of manuscripts, at that time they were called 'illuminators', or illustrators of texts, and they became painters or musavvirs, that is, painters representing figures and decorations.[918]

Famous traveller Evliya Çelebi, who wrote extensively about life in the Ottoman world in the first quarter of the seventeenth century, listed hundreds of artists and artisans in Istanbul, including illuminators and painters. He states that a thousand

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[915] Erdoğan, "The *Nakkaşhâne*," p. 39.
Enderun means "inner part of the palace" in Persian. Children who were admitted to Enderun School were educated and assigned in various parts of the state.
[916] Erdoğan, "The *Nakkaşhâne*," p. 39.
Devshirme is a system of gathering young and talented Christian children from the lands conquered by the Ottoman Empire, especially the Balkans, and training them to form superior soldiers or bureaucrats.
[917] Erdoğan, "The *Nakkaşhâne*," p. 39.
[918] Atıl, *The Age of Sultan Süleyman the Magnificent*, p. 29.

miniaturists, work in a hundred shops.[919] At the same time, Evliya Çelebi (1611-1682) says the following about cartographers:

> Fifteen artisans in eight shops, these artisans have all the strange and strange knowledge, they know several languages. They read the books, written by past scholars on astronomy, such as Atlas Minor, Ptolemaios's Geography, *Mappa Mundis* (world maps), and described the Black Sea, the Mediterranean, Ocean, and all over the world. Oman, Suez Canal, the Caspian Sea, that is, the Gilan Sea, the Sea of Hormuz, the Golden Horn, Van Lake (Turkey's largest lake), in short, all the seas, gulfs and large rivers that merge into these seas, all the mountains and stones on the earth. They draw pictures, write them up and sell them to sailors. This knowledge of map is the life of all sailors, because eight winds, in seventy rhumb lines, decide which land they will go to, which island they will visit, whether it is shallow or rocky near the port, sandy, deep, or a good berth. It is written on all these maps and the chiefs act, according to these maps and sail the seas. It is a great science. In short, this tribe of cartographers decorate their shops with pictures of many castles and cities, written on map papers, depicting the world.[920]

It is understood from Evliya Çelebi's words that the cartography tradition of the 16th century was reflected in later periods and became a profession. In fact, workshops have been opened on this subject, and maps are being prepared to be sold to sailors. Another detail, given by Evliya Çelebi, is that these people knew more than one language, and produced charts, using various maps, for example, Atlas Minor, Ptolemy's Geography, *Mappa Mundi* (world map).[921] The fact that these crafts are produced by well-equipped and knowledgeable artisans, and that they now trade in this work shows that artisans have been trained in this field. This development reflects the tradition of the 16th century on the next century.

At the same time, the two main components of illustrated histories, the documentation of settings and the depiction of the eras of historical figures, were certainly influenced by the paintings of the two men, who worked outside the *Nakkaşhâne*. Piri Reis's and Nasuh's topographic and seascapes are not just maps, but elegantly illustrated paintings of great artistic value. Inspired to some extent by contemporary European examples, his works established the concept of depicting geographical and architectural environments.[922]

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[919] Erdoğan, "The *Nakkaşhâne*," p. 41.

[920] Evliya Çelebi, *Günümüz Türkçesiyle Evliya Çelebi Seyahatnamesi: Istanbul*, trans. Seyit Ali Kahraman and Yücel Dağlı (Istanbul: Yapı Kredi Yayınları, 2003) Volume I, Part 2, pp. 502-503.

[921] Atlas Minor included a collection of maps by Gerardus Mercator, the most influential cartographer of the 16th century.

[922] Erdoğan, "The *Nakkaşhâne*," p. 33.

As can be understood from his extant works, Piri Reis' world maps, dated 1513 and 1528, and *Kitâb-ı Bahriyye* (1521) were prepared, and colored in portolan and *isolario* style, with details such as direction lines, wind roses, and scale indicators, as seen above. Piri Reis's city depictions, especially in the *Kitâb-ı Bahriyye*, are influential in terms of miniature art as well as Ottoman cartography. In this work, the architecture of the cities, depicted, is given in a schematic manner, islands, coasts, and shallow areas are coloured in the same way, towns are indicated with symbols, and capital ports are shown with topographic drawings.[923]

Piri Reis's city depictions, drawn realistically in every detail, are not only the nautical instrument, but also a realistic source of the historical views of cities. There are no imaginary depictions on the maps in the *Kitâb-ı Bahriyye*. If we examine one of the descriptions in the book, one of the most interesting is the description of Alanya (a district of today's Antalya province in the Mediterranean Region of Turkey). This city depiction, which does not contain any imaginary elements, represents one of the first examples of the topographic painting genre. It is seen that the city surrounded by walls consists of two parts, the upper and lower castle. In the chart, the castle on the slopes, the mosque, the shipyard, used since the Seljuk period (1077-1308), the Red Tower on the seashore, and the Turkish bath and well outside the castle are depicted with a realistic understanding. The work can be considered as a joint product of maritime and urban culture.[924] Piri Reis' influence on both the Ottoman map tradition, and the depiction tradition with his works as an artisanal pirate, and the continuation of the tradition is very momentous in terms of artisanal epistemology. In addition, the city and port depictions, in works, written and illustrated by Matrakçı Nasuh, such as *Süleymannâme* and *Târîh-i Sultân Bâyezid*, are compositions, created with a rising perspective, and were taken as models by the artisanal working in *Nakkaşhâne*.[925]

[923] Banu Mahir, *Osmanlı Minyatür Sanatı* (Istanbul: Kabalcı Yayıncılık, 2017), p. 163.
[924] Mahir, *Osmanlı Minyatür Sanatı*, p. 163.
[925] Mahir, *Osmanlı Minyatür Sanatı*, p. 164.

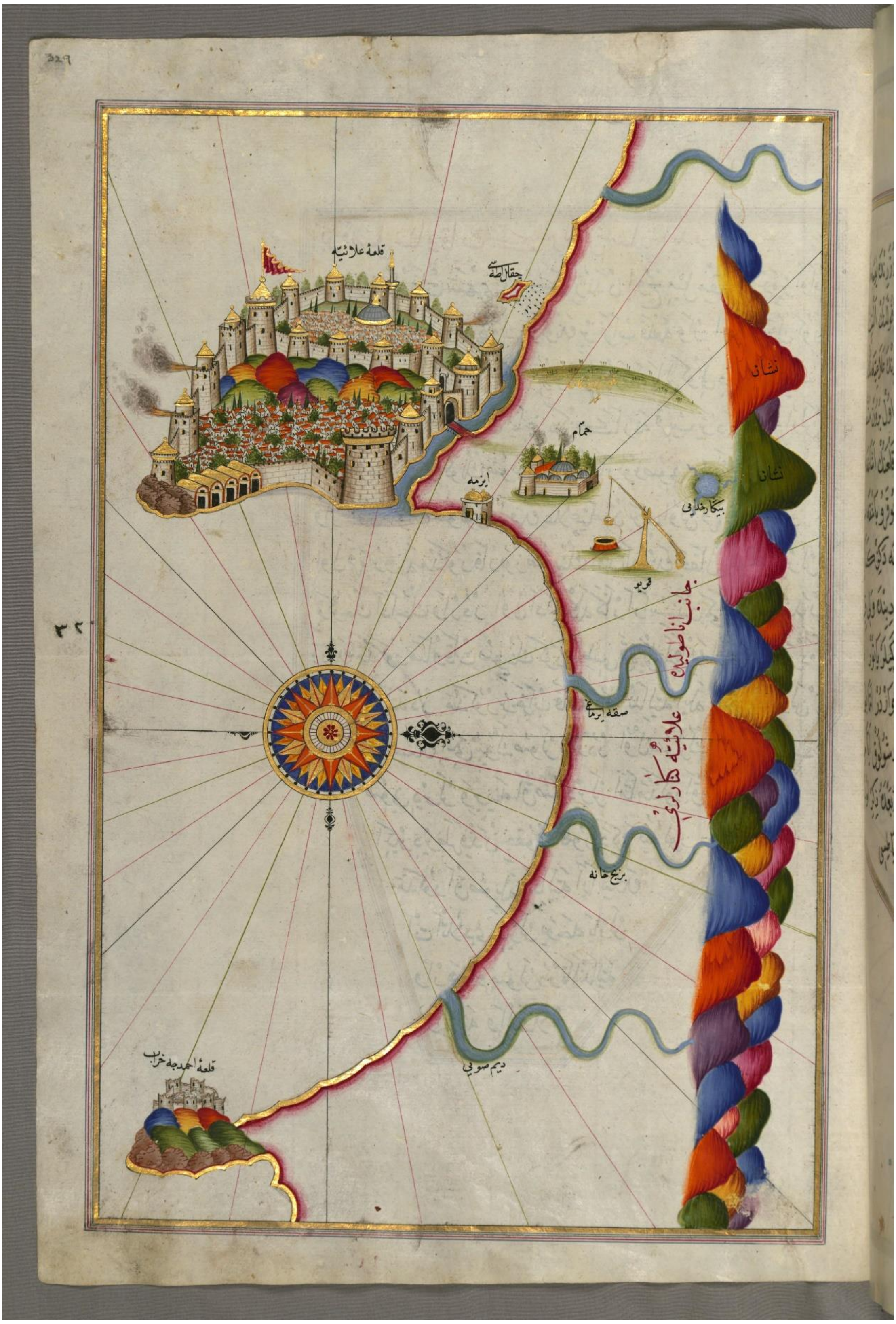

Figure 137. Piri Reis's depiction of Alanya, map style, coastal drawings, and the colours, he used, have their own unique character. Piri Reis, *Kitâb-ı Bahriyye*, 1521, https://www.loc.gov/item/2021667235/.

Figure 138. Pages depicting Lepanto Castle in Matrakçı Nasuh's work, titled *Târîh-i Sultân Bâyezid*, 1551, Topkapı Palace Museum Library, Revan Mansion, nr. 1272, vr. 21b-22a, https://islamansiklopedisi.org.tr/matrakci-nasuh.

This style of drawings was formulated by people from outside of *Nakkaşhâne*, such as Piri Reis and Matrakçı Nasuh, and they became a model. Due to the similarities of the maps to be seen in the future, *Walters Sea Atlas* (1560-1570) and *Atlas-ı Hümayûn* (Imperial Atlas, 1570), with the map of Ali Macar Reis, it seems that Ali Macar Reis's map was also used as a model. Here, in the studies on *Nakkaşhâne*, it is not mentioned that the maps in the Ali Macar Reis atlas were used for modeling. However, in this thesis, we will see in *Walters Sea Atlas* and *Atlas-ı Hümayûn* that Ali Macar Reis' maps were used as a model by the artisans on this issue, which is momentous in terms of artisanal epistemology.

9. 1. The First Cartographical Artifact from the *Nakkaşhâne* of Palace: *Walters Sea Atlas* (1560-1570)

Walters Sea Atlas is one of the flamboyant examples of 16th century Ottoman cartography. It is a nautical atlas, has very similar features to the portolan charts in the *Nautical Atlas* of Ali Macar Reis, or almost the same. However, its difference from the *Nautical Atlas* of Ali Macar Reis is that some of the portolan charts in the Walters Atlas, are not fully completed, due to the absence of place names. *Walters Sea Atlas* is located at Walters Art Gallery in Baltimore, Maryland, and United States. It got its name from where it is located.[926]

At first glance, it is obvious that *Nautical Atlas* was prepared for the Ottoman Palace. When you look at its pages, it is immediately obvious that nautical charts and Turkish miniature art are intertwined. It can be understood that we are faced with a beautiful work produced in the Palace' *Nakkaşhâne*.[927] It can be thought that it was drawn by taking the Ali Macar Reis' *Nautical Atlas,* as an example. These charts are type of portolan charts, as the *Nautical Atlas* of Ali Macar Reis. The nautical charts, in the Atlas, were drawn on two pages, and charts have dimensions of 45 x 30,1. The portolans were prepared in eight colours on Venetian parchment.[928]

The *tezhip* (illumination) and miniature art, used on the map, is evidence that the maps were made by an artist.[929] The compass roses, used especially in the atlas, were made with the art of *tezhip*. The blue colour used is using in illumination, which is traditionally an Ottoman art. Vivid and eye-catching colours, such as black, red, gold gilding, green, yellow, blue, magenta, and light green were used. Among the goods imported by the Ottomans from Venice, in the 16th century, paper and parchment came right, after silk fabric. Also, in these years, Turkish merchants were staying in a house,

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926 Özdemir*, Osmanlı Haritaları*, p. 110.

927 *Nakkaşhâne:* These are the workshops, where painters, pencil workers, book embroiderers such as musavvir, illuminator, bookbinder, precious stone carvers, embroiderers, stonemasons, and glass makers gather.

928 Sarıcaoğlu, *Osmanlı Tarihi Haritaları ve Tarihi Coğrafya Eserleri*, p. 65.

929 Özdemir*, Osmanlı Haritaları*, p. 110.

Tezhip is the decoration art, applied by using crushed gold leaf and various colours in the decoration of manuscripts, plates and murakkas.

in the Canaregio district, in Venice. He also had a business and stores in Rialto.[930] It can be said that the parchment, produced in Venice, was used in *Nautical Atlas*, and it was drawn in the *Nakkaşhâne,* in the Ottoman palace. Again, as in Ali Macar Reis *Nautical Atlas*, there is a portolan chart, including the whole world at the end of the atlas. There are 17 wind roses in all, and the direction lines from these wind roses cover the entire portolans surface. On the charts, two full and two half four wind roses are large and ornate.[931] There are a total of eight portolan charts, in *Nautical Atlas*: [932]

[930] Özdemir*, Osmanlı Haritaları*, p. 110.
[931] Özdemir, *Osmanlı Deniz Haritaları ve Ali Macar Reis Atlası*, p. 131.
[932] Özdemir*, Osmanlı Haritaları*, p. 110.

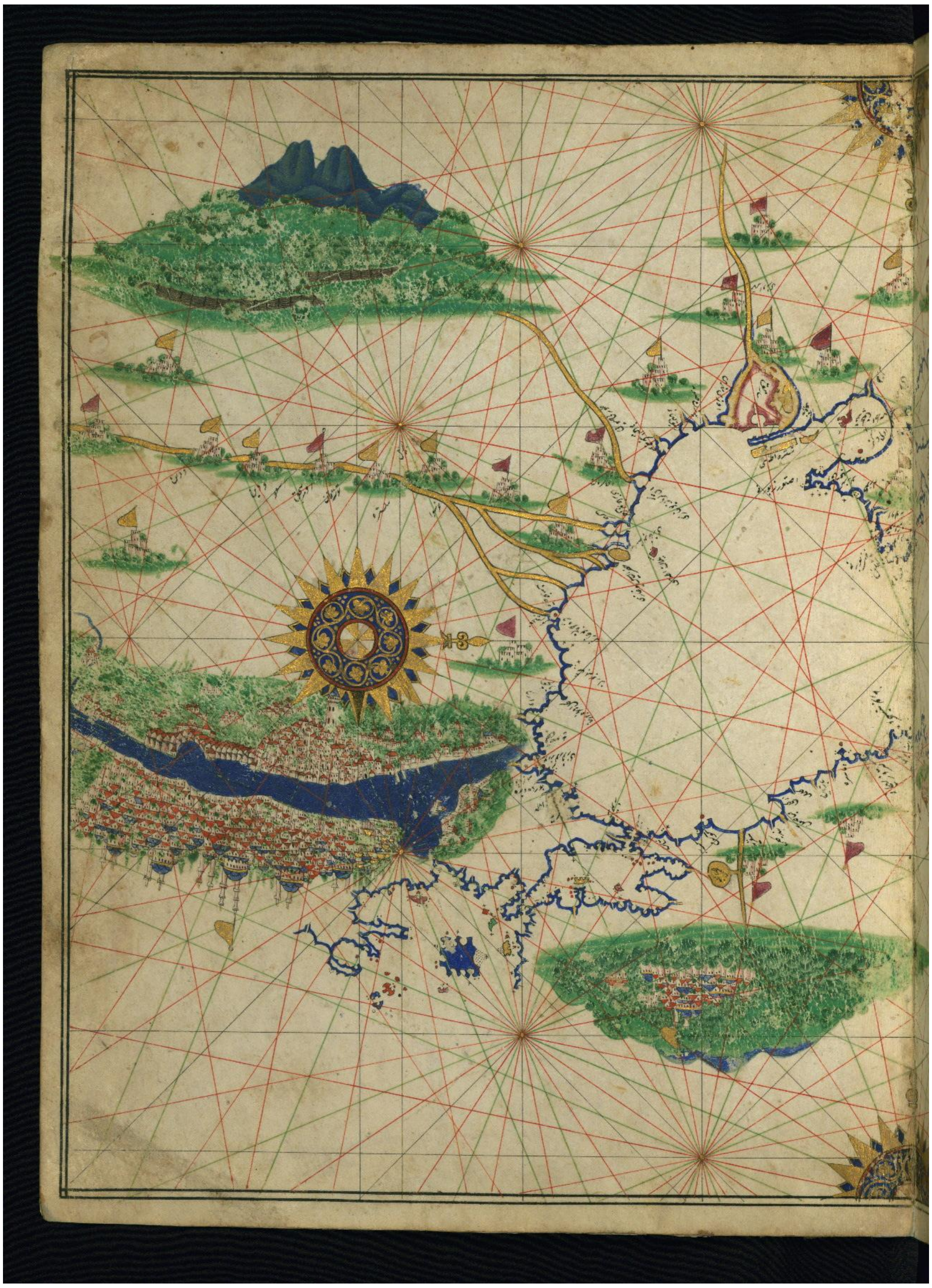

Figure 139. Western part of the Black Sea and the city of Istanbul, *Walters Sea Atlas*, dated 1560-1570. The detailed and skilful depiction of the cities and the depiction of the compass rose with the art of illumination, which is important in the Ottoman tradition, prove that this map was made by the artisans of the Ottoman *Nakkaşhâne*. https://www.thedigitalwalters.org/Data/WaltersManuscripts/W660/data/W.660/sap/W660_000021_sap.jpg.

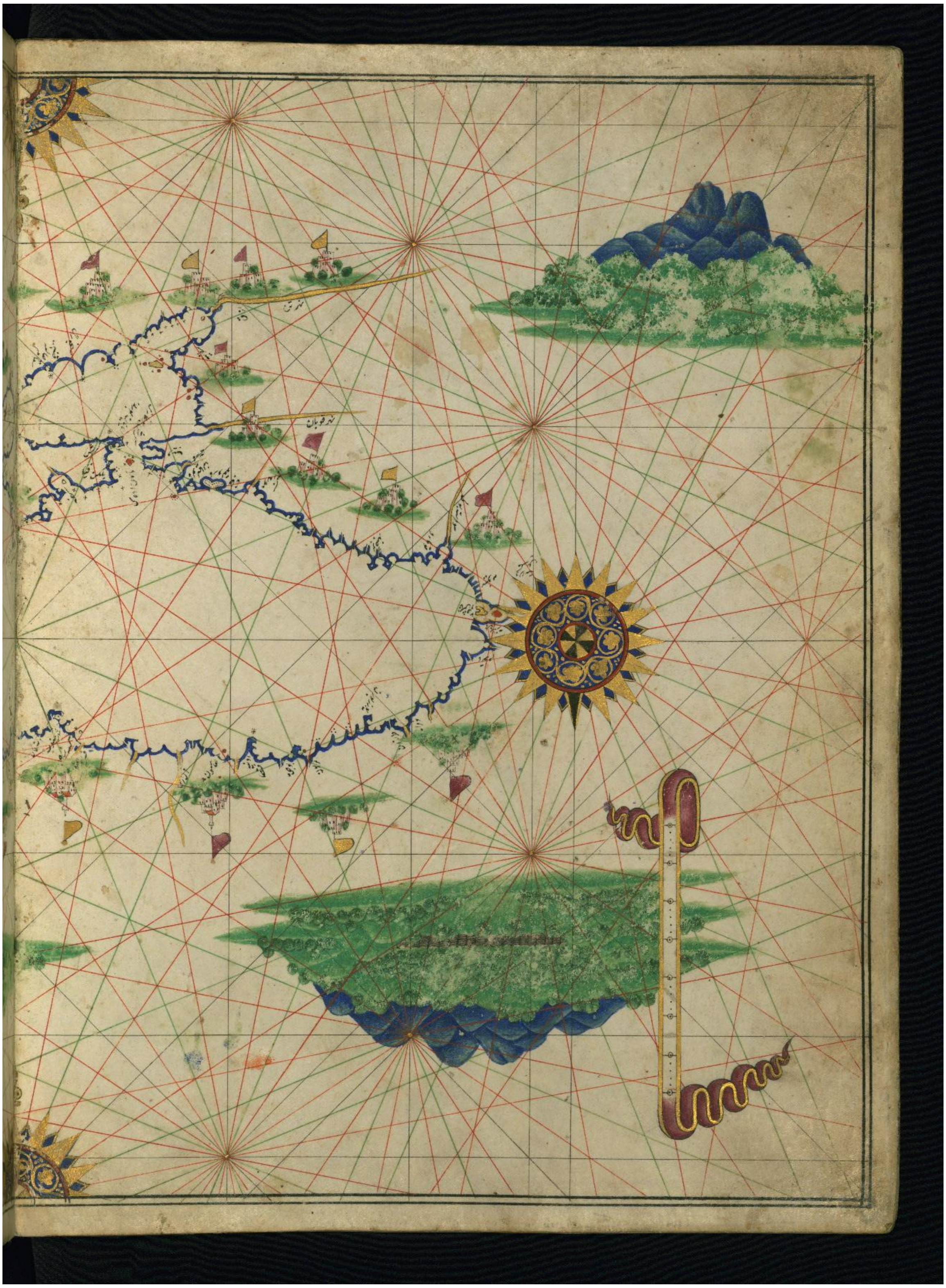

Figure 140. Black Sea and the Marmara, *Walters Sea Atlas*, dated 1560-1570. The gold and blue colours, are in the compass rose, are widely used in illumination art. At the same time, the subtleties in the city depictions, and the punctuations on the drawn mountain show that it is the work of an artist. https://www.thedigitalwalters.org/Data/WaltersManuscripts/W660/data/W.660/sap/W660_000020_sap.jpg.

This chart, which shows the same cities and places as portolan chart of the Black Sea in the *Nautical Atlas* of Ali Macar Reis, is much more detailed and artistically more prominent. When we examine the chart, we see much more stylized miniature city and castle drawings. Due to its much more ornate and detailed drawings, it is seen as an instrument literally crafted for the palace. Again, as in Ali Macar Reis' chart, the image of steep mountains and forest is shown very realistically. Likewise, the settlements on the Anatolian and Thrace coasts bear their current names (Fig. 139-140).[933]

Likewise, the Aegean and Eastern Mediterranean chart in the Atlas is the portolan chart covering the Aegean Sea, Greece, the southwestern and southern coasts of Anatolia, Cyprus, Syria, Palestine, and Egypt, as in the Ali Macar Reis *Atlas* (Fig. 141-142). The portolan chart is an invaluable guide for sailors traveling from Istanbul to the important ports of Egypt, Cyprus, and Syria. The drawings are much more detailed and artistic, like others. The chart, which shows quite a lot of cities and ports, reveals that it is a portolan that contains very beneficial information geographically.[934]

[933] Özdemir, *Osmanlı Deniz Haritaları ve Ali Macar Reis Atlası*, p. 127.
[934] Özdemir, *Osmanlı Deniz Haritaları ve Ali Macar Reis Atlası*, p. 127.

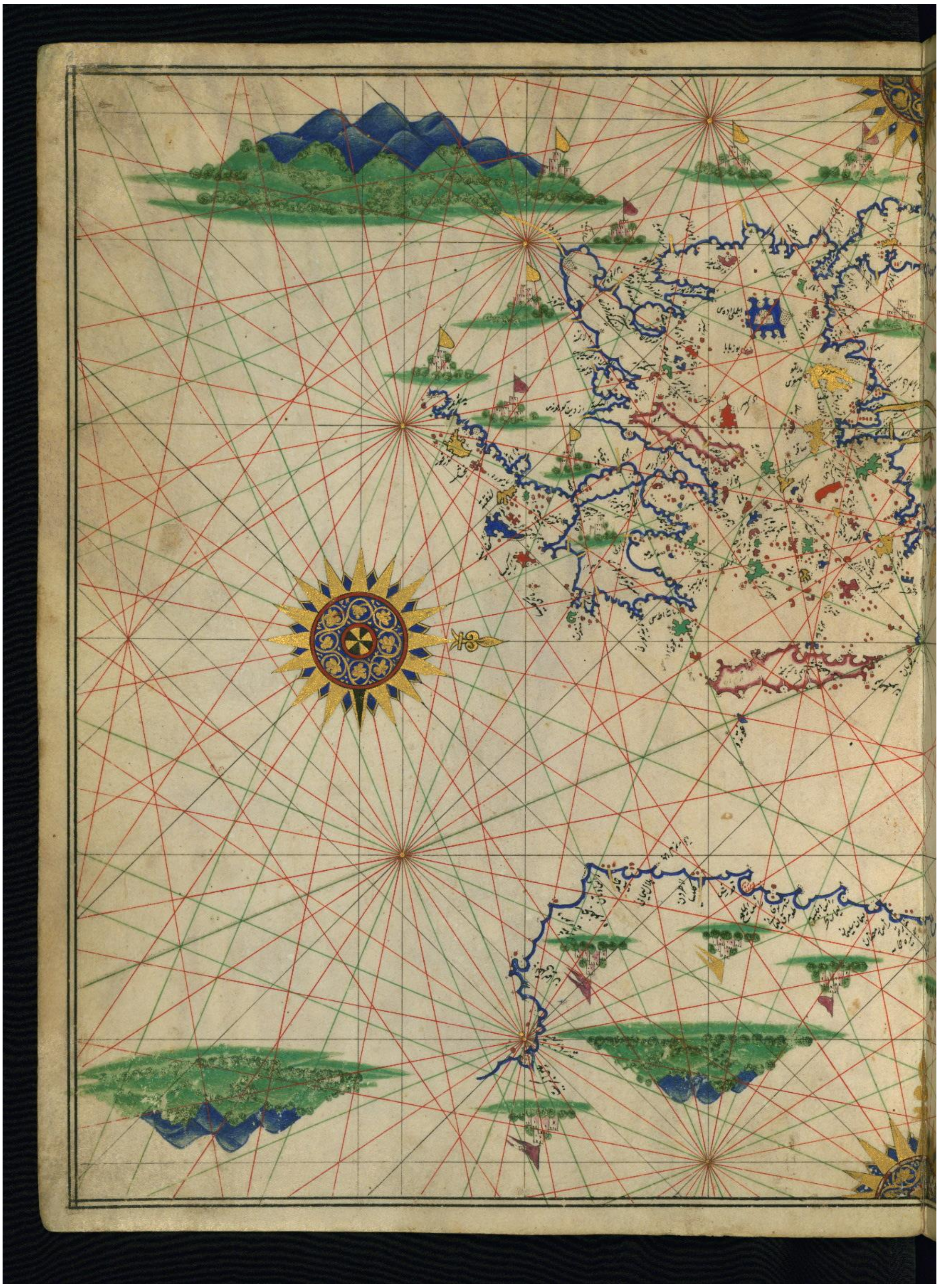

Figure 141. Southern Greece and the Aegean Sea, *Walters Sea Atlas,* dated 1560-1570. In the depictions of mountains and cities, the dotting method, which is the rules of miniature art, was used, and the coasts were painted in different colours to distinguish them. https://www.thedigitalwalters.org/Data/WaltersManuscripts/W660/data/W.660/sap/W660_000019_sap.jpg.

Figure 142. Eastern Mediterranean and the Aegean Sea, *Walters Sea Atlas*, dated 1560-1570. The houses detailed one by one in the city drawings, and the mosques depicted in the cities, show that only an artist can make these details.
https://www.thedigitalwalters.org/Data/WaltersManuscripts/W660/data/W.660/sap/W660_000018_sap.jpg.

This chart showing the central Mediterranean and Italy is a portolan chart, and Tunisia, Sicily, Italy, and the Adriatic Gulf (Fig. 143-144). The chart has been detailed so that Turkish ships departing from Ottoman ports follow a safe route to and from Tunisia and Algerian ports. It appears to be drawn very close to reality. Again, as in the portolan of Ali Macar Reis, the place names were written in Ottoman Turkish.[935]

Figure 143. Central Mediterranean with Italy and the Adriatic Sea, *Walters Sea Atlas*, dated 1560-1570. The colours and shading, used in mountain drawings, are details that can only be seen in miniature art.
https://www.thedigitalwalters.org/Data/WaltersManuscripts/W660/data/W.660/sap/W660_000017_sap.jpg.

[935] Özdemir, *Osmanlı Deniz Haritaları ve Ali Macar Reis Atlası*, p. 129.

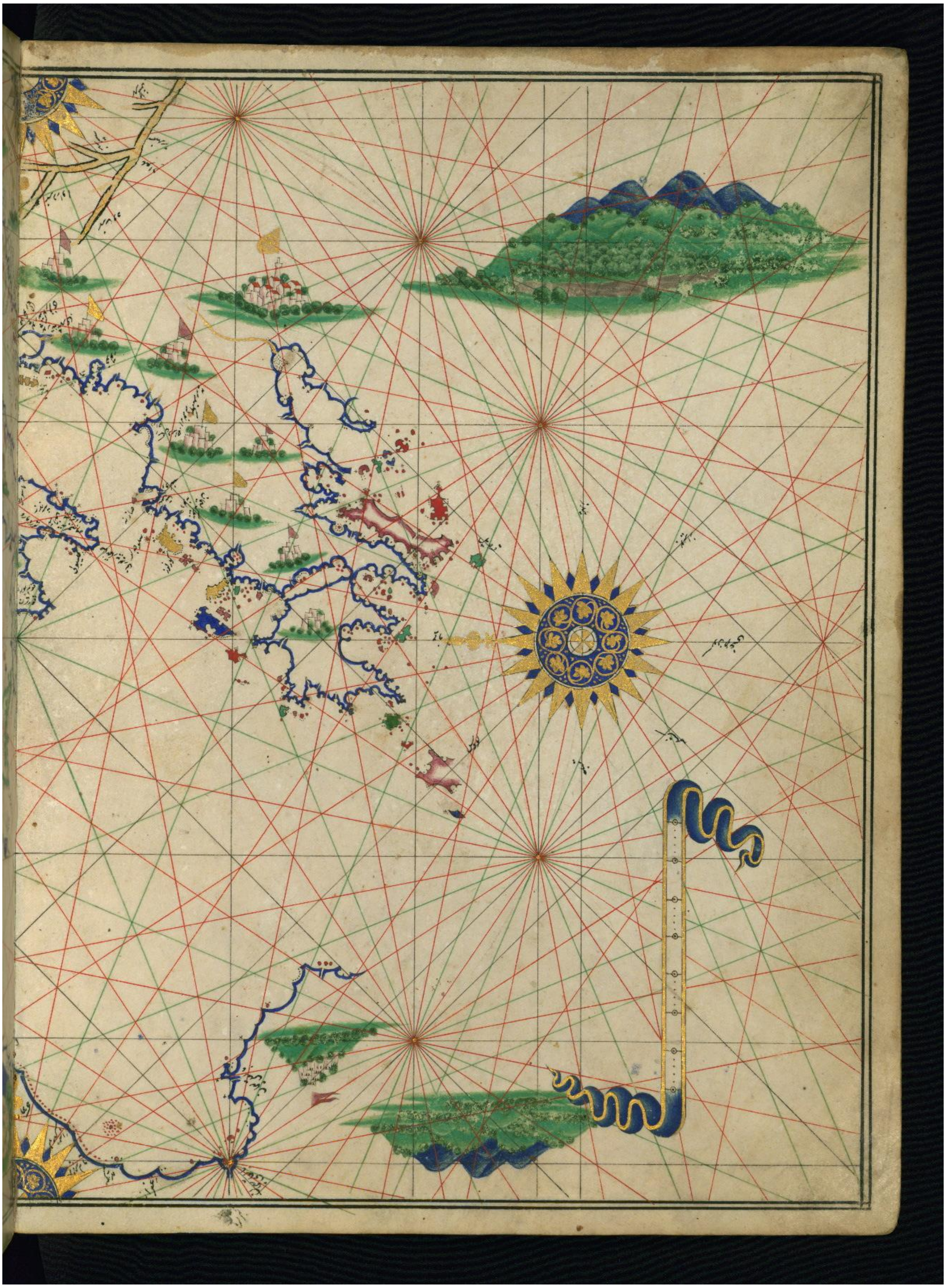

Figure 144. Central Mediterranean and the coastline of Greece, *Walters Sea Atlas*, dated 1560-1570. There are cities drawn in detail on the map, and two half and one full compass rose. https://www.thedigitalwalters.org/Data/WaltersManuscripts/W660/data/W.660/sap/W660_000016_sap.jpg.

This chart showing the Western Mediterranean and Spain is very close to the original and perfect drawing of the Western Mediterranean, as in the Ali Macar Reis *Atlas* (Fig. 145-146). Miniatures of cities and castles in Algeria, Spain and France are seen more intensely. Likewise, places such as Karamanlı Island off the Strait of Gibraltar, Koyunluca Island in the south of Ibiza from the Balearic Islands, Üçadalar off the city of Toulon in France, Caprera, Asinera between Corsica and Sardinia Island, and San Pietro in the southwest of Sardinia are shown in detail on this chart. The portolan is drawn in very vivid colours.[936]

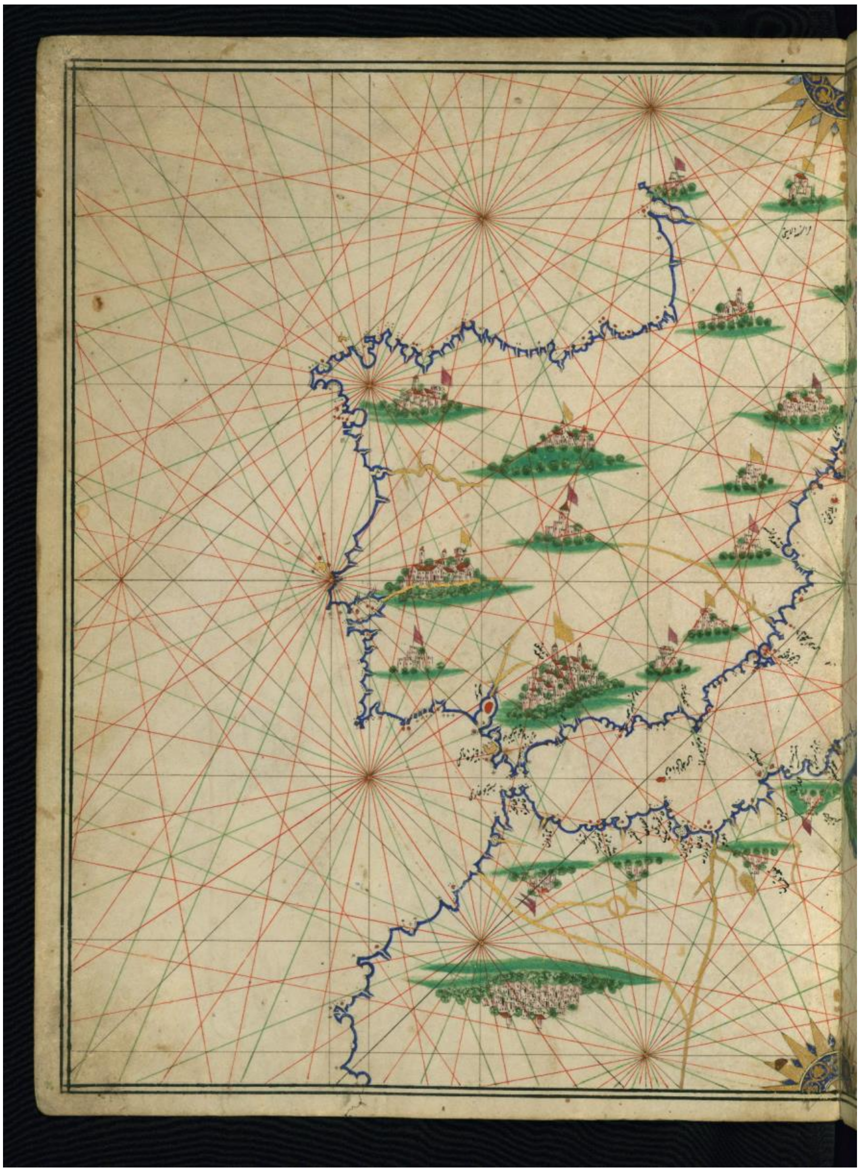

Figure 145. Iberian Peninsula, *Walters Sea Atlas*, dated 1560-1570. There are more detailed city depictions are included in this map. https://www.thedigitalwalters.org/Data/WaltersManuscripts/W660/data/W.660/sap/W660_000015_sap.jpg.

[936] Özdemir, *Osmanlı Deniz Haritaları ve Ali Macar Reis Atlası*, p. 129.

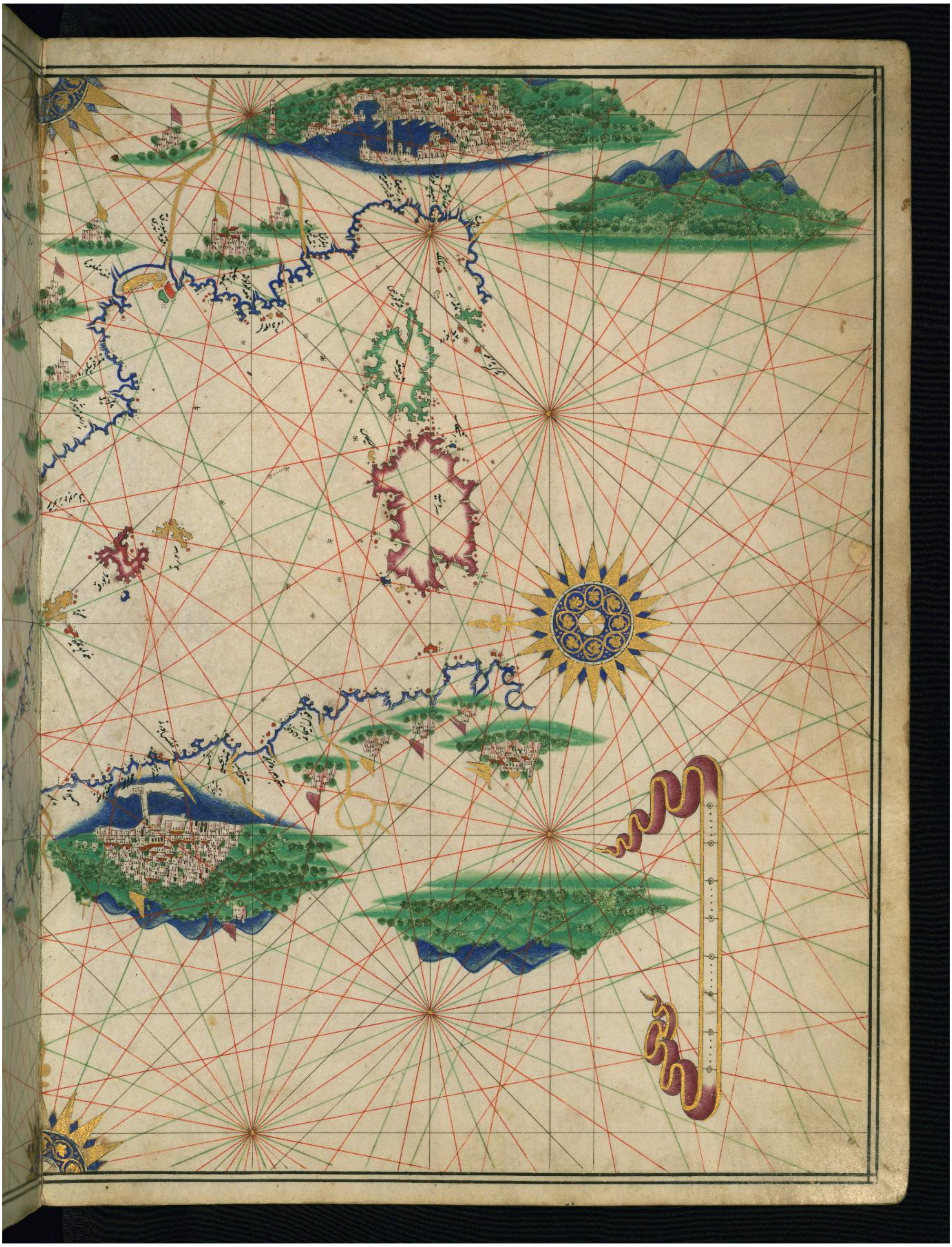

Figure 146. Western Mediterranean Sea with the coastlines of France and North Africa, *Walters Sea Atlas*, dated 1560-1570. Cities are depicted in detail, along with places of worship, and compass roses are also included.
https://www.thedigitalwalters.org/Data/WaltersManuscripts/W660/data/W.660/sap/W660_000014_sap.jpg.

On this portolan, which shows the British Isles, France, and the Baltic Sea, the region of the British Isles does not seem very successful (Fig. 147-148). It can be said that there is a lack of information about these coasts, as Ottoman sailors were rarely seen in these regions, as in the Ali Macar Reis's *Atlas*. The place names, on the chart, do not resemble today's names, and it can be concluded that these regions were quoted from other foreign nautical charts.[937]

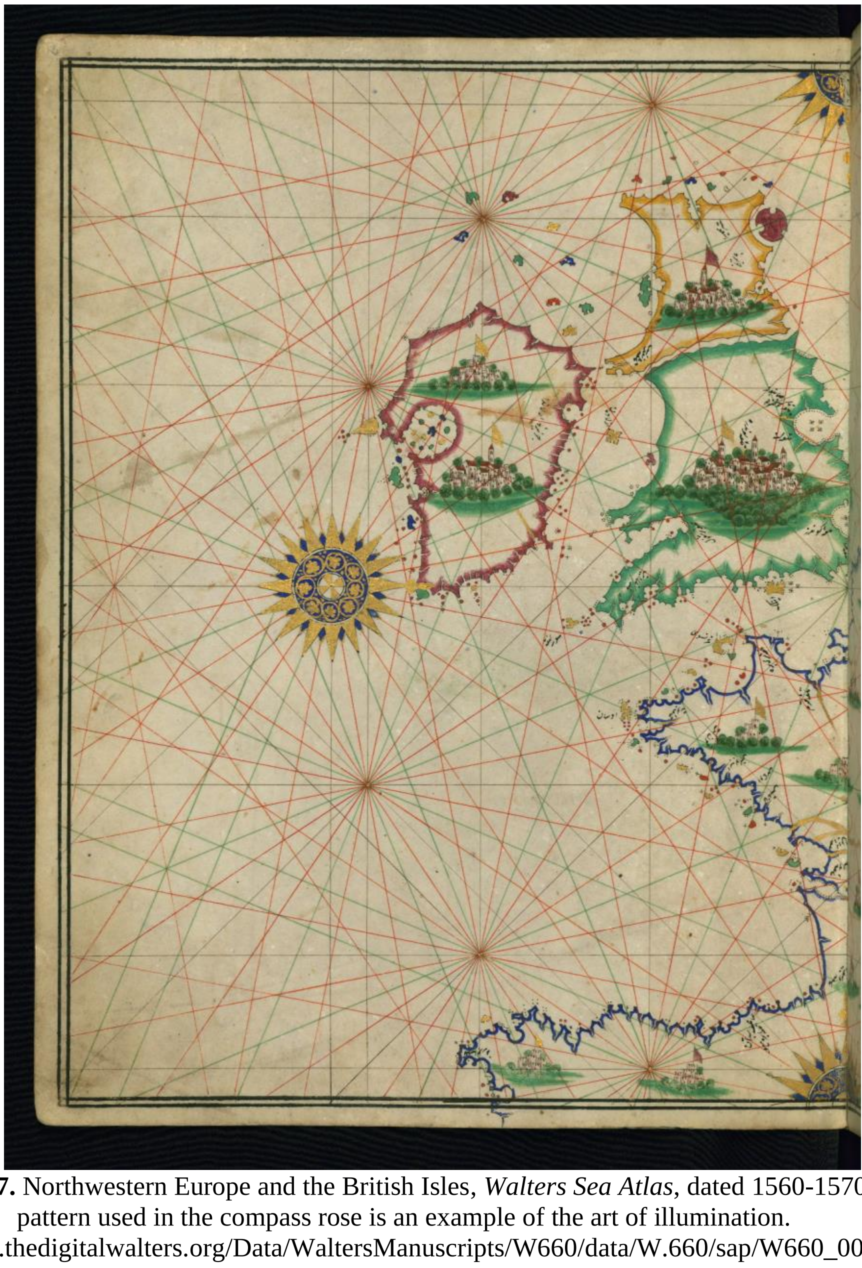

Figure 147. Northwestern Europe and the British Isles, *Walters Sea Atlas*, dated 1560-1570. The pattern used in the compass rose is an example of the art of illumination. https://www.thedigitalwalters.org/Data/WaltersManuscripts/W660/data/W.660/sap/W660_000013_sap.jpg.

[937] Özdemir, *Osmanlı Deniz Haritaları ve Ali Macar Reis Atlası*, p. 131.

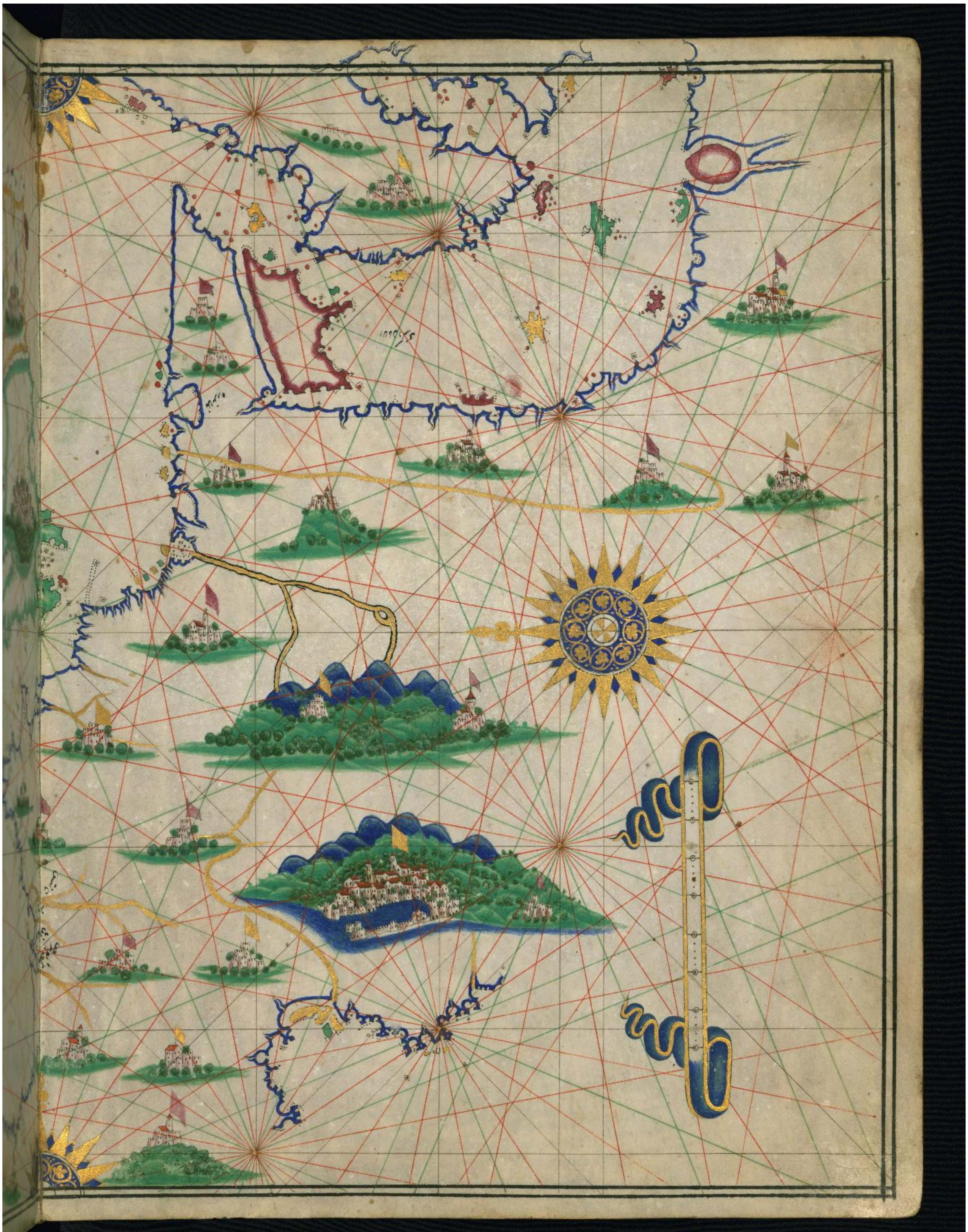

Figure 148. France and northwestern Europe, *Walters Sea Atlas*, dated 1560-1570. As in the other maps in the atlas, city depictions and compass roses have the details that an artisan could do. https://www.thedigitalwalters.org/Data/WaltersManuscripts/W660/data/W.660/sap/W660_000012_sap.jpg.

When we come to these charts showing the regions of Europe, the Mediterranean and North Africa, it can be concluded that the atlas is not complete. Because this and subsequent charts seem to be much simpler and incomplete than the general view of the atlas (Fig. 149-150). Unlike the Ali Macar Reis's *Atlas*, neither place names were written on the portolan, on which these regions were drawn, nor were they stylized like the cities on other charts.

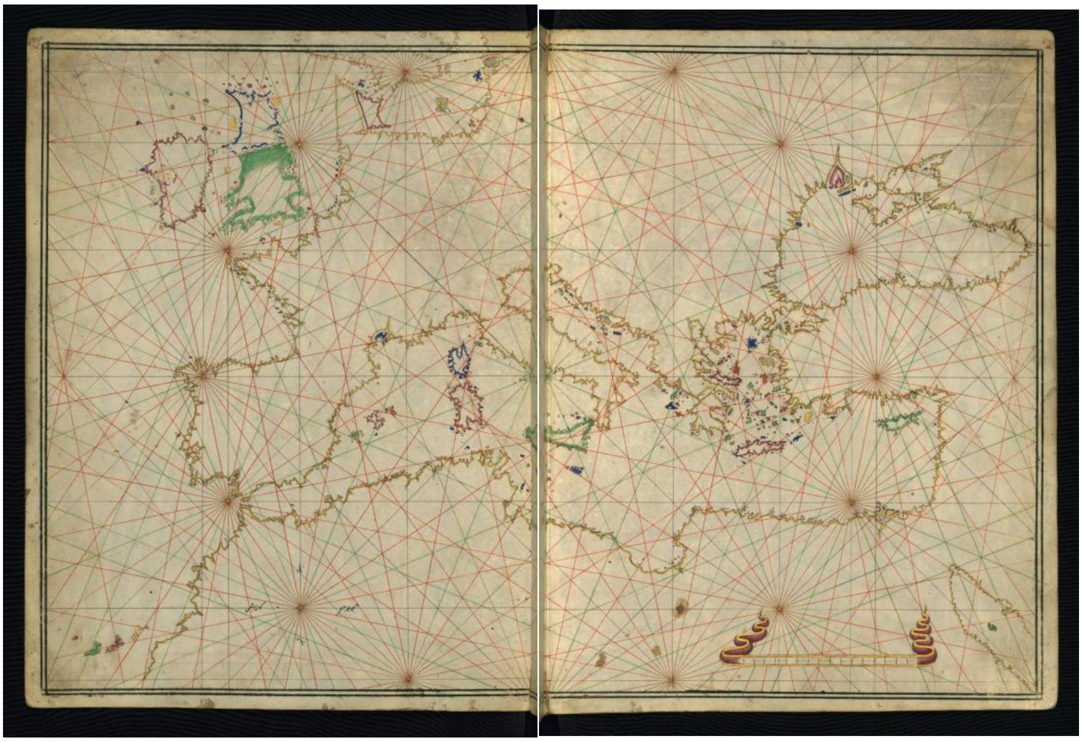

Figure 149-150. Western Mediterranean and Western Europe and Eastern Mediterranean and the Caspian Sea, *Walters Sea Atlas*, dated 1560-1570. Unlike other maps in the atlas, this map does not have any detailing, city descriptions or compass roses. At the same time, place names were not written down. So, it is clear that the map is incomplete. https://www.thedigitalwalters.org/Data/WaltersManuscripts/W660/data/W.660/sap/W660_000011_sap.jpg.

Likewise, the chart of South Asia and the Indian Ocean is incomplete (Fig. 151-152). However, very different from the Ali Macar Reis Atlas, portolans of South Asia and the Indian Ocean were intended to be drawn. The drawings are completed, but place names and cities are not specified. There are not miniatures or depictions.

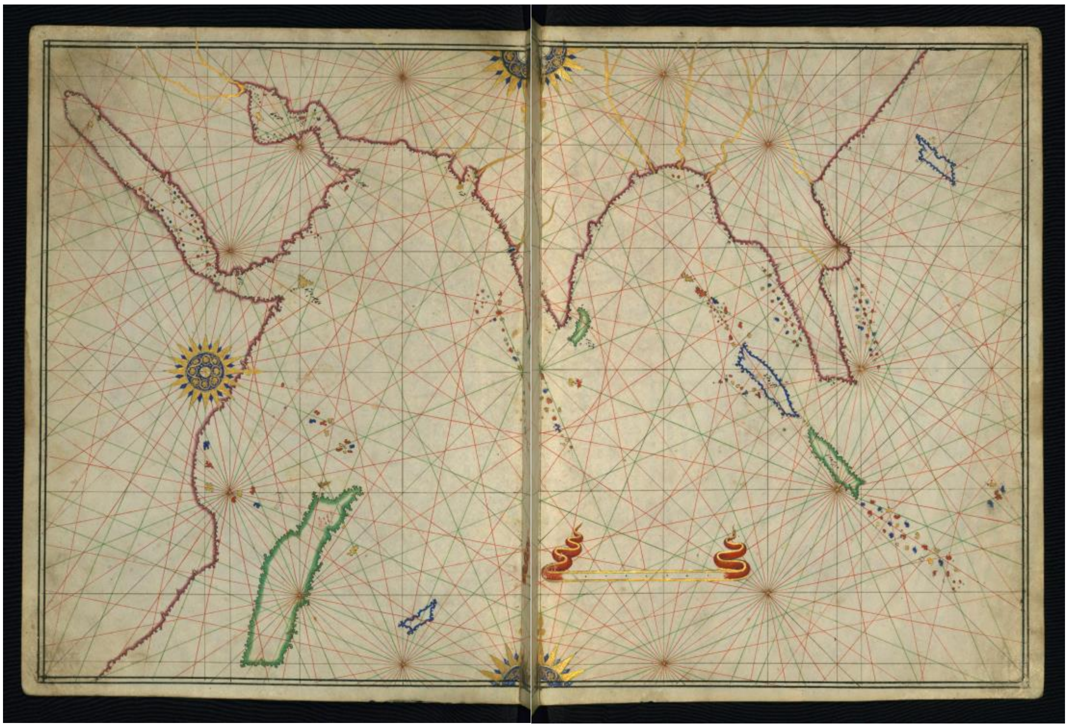

Figure 151-152. East Africa and the Arabian Peninsula and Indian Ocean and South Asia, *Walters Sea Atlas*, dated 1560-1570. There is no detail on the map other than two halves and one full compass roses and a scale. At the same time, place names are not included. It is clear that this map is also incomplete. https://www.thedigitalwalters.org/Data/WaltersManuscripts/W660/data/W.660/sap/W660_000011_sap.jpg.

The world map is located at the end of the Atlas, as in the Ali Macar Reis' Atlas (Fig. 153-154). The world maps, which are generally at the beginning of the atlases, are at the end of these two atlases. This once again reinforces the idea that *Walters Sea Atlas* was drawn, after the Ali Macar Reis portolan and copied from this chart. All lands, on the world map, are coloured green. No place name is specified. This shows us that the world map is also incomplete.

Figure 153-154. Left half of a world map, showing the Americas and Right half of a world map, showing Africa and the Far East, *Walters Sea Atlas*, dated 1560-1570. Although the entire world map at the end of the atlas was drawn, place names were not written, and the map was not completed. https://www.thedigitalwalters.org/Data/WaltersManuscripts/W660/data/W.660/sap/W660_000007_sap.jpg.

Except for the numbers 6 and 7, the charts are very similar to the Ali Macar Reis' *Nautical Atlas*, in terms of the area they cover. Number 7 is a completely different chart, because there is East of Africa, Madagascar, Arabian Peninsula, India, and South Asian coasts in this portolan. The source of this chart was from the book of Seydi Ali Reis. He presented some of his charts and his work, called *Muhit* (Ocean) to the Sultan, as was customary, when he was admitted to the presence of Suleiman the Magnificent, in Edirne. And we know that also Piri Reis made portolans of this region. Those, who prepared the atlas, should have added the chart of South Asia, which is not in the Ali Macar Reis' *Nautical Atlas*, to give more information about the world to the interested parties. The Ottomans' struggle, with the Portuguese for the control of the eastern trade routes in the Indian seas, made it necessary to make charts of these regions. It can be said that *Walters Sea Atlas* was made in the years 1570-1575, right after Ali Macar Reis' *Nautical Atlas*.[938]

[938] Özdemir, *Osmanlı Deniz Haritaları ve Ali Macar Reis Atlası*, p. 92.

This atlas, which was made in the *Nakkaşhâne* and is very similar to the Ali Macar Reis' *Nautical Atlas*, is much more detailed and much more beautiful because it was made by artists, who are experts in drawing. When we evaluate these portolans, which we do not know by whom or by whom the drawing was made, we see that this atlas is an instrument, made by a sailor with calculations and directions. It is conceivable that his drawings may have been made by a team of artists, under the direction of a sailor, in *Nakkaşhâne*. It is possible that it was made by using Ali Macar Reis' *Atlas* and other charts, while creating the Atlas. However, it is obvious that this atlas does not only consist of drawings made with artistic knowledge. From the point of view of rhumb lines, directions and accuracy, it can be concluded that the atlas was made under the guidance of a sailor or sailors.

9. 2. The Second Cartographical Artifact from the *Nakkaşhâne* of Palace: *Atlas-ı Hümayûn* (Imperial Atlas) (1570)

There is one of the rare Ottoman atlases that have survived from the 16th century, on the shelves of the Istanbul Archaeology Museum Library. Until 1984, Ali Macar Reis' charts were the only known Ottoman charts in atlas format. However, in 1984, the historian of the Ottoman empire and the American Thomas D. Goodrich, who had worked in the Ottoman archives for years, discovered another atlas in the Istanbul Archaeology Museum, which he tentatively named *Atlas-ı Hümayûn* (Imperial atlas).[939] *Atlas-ı Hümayûn*, which is a nautical atlas, was a work produced in *Nakkaşhâne*, for the palace. Atlas's size is 35 x 53 cm.[940] The front and back, covers of the leather binding, were decorated with embellishments. The side paper, inside the front and back, covers of the linkings, occurred of marbling paper, the usual material of Ottoman bindings. *Atlas-ı Hümayûn* consisted of ten leather parchment sheets. The charts cover an area of 53 x 70 cm on two facing pages. With these dimensions, it is quite large compared to Ali Macar Reis' *Nautical Atlas* and Walters Sea Atlas.[941] It was produced right, after Ali Macar Reis' *Nautical Atlas*. The *Atlas-ı Hümayûn* was used frequently in the palace, and especially, it is estimated that it was used in the education of the princes.[942]

Eight of the charts, in the nautical atlas, are typical portolan charts. In these charts, the traditional drawing rules of the portolans were applied exactly. Charts were drawn in eye-catching colours.[943] Except for the world map, black, red, gold gilding, dirty yellow, light, and dark green, magenta, and orange colours were used in the portolans. The points, where the land meets the sea, and all the edges were be shaded in red. The islands were painted in vivid colours, as in Ali Macar Reis' *Nautical Atlas*.

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939 Soucek, "Islamic Charting in the Mediterranean," p. 282.
940 Özdemir, *Osmanlı Haritaları*, p. 112.
941 Özdemir, *Osmanlı Deniz Haritaları ve Ali Macar Reis Atlası*, p. 98.
942 Murat Tanrıkulu, *Haritaya Davet* (Istanbul: Yeditepe Yayınevi, 2017), p. 153.
943 Sarıcaoğlu, *Osmanlı Tarihi Haritaları ve Tarihi Coğrafya Eserleri,* p. 65.

There are seventeen wind roses, and direction lines dispersed from them on all portolan charts.[944] The nine portolan charts included, in the nautical atlas, are as follows:

1. Marmara Sea and Black Sea (Fig. 155-156),
2. Eastern Mediterranean and Aegean (Fig. 157-158),
3. Central Mediterranean and Southern Italy (Fig. 159-160),
4. Western Mediterranean and Spain (Fig. 161-162),
5. Western Europe, the English Channel, and the British Isles (Fig. 163-164),
6. Aegean Sea (Fig. 165-166),
7. Greek Peninsula, Peloponnese, and Southern Italy (Fig. 167-168),
8. World Map (Fig. 169-170),
9. Europe, Mediterranean, Middle East, and North Atlantic (Fig. 171-172).[945]

The chart showing the Black Sea and the Sea of Marmara is a portolan chart, covering their ports and the lands surrounding these seas (Fig. 155-156). Although it looks like a copy of the other two atlases, it is made much simpler, unlike them. And, as can be understood, it is made to be used actively. Every chart, in the atlas, is drawn very simply. Place names are written in a very fine. In general, cities and ports were written, and city descriptions were not made. Some charts of the atlas are incomplete. Drawings have been made, but place names are missing. The portolan charts, which have the features mentioned above, included in the atlas are as follows:

[944] Özdemir, *Osmanlı Deniz Haritaları ve Ali Macar Reis Atlası*, p. 98.
[945] Özdemir, *Osmanlı Haritaları*, p. 112.

Figure 155-156. The Portolan Chart of Marmara Sea and Black Sea, *Atlas-ı Hümayûn*, dated 1570. The map, which appears to belong to an artist based on the details on it, is drawn more simply than the previous Walters Sea Atlas. Istanbul Archaeology Museum Library, Nu. 1621.

Figure 157-158. Aegean Sea and Eastern Mediterranean, *Atlas-ı Hümayûn*, dated 1570. The details of the city drawings are expressed in very small depictions on the map, and an attempt has been made to make the coasts, stand out by separating them from each other with colours. Istanbul Archaeology Museum Library, Nu. 1621.

Figure 159-160. Central Mediterranean and Southern Italy, *Atlas-ı Hümayûn*, dated 1570. Place names on maps are relatively fewer than others. Istanbul Archaeology Museum Library, Nu. 1621.

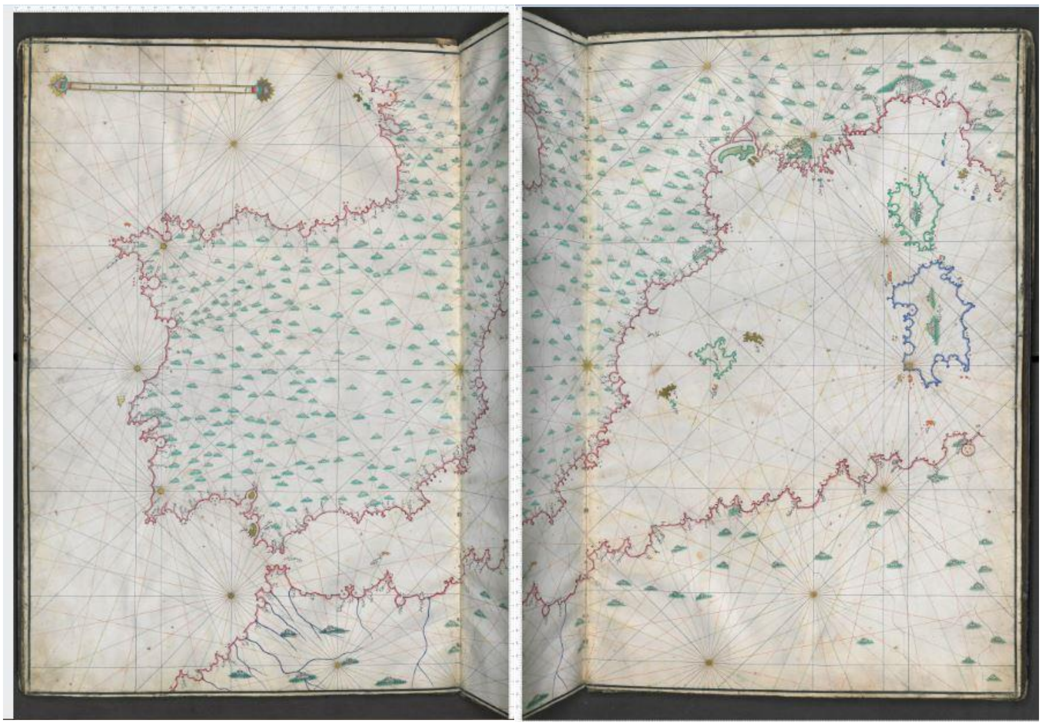

Figure 161-162. Spain and Western Mediterranean, *Atlas-ı Hümayûn*, dated 1570. More cities depicted with green areas are given here. Istanbul Archaeology Museum Library, Nu. 1621.

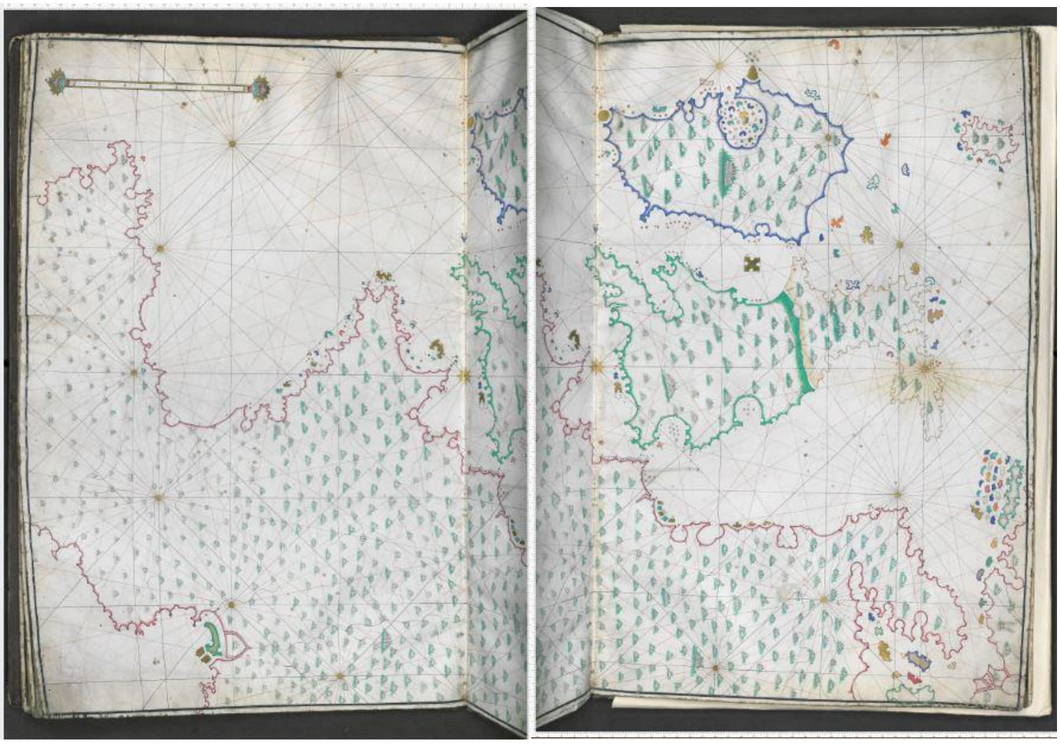

Figure 163-164. English Channel, British Isles and Western Europe, *Atlas-ı Hümayûn*, dated 1570. This map contains more cities and places that are intended to be easier to distinguish with colours. For example, the islands are coloured with various paints. This shape of depiction reminds us of Piri Reis' style. Istanbul Archaeology Museum Library, Nu. 1621.

Figure 165-166. Aegean Sea and Marmara Sea, *Atlas-ı Hümayûn*, dated 1570. The islands are coloured to make them more visible to separate from the shores. Istanbul Archaeology Museum Library, Nu. 1621.

Figure 167-168. Southern Italy, Greek Peninsula and Peloponnese, *Atlas-ı Hümayûn*, dated 1570. Coasts and islands are highlighted without details of cities. Istanbul Archaeology Museum Library, Nu. 1621.

Figure 169-170. Left and Right Part of World Map, *Atlas-ı Hümayûn*, dated 1570. The world map is drawn as it is in the Walters Sea Atlas, but different colours are used. However, place names are completed, unlike Walters Sea Atlas. Istanbul Archaeology Museum Library, Nu. 1621.

Figure 171-172. Europe, Mediterranean, North Atlantic and Middle East, World Map, *Atlas-ı Hümayûn*, dated 1570. The world map, placed at the end of the atlas, is simply depicted with only place names and coasts. Istanbul Archaeology Museum Library, Nu. 1621.

Except for the portolan charts numbered seven (Fig. 167-168) and nine (Fig. 171-172), all of them are almost identical to the Ali Macar Reis' *Nautical Atlas*. The first five nautical charts contain simple city images, representing settlements, these were drawn very often in Europe. Images of some momentous cities are larger than others. These simple drawings are created in black and green. The borders of the countries were not included in the portolan charts. Since the aim is not to draw a political chart, this should not have been necessary.[946] All portolan charts are in mile scale. Another feature of the scale, frame drawn at the bottom left of the ninth portolan chart is that only the names of the settlements, on the Black Sea coast, are written. These two clues give the impression that this portolan chart is incomplete. The ninth portolan is interesting in that it covers the areas outside the borders of the traditional portolan charts, made in the Mediterranean.[947] Its western borders start from the Island of Greenland. In the east, the borders extend to the Persian Gulf and the Strait of

[946] Özdemir, *Osmanlı Deniz Haritaları ve Ali Macar Reis Atlası*, p. 98.
[947] Özdemir, *Osmanlı Deniz Haritaları ve Ali Macar Reis Atlası*, p. 98.

Hormuz. The portolan chart includes Central Africa to the south, and most of the Scandinavian Peninsula to the north. [948]

The World Map of the nautical atlas is similar to the World Map of Ali Macar Reis. However, the rivers were not clearly drawn in this. Only rivers, flowing into the Caspian Sea, and some rivers, in South Asia, are vaguely shown. On the chart, the land is coloured yellow, the equator and the tropics are drawn. It is immediately obvious that *Atlas-ı Hümayun* was traveling from hand to hand in the palace and was frequently looked at.[949] We would not be wrong, if we say that *Nautical Atlas* was prepared to be used in the education of princes. The date of construction was not registered. It is an interesting example of 16th century nautical charts with its typical features. It is understood that it was built right, after the Ali Macar Reis' *Nautical Chart*, dated 1567. Like the Walters Sea Atlas, it can be dated between 1570-1575.[950]

As you can see, *Atlas-ı Hümayûn*, which is very similar to the other two atlas, I mentioned before, the Ali Macar Reis *Nautical Atlas* and Walters Sea Atlas. It must have been drawn by an artisan, who has knowledge of cartography, navigation, and calculus, as I said in previous chapter on Walters Sea Atlas. If it is used in the education of the princes, it can be thought that the portolan charts, in this atlas, must have been drawn with calculations. In this period, it can be said that cartographic education progressed and transferred.

It can be thought that the maps in the *Atlas-ı Hümayûn* seen in this section, were made by an artisan, by taking details from the *Ali Macar Reis*'s Atlas and the Piri Reis' *Kitâb-ı Bahriyye*. The island details and colouring of the maps, which are almost identical in shape to the maps in the Ali Macar Reis' *Atlas*, point to Piri Reis's book.

However, colour differences indicate that it was made by another artisan. Especially the distinction of the world map, at the end of the atlas, is proof that it was made, according to the taste of an artisan. Because the gold colour is mostly used by illumination or miniature artisans. Gold details are not included much in Piri Reis' book and Ali Macar Reis' *Atlas*, analysed above. All these details, given above, are signs

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[948] Özdemir, *Osmanlı Deniz Haritaları ve Ali Macar Reis Atlası*, p. 98.
[949] Özdemir, *Osmanlı Haritaları*, p. 114
[950] Özdemir, *Osmanlı Deniz Haritaları ve Ali Macar Reis Atlası*, p. 104.

that the *Atlas-ı Hümayûn* was depicted in a more simplified style by an artisan in *Nakkaşhâne*.

Conclusions

It can be seen that *Nakkaşhane* is a distinct institution from *Tersâne-i Âmire*. However, it works with the same system. Again, talented and experienced artisans are called, and work at *Nakkaşhâne*. At the same time, artisans are trained in this institution. With these professions requiring a certain skill and interest, it seems that cartography has now become a profession.

It is understood that with the works of Piri Reis, the tradition of new and original topographic city depictions that the Ottoman art of depiction, gained in the 16th century, was continued. Especially the works of Piri Reis and the Ali Macar Reis' *Nautical Atlas*, which broke new ground in the Ottoman book painting tradition, are the most influential works in the formation of this tradition.[951] It seems that the maps that were artistically incorporated into the modelling, made from the Ali Macar Reis' *Nautical Atlas*, were now prepared by the *Nakkaşhâne*.

Conclusions of Part 3

The definition of piracy in the Ottoman world seen in this part, and the examination of the works produced by the artisan pirates Piri Reis, Seydi Ali Reis, and Ali Macar Reis, who are classified as Zilsel's superior artisans, with their experience and scientific knowledge, give information about the unit, they own. First, the Ottoman perspective on piracy and the understanding and laws applied when recruiting these people to the Ottoman navy can be seen. The Ottomans relied on the experience and knowledge of artisanal pirates, and these people, who were effective in the rapid progress of the shipyard, also presented scientific works to the Ottomans. As seen in the example of Seydi Ali Reis, whose works are analysed here, he is one of the sailors, who

[951] Mahir, *Osmanlı Minyatür Sanatı*, p. 162.

trained under Hayreddin Barbarossa at *Tersâne-i Âmire*. He also has scientific knowledge such as astronomy and navigation.

The examined works, books, atlases, and maps show us that artisanal pirates, such as Piri Reis and Seydi Ali Reis approached the maritime profession scientifically and created works by adding their experience. It is seen that they emphasized the necessity of knowledge of astronomy, navigation and geography in their works.

In this part, we also see the scientific, technological, and nautical instruments, used by artisanal pirates in the early modern Ottoman empire. It can be concluded that these artisanal pirates had and were able to use the scientific knowledge and instruments necessary for seafaring. They were experts in using the knowledge needed in sciences, such as astronomy, navigation, and in the use of nautical instruments, such as the compass, astrolabe, and portolan charts, thus leaving these valuable works that have survived to this day. Piri Reis's two portolan charts and *Kitâb-ı Bahriyye*, Nautical Books and Atlases of Seydi Ali Reis and Ali Macar Reis, and the anonymous *Walters Sea Atlas* and *Atlas-ı Hümayûn* are valuable nautical instruments, introduced in the Ottoman empire, in the early modern period. These instruments, which we have examined in detail above, also show the status and content of the knowledge owned and produced by the artisans in the Ottoman nautical science. At the same time, it is very significant for us to see how practical knowledge circulated in the early modern Mediterranean, and how this knowledge evolved. I hope this chapter will be one, where the situation of the artisans, with whom the Ottomans cooperated, can be seen clearly. This section is intended to be effective in revealing, a clearer framework, in terms of Ottoman artisanal epistemology.

CONCLUSIONS

Although there are many studies on the early modern Ottoman history of science, there is no study from the perspective of practical dimension of knowledge and recent artisanal epistemology. My thesis covers the early modern period, from the conquest of Constantinople in 1453, that is, in the late 15th century and 16th century. My hypothesis is that when the Ottoman empire had successfully adapted to engage scientific and technological developments in the Mediterranean, like other European states of the period. In support of this hypothesis, I showed how the artisans, who played an active role in scientific and technological developments, that is, in the dissemination and production of practical knowledge in the early modern period, had a place in the Ottoman empire. I think this is invaluable for both practical knowledge literature and more recent historiographical debates on artisanal epistemology. Therefore, I find these activities and works of the Ottoman empire, which is a part of the Mediterranean, worth mentioning.

The Ottomans, who had a very different culture and understanding from other European states, bordering the Mediterranean, had a very different perspective on artisans. To recall the statement, I made in the conclusion part of the first chapter, as David N. Livingstone points out, the consumption of science and the acceptance of scientific theories and practices, in different fields, also bear the traces of local conditions. It can be said that in the early modern period, the Eastern and Western borders of the Mediterranean were completely permeable, and there was mutual recognition of symbols and images, cultural cross-interaction, and a two-way traffic of influence, even in conflict situations. From this, it can be concluded that it is inevitable that the joint ventures of East and West, which have different and traditionally separate cultures, can be rewritten. Because the artisans, described in the second and third chapters, created these conditions. Artisans and artisanal pirates brought together from different cultures in *Tersâne-i Âmire*, which we accept as the Ottoman practical knowledge or applied science institution, combined their knowledge, and ensured the formation of the Ottoman’s own tradition in the production of nautical and mathematical instruments.

In the Ottoman empire, the most active people, in raising artisans in the maritime and navy production stages in the shipyards, were the pirates. As I explained above, piracy, which has a very different structure from the European understanding, was the people consulted in the navy management in the Ottoman shipyards. In other words, artisanal pirates, who were seen as a kind of sea master, had a great importance in scientific and technological developments and maritime in the Ottoman empire.

Due to the political and economic conditions of the early modern period, it can be said that the political goals of the states necessitated them to turn to technological developments. States needed nautical means to expand their borders, seek commercial markets, protect their ports, and sail the seas. For these purposes they turned to the instruments of nautical science. When the states turned their faces to the seas, they primarily needed shipbuilding technology and artisans, who would produce these technologies. At this point, it can be said that the Ottoman empire developed and changed the scientific and technological developments, it followed, and added something from its own identity to its own body.

First, what it can be said about ship technology is that the Ottomans made great strides, and worked effectively, and were very active in shipbuilding. In terms of the issues, I have explained above, *Tersâne-i Âmire* (Ottoman Shipbuilding Centre), where nautical instruments were produced, was established for the conquest movements in the Aegean, after the conquest of Constantinopolis. During the reign of Sultan Mehmed, the Conqueror, the shipbuilding activities started, encouraged the following Sultans. In addition, I mentioned above that the political aims of the Ottoman Sultans, continued in the same way from Sultan to next Sultan. Scientific and technological activities carried out by taking the artisans into the Ottoman service come to the fore.

The Ottoman Sultans continued their political aims, besides the reign, they received from their fathers. The most prominent political goal is the expansion of the Ottoman lands, that is, the conquests. This political aim, which continued with his son Bayezid II, after Sultan Mehmed the Conqueror, also caused Bayezid II to turn to shipbuilding technologies. It can be said that the period of Sultan Bayezid was a period, in which Ottoman maritime and ship technology made great progress. In particular, the expansion of *Tersâne-i Âmire* was an effective step in increasing shipbuilding. The big attempt, in the Ottoman navy, was to cooperate with Muslim pirates, in the Mediterranean. Kemal Reis's captaincy and the start of shipbuilding, by utilizing his knowledge, and experience, in ship technique and technology, provided a great improvement in the Ottoman navy.

It can be also said that between 1495-1512, which is the period of Bayezid II, the core of the Ottoman navy began to form. Because this was a period that when the borders of the empire expanded mostly in the seas, and the Eastern Mediterranean sovereignty region began to be established. The Ottoman navy started to have a serious impact on the seas, as a value over the traditional Ottoman land power and started to form the core of the imperial navy to be established in the future. Sultan Bayezid saw that as a ruler, who was aware of the importance of the seas, he needed to have a strong navy, due to the new structuring in the Eastern Mediterranean. In this period of many conquests, especially, after the long naval wars with Venice and its allies (1499-1503), there were changes in the Ottoman shipbuilding technology. Ottoman sailors, who worked about Venetian, Genoese, and Spanish ships for a long time, built cektiri and galleons in the style of Venetian ships, and 'Göke' in the style of Spanish ships. During the Ottoman-Venetian wars, Ottoman warships were seriously built in the years 1499-1503. The types of ships, built in the Ottoman navy, were göke (cog/cocca/kuka), galleon galley, barges, kalyatas, and frigates.

The other revolution, made in this period, is the admission of the Mediterranean pirate Kemal Reis to the Ottoman navy service. Ottoman utilized the technical knowledge of Kemal Reis, who was an experienced pirate and artisan in the Mediterranean, to build Ottoman ships. Thus, Ottoman ships were produced with the techniques, learned from Kemal Reis, and the battles, with Venice, were won with his tactics. The Ottoman navy won victories, especially, because it was more technologically advanced, and had good captains, like Hayreddin Barbarossa. He, who was brought to the head of the Ottoman navy, during the reign of Sultan Suleiman, also constitutes a turning point for the navy. The technical and tactical knowledge, I mentioned above, which he applied thanks to his artisanal knowledge, carried the desired development in the Ottoman navy to much higher levels.

From this period, when portolan charts and atlases are widely seen, Piri Reis's the First World Map (1513) and the Second World Map (1528) and *Kitâb-ı Bahriyye* (1520) and Seydi Ali Reis' Nautical Books, the *Nautical Atlas* of Ali Macar Reis (1567), *Walters Sea Atlas* (1560-1570) and *Atlas-ı Hümayûn* (1570) remained. These charts are not only scientific and technological nautical instruments, used effectively in the period they were made, but also historical sources that shed light on the scientific conditions of that period. They give us detailed information on sources, charts and other instruments that have not survived. Especially, the nautical books and charts that we consider as nautical instruments, which I have examined in detail, in the third part of my thesis, give us information about the nautical instruments, they used in their period, such as astrolabe, compasses and portolan charts. Reaching this information through the narration of the people, who lived in that period and used these instruments themselves, is an invaluable situation for the new understandings, concepts, and information, brought to the literature on the practical conception of knowledge in early modern world.

If we give an example of one of the new information we saw above, the knowledge given by Piri Reis, whose charts I have examined in detail, also gives information about the discovery of Christopher Columbus. It can be said that Piri Reis, who said that drew the New World by using the chart of the Genoese admiral on the First World Map, dated 1513, at a time, when it was not seen that cartographers gave detailed sources of the charts, they used, it can be said that he behaved like a real scientist. Because, thanks to this information, I think we have an idea about how Columbus drew the New World, on his chart. In this area, with the initiation of the Ottoman cartography tradition by Piri Reis, the portolan charts, which were created by synthesizing the charts of the East and the West, are among the valuable works that have survived to the present day. In addition, although Ottomans did not attempt any exploration of the New World in the age of discoveries, it is seen that he was closely interested in the discoveries, which were made. Because as far as we understand from Piri Reis charts and his book, *Kitâb-ı Bahriyye*, this subject had been followed closely. Piri Reis, who we see the combination of both technological and scientific knowledge in an artisan, is one of the most important people announced in this thesis. Also, these nautical instruments were used both in Ottoman maritime, and are detailed sources from that time, for today.

In short, in this thesis, I tried to explain the formation process of practical knowledge in the world of cosmography and navigation within the Ottoman empire, how it emerged and how it was developed by whom. On this occasion, I endeavoured to announce the existence of people we refer to as artisanal pirates in the Ottoman empire and that this knowledge was gathered and produced in the imperial navy.

It is seen that there were occurred an Ottoman tradition by synthesizing the information, he received from both the east and the west, especially due to the proximity of his geographical location. The fact that all these manuscripts and charts are waiting to be discovered in the Ottoman archives, due to the limited number of studies in this field, arouses the desire to carry out these studies more diligently. I hope that I can draw people's attention to this subject and conduce in further studies on this topic. Also, I hope this thesis, which I wrote to fill the deficiencies in the literature of practical knowledge on Ottoman practical knowledge and technologies and artisans, will fill this gap.

APPENDİX A

Cartographers, Artisanal Pirates and Captains of *Tersane-i Amire*

PERSON	JOB & WORKING DATES	
Hamza Bey (d. 1460)	Ottoman Mariner	1453-1455
Has Yunus Bey	Ottoman Mariner	1453-1456
Yakub Bey	Kapudan Pasha	1462-1463
Burak Reis (d. 1499)	Sailor	1488-1499
Güveği Sinan Pasha (d. 1504)	Kapudan Pasha	1491-1492
Kara Nişancı Davud Pasha (d. 1505)	Ottoman Mariner	1492-1503
Kemal Reis (1451-1510)	Sailor, Artisanal Pirate	1494-1510
Küçük Davut Pasha	Kapudan Pasha	1503-1506
Hersekzade Ahmed Pasha (1459-1517)	Kapudan Pasha	1506-1511
Selman Reis (d. 1528)	Ottoman Captain	1511-1528
Cafer Agha (d. 1521)	Kapudan Pasha	1516-1520
Pulak Mustafa Pasha (d. 1533)	Kapudan Pasha	1520-1522
Kurdoğlu Muslihiddin Reis (1487 - 1535)	Ottoman Mariner	1525-1530
Kemankeş Ahmed Pasha	Kapudan Pasha	1531-1533
Hayreddin Barbarossa (d. 1546)	Kapudan Pasha and artisanal pirate	1533-1546
Sokullu Mehmed Pasha (1505-1579)	Kapudan Pasha	1546-1550

Sinan Pasha (d. 1553)	Kapudan Pasha	1550-1553
Piri Reis (1465/1470-1553)	Ottoman cartographer, Sailor	1495-1553
Seydi Ali Reis (1498-1562)	Ottoman cosmographer, Sailor	1522-1562
Piyale Pasha (d. 1578)	Kapudan Pasha	1553-1569
Müezzinzade Ali Pasha (d. 1571)	Ottoman sailor and statesman	1569-1571
Kılıç Ali Pasha (1500-1587)	Ottoman captain	1571-1587
Ali Macar Reis (16th century)	Cartographer and sailor	1566-…
Kılıç Ali Pasha (1500-1587)	Kapudan Pasha	1571-1587
Yusuf Sinan Pasha (1545-1606)	Kapudan Pasha	1587-1595

APPENDİX B

Artists and Artisans working in *Nakkaşhâne**

Nakkaş Sinan Bey	15th century
Ahmed Şiblizade	15th century
Nakkaş Sinan Bey	15th century
Nigârî	15th-16th century
Nakkaş Osman	16th century
Nakkaş Hasan Paşa	17th century
Levni	17th century
Seyyid Lokmân Çelebi	17th century
Abdullah Buhari	18th century

*The names of some of the prominent *Nakkaşhâne*'s artisans and the centuries in which they lived are known.

APPENDİX C

Ottoman Portolan Chart and Nautical Atlases in 16th Century

Treatise	**Author of the Treatise**
The First World Map (1513)	Piri Reis
The Second World Map (1528)	Piri Reis
Kitâb-ı Bahriyye (The Book of Navigation) (1520)	Piri Reis
Kitâbü'l-Muhit (the Book of Ocean) (1554)	Seydi Ali Reis
Hulâsatü'l-hey'e (The Summary of Astronomy) (1549)	Seydi Ali Reis
Mir'ât-ı Kâinât (The Mirror of the Universe) (1555?)	Seydi Ali Reis
Risâle-i Zâtü'l-Kürsî (Unknown)	Seydi Ali Reis
The *Nautical Atlas* (1567)	Ali Macar (Hungarian) Reis
Walters Sea Atlas (1560-1570)	Unknown
Atlas-ı Hümayûn (Imperial Atlas) (1570)	Unknown

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