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The role of Piri Reis and Ahmad Ibn Majid in developing the science of maritime navigation and drawing of geographical maps in the 16th century.

Le rôle de Piri Reis et Ahmad Ibn Majid dans le développement de la science de la navigation maritime et du dessin de cartes géographiques au XVIe siècle.

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Abstract:

This article aims to reveal the reasons for the superiority of the Ottoman and Omani navies in the 16th century, thanks to the expertise of maritime navigators such as Piri Reis and Ahmad ibn Majid.

This study aims to highlight the reasons for the development of Arab and Islamic navigation in the 16th century.

In this study, we have relied on a narrative and descriptive historical approach to the events, within a specific temporal and spatial framework that encompasses the waters of the Mediterranean Sea, the Indian Ocean, and the Arabian Gulf during the sixteenth century.

We have also reached several conclusions, the most important of which are:

The advancement of Arab and Muslims by The Ottoman navigation through the use of various advanced technical means, such as the astrolabe, the movable rudder, and the compass, alongside their reliance on navigational and geographical mapping.

We also found that the Omani navigator Ahmad Ibn Majid contributed to the advancement of maritime navigation in the waters of the Indian Ocean and the Arabian Gulf through his diverse scientific writings on maritime navigation and the measuring and observational instruments he used to determine the direction of ships and geographical north.

Keywords: Cartography; maritime navigation; Piri Reis; Ahmad Ibn Majid.

Résumé:

Cet article vise à révéler les raisons de la supériorité des marines ottomane et omanaise au XVIe siècle, grâce à l'expertise des navigateurs maritimes tels que Piri Reis et Ahmad Ibn Majid.

Cette étude vise à mettre en lumière les raisons du développement de la navigation arabe et islamique au XVIe siècle. Dans cette étude, nous avons recours à une approche historique narrative et descriptive des événements, dans un cadre temporel et spatial spécifique englobant les eaux de la mer Méditerranée, de l'océan Indien et du golfe Arabe pendant le seizième siècle.

Nous avons également tiré plusieurs conclusions, les plus importantes étant : l'avancement des Arabes et des Musulmans par la navigation ottomane grâce à l'utilisation de divers moyens techniques avancés, tels que l'astrolabe, la gouverne mobile et la boussole, en plus de leur relance sur la cartographie navigatrice et géographique.

Nous avons également constaté que le navigateur omanais Ahmad Ibn Majid a contribué à l'avancement de la navigation maritime dans les eaux de l'océan Indien et du golfe Arabe par ses divers écrits scientifiques sur la navigation maritime et les instruments de mesure et d'observation qu'il utilisait pour déterminer la direction des navires et le nord géographique.

Mots-clés: Cartographie; navigation maritime; Piri Reis; Ahmad Ibn Majid.

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Introduction:

This topic addresses the role of Arab and Muslim navigators in the development of maritime navigation science and the art of cartography, through their scientific works and the maps they created to facilitate navigation in the Mediterranean Sea, the Indian Ocean, and the Arabian Gulf. We have chosen two figures who played a significant role during the 16th century in advancing Arab navigation: the navigator and geographer Piri Reis, the Ottoman, known as the father of visual geography, and the navigator and geographer Ahmad Ibn Majid, the Omani, author of the "Kitab al-Fawa'id" or "The Book of Guidance for Navigators."

This study aims to shed light on the role of these navigators, geographers, Arab and Muslim sea captains, highlighting their contributions to the development of maritime navigation science and the art of cartography during the 16th century, as well as showcasing their scientific works and geographical maps and studying their geographical achievements regarding maritime navigation in the waters of the Mediterranean Sea, the Indian Ocean, and the Arabian Gulf.

Among the previous studies that have addressed this topic from various aspects, we mention, for example, the study by the Turkish historian and bibliographer Katip Çelebi (1509-1556) titled "The Gift Of The Great Ones In The Travels Of The Seas," through which the author provided important geographical and navigational information about the history of the Ottoman navy, as well as numerous pieces of advice for sailors in the waters of the Mediterranean Sea. However, what predominates in this study is the emphasis on the military nature of the Ottoman navy and the frequent praise for Ottoman naval victories.

The second source that addressed the subject of the study is a source that experienced the event itself, which is the book "The Navy" by the Ottoman navigator Piri Reis, studied by Dr. Muhammad Daraj in his book: "Al-Jazair in Ottoman Sources," as it represents an important source for the history and geography of the region.

We also relied in this study on a third source, which is the memoirs of Hayreddin Barbarossa, considered a primary source on the events of his era. However, a drawback of these memoirs is their unique approach to write historical and geographical events with a subjective bias, as they are an autobiography that combines literary narrative with historical writing.

We also relied on a diverse set of references in our study, among which the most important is the series of Omani studies by Ahmad Ibn Majid, published by the National Records and Archives Authority of the Sultanate of Oman, which contains the complete astronomical, geographical, and scientific works of Ibn Majid. It is an important reference for the study.

Thus, our study aims to provide the reader with new knowledge and an objective reading of the development of Ottoman and Omani maritime navigation during the 16th century, through two models: the navigator and geographer Piri Reis of the Ottomans and Ahmad Ibn Majid of Oman.

The problem posed in this study is: What are the contributions of the Omani navigator Ahmad Ibn Majid and the Ottoman Piri Reis in navigation, science, and geography during the 16th century? This problem follows subsidiary questions: What geographical maps did Piri Reis draw? What scientific works did he write? How did Ahmad Ibn Majid contribute to the development of maritime navigation in the waters of the Indian Ocean and the Arabian Gulf? What scientific works did he author in this field of study?

In this study, we relied on a narrative and descriptive methodology for historical events, within a specific temporal and spatial framework that encompasses this description of all the works, books, and geographical and navigational maps of the Ottoman navigator Piri Reis and the Omani Ahmad Ibn Majid, as well as the navigational tools they developed and the scientific works they authored.

Among the most important sources used to address the topic, we mention, for example but not limited to: The Memoirs of Khairuddin Barbaross, as this book is considered a primary source on the events of his era in the waters of the Mediterranean Sea. We also used the book by Ahmad Ibn Majid titled: The benefits in the principles of Nautical science and rules, which clarifies the maritime sciences that Ibn Majid addressed. Additionally, we utilised Ibn Majid's book titled: Three Flowers In The Knowledge Of The Seas, which outlines the main navigation methods and how ships navigate in the Indian Ocean. The third book is by the Ottoman navigator Piri Reis, titled: The Book Of Navigation, which contains abundant information on maritime geography, marine sciences, hydrography, and marine topography. It also includes a detailed description of various coasts, islands, ports, cities, and civil and military installations overlooking the different seas traversed by Ottoman ships, in addition to many references, journals, and articles that are considered modern studies that we should consider and draw upon in our research.

1. Biography of the Ottoman geographer and navigator Piri Reis:

Piri Reis, the Ottoman geographer and navigator, was born on the peninsula of Gallipoli (GELİBOLU), on the western coast of the Sea of Marmara, which was considered one of the bases of the Ottoman navy1. Although the exact date of his birth is not known, the events recorded in his "Book of Navigation" suggest that he was born between 1465 and 1467 (Thuraya, *Record:* 33). His full name is Muhyiddin Piri and he is also referred to as Ahmad Ibn Ali al-Hajj Muhammad al-Qurmani al-Darandi (Larendevi) (Daraj, 2018 :31). His book titled 'Kitab al-Bahrieh' is the main source that provides important information about its author, as he includes scattered details about his works throughout the text. Most of what has been translated and later recognised about him comes from this source (Barbarossa, *Memoirs:* 62).

According to the source, Piri Reis began his maritime career at the side of his famous Turkish uncle, Kemal Reis2. Thanks to him, Piri Reis became familiar with most of the coasts and ports of the eastern Mediterranean in his youth3.

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[1]- The Gallipoli peninsula has been home to the Kapudan Pasha, the commander of the Ottoman fleet, since the early 14th century. While the Kapudan Pasha was in Istanbul, Gallipoli was under the authority of the Beylerbey (Governor) of Gallipoli. In 1390, Sultan Bayezid I ordered the establishment of a shipbuilding workshop, followed by several other facilities that made it a secure and permanent military base. Over time, Gallipoli became a central base for Ottoman influence in the eastern Mediterranean.

[2]- Piri Reis is known to be related to the famous Turkish admiral Kemal Reis, but there are differing accounts of the nature of their relationship. Some say that Piri Reis was Kemal Reis's nephew, while others claim that he was his niece's son. This disagreement stems from inconsistencies in two different versions of the Kitab-iBahriye. In one version, Piri Reis states that he is the nephew of the late Ghazi Kemal Reis, while the other version, published alongside an Ottoman record, claims that he is the niece's son. This discrepancy may be due to an error made by some copyists.
Whatever the exact nature of Piri Reis's relationship with Kemal Reis, Khayr al-Din Barbarossa mentions in his memoirs that Piri Reis was indeed the son of Kemal Reis's niece. It is known that Piri Reis accompanied Khayr al-Din after Kemal Reis's death, and that Khayr al-Din sent him from Tunisia as part of the first delegation to meet Sultan Selim I after his return from Egypt. ThusKhayr al-Din Barbarossa was well acquainted with Piri Reis, which supports the likelihood that Piri Reis was the niece's son rather than the nephew.
The details of Piri Reis's embassy to Istanbul, sent by Barbarossa, and the circumstances of this mission are described in the Memoirs of Khayr al-Din Barbarossa.

[3]- The reason Sultan Bayezid II asked Kemal Reis to join the Ottoman fleet was an appeal for help from the people of Andalusia, who were seeking protection from Christian oppression and terrorism after the fall of Granada. Sultan Bayezid ordered Kemal Reis to put pressure on the Spanish by raiding their coasts. Kemal Reis successfully burned and

In 1495, Sultan Bayezid II asked Kemal Reis to join the Ottoman fleet to strengthen and support it with his vast experience. Kemal Reis accepted and became one of the leading figures in the Ottoman navy. In 1499, Piri Reis participated in his first naval battle during the war between the Ottoman Empire and the Republic of Venice, where he served as the captain of a warship (Daraj, 2018 : 33).

Piri Reis also stated that he participated in the conquest of the city of Inebakt (Inebaht), known to Arab and Western scholars as Lepanto. The following year he took part in a battle against the Venetians on the coast of Navarino (Nevarin), where he mentioned that he was the captain of the warship. In 1504, together with Kemal Reis, Piri Reis took part in a naval landing on the island of Rhodes and conducted several naval campaigns on the dependent islands. It should be noted that in 1511, while Kemal Reis was preparing to attack Rhodes, a severe storm broke out, sinking Kemal Reis's ship and leading to his death (Oztuna, 1988 : 194-199).

Piri Reis was deeply affected by the loss of his uncle, Kemal Reis, who had been his mentor and main inspiration in the sciences of the sea. He retreated to Gallipoli until 1513, where he documented his observations and notes, as well as the information he gathered while working in the Mediterranean alongside Kemal Reis. He also created a map of the world during his stay in Gallipoli (Daraj, 2018 : 35).

Piri Reis did not cease his maritime work because of the death of Kemal Reis; rather, he quickly joined Hayreddin Barbarossa, who arrived on the western Mediterranean coast around this time and became one of his close unit commanders in 1512 (Daraj, 2018 : 35).

Working alongside his uncle Kemal Reis and Hayreddin Barbarossa, Piri Reis became well acquainted with Algeria. During this period, he also spent a long time transporting Andalusian migrants to the shores of North Africa. This mission was not easy; it was fraught with danger, as the transport of migrants from Andalusia often involved clashes with the Spanish navy on the coasts of Spain or North Africa, or even in the open Mediterranean (Barbarossa, *Memoirs* : 63).

The Ottoman historian, scholar, geographer and bibliographer Katib Çelebi (1609-1656) confirmed what Hayreddin Barbarossa mentioned in his memoirs, noting that: "Piri Reis was sent to Istanbul in command of four ships loaded with the finest kinds of wood to make masts for sailing ships" (Katib, *The Gift*: 29). This wood was captured by Hayreddin Barbarossa during one of his raids on the island of Sicily (Barbarossa, *Memoirs* : 62). As a reward, the Sultan honored him and his brother with two jewelled swords and two warships loaded with military equipment (Katib, *The Gift*: 29)

During Sultan Selim I's (1512-1520) time in Egypt, after his campaign there in 1517, Piri Reis gave him a map of the world that he had drawn in Gallipoli (Klo, 1991 : 285). The Sultan greatly appreciated this gift, which motivated Piri Reis to consider writing his famous book 'The Book of Navigation'. It should also be noted that Piri Reis accompanied Sultan Selim I on his campaign against Egypt, during which he drew a map of the banks of the Nile while travelling up the river to Cairo in 1516-1517.

destroyed the Spanish, Italian and southern French coasts, as well as Sardinia, Corsica, Malta and others. During this period, he also facilitated the first caravans of Muslim and Jewish migrants to Ottoman lands in Anatolia, where they were settled and given tax exemptions for several years to help them adapt to their new circumstances. Kemal Reis repeated his raids on the Spanish coast in 1510, starting from the Moroccan coast, and Piri Reis accompanied him on this campaign.

After the Ottoman campaign in Egypt, Piri Reis returned to Gallipoli, where he organised the information he had collected, the notes he had made and the maps he had drawn into his aforementioned book. By 1521 he had completed the draft of the "Book of Navigation (Daraj, 2018 : 37) This draft was copied by Piri Reis's colleagues and circulated among scribes, and for a long time became a reference for navigators, geographers and those interested in maritime science and sea routes. The number of manuscript copies of the draft of the book is now thought to be 43, scattered in various libraries around the world.

In 1524, Sultan Suleiman the Magnificent sent Grand Vizier Ibrahim Pasha to Egypt to settle disputes between senior officials of the Ottoman administration. Piri Reis accompanied him on this voyage as an expert on sea routes. However, the voyage was hampered by severe storms that forced the Ottoman fleet to anchor off the island of Rhodes (Al-Haj Alawi : 2009 : 79).

It was during this voyage that Ibrahim Pasha met Piri Reis and recognised his scientific talents. Noticing that Piri Reis was reviewing his notes on the development of sea storms, the Pasha asked to see them. After reviewing the notes, Ibrahim Pasha was impressed and suggested that Piri Reis compile them into a book to present to Sultan Suleiman the Magnificent (1520-1566). In response, Piri Reis organised and structured his book in 1526 and dedicated it to Sultan Suleiman through the Grand Vizier Ibrahim Pasha (Al-Hajj Alawi, 2009: 80) With this revision, Piri Reis had organised and structured his work for the second time, following the first draft he had produced in Gallipoli in 1521 (Daraj, 2018 : 32).

In this book, Piri Reis discussed the naval campaigns of Kemal Reis, sea storms, their times and directions, as well as the compass, nautical charts, descriptions of seas and waterways, among other topics related to the maritime sciences prevalent in his time. He summarised all this in 972 verses of poetry, concluding with ninety-one verses composed by the poet Seyyid Ali Murad (Orhonulu, 1970 : 34), in which he indicated the date of completion of the book (Efetinan, 1983 : 18).

What distinguishes this version of the "Book of Navigation" from the one prepared by Piri Reis in 1521 is that he corrected it and addressed the scientific deficiencies found in the previous version, in addition to organising his book according to a specific methodology mentioned at the beginning of the text. From a thematic point of view, Piri Reis provided important information about the peoples living along the coasts, islands and regions he mapped, as well as very rare information about the economic, political and social conditions of their inhabitants, and about the natural, animal, plant and water resources available in these areas.

When Piri Reis's book was appreciated by Sultan Suleiman the Magnificent, he produced another map of the world in 1528, which is believed to be the world map currently preserved in the Topkapi Palace Museum Library (Top kapi Sarayi Müzesi Kütüphanesi) in Istanbul. This piece is the remaining part of the map that was later discovered by the director of the Topkapi Palace Museum in 1929.

Piri Reis was appointed commander of the Ottoman fleet in the waters of the Indian Ocean in 1547, where he succeeded in retaking the port of Aden from the Portuguese in 1549 (Orhonulu, 1970 : 34) He then recaptured the port of Muscat and in 1552 laid siege to the fortress on the island of Hormuz in the Arabian Gulf for twenty days. However, he was unable to liberate it and lifted the naval blockade because the Portuguese fleets tried to besiege him in the Strait of Hormuz from the port of Goa in India (Djebri, 2023 : 92).

It seems that the victories achieved by Piri Reis provoked the anger of the governor of Basra, Kubad Pasha, and the governor of Egypt, the Beylerbey Dawood Pasha. This led them to tarnish his reputation before Sultan Suleiman4the Magnificent by sending letters accusing Piri Reis of accepting money, gifts and bribes to lift the naval blockade of the island of Hormuz in the Arabian Gulf. This eventually led to a decree from the Sultan ordering Piri Reis's execution, which was carried out in Egypt in 1554 (Djebri, 2023 : 155).

2. The book of navigation (reasons for its composition and its scientific and geographical importance):

The author chose the title "Book of Navigation", as it is called in Turkish, written in Arabic script and pronounced according to Persian rules, which means "Book of Navigation" in Arabic. Through the title and what the author said in the introduction of the book, where he praised God, sent blessings on the Prophet Muhammad (peace be upon him), and prayed for the success of Sultan Suleiman Khan and for the health and well-being of his children, as well as for the perseverance of the Ottoman Empire until the Day of Judgement, he began to discuss the subject of the book directly.

He devoted the first hundred pages of his book, written in verse, to discussing the direction of winds and storms, the definition of the compass, maps and the key to the map, and the South China Sea, the Indian Ocean and the Atlantic Ocean. He also briefly touched on the reasons for the geographical (colonial) discoveries made by the Portuguese and the significant campaigns they undertook in the seas as part of their geographical explorations (Reis, 1988 : 48).

Piri Reis also discussed the Adriatic Sea, mentioning the various islands within it, as well as its coasts and fortresses - whether they were under Ottoman, Venetian, Papal or other control. In the second part of the book he spoke about the Mediterranean coasts, such as those of France, Spain, the Maghreb, Egypt, the Levant, and the southern shores of Anatolia, concluding with the coasts and islands of the Aegean (Paul, 1965 : 102).

In the introduction to his book, the author explains the reason for writing it, stating that he composed it to present it as a gift to Sultan Suleiman the Magnificent (Reis, 1988 : 27). He justified this by saying that no one had ever written a book of this kind before. The importance of the book lies in the fact that it contains very important information relating to the maritime sciences, marine geography, cartography and historical geography. The book is therefore considered a fundamental reference for researchers in these fields, in addition to its historical value as a primary source for the period contemporary with the author or before. Piri Reis documented his observations, as well as what he read or heard from the seafarers with whom he worked, especially Kemal Reis, in addition to other sources in various languages that have not reached us (Reis, 1988 : 27).

Since the book contains some 290 detailed maps of the various regions mentioned, its importance as an important reference work for marine and historical geography, cartography, the history of the Mediterranean and the relations between its shores, as well as the history of coastal cities, ports, naval wars, maritime trade and piracy is greatly enhanced. Thus, it is relevant not only to researchers interested in Ottoman studies, but also to many scholars who focused on Mediterranean studies during the period in which the book was written (Al-Kandari, 1999 : 24).

[4]- Suleyman the Magnificent was the son of Sultan Selim I (1512-1520) and was born in Trabzon in 1494. He was the tenth Ottoman Sultan and the seventy-fifth ruler of the state. During his reign, the Ottoman Empire reached a peak of power and geographical expansion across three continents: Asia, Africa and Europe. He ruled from 1520 until his death in 1566, shortly after succeeding his father. He earned the title of "the Lawgiver" for his implementation of numerous political, economic, social, administrative and judicial laws within the Ottoman Empire.

From the above, it can be concluded that the geographer and navigator Piri Reis is considered one of the most prominent geographical figures who contributed significantly to shedding light on many hitherto unknown geographical and historical issues. He discovered many previously unknown regions and is regarded as one of the finest Muslim geographers who relied on close observation and scientific precision. Therefore, his works served as a source for many European geographers and sailors, who called him the "father of modern geography" (Djebri, 2023 : 157).

2.1 Biography of the navigator and geographer Ibn Majid al-Najdi al-Saadi al-Omani:

Scholars have attempted to determine Ibn Majid's date of birth by studying his works, analysing his travels, interpreting his statements, and examining some of the verses in his poetry. The results of these efforts are mainly speculative and provide approximate information that is neither definitive nor precise. This paragraph summarises the challenge faced by researchers in determining the true date of birth of this famous Arab navigator. Despite efforts to gather information through induction, inference, interpretation and weighing of evidence, the truth remains elusive. The conclusions drawn are largely based on personal opinion and therefore his date of birth remains unknown.

However, there are a few glimpses in some of his poems that allow us to deduce an approximate date of birth. In his poem "Al-Hawiya", Ibn Majid states that he composed it in his book "Al-Fawa'id fi UsulIlm al-Bahr wa al-Qawa'id". In the last chapter, he mentions that he completed it in Dhul-Hijjah 866 AH (Ibn Majid, *The Great* : 11).

It is also reported that Ibn Majid was born around 836 AH / 1432 AD, in the coastal area of Oman, specifically in the town of Julfar, which is now the Emirate of Ras Al Khaimah. The historian Khoury, who wrote about the date of birth of Ahmad Ibn Majid, states that it is impossible to determine the exact date of his birth. However, it is possible to estimate it approximately (Khouri, 2010 : 43-46). He noted that Ibn Majid became a skilled teacher in 845 AH, and after fifty years of observing the stars, he wrote his book "Mukhtasar Al-Fawa'id". This is derived from the ninth line of his "Golden Poem".

From the above, we can conclude that historians and researchers have not agreed on a single date for Ibn Majid's birth. However, the prevailing opinion is that his birth took place in the early thirties of the ninth century AH, which corresponds to the late twenties of the fifteenth century AD.

2.2. Birthplace of Ibn Majid al-Najdi al-Saadi al-Omani:

Most historical accounts confirm that Ahmad Ibn Majid was born in the town of Julfar on the coast of Oman. Ibn Majid himself mentioned that he grew up there in one of his poems (Ibn Majid, *The Great* : 12-13).

These verses confirm that Ibn Majid was born in the town of Julfar on the coast of Oman, where he grew up and was educated. About Julfar, the navigator Mansour bin Al-Haj Ibrahim said: "This is a summary in the science of the sea from the words of the esteemed Sheikh, the knowledgeable of the lands, known as the teacher of the two seas, the honorable Sheikh Ahmad bin Majid bin Muhammad bin Amr bin Yusuf bin Fadl bin Hassan bin Hussein bin Dweik Al-Saadi, son of Abu Raka'ib Al-Naqdi (Al-Najdi), residing in (Julfar)". In Yaqut al-Hamawi's "Mu'jam al-Buldan", Julfar is mentioned with a pronounced and then opened letter, emphasising its importance in Oman as a prosperous area rich in sheep, ghee and butter, exported to neighbouring countries. Ibn Majid also refers to his birthplace, Julfar, in some of his poems in Al-Hawiya, stating that he completed

their composition in Julfar on the ninth day of Dhul-Hijjah, the day of standing in Arafat, in 866 AH (Shihab, 1988 : 81).

As for Al-Hashimi, he says of Ibn Majid's birth and upbringing: "Ahmad bin Majid bin Muhammad Al-Saadi Al-Najdi was born in Julfar, Oman, around the year 825 AH / 1421 AD. He probably died after the year 906 AH / 1500 AD and is attributed to the BanuSaad tribe, which is one of the largest Omani tribes residing in the Al-Batinah region, with its members distributed in the Wilayat of Al-Suwaiq and Al-Masnah" (Al-Aidros, 1991 : 109).

states that Ibn Majid is from Julfar (Ferrand, 1928 : 197), one of the regions of Oman, and most earlier texts identify his birthplace and upbringing in Oman, as Julfar is originally Omani. Ibn Majid's self-identification as born in Julfar, a region that was part of Oman in his time, is supported by his mention of Julfar in at least three of his poems: "Al-Hawiya", "Al-Baligha" and "Al-Mu'arab" (Shihab, 1988 : 23). Moreover, his pride in the city in which he grew up is explicit in his earlier verses. Many Arab and Western scholars confirm Ibn Majid's Omani identity after recording that he was from Julfar.

Based on the above, we can conclude that everyone claims Ibn Majid as a member of their community and attributes him to their homeland in order to gain pride and honour from having a distinguished figure from their country. However, there is strong evidence that Ahmad Ibn Majid was born in the town of Julfar on the coast of Oman, confirming that he is an Omani by birth and residence.

2.3. The education of Ibn Majid:

Ibn Majid grew up in a maritime environment known for its enduring commercial and navigational importance. He was brought up in a family with a deep-rooted love of the sea and maritime adventure. Al-Tai states that Ibn Majid grew up in Julfar under the guidance of his father and grandfather, both of whom were famous seafarers. Ibn Majid inherited from his grandfather a penchant for poetry and authorship, and in addition to his maritime knowledge, he acquired a literary culture that enabled him to compose poetry. He dedicated his life to the sea and spent his youth immersed in reading (Al-Tai, 1983 : 246).

Moreover, Ibn Majid grew up in a family known for its leadership at sea and its passion for travel and navigation. They were well versed in the arts of the sea and its literature. His grandfather and father were both teachers and leaders of the Arabian Sea, as well as poets and literary figures5. Abu Ahmad Ibn Majid was also a literary figure in the field of maritime guides, which greatly influenced him. Abu Ahmad Ibn Majid developed a love for navigation from an early age, and strove to acquire the skills of his ancestors. He excelled in this field, producing significant works in the art of navigation and continuing the legacy of his grandfather, father and predecessors among the navigators of the Gulf as an early literary navigator. He criticised them and corrected many of their misconceptions, while adding a wealth of knowledge from his own maritime experience and literary culture (Atiyah, 1983 : 159).

[5]- Professor Ismail al-Amin has provided important clarifications about the period in which Ibn Majid lived, shedding light on various aspects of his maritime career. This context helps to explain certain actions he took and his relationships with various parties, as well as the mixed reviews he received - both praise and criticism. Ahmed Ibn Majid lived through a critical period in the history of seafaring. During this period, Europeans were on the verge of discovering the route to India via the Cape of Good Hope, marking a period of collision between European and Islamic maritime influences, which heralded the beginning of European dominance in international maritime trade.

Ibn Majid's grandfather was a meticulous researcher and expert on Red Sea navigation, while his father also wrote a long poem entitled 'Al-Hijaziyah', which consists of over a thousand verses on Red Sea navigation. Ibn Majid discussed his scientific and literary approach to producing maritime guides, refining and correcting the statements of his predecessors, especially the three of whom he considered himself the fourth (Al-Amin, 1990 : 90). He relied on his practical maritime experience and organised it into verses and poems, stating: "We revered their knowledge and authorship" (Al-Amin, 1990 : 159).

4. Ibn Majid's maritime and astronomical works:

4.1. Ibn Majid's efforts to advance the science of navigation:

Ibn Majid brought about a major revolution in the development of navigational science in the Eastern and Gulf Seas of Oman by introducing new knowledge in the fields of geography, climate and astronomy. His contributions include the development invention of the magnetic needle and the marine compass, as well as the development of astronomical instruments such as the 'Haqa', 'Khashabat Ibn Majid' (Ibn Majid's wooden instrument) and development the astrolabe. He also improved maritime instruments such as the magnet, the balad and the lantern. In addition, Ibn Majid focused on the classification of maritime guides (Al-Rahmaniyat), which are nautical manuals containing maritime, geographical and astronomical information. He distilled the essence of his experience into two important works: one in verse, a concise guide, and the other in prose, known as "Al-Fawa'id". These texts became important references in the science of navigation in the western Indian Ocean, the Red Sea and the Arabian Gulf (Ibn Majid, *Benefits* : 135).

Ibn Majid is considered one of the most prominent navigators to have mastered the techniques of measurement, using his fingers and hand to take measurements. He established a relationship between the division of the circle of the horizon into thirty-two parts, demonstrating the use of the width of the hand and the outstretched arm in the line of sight of the observer. He used some known instruments of observation, such as the astrolabe and the 'Kamal', which he invented and developed as a marine compass. He states: "And among our inventions in the science of the sea is the arrangement of the magnet on the Haqa, in which we have a great wisdom that has not been recorded in any book. If anyone knows it, we are already ahead of him, so we have arranged in it a great wisdom that has not been recorded in a book. If anyone knows it, we are already ahead of him. We have also numbered the measurements and recorded its conditions in the 'Golden Poem', and it is sufficient as a measure of our knowledge for those who know after our death' (Ibn Majid, *Benefits* : 135).

4.2. Ibn Majid's knowledge of navigation and its importance in his time:

The nautical principles recorded by Ibn Majid are based on two fundamental pillars:

1. Geographical knowledge.

2. Astronomical knowledge.

Ibn Majid excelled in celestial navigation, where he demonstrated considerable skill and competence and made remarkable scientific contributions. He recorded rules and defined standards for dealing with the sea. His knowledge is accurate, tested and respected by experienced seafarers. He felt compelled to spread this knowledge so that it would not be lost with him, so that future generations could benefit from it and so that his legacy would endure. He wrote extensively in both prose and poetry, displaying rare skills, and became well known along the coasts of the Indian

Ocean, the Arabian Gulf and East Africa, gaining the favour of some rulers in the southern Arabian Peninsula (Khouri, 2010 : 07).

Ibn Majid's expertise in astronomy is evident in his precise measurements of the rising and setting of the stars (Al-Aidros, 1991 : 58).

4.2. Navigational organisation according to Ibn Majid:

Professor Khoury states that Ibn Majid's navigational organisation is evident in his presentation of the principles of maritime navigation in eleven chapters in his poem "Hawiya al-Ihtisar" on the fundamentals of marine science. He specifies each chapter, giving the total number of verses and the number of verses in each chapter. This suggests that Ibn Majid developed a plan for his research before turning it into poetry and combining the verses into a single poem. The organisation is also clear in the presentation of the sub-ideas in all the chapters of the Hawiya, in their order and interrelationship. Any researcher or reader can, on careful examination, see this and categorise it into paragraphs, each of which contains a single prominent idea (Bouhjam, 2015 : 25).

4.3. Navigational experimentation according to Ibn Majid:

Ibn Majid believes that knowledge of the sea requires both thoughtful consideration and practical experimentation. He relied on experimentation to establish facts and affirmed that his "Hawiya" was the result of these experiments. He states in his poem.

He saw himself as having a responsibility to teach others and believed that he had written about navigation in a way that would serve as a resource for others to benefit from. Therefore, he was careful to give advice to captains and insisted that the teacher follow correct methods in his work, based on experimentation in his measurements. This characteristic is evident in Ibn Majid's methodology of experimentation, characterised by repeated measurements over a long period, which he extended to a maximum of fifty full years (Ibn Majid, *Benefits* : 206).

From the above, we can conclude that these characteristics enabled Ibn Majid to establish a rigorous methodology in the service of nautical science. Thus, we see that Ahmad Ibn Majid purified the principles of navigation from impurities, organised them logically, and was able to breathe new life into this science based on scientific experimentation and accurate scientific facts (Bouhjam, 2015 : 28).

5. Technical knowledge in the navigation of Ahmad Ibn Majid:

The Russian historian Theodore Shumovsky, who is the editor of Ibn Majid's navigational book entitled "Three Flowers in the Knowledge of the Seas", notes that Arab authors believe that a geographical description of coastal maritime countries does not necessarily require seeing them with the naked eye. Ibn Majid, however, takes the opposite view of maritime geography, believing that the harmony between theoretical aspects and practical or applied dimensions is crucial. The navigator is at the same time the captain of the ship; he must use the available guidelines to determine his position in general. However, he makes various corrections, modifications and additions based on his daily experience. Over time, this leads him to create new maps of maritime routes. The dynamic and creative interaction between theoretical generalisations and practical efforts is what distinguishes marine geography from other fields in Arabic literature (Ibn Majid, *three Flowers* : 88).

This characteristic is clearly evident in Ibn Majid's works. It is no coincidence that in addition to the title "Lion of the Seas", which is often associated with his name, there is another title: "Chief of the Science of the Sea" (Al-Aidros, 1991 : 49-57). He dedicated almost half a century of his life to the sea, having inherited the profession from his ancestors. He commanded many different ships and sailed various sea routes, from the Indian Ocean to Jeddah, then to Kardafur, from Oman to Safala on the East African coast, and from there to India, the Malay Islands and the bays of southern China (Ibn Majid, *three Flowers* : 89). Ibn Majid's technical knowledge is presented as follows:

5.1. The Ship:

Ibn Majid attached great importance to the subject of the ship, considering it an essential element of navigation. Everything related to rules, guidelines, considerations and developments requires the ship for practical application. However, Ibn Majid did not cover every aspect of the ship, but focused on the essential components and what he considered necessary. His approach relies on concentration and brevity to provide the navigator with vital information. Ibn Majid dealt with the following elements: the parts of the Arab ship, the equipment of the Arab ship, the Arab sail, its shape and dimensions, the stages of its tailoring, the crew of the Arab ship, and the instruments of the Arab ship, which included astronomical tools such as the "haqa", the wooden instrument, the astrolabe, and navigational tools, namely the "hajar", the "balad", the lantern, and the "rahnamaj" (Khouri, 2010 : 48).

5.2. The ship's captain:

Every ship needs a captain to guide it. Ibn Majid emphasises the importance of the captain, as the ship's course depends on him. He advises captains to pay attention to the maintenance of the ship at all times and not to overlook any defect, no matter how small (Al-Aidros, 1991 : 51). Ibn Majid laid down a number of conditions and guidelines for the captain's duties, including the following:

- He should have achieved a high level of leadership and professional competence.

- He should be of high moral character, as he is the leader, guide and director.

- He should be well versed in the art of navigation and astronomy, and be familiar with sea routes by day and by night (Anwar, 1967 : 112).

The sciences that the captain must master include:

- Astronomical mathematics,

- Basic principles of navigation,

- Knowledge of sea conditions, weather patterns and winds, including meteorological and maritime forecasting (Anwar, 1967 : 113).

- Familiarity with observation and measurement instruments and their use and maintenance, such as the compass, quadrant and astrolabe.

- A basic understanding of oceanography (both physical and biological) to help him understand the properties of water, marine life and birds that indicate proximity to coasts and the nature of the seabed (Al-Aidros, 1991 : 53).

Conclusion:

The findings from this research we can conclude the following that:

The Book of Navigation by Piri Reis is a maritime voyage around the world. The author combined elements of travel literature and navigational geography with historical information. Piri Reis was neither a professional historian nor a poet; he mixed both with geography and cartography. The book is an important source on the science of the sea and navigation, describing sea storms, monsoon winds, the compass, maps and the names of seas, fortresses and islands, and served as a navigational and geographical atlas in the 16th century.

Ibn Majid made significant advances in the development of navigation in the eastern seas and the Indian Ocean. He introduced new sciences related to geography, climate and astronomy. His contributions included the invention of the magnetic needle and the marine compass, as well as the development of astronomical instruments such as the “Haqa” and Ibn Majid’s “Khashabat” and the astrolabe.

As a navigator and geographer, Piri Reis was one of the most important geographical figures of his time. He was instrumental in uncovering many previously unknown geographical and historical questions, and in exploring previously unknown areas. He stands out as one of the finest Muslim geographers, relying on deep observation and scientific accuracy. His works became a source for many European geographers and navigators, who called him the ‘father of modern geography’.

Ahmed Ibn Majid of Oman established a rigorous methodology for maritime navigation. He purified the principles of navigation from errors and organised them logically, breathing new life into the field. He relied on experimental science and precise scientific facts and applied all his astronomical knowledge during his voyages in the Red Sea, the Arabian Gulf, the Arabian Sea and the Indian Ocean.

Through the historical approach that we took in studying the efforts of Muslim and Arab geographers and navigators and their role in promoting the development of the science of maritime navigation and the science of geographical cartography in the 16th century AD, we can say that the Arabs and Muslims played an important role in this, as both the navigator and geographer Piri Reis Al-Othmani or Ahmed Ibn Majid Al-Omani contributed to the development of maritime knowledge and theories and geographical mapping, Developing the use of new marine means, such as monitoring and north direction instruments, the astrolabe device, the moving rudder, and Ibn Majid’s logs.

A large number of Arab and European geographers and navigators have benefited from the achievements of Ahmed bin Majid and his maritime exploits, such as the Frenchman Ferrand and Raymond Payne, and the famous British traveler Sir Barton, who mentioned that the navigators of Aden were all reciting Al-Fatihah for the soul of Ibn Majid before they went down to the sea, in addition to paying attention Historian de Ceylon and Russian historian Krtchkovsky with Ibn Majid's marine works.

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