RUTTER
MAKING THE EARTH GLOBAL

Conspectus of Works of Sulaymān al-Mahrī

محتويات مؤلفات سليمان المهري

TN no. 13, Version 1, Lisbon 29 February 2024

Inês Bénard

Juan Acevedo

RUTTER Technical Notes Series

ISSN 2184-7630

RUTTER Technical Notes are research materials and studies resulting from the activities and investigation of members of the Project RUTTER Making the Earth Global. Although their primary intention is to assist in the various tasks of the RUTTER Team, they are made public in the spirit of academic collaboration and sharing. *RUTTER Technical Notes* are non-periodic and will cover topics as diverse as the ones that interest the international and multidisciplinary Project's team. The main objective of the RUTTER Project is to write a narrative of the scaling up of a scientific description of the earth in the sixteenth and seventeenth centuries, and how it grew out of the lived experience of travelling and observing the earth in long-distance sea voyages. It aims at radically improving our present knowledge of the historical processes that led to the formation of global concepts about the earth. The RUTTER Project is the ERC-funded Project "RUTTER Making the Earth Global: Early Modern Rutters and the Construction of a Global Concept of the Earth" (ERC Advanced Grant 833438; IR: Henrique Leitão, Faculdade de Ciências, University of Lisbon).

The RUTTER project has received funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (grant agreement No. 833438). Financed by Fundação para a Ciência e a Tecnologia (FCT), I.P./MCTES through Portuguese national funds (PIDDAC): UIDB/00286/2020 e UIDP/00286/2020.

Citation:

Bénard, Inês, and Juan Acevedo. 2024. "Conspectus of Works of Sulaymān al-Mahrī: A Table of Contents (Muḥtawiyāt muʾallafāt Sulaymān al-Mahrī)." *RUTTER Technical Notes* 13. Lisbon: ERC RUTTER Project, University of Lisbon. doi: 10.5281/zenodo.10718847

Contents

محتويات مؤلّفات سليمان المهري

Conspectus of Works of Sulaymān al-Mahrī

A Table of Contents

Introduction

Sulaymān ibn Aḥmad ibn Sulaymān al-Mahrī is an elusive historical figure. His texts provide little biographical information, and he is rarely found mentioned in other sources. The clearest details available to modern scholars are, first, that the name *Mahrī* suggests descendance from a family of Mahrā, in the southern Arabian coast running from Shihr to the region of Dhofar,[1] and, second, that his nautical descriptions—namely those in the *Minhāj al-Fākhir*—indicate that its author was a navigator who personally tried some of the measurements under discussion.[2] Every other piece of information on the life of this nautical author has come to us only through the Turkish work *El-Muḥīṭ fi İlm el-eflak ve'l-ebhur* (*Book of the Ocean on the Science of the Spheres and the Seas.*),[3] written by the 16th-century Admiral Seydi ʿAlī Çelebī. This latter work is for the most part a translation of the *ʿUmda al-Mahriyya*, and it comments that the original treatise had been written in 1511 by a native of Shiḥr called Sulaymān al-Mahrī who had already been deceased by the time of writing, that is, in 1554. Al-Mahrī was therefore active in the first decades of the Portuguese presence in the Indian Ocean, although he is almost silent about the changes occurring in the maritime space at the time.[4] Likewise, Sulaymān al-Mahrī is not mentioned by name in any contemporaneous European text.

On a more interpretative level, a careful reading of the sources suggests a strong influence coming from the famous Indian Ocean navigator Aḥmad ibn Mājid, who died around 1500. Al-Mahrī refers to him by name in specific sections of his treatises,[5] covers a

[1] See Müller, n.d.; Facey, 1979: 105.

[2] See, for example, al-Mahrī 1970b, 2:23: "(…) and the reason for this is that I have experienced some of the headlands that I thought had deficiencies or omissions."

[3] We are grateful to Dr Gaye Danışan, our colleague in Istanbul, for her generous help with with this and other Turkish sources.

[4] See also Lunde 2012, 61.

[5] See, for example, al-Mahrī 1970a, 17; or al-Mahrī 1970b, 140.

very similar range of subjects and presents the same arguments at times[6]—so much so, that Paul Lunde argued that the *ʿUmda* was "essentially a prose abridgment and a simplification" of Ibn Mājid's *Ḥāwīyat al-ikhtiṣār*,[7] albeit with some original information.[8] The relationship between the two pilots and the way such influence took place more precisely is, however, unknown. There is no proof that the two ever met.

But if al-Mahrī and Ibn Mājid are similar regarding the contents of their work, their literary styles differ considerably. Several scholars working on topics related to Indian Ocean navigation history have noted this contrast.[9] Ibn Mājid wrote mostly in verse, with the main exception of the *Fawā'id fī uṣūl ʿilm al-baḥr wa'l-qawāʿid* (*Commentaries on the Principles and Foundations of Maritime Science*),[10] which is nowadays the most famous Arabic navigational treatise produced prior to the seventeenth century. Whether in verse or prose, Ibn Mājid has a constant rambling style, frequently deviating from the main subject to introduce stories and tangential information. Al-Mahrī is different. All of his six works were written in prose following an organized structure, keeping to the point and rarely introducing off-topic information. On the other hand, Ibn Mājid wrote texts related just to navigation, only venturing into related topics briefly in his poems on the calendar or the variation of the qibla.[11]

Sulaymān al-Mahrī produced only four out of six works completely dedicated to navigation matters: two are nautical treatises[12] and two discuss the practical and theoretical foundations of the principles and definitions behind the discipline.[13] Apart from these, Mahrī composed a small work on the calendar, the *Qilādat al-Shumūs*, giving it a much more mathematical approach than that of Ibn Mājid.[14] His last text does not seem to be nautical at all, but is instead an introduction to theoretical astronomy.

Ibn Mājid and Sulaymān al-Mahrī are at this moment the only known authors of the

[6]This happens with a variety of topics. One example is the explanation on the origin of the winds in Mahrī, 1972c: 34–35, and Ibn Mājid, 1971a: 155–156.

[7]Ibn Mājid 1971b.

[8]Lunde 2012, 62. See also Ibn Mājid 1985, 165; Ibn Mājid 1987, 192.

[9]For example in Ibn Mājid 1985, 165; Tibbetts 1971, 42; Grosset-Grange 1997, 1; Lunde 2012, 62.

[10]Ibn Mājid 1971a; Tibbetts 1971.

[11]Viz. the poems "*ʿIddat al-shuhūr al-rūmiyya wa-kullu shahr kam huwa*" ("The Number of The Byzantine Months and the Days in Each Month") and "*Taṣnīf qiblat al-islām fī jāmiʿ al-dunyā*" ("The Qibla of Islam in the Entire World"). See Khoury 1985, 207–208; and Khoury 1987, 353–337.

[12]al-Mahrī 1970a; al-Mahrī 1970b.

[13]al-Mahrī 1972b, al-Mahrī 1972c.

[14]al-Mahrī 1972c, 3–11.

Early Arabic Maritime Corpus (EAMC), i.e. all the extant Arabic-language sources on Indian Ocean navigation prior to the 17th century. Despite this, the amount of academic interest that has been given to each varies substantially. There are several publications on the life and work of Ibn Mājid, especially dating from the 1970s and 80s, by Gerald Randall Tibbetts and Ibrahim Khoury.[15] They are, indeed, too many to be listed in this introduction, but to single out one significant example, between 1971 and 1988 Khoury published all the poems by Ibn Mājid available to him. While the verses themselves remained in Arabic, short French introductions to each one were added, discussing their structure and contents. Nothing of the same kind was ever done for al-Mahrī. There are few studies on this author apart from those published by Ferrand, Khoury, Tibbetts, Teodor Adamovich Shumovsky and, more recently, Paul Lunde—on some of the nautical routes described,[16]—and partial translations by Al-Salimi and Staples.[17] The greatest contribution came once again from Khoury, who published all the works of the Arab navigator in Arabic with the exception of the *Mirʾāt al-Salāk*. [18] The Russian edition of the *ʿUmda al-Mahriyya* by Shumovsky in 1970[19] should be highlighted here as well, as it is the only full translation ever published of a work by al-Mahrī. It is also clear that not all of his works have received the same level of attention. Most scholars have engaged with them through maritime history, meaning that the texts and sections that are more theoretical and not so focused on navigation are usually set aside.

The present technical note is an analytic table of contents of all works written by Sulaymān al-Mahrī, with itemized chapters and sections. Our intention is to bring together and unpack all the topics discussed, in order to provide the reader with a detailed image, a subject index in a way, of the literary corpus produced by this author. In that sense, it is inspired by the work that Ibrahim Khoury dedicated to the poems of Ibn Mājid some fifty years ago.

In the following pages, the six texts by al-Mahrī are organized by date of composition whenever possible and, when not, by thematic relations. For example, although it is not

[15]Ibn Mājid 1971a; Ibn Mājid 1971b; Ibn Mājid 1985; Ibn Mājid 1987; Tibbetts 1981. See also Shihāb 1986. For more details on these and related publications, see our technical note, Acevedo, Bénard, and Müller 2023.

[16]Lunde 2012.

[17]See Al Salimi and Staples 2019, and Acevedo, Bénard, and Müller 2023, for all the relevant references.

[18]al-Mahrī 1970a; al-Mahrī 1970b; al-Mahrī 1972a; al-Mahrī 1972b; al-Mahrī 1972c.

[19]al-Mahrī 2011

entirely clear whether the composition of the *Minhāj* was prior to that of the *Tuḥfa*, it was decided that the former should follow the *ʿUmda* due to the close connection between the two nautical treatises. The *Mirʾāt* was placed last because it is the work that diverges most from navigation.

The aim of the present note is thus synoptic, to gather all topics discussed by al-Mahrī, so that when seen together they open research avenues and raise questions to be developed and reflected upon in later works, topics such as the role of theory and practice in the field of navigation; or the kind of education that at least some Arab pilots would have received; or the audience targeted by these texts. Any attempt at discussing the details or the information provided by the titles of certain chapters and sections—as fascinating as they may be—would already fall outside of the scope of this technical note.

It should also be noted that we did not venture to identify all toponyms found in the works of al-Mahrī, but limited ourselves instead to translating only the names of the largest and most famous places. All translations are ours except when mentioned otherwise. Our readings are based on the editions published by Khoury between 1970 and 1972, checked and corrected when necessary against BnF and Yale manuscripts, with the exception of the last work, *Mirʾāt al-sallāk*, for which we use the only extant witness, Yale Beinecke Library Landberg MSS 401. This attention to the original manuscript sources has proved a laborious and time-consuming, if enjoyable, task, and we hope that the various little adjustments to terminology will be of use to our colleagues worldwide, primarily by feeding into new exchanges and scholarship. We could not have gone too far in this work without the expert and selfless collaboration of Eric Staples (Zayed University, Abu Dhabi) and our colleagues at the RUTTER team, in particular Prof. Henrique Leitão, who has often helped us make sense of puzzling medieval technicalities.

Although we have added a select bibliography at the end of this note, we invite the interested reader to consult our previous technical note, "Indian Ocean Arab Navigation Studies Towards a Global Perspective", where a comprehensive and regularly updated bibliography covers all the literature related to the Early Arabic Maritime Corpus.

العمدة المهريّة في ضبط العلوم البحريّة

al-ʿUmda al-mahriyya fī ḍabṭ al-ʿulūm al-baḥriyya

Al-Mahrī's Pillar on the Exactitude of Maritime Sciences

Introduction

Al-ʿUmda al-mahriyya is the earliest and most famous navigation treatise by Sulaymān al-Mahrī. The date of its original production in 1511 is not mentioned anywhere in the text, but in the later Turkish work by the Admiral Seydi ʿAlī Reis (Çelebī). The treatise is known to have survived in five manuscript copies which are available at the Bibliothèque nationale (Paris), the Leiden University Library, the Yale University Library, the Library of Islamia College (Peshawar), and the Tehran University Library. To the best of our knowledge, the name of the author appears only in the Leiden copy.[20].

The *ʿUmda* has been contrasted to the navigational treatises by Aḥmad ibn Mājid in the clear organisation of its material. The book is divided in seven chapters, where the first two start by introducing the most basic principles and definitions that every pilot (*muʿallim*) of the deep seas should master. These include concepts such as the nautical rhumbs, units of time and latitude, and techniques to measure the altitude of stars. The second part of the book is dedicated to the geographical knowledge needed to travel, covering topics such as the routes in a general course (*dīra*), the latitudes of specific places, and dates of the monsoons. The entire work culminates in the last and longest chapter, with descriptions of multiple sea voyages across the Indian Ocean and the Red Sea.

Al-Mahrī's first navigational treatise brings forward essentially what it proposes: a systematization of nautical science, meant to assist those who enquire about the principles and branches of navigation.[21]

[20]To the date of this publication, we have not yet had access to the copies in the Library of Islamia College and the Tehran University Library

[21]See Mahrī 1970a, 3.

Nowadays it is considered as one of the most important nautical texts of the Indian Ocean. Why so? Lunde has noted that, contents-wise, the treatise nearly paraphrases in prose what Ibn Mājid had already written in the *Hāwiyat al-ikhtiṣār*[22]—although acknowledging that the text does contain its share of original information. An extensive comparison of the two works has not yet been produced, but this would perhaps be unnecessary here. The historical value attributed to the *ʿUmda* soon after it was written resulted from a combination of key elements: the sea voyages it described, its above-mentioned structure, the clarity of the literary style, and—last but not least—the contemporaneous translations it prompted.[23] The most famous one was the Turkish work written by Seydi ʿAlī Reis, but there are indications of another one being produced in Sindhi during the 17th century.[24] These are four reasons which have been used consistently to argue on the historical importance of the *ʿUmda* and the need to study it further. We would like to add yet a fifth one to this technical note, and it is the fact that the *ʿUmda* is one of the few early nautical works of the Indian Ocean for which there are manuscript copies containing annotations from actual sailors. The most interesting case is the Leiden manuscript, where a man called Yaḥyā ibn Muḥammad al-Madīḥ al-Ahdhal wrote down his own account of the *Taḥtiyyat* islands in the Red Sea and their navigational hazards. Al-Ahdhal claims to have found them different than what had been described by Ibn Mājid and discusses two of his voyages to these islands, each carried under a different sea captain (*nākhūda*): the first called Ibrāhīm Ḥīlī al-Shādhilī and the second Ḥasan al-Ḥasānī. This copy is a small indication of actual texts being used in navigation practice.

[22]Lunde 2012, 62.
[23]See Mahrī 1970a, VIII-IX; Tibbetts 1971: 42; Grosset-Grange and Rouquette 1997, ??; Lunde 2021: 62.
[24]See Mahrī 1970a, ix; Lunde 2021, 62.

Chapter One:

On the Knowledge of the Principles

باب الأوّل في معرفة الأصول

1.15 · Knowledge of the division of the types of calculations

Chapter Two:

Knowledge of the names of the stars and what relates to them

2.1 · Knowledge of the names of stars

2.2 · Knowledge of the number of finger distances between the North Pole, the Pole Star, the Guardians and Errai

2.3 · Knowledge of the rotation of the Guardians around the Pole

2.4 · Knowledge of the preconditions of the navigator

Chapter Three: Knowledge of routes West and East of Cape Comorin

3.1 · Knowledge of the routes of the headlands and the reefs of the sea of Hijaz and its islands

3.2 · Knowledge of the routes of the capes of seaward islands from the Sudanese and Eritrean coasts (*barr al-ʿajam*)

3.3 · Knowledge of the routes of the Arabian coast, such as the coast of al-Juzr, al-Aḥqāf, al-Aṭwāḥ, Sawāḥil, the Omani lands and the island of Jurūn

3.4 · Knowledge of the routes of non-Arab lands (*barr al-ʿajam*) like Mukrān, Sind, Gujarat, Konkan, Tulwān and Malabar

١٥ فصل في معرفة تقسيم أنواع الحساب

باب الثاني في معرفة أسماء الكواكب وما يتعلّق بها

١ فصل في معرفة أسماء الكواكب

٢ فصل في معرفة عدد الأصابع بين القطب الشمالي والجاه والفرقد والميخ

٣ فصل في معرفة دورة الفرقدين على القطب

٤ فصل في معرفة شروط صاحب الدرك

باب الثالث

في معرفة دير فوق الريح وتحت الريح

١ فصل في معرفة دير رؤوس وشعبان بحر الحجاز وجزره

٢ فصل في معرفة دير رؤوس الجزر البحريّات من برّ العجم

٣ فصل في معرفة دير برّ العرب كأرض الجزر والأحقاف والأطواح وسواحل وعمانات وجزيرة جرون

٤ فصل في معرفة دير برّ العجم كمكران وسند وجوزرات وكنكن وتلوان ومليبار

3.5 · Knowledge of the routes of the coast of Zayālaʿ, Madjān, Somalia, Rīm and Sofala

3.6 · Knowledge of the deep-sea routes

3.7 · Knowledge of the routes East of Cape Comorin (*taḥta al-rīḥ*), such as the coast of the land of the Cholas, Nāt, Warīsā and Banj

3.8 · Knowledge of the routes of the coast of Siam

3.9 · Knowledge of the routes of the coast of Ṣanf and China

٥ فصل في معرفة دير برّ الزّيالع والمدجان وسومال والريم والسفال

٦ فصل في معرفة دير المطالق

٧ فصل في معرفة دير تحت الرّيح كبرّ الشّوليان والنات ووريسا والبنج

٨ فصل في معرفة دير برّ السّيام

٩ فصل في معرفة دير برّ الصّنف والصّين

Chapter Four: Knowledge of the islands and their routes

4.1 · Knowledge of the island of Qumr (Madagascar)

4.2 · Knowledge of the islands of Zarrīn

4.3 · Knowledge of the island of Socotra

4.4 · Knowledge of the Fāl islands (Lakshadweep)

4.5 · Knowledge of the Dhīb islands (Maldives)

4.6 . Knowledge of the island of Sīlān (Sri Lanka), called Sarandīb

4.7 · Knowledge of the islands of Andaman and Nāj Bārī

4.8 · Knowledge of the seaward islands off the coast of Siam, called Tākū, from Polaris at five fingers high to Polaris at two fingers

4.9 · Knowledge of the island of Sumatra

باب الرابع في معرفة الجزر وديرهنّ

١ فصل في معرفة جزيرة القمر

٢ فصل في معرفة جزر زرّين

٣ فصل في معرفة جزيرة سقطرى

٤ فصل في معرفة جزر الفال

٥ فصل في معرفة جزر الذيب

٦ فصل في معرفة جزيرة سيلان المسمّاة سرنديب

٧ فصل في معرفة جزر أندمان وجزر ناج باري

٨ فصل في معرفة الجزر البحريّات على برّ السّيام المسمّاة تاكوا من جاه خمس لجاه إصبعين

٩ فصل في معرفة جزيرة شمطرى

Chapter Five:

Knowledge of altitude measurements in famous lands

باب الخامس في معرفة القياس على البرور المشهورة

5.10 · Knowledge of the altitude measurements of the stars that are well known among people, whose beginning and end are fettered in the days of the Nayrūz which, however, changes through time, every year a quarter of a day for the sake of the leap-year

Chapter Six:

Knowledge of the sailing seasons in the days of the Nayruz

6.1 · The first part of the first branch is called the beginning of the wind

6.2 · The second part of the first branch, which is the end of Kaws and is called Tiramah by some people, and Damānī

6.3 · Knowledge of the sailing seasons East of Cape Comorin

6.4 · The second branch of the sailing seasons of the Qabūl wind, which is the Azyab

6.5 The sailing seasons East of Cape Comorin to the land of the Arabs and what is contiguous

Chapter Seven: On the Voyages

7.1 · Knowledge of the islands of the Arabian coasts

7.2 · Knowledge of the islands of non-Arab coasts

7.3 · Voyage from Bab-el-Mandeb to the mountain of Zuqar, Saybān and Kamarān

١٠ فصل في معرفة قياسات الكواكب المشهورة عند الجمهور بالصّحّة مقيّدة ابتداء وانتهاء بأيّام النيروز لكن تختلف على طول الزمان كلّ سنة ربع يوم من أجل الكَبِيسَة

باب السادس في معرفة المواسم على أيّام النّيروز

١ فصل القسم الأوّل من الضرب الأوّل يسمّى رأس الريح

٢ فصل القسم الثاني من الضرب الأوّل وهو آخر الكوس ويسمّى تِيرَمه عند بعض الناس، ويسمّى الداماني

٣ فصل في معرفة مواسم تحت الريح

٤ فصل الضرب الثاني في مواسم ريح القبول وهو الأزْيَب

٥ مواسم تحت الريح لبرّ العرب وما يليه

باب السابع في الأسفار

١ فصل في معرفة جزر بحريّات برّ العرب

٢ فصل في معرفة جزر بحريّات برّ العجم

٣ السفر من باب المندب إلى جبل الزّقر و إلى سيبان وكمران

المنهاج الفاخر في علم البحر الزاخر

al-Minhāj al-Fākhir fī ʿIlm al-Baḥr al-Zākhir

The Precious Method on the Science of the Rising Sea

Introduction

The *Minhāj* is the second and last navigational treatise composed by Sulaymān al-Mahrī. The date and authorship of the work are not mentioned anywhere in the text. The explicit connection with the literary corpus of al-Mahrī is made rather through the passages referring to the *ʿUmda al-Mahriyya* and the *Tuḥfat al-Fuḥūl*,[25] as well as through the obvious textual correspondences between these works. The *Minhāj* is extant in ten manuscripts kept at the private collection of ʿAlī Muḥammad al-Tājir (Bahrain), the Egyptian National Library (Cairo), the Azhar Library (Cairo), the Assad National Library (Damascus), the Bibliothèque nationale (Paris), Leiden University Library, the Ministry of Heritage and Culture in Muscat, the Bodleian Library (Oxford), the Vatican Library and Yale University Library.

The introduction at the beginning of the *Minhāj*,[26] clarifies that the aim of the book was to gather knowledge about the seas of inhabited lands (*al-buḥūr al-maʿmūrāt*) in terms of their routes, star-altitude measurements and distances. The impression left on the reader is that this is also to a great extent an attempt at perfecting the *ʿUmda*: the topics are mostly the same but duplicated side information is often dismissed, numerical values are corrected, and further descriptions of sea routes are included. The passages alluding to disagreements between different groups of navigations with regard to nautical details are much briefer as they simply refer the reader to the *ʿUmda*,

[25] See Mahrī 1970, 6: "And whoever wants the confirmation will find the principles that I have set forth in my book, called *Tuḥfat al-fuḥūl fī tamhīd al-uṣūl*."; and also Mahrī 1970, 88: "and I have mentioned it in the *ʿUmda* according to what has reached me."

[26] See Mahrī 1970b, 3.

where those had been already discussed. No introductory chapters on the principles of navigation are included, for the author claims to have discussed them in detail in yet a third work. These are only briefly alluded to in the first chapter through a discussion on the distance between the rhumbs, possibly because it was one of the most problematic topics in Indian Ocean nautical literature. The difference in the numerical values for the latitude measurements is explained, as al-Mahrī claims to have tried those of the *ʿUmda* in some places and found there to be errors. Instead of those recorded by the Cholas, the second navigational treatise followed those of predecessors which the author must have considered to be more accurate. Four descriptions of sea voyages are further included in the conclusion, together with a route from Diu to Malacca alternative to that described in the *ʿUmda*.
The main sections of the *Minhāj* are almost entirely geographical. The majority of the treatise is in fact a description of the Indian Ocean, as it begins to identify coastal lands and islands according to their latitudes and then continues to describe the general courses and distances between them. As Lunde has already noted, a considerable part of the information provided in the *Minhaj* could have been used to produce a nautical chart. The sailing seasons are discussed in chapter five, and the final two bring new topics that had not been previously discussed before by al-Mahrī. The first is the *ishārāt*, or the signs of approaching land, which had also appeared in works of Ibn Mājid such as the *Fawā'id* or the *Ḥāwīyat al-Ikhtiṣār*. The second new topic is the calendar, mostly dedicated to the solar and lunar systems and the conversion from one to the other.
The production of the *Minhāj* does not seem to have ever diminished the relevance of the *ʿUmda* as a navigational treatise. The clearest indication for this is—as mentioned in the introduction to the previous work—the fact that so far the *ʿUmda* is the only text by al-Mahrī known to have been translated around the time it was written. In the eyes of the author, however, the *Minhāj* was an attempt at improving the *ʿUmda*, keeping a similar structure to the previous treatise but with corrected values and additional information.

3.5 · Knowledge relating to of the Maldives Islands (Dhīb)

3.6 · Knowledge of the island of Sri Lanka (Sīlān)

3.7 · Knowledge of the Andaman and the Nicobar islands (Nāj Bārī)

3.8 · Knowledge of the Tākwā islands, which are the Mākuwā, seawards from the Siamese coast

3.9 · Knowledge of the island of Sumatra

3.10 · Knowledge of the island of Java, summary

3.11 · Report on some southeastern islands

الباب الرابع في المسافة على قياس الجاه والفرقدين

Chapter Four:

Distance calculation according to the altitude measurements of Polaris and the Guardians

4.1 · Reporting the distance between the Arabian and Indian coasts, staring from distances when Polaris is eleven fingers high

4.2 · Reporting the distances East of Cape Comorin, starting from Polaris at eleven fingers high as well

4.3 · Reporting the distances according to the altitude measurements of the Guardians between the coast of Zanj and the back side of the islands of Socotra and Java

4.4 · Reporting on the distances between some locations

Chapter Five:

On the knowledge of the winds and the navigational hazards

5.1 · On storms

5.2 · On navigational hazards

Chapter Six:

On the signs of approaching land

6.1 · Knowledge of the signs of proximity to the shores of India

6.2 · Knowledge relating to proximity to the Arabian and Somali lands

Chapter Seven:

Knowledge of the transits of the Sun and the Moon through the zodiacal signs and the lunar mansions, and related matters

7.1 · Transits of the Sun and the Moon through the zodiac signs according to the Nayrūz calendar

7.2 · Transits of the Sun and the Moon through the Lunar Mansions

7.3 · The hours

باب الخامس في معرفة الأرياح والمحذورات

١ فصل في الطوفانات

٢ فصل في المحذورات

باب السادس في علامات قرب البرور

١ فصل في معرفة علامات قرب البرور من أرض الهند

٢ فصل في معرفة قرب برّ العرب وبرّ السّمال

باب السابع في معرفة حلول الشّمس والقمر في البروج والمنازل وما يتعلّق به

١ فصل في حلول الشّمس والقمر في البروج على حساب النّيروز

٢ فصل في حلول الشّمس والقمر في المنازل

٣ فصل في الساعات

Conclusion: Description of travelling by some ports of Shiyūbād

8.1 · Voyage from Diu to Malacca

8.2 · Voyage from Malacca to the Maldives (al-Dhīb)

8.3 · Voyage to Fanṣūr from Diu

8.4 · Voyage to Marṭabān and Tanāṣrī

8.5 · Voyage to Ṣādjām in Bengal from the coast of Nāt

الخاتمة صفة سفر بعض بنادر شيوباد

١ فصل: السّفر من الدّيو إلى ملّاقة

٢ فصل: السفر من ملاقة للذّيب

٣ فصل: السفر إلى فنصور من الديو

٤ فصل: السفر إلى مرطبان وتناصري

٥ فصل: السفر إلى بنجاله صادجام من برّ النّات

Addendum: On the description of the land from Karāzī to Karāshī

9.1 · Knowledge of the five altitude measurements when Polaris is five

9.2 · Knowledge of the deep-sea route from the land of Sawāḥil to the islands of Madagascar

فائدة في وصف البرّ من الكرازي لكراشي

١ في معرفة خمسة قياسات في جاه خمس

٢ في معرفة المطالق من برّ السواحل إلى جزائر القمر

تحفة الفحول في تمهيد الأصول علم البحر

Tuḥfat al-Fuḥūl fī Tamhīd al-Uṣūl ʿIlm al-Baḥr

The Worthy Men's Gift on the Introduction to the Principles of Maritime Science

Introduction

There is not much information about the time of composition of the *Tuḥfat al-fuḥūl*. The date and the authorship are missing from the text, which leaves only small passages concerning the *ʿUmda* and the *Minhāj* as chronology markers.[27] The fact that the tittle of the *Minhāj* appears in this work is of little use and even baffling, for the *Tuḥfa* is likewise mentioned in that treatise,[28] and so we can hardly rely on these mentions to determine which of the two was first produced. The only safe conclusion is that it must have been written later than the *ʿUmda*, meaning after 1511. The text is extant in four manuscript copies available at the Bibliothèque nationale (Paris), Qatar National Library (Doha), Yale University Library and Azhar Library (Cairo).

The relation between the *Tuḥfa* and the *ʿUmda* is closer than what may appear at first sight. al-Mahrī begins the latter with two chapters listing and clarifying the navigational principles that he considers to be necessary to every deep-sea pilot. What the *Tuḥfa* then proposes is "a work small in size but large in its knowledge of the principles of the science of the sea",[29] i.e. the same principles that had been previously presented in the *ʿUmda*. The configuration of the heavens, for example, was a section in the *ʿUmda* limited to explaining that the celestial sphere has three most elementary circles: the meridian, the equator and the horizon. This was extended in the *Tuḥfa* to become a "description of the orbs and the celestial bodies in them."[30] The second

[27] See al-Mahrī 1972, 20, "This is more correct than what is in the *ʿUmda* because…"; see also al-Mahrī 1972, 24, "And as for the establishment of the *zām* that I have put in my book, the *Minhāj*…"

[28] See Mahrī 1970b, 6.

[29] Mahrī 1972c, 15.

[30] Mahrī 1972c, 16.

chapter of this work does the same for the rhumbs, and so on with every other principle that had been discussed in al-Mahrī's first navigational treatise. The aim of the *Tuḥfa*, it seems, is thus to provide a clearer explanation on each topic and, in cases such as that of the distance between the stars of the Plough, γ Cephei and the Pole, even to correct the numerical values that had been given previously: "This is more correct than what is in the *ʿUmda*, because it has been tried with instruments of fraction"—that is, astronomical or mathematically based—"instead of hand instruments."[31] In the second navigation treatise, the *Minhāj*, the author no longer bothers to spend much space dealing with the principles, as he refers the reader to the *Tuḥfa* instead.[32]

The entire work seems to carry a constant question in the background, related to the role of practical and theoretical knowledge in the field of navigation. The topic is partially approached in each chapter, where more practical techniques are at times contrasted with more mathematical ones. It is in this text that al-Mahrī is especially concerned with, for instance, specifying the exact distance in fingers between the nautical rhumbs.[33] It is also here that the methods (*madhhab*) of Arabs, Cholas and Indians are put in comparison when dealing with topics such as the incorrectness of the *taraffā* or oflatitude measurements. The reflection on the prevailing kind of knowledge used for navigation becomes explicit at the end of the book once all the principles have been dealt with, in the Conclusion. "Know"—al-Mahrī states—"that the foundation of this craft is both theory (*ʿaql*) and practice (*tajrīb*), because what has been tested and agrees with theory is reliably true. What is one without being the other is also valid, but not with confirmation as in the first case."[34] Having stated that, al-Mahrī argues that experience proves to be more valuable in some instances, such as the knowledge of the monsoons, or the sailing seasons; while theory can be more so when dealing with star altitude measurements or distances. Yet, he concedes, the most accurate knowledge about any given place is usually the one developed and authenticated by local people.[35]

[31] Mahrī 1972, 20. Navigators of the Indian Ocean used a small piece of wood called the *khashaba* to perform star altitude measurements. This instrument was calibrated in terms of fingers, and it seems to have derived from measurements using the hand. One basic unit would correspond to the width of a finger seen at the distance of an outstreched arm. See Al Salimi and Staples 2019, 398–99; Staples 2012, 51–54; Bénard 2022, 27.

[32] Mahrī 1970b, 6.

[33] Mahrī 1972c, 18–19.

[34] Mahrī 1972c, 36.

[35] Mahrī 1972c, 37.

٢ فصل في لواحق القياس وهي ارتفاع الكواكب وانحطاطها

5.2 · On the complements to altitude measurements, which are the ascending and descending of stars

باب السادس في المسافة

Chapter Six:

On the distance

باب السابع في الأرياح

Chapter Seven:

On the winds

خاتمة

Conclusion

شرح تحفة الفحول في تمهيد الأصول علم البحر

Sharḥ Tuḥfat al-Fuḥūl fī Tamhīd al-Uṣūl ʿIlm al-Baḥr

A Commentary to *The Worthy Men's Gift on the Introduction to the Principles of Maritime Science*

Introduction

As per its title, the *Sharḥ al-Tuḥfa*, or *Ḥāshiyat al-Tuḥfa*, is a commentary written by al-Mahrī to his own previous work, the *Tuḥfat al-Fuḥūl*. Each topic introduced in the first is then developed by the seconf always according to the same structure—"I have said this (viz. in the *Tuḥfa*)…", and "Now I say the following…"—to introduce yet another section that explains a specific point. Some explanations are longer and take several paragraphs, others are limited to just a few lines paraphrasing the information above. This technical note details all such sections over the next pages, in both the original Arabic and our English translation. The idea is to provide a better view of the variety of topics explored in the *Commentary*, which would not be seen just by listing the chapters and sections. The work is available in two manuscript copies, one of them kept at the Bibliothèque nationale (Paris) and the other at Yale University Library.

Al-Mahrī used the *Sharḥ* to dive even deeper into the scattered sciences (*ʿulūm shattā*) that integrate the field of navigation. To give an example, the author comments on the first chapter to an extension that allows him to move beyond the general cosmography introduced in the *Tuḥfa* and into the discussion of more theoretical aspects of astronomy, such as the number and the kind of orbs pertaining to each celestial body. Questions related to nautical concepts and techniques are also developed, as the reason why the *taraffā* is incorrect, or the way problems of the compass may undermine the measurement of courses. The author also tries to improve geographical sections such as the one on the formation of winds. The *Sharḥ al-Tuḥfa* is in this sense a work that, although secondary in terms of its nautical utility, tries to establish a closer connection between the knowledge applied in the practice of navigation and the theoretical tradition of the

astronomers and geographers. It attempts to relate the information provided by sailors all around the Indian Ocean with that of sources such as Abū al-Fidā's *Taqwīm al-buldān*, Ptolemy, al-Sufi, and *hay'ah* astronomical works.

باب الأوّل في صفة الأفلاك والكواكب فيها

١ قلت فالأفلاك كلّها بمنزلة كرة واحدة يحيط بها سطحان متوازيان مركزهما مركز العلم

٢ قلت لكنها تنقسم إلى تسعة أفلاك كلية يحيط بعضها ببعض يماس السطح الأدنى من كلّ واحد منها السطح الأعلى من الفلك الآخر الذي دونه في الترتيب

٣ قلت فأدنى الأفلاك إلى العالم السفلي

٤ قلت فلك القمر

٥ قلت ثمّ فلك العطارد

٦ قلت ثمّ فلك الزهرة

٧ قلت ثمّ فلك الشمس

٨ قلت ثمّ فلك المرّيخ ثمّ فلك المشتري ثمّ فلك زحل

٩ قلت ثمّ فلك الثوابت

١٠ قلت ثمّ الفلك العظم و هو الأطلس

١١ قلت والدليل على عددها وجدان تسع حركات متخالفة

١٢ قلت ودليل على ترتيبها المذكور كسف الكواكب بعضها بعضا ففلك الكاسف تحت فلك المكسوف

Chapter One: On the description of the orbs and the celestial bodies in them

1.1 · I said: Every orb is like a single sphere surrounded by two parallel layers, the centre of which is the centre of the world.

1.2 · I said: However, they are divided into nine comprehensive orbs which surround each other. The lower layer of each one touches the higher layer of other orb directly below it in the sequence.

1.3 · I said: The orbs draw close to the inferior world.

1.4 · I said: The orb of the Moon.

1.5 · I said: The orb of Mercury.

1.6 · I said: The orb of Venus.

1.7 · I said: The orb of the Sun.

1.8 · I said: The orbs of Mars, Jupiter and Saturn.

1.9 · I said: The orb of the fixed stars.

1.10 · I said: The highest orb, which is the Aṭlas.

1.11 · I said: The indication of their number [i.e., of the orbs] is the perception of nine different movements.

1.12 · I said: The indication of their mentioned order is that planets eclipse one another, and so the eclipsing planet is below the eclipsed planet.

١٣ قلت واعلم أن الكواكب على ثلاثة أقسام
١٤ قلت القسم الأوّل السبعة السيارة وكلّ واحد في فلكه المعروف
١٥ قلت القسم الثاني الثوابت وهي جميع الكواكب الظاهرة من نيرة وخفية وكلّها في الفلك الثامن
١٦ قلت القسم الثالث ليس بكواكب حقيقة بل مجازا وهما القطبان الفاصلان بين المشرق والمغرب وهما نقطتان غير محسوستين من الفلك التاسع
١٧ قلت تنبيه الكواكب كلّها مغرقة في كرات الأفلاك كالفص في الخاتم وطلوعها وغروبها بدوران الكرات وليس حركاتها في الأفلاك كمشي الحوت في الماء

1.13 · I said: Know that celestial bodies are of three kinds.

1.14 · I said: The first kind is of the seven planets, and each one of them is in its known orb.

1.15 · I said: The second kind is of the fixed stars, which concerns all the visible celestial bodies, from the bright to the fading ones, and all of them are in the eighth orb.

1.16 · I said: The third division does not have real celestial bodies, but figurative. And they are the two poles which separate East from West. They are two unperceivable points from the ninth sphere.

1.17 · I said: Note: All celestial bodies are immersed in the spheres of the orbs as the stone is in the ring. Their risings and settings go with the circular movements of the spheres, and their movements in the orbs are not as the advance of a fish in the water.

باب الثاني في تجزئة الدورة

١ قلت اتّفق علماء البحر على تجزئة الدورة باثنين وثلاثين جزءًا
٢ قلت وسموا كلّ جزء منها خَنّا لمناسبة أخنان المركب وهي أجزاؤه وأضيف كلّ لكوكبه المعروف فصارت أعلاما بالإضافة إليها

Chapter Two: On the parts of the circle

2.1 · I said: Those who know about the sea have agreed that the circle is divided in thirty two parts.

2.2 · I said: They called each of its parts “rhumbs” due to their correspondence with the rhumbs of the ship, which are its parts. Each one of them is attributed to its famous star, and becomes its sign due to the attribution.

2.3 · I said: The rising points of the stars used by most people in the division of the rhumbs do not actually correspond to the divisions, but only by extension. The actual divisions are in the apportioning of the compass.

2.4 · I said: Between every two divisions there are six and a half fingers, and three quarters of one-half of a sixth in measuring fingers.

2.5 · I said: The entire circle has 210 fingers according to us.

2.6 · I said: According to the ancients, between every two rhumbs there are seven fingers and, thus, the entire circle has 224 fingers.

2.7 · I said: The first opinion is more accurate, for it indicates that the highest *bāshī* is four fingers, and it is known among the astronomers that from the ascension of Polaris to its descending there are six degrees and six sevenths of a degree. Thus, every finger comes to one degree and five sevenths of a degree.

2.8 · I said: Every degree is four *zām* and two thirds.

2.9 · I said: Know that the finger is of two kinds.

2.10 · I said: The kind of finger of the sea pilots is a quarter of the known *dhubbān*.

2.11 · I said: The other kind is the finger of the land surveyors. They have agreed among themselves that a finger is six average hairs placed side by side.

2.12 · I said: And they have differences about the cubit, the mile and the farsang, but it is not up to us to talk about their craft.

٣ قلت الكواكب المستعملة عند الجمهور في تجزئة الأخنان ليس طلوعها موافقا للتجزئة حقيقة بل مجازا وحقيقة الأجزاء في قسمة بيت الإبرة

٤ قلت بين كلّ جزأين ستّ أصابع ونصف وثلاثة أرباع نصف سدس أصابع قياسًا

٥ قلت فتكون جملة الدورة مائتين وعشر أصابع عندنا

٦ قلت وعند القدماء بين كلّ خنّين سبع أصابع فتكون الدورة مائتين وأربع وعشرين إصبعا

٧ قلت والأوّل أصحّ بدليل أن غاية الباشي أربع أصابع ومشهور عند أهل الفلك أن من صعود الجاه إلى هبوطه ست درج وستة أسباع درجة فصار كلّ إصبع درجة وخمسة أسباع درجة

٨ قلت وكلّ درجة خمسة أزوام إلا ثلثا

٩ قلت ثمّ إعلم أن الإصبع على نوعين

١٠ قلت نوع إصبع معالمة البحر وهي ربع ذبّان المعروف

١١ قلت ونوع آخر إصبع أهل المساحة إتفقوا الإصبع عندهم ستّ شعيرات معتدلات مضموم بطون إلى بعضها بعض

١٢ قلت واختلفوا بالذراع والميل والفرسخ وليس لنا كلام في فنّهم

2.13 · I said: Between the Pole and Polaris there are two fingers, and there is agreement about this.

2.14 · I said: Between the Pole and Kochab there are 8 fingers.

2.15 · I said: Between the Pole and Errai (Mīkh) there are 8 fingers and a quarter.

2.16 · I said: Between Polaris and Errai there are 6 fingers and a quarter.

2.17 · I said: This is more accurate than what is in the *ʿUmda*, because it was tested with a graduated instrument, not a hand instrument. This latter varies in the altitude of celestial bodies by a little more or less, while the graduated instrument does not.

Chapter Three:

On the *zām*

3.1 · I said: The *zām* is of two kinds, the conventional and the technical.

3.2 · I said: The conventional is one of the eight parts of the duration of a day with its night.

3.3 · I said: And the technical is one of the eight parts of the distance required to raise or lower a star by one finger when moving towards or away from it, either by conjecture or experience, and through the use a well-known star or not.

3.4 · I said: The *zām* are placed between the rhumbs and, according to the sea pilots, they follow three methods.

١٣ قلت وبين القطب والجاه إصبعان وقيل فيهما النفس

١٤ قلت وبين القطب والفرقد الكبير ثمان أصابع

١٥ قلت وبين القطب والميخ ثمان أصابع وربع

١٦ قلت وبين الجاه والميخ ست أصابع وربع

١٧ قلت هذا أصحّ من الذي في العمدة لأنّ هذا مجرّب بآلة الجزء بخلاف آلة اليد فانّه يختلف باختلاف ارتفاع الكواكب بالضيق والنفس وليس آلة الجزء كذلك

باب الثالث في الأزوام

١ قلت الزام على قسمين عرفي واصطلاحي

٢ قلت فالعرفي هو قطع جزء من ثمانية أجزاء من مسافة يوم بليله

٣ قلت والإصطلاحي هو قطع جزء من ثمانية أجزاء من مسافة ارتفاع كوكب أو انحطاطه إصبعًا بجريك إليه أو عنه فرضًا واستعمالًا في الكواكب المشهورة أو غيره

٤ قلت الأزوام الموضوعة بين الأخنان فهي عند المعالمة البحر على ثلاث مذاهب

٥ قلت مذهب للعرب والهرامزة

٦ قلت ومذهب لأهل الهند

٧ قلت ومذهب للشوليان

٨ قلت ولكن وضع غير وضع الآخر إلا أنّهم اتفقوا على أن من القطب إلى العيّوق بين كلّ خنّين زامان

٩ قلت والحقيقة أنّها ثمانية لكن ليست بالسويّة بين الأخنان

١٠ قلت ودليل بطلان صحّتها أن من جرى تحت القطب ثمانية أزوام رفع إصبعًا من الجاه ومن جرى في خنّ الفرقد حتى يرفع إصبعًا من الجاه فلا يرفعه إلّا بأكثر جري من القطب لإنحرافه عنه وكذلك الجري في النعش والناقة والعيّوق

١١ قلت فلنصوّر مثلان على قاعدة أزوامهم وترفّاتهم

١٢ قلت إن مركبين أحدهما جرى في القطب ثمانية أزوام رفع إصبعًا من الجاه والمركب الآخر جرى في خنّ الفرقد عشرة أزوام رفع إصبعًا من الجاه مجموع جري المركبين ثمانية عشر زامًا

١٣ قلت ومركبين آخرين جرى أحدهما في خنّ الناقة أربعة عشر زامًا رفع إصبعًا من الجاه والمركب الآخر جرى في العيّوق ستّة عشر زامًا رفع إصبعًا من الجاه فمجموع الجريين ثلاثون زامًا

3.5 · I said: the Arabs and the people of Hormuz have one method.

3.6 · I said: the people of India have one method.

3.7 · I said: the Cholas have one method.

3.8 · I said: But the placements do not agree with one another except in that from the Pole to Capella there are two *zām* between every two rhumbs.

3.9 · I said: The truth is that it is they are eight, but they [i.e., the *zām*] are not equal between the rhumbs.

3.10 · I said: The proof of its inexactitude is that whoever heads due north for eight *zām* raises Polaris by one finger; and whoever heads N by E will not manage to raise Polaris by one finger until he has sailed longer than towards the Pole, due to his deviation from it. The same applies for the headings of NNE, NE by N and NE.

3.11 · I said: Let us picture two examples according to the principle of their *zām* and their *taraffa*.

3.12 · I said: If one of two ships heads towards the Pole by eight *zām*, raising Polaris by one finger, and if the other ship heads N by E by ten *zām*, raising Polaris by one finger, the sum of the course taken by the two ships is 18 *zām*.

3.13 · I said: One of two other ships heads due NE by N for 14 *zām* raising Polaris by one finger, while the other ship heads due NE for 16 *zām* raising Polaris by one finger. The sum of the two voyages is 30 *zām*.

3.14 · I said: How can it be conceived that between the Pole and N by E it be like between NE and NE by N, if the course is not laid on equal divisions, as per the above? The reality is not that there is an extra course but the distance is longer, and this is a sure proof about the invalidity of the equality.[36]

3.15 · I said: As for between NE and due East, there are differences about them in the well-known schools, for every earnest study has its technical way of speaking.

3.16 · I said: The ṭirfas are likewise not accurate.

3.17 · I said: The proof of their inexactitude.

3.18 · I said: If a ship approaches Sauqira from the deep sea —when Polaris is eight— for 16 *zām*, and that ship is forced to make landfall, the approach would be set to NW following equal halving between the two extremes of the route.

3.19 · I said: It will only touch land by heading towards a *taraffā* where Polaris is nine. And on the NW *taraffā*, it is 16 *zām* according to their placement.

3.20 · I said: Now, one who heads due West for 16 *zām* will reach land, so how can the land there be on equal placement, both a distant and close course?

3.21 · I said: A second indication is that if a ship is sailing 21 *zām* in the deep sea towards Dābūl, and the ship intends to approach land, then the nearby land is towards ENE because of its centrality between the two extremes of the route. But he will only reach land following a ENE course if sailing on a *taraffā* where

[36] This section is missing in Khoury 1972b.

١٤ قلت فكيف بتصوّر بين القطب والفرقد كمثل بين العيّوق والناقة والجري ليس بالسويّة على ما سلف والحقيقة ما كان أكثر جريًا فهو أكثر بعدًا فهذا دليل مؤكّد على البطلان بالسويّة

١٥ قلت وأمّا من العيّوق إلى نقطة المشرق فهم فيه مختلفون على مذاهبهم المشهورة فكلّ له إصطلاح من اجتهاد

١٦ قلت وكذا الترفّات انّها غير صحيحة

١٧ قلت ودليل بطلان صحّتها

١٨ قلت إنّ مركبًا مغزرًا على صوقرة جاه ثمان بستّة عشر زامًا وأراد المركب قرب البرّ لضرورة فالقرب متعيّن في مغيب العيّوق لمناصفته بين طرفي الديرة

١٩ قلت ولا يلحق البرّ إلّا بجري ترفّا لجاه تسع وترفّا العيّوق ستّة عشر زامًا على وضعهم

٢٠ قلت ومن جرى في المغيب الأصلي ستّة عشر زامًا أخذ البرّ فكيف يكون البرّ هنا بالسويّة في جري البعيد والقريب

٢١ قلت وايضًا دليل ثان أنّ مركبًا مغزرًا على دابول بأحد وعشرين زامًا وأراد المركب قرب البرّ فالقرب متعيّن في مطلع السماك لتوسطه بين طرفي الديرة ولا يلحق البرّ في السماك إلّا بجري ترفّا لجاه تسع على وضع أزوامهم وترفا

Polaris is nine, according to their placement of the *zām*, and a *taraffā* of ENE is with 25 *zām*.

3.22 · I said: Whoever sails due East for 21 *zām* reaches the land. But how can nearby land be far, and the one far be nearby? This is the error, and this is *taraffā*.

3.23 · I said: The *zām* are also between the rhumbs.

3.24 · I said: I mentioned NE and ENE, and I did not mention NE by N and what is between it and the Pole, because the error is apparent on NE and what is near it, down to due E.

3.25 · I said: And it is not apparent on NE by N and what is between it and the Pole, but rather its error is hidden.

3.26 · I said: As for the placement of the *zām* that I used in my book the *Minhāj*, it is closer to what is correct and simpler to calculate than theirs.

3.27 · I said: Concerning the two ways, one of them is theoretical, and the other is based on experience. These are the two principles of this craft.

Chapter Four:
On the route in a general course

4.1 · I said: The route is of two types.

4.2 · I said: The coastal route.

السماك بخمسة وعشرين زامًا

٢٢ قلت ومن جرى في المطلع الأصلي أحدا وعشرين زامًا أخذ البرّ فكيف يكون البرّ القريب بعيدا أو البعيد قريبًا وذلك الفساد ولترفّا

٢٣ قلت والأزوام بين الأخنان أيضًا

٢٤ قلت وإنّما ذكرت العيّوق والسماك ولم أذكر الناقة وما بينها إلى القطب لانّ الفساد ظاهر في العيّوق وما يليه إلى نقطة المشرق

٢٥ قلت ولم يكن ظاهرًا في الناقة وما بينها إلى القطب بل فسادها خفيّ

٢٦ قلت وأمّا وضع أزوامي الّتي وضعتها في كتابي المنهاج فهو أقرب للصواب وأسهل للحساب من وضعهم

٢٧ قلت من وجهين أحدهما عقلي والآخر تجريبي وهما الأصلان في هذا الفنّ

باب الرابع
في الديرة

١ قلت الديرة على قسمين

٢ قلت ديرة مُلّ

٣ قلت وديرة مُطلق

٤ قلت وكلّ منهما إمّا حقيقيّة أو مجازيّة فالحقيقيّة هي المجرى في أحد الأخنان أو كسره مواز لذلك البرّ لو أخذ غيره لاختلفت الموازاة

٥ قلت والغالب على الدير المجاز خصوصًا البرور الطوليّة مع اتّحاد ديرهم

٦ قلت وللدير آفات تفسدها

٧ قلت الآفة الؤولى إذا كنت تجري بالديرة والموجه عولي والقلع بالفيش فترتمي للبرّ

٨ قلت الآفة الثانية غفلة صاحب الدرك عن ضبط المجرى وتهاونه به

٩ قلت الآفة الثالثة المدّ إذا كان بحريًا أو برّيًا أو يمينًا أو يسارًا في ديرة المطلق

١٠ قلت الآفة الرابعة خلل الدائرة أو خلل من تجليس الحقّة أو من علامات المجرى

١١ قلت الآفة الخامسة أخذ الديرة والجري بها من قرب البرّ

١٢ قلت وقيد أخذ الديرة والجري بها من برّ ذي بطون ورؤوس خارجة في البحر أربعة أزوام ومن غيره ثلاثة أزوام وزامًا أو أقلّ أو أكثر كبرّ جوزرات هذا في دير الملّ في برّ الهند

4.3 · I said: And the deep-sea route.

4.4 · I said: : Each of these two is either real or figurative. The real one is the course on one of the rhumbs or its fractions, corresponding to a given land, such that if another course were taken, the correspondence would differ.

4.5 · I said: The prevalent among routes is the figurative, especially among extended lands with the combination of their routes.

4.6 · I said: Routes have hazards that make them difficult.

4.7 · I said: The first hazard is when you are travelling on a route, that the waves force you astray, the vessel's sail is aloft, and you are thrown onto the shore.

4.8 · I said: The second hazard is that the navigator is absent-minded regarding the accuracy of his course, or is remiss about it.

4.9 · I said: The third hazard is the tide—coming from the sea, land, starboard or port—in the high sea route.

4.10 · I said: The fourth hazard is a fault of the compass circle, or a fault in the setting of the compass-box or in the signs along the route.

4.11 · I said: The fifth hazard is following a route and its course which are close to land.

4.12 · I said: Note: when your route and its course are near a land of inlets and protruding headlands, make sure to keep 4 *zām* offshore, and elsewhere 3 or 2 *zām*, such as in Gujarat. This has to do with the coastal route of India.

Chapter Five:

On star altitude measurements

5.1 · I said: “Measurement”, in the jargon of the people of the sea, means how high or low a celestial body is in relation to the horizon.

5.2 · I said: Of it, what is nearest the pole is the most accurate, and the weakest is what is near the East-West axis.

5.3 · I said: The accuracy of the measurements is conditioned by factors.

5.4 · I said: The first is that measuring follows an accurate sighting, for there is no measurement if the sighting is faulty.[37]

5.5 · I said: The second is that the sea is black at the time of the measurements, that there is no white in it, nor fog, and that the stars are visible and clear.

5.6 · I said: The third is that the altitude measurements match up with the best known headlands through the accuracy of the measuring.

5.7 · I said: Note: It is not correct that a star increases or decreases altitude when on an equatorial course, “between the poles”, because the stars are fixed to the sphere, and these shapes are familiar to the pilots as they travel latitudinally. This is among the impossibilities.

5.8 · I said: When the pilots refer to the “basic measurement”, it refers to the measurement of Polaris upon the culmination of Ṣarfah, then to that of the

[37] P has *mḥyl*, this reading is conjectural, pending corroboration with Y.

باب الخامس

في القياس

١ قلت القياس في اصطلاح أهل البحر هو ارتفاع الكوكب أو انحطاطه إلى الأفق

٢ قلت أصحه ما كان قطبيا وأضعفه ما كان شقاقا

٣ قلت صحّة القياس مشروطة بأمور

٤ قلت الأوّل أن يكون القياس صحيح البصر فليس بمختلّ البصر قياس

٥ قلت الثاني أن يكون البحر وقت القياس أسود ليس فيه بياض ولاغبار ويكن النجم ظاهرا بينا

٦ قلت الثالث أن يكون قياس القائس موافقًا على الرؤوس المشهورة بصحّة القياس

٧ قلت تنبيه لا صحّة لزيادة ارتفاع كوكب أو انحطاطه في الجري ما بين القطبين لأنّ الكواكب مغرقة في الكرة وهذه الصور هي المعروفة عند المعالمة بالمرقّ والمغزر وهو من المحالات

٨ قلت إذا أطلق على قياس الأصلي فهو قياس الجاه عند استقلال الصرفة ثمّ الفرقدين ثمّ النعش ثمّ الباشي

Guardians, then to the Plough, then to the Pole star calibration.

5.9 · I said: Know that the differences in the altitude measurements of Polaris in some places come from the largeness or smallness of the instrument through which the measurements were made, or from faulty recording.

5.10 · I said: And so with Rakanj and Midwar: According to the Arabs, the Hormuzis and Indians, it is ten, but according to the Cholas it is nine. Tawāhī and Dābūl: everyone agrees that they are eight. Likewise, Rāmin Kawtah and Jāmis Fula: According to the Arabs and the Cholas, the Guardians are eight, while for the people of India they are eight and a half. The truest is the experience of the one who has actual knowledge.

5.11 · I said: And the same applies to the routes.

5.12 · I said: Section on what pertains to altitude measurements, namely the risings and settings of stars.

5.13 · I said: One of the basics is when two stars are horizontally aligned in a single measurement, one of them rising and the other setting, either north or south.

5.14 · I said: If they are considered in their relation to the pole, they will be the same when in their opposite position.

5.15 · I said: And if they are higher than the pole by any height, then they will be under the pole in the opposite position by the same height by which they were above it.

٩ قلت واعلم أن ما وقع من اختلاف في قياس الجاه في بعض الأماكن إمّا من كبر الآلة المقاس بها وصغرها أو نقل فاسد

١٠ قلت كمثل رَكَنْج ومِدور فعند العرب والهرامزة وأهل الهند عشرة وعند الشوليان تسعة وتَواهي ودابول الكلّ متفّقون أنّهما ثمانية ومثل رامن كوته وجامس فُلَه فعند العرب والشوليان الفرقدان ثمانية وعند أهل الهند ثمانية ونصف والأصحّ تجربة العارف

١١ قلت وكذا الدير أيضا

١٢ قلت فصل في لواحق القياس وهو ارتفاعات الكواكب وانحطاطاتها

١٣ قلت قاعدة إذا اعتدلا كوكبان في قياس واحد أحدهما في الطلوع والآخر في الغروب شمالا كان أو جنوبا

١٤ قلت فإن كانا مسامتين للقطب فعند العكس يكونان كذلك

١٥ قلت وإن كانا أعلى من القطب بأي ارتفاع كان فعند العكس يكونا تحت القطب بالارتفاع الذي كانا فوقه

١٦ قلت وكذلك إذا كانا تحته في الأصل فعند العكس يكونان فوقه

١٧ قلت وكذا ارتفاع نفس الجاه وانحطاطه عن القطب برقباء المنازل إذ هو دليل على صحة الباشيّات بشرط صحة المراقبة

١٨ قلت قاعدة أخرى إذا أردت غاية ارتفاع كوكب في أيّ مكان شئت

١٩ قلت انظر أوّلًا ارتفاع القطب في ذلك المكان من الدرج ثمّ أسقطه

٢٠ قلت أمّا أبعاد الكواكب المشهورة عند الجمهور

٢١ قلت بعد الجاه سبع وثمانون درجة بعد الفرقد سبع وستّون بعد مقدَّم النعش ستّ وستّون بعد منير الناقة اثنتان وخمسون بعد العيّوق خمس وأربعون بعد الواقع ثمان وعشرون ونصف بعد السماك الرامح ثلاث وعشرون ونصف بعد الثريّا أحد وعشرون بعد الطائر سبع درج شمالًا

٢٢ قلت وأمّا أبعاد الجنوبيّة

٢٣ قلت بعد السِلّبار أحد وستّون درجة بعد سُهَيل اثنتان وخمسون بعد الظليم تسع وخمسون درجة بعد القلب أربع وعشرون بعد الإكليل تسع عشرة بعد التير خمس عشرة درجة بعد الجوزاء درجة واحدة

5.16 · I said: Likewise, if they were both originally below the Pole, in the opposite position they will be above it.

5.17 · I said: This ascending and descending is the same as that of Polaris in relation to the Pole with the control of the mansions, since it is an indication for the accuracy of the *bāshī*—assuming that the observation is accurate.

5.18 · I said: Another basic is if you want to know the extreme elevation of a star in any place.

5.19 · I said: Know first how much the elevation of the pole is in that place in terms of degrees, then subtract it.

5.20 · I said: Regarding the declinations of the best-known stars.

5.21 · I said: The declination of Polaris is 87°. The declination of the Guardians is 67. The declination of Dubhe is 66. The declination of Caph is 52. The declination of Capella is 45. The declination of Vega is 28.5. The declination of Arcturus is 23.5. The declination of the Pleiades is 25. The declination of Altair 7° to the north.

5.22 · I said: Regarding the southern declinations.

5.23 · I said: The declination of Achernar is 61°. The declination of Canopus is 52°. The declination of Hadar is 59°. The declination of Antares is 24. The declination of Acrab is 19. The declination of Sirius is 15 degrees. The declination of Bellatrix is one degree.

٢٤ قلت وبين كلّ خنّ وصاحبه أحدى عشرة درجة وربع درجة وابتداء الأبعاد من نقطة المشرق

5.24 · I said: Between each rhumb and the adjacent one there are 11 degrees and a quarter. And declinations start from the Vernal Point.

باب السادس
في المسافة

١ قلت المسافة في اصطلاح أهل البحر عدّة أزوام ما بين رأسين متقابلين شرقًا وغربًا

٢ قلت أصحّها ما تولّدت من ديرتين صاحتي القياس والجري مبدأ ومنتهى وهيئتها مثلّثة الأضلاع فإذا صحّ الضلعان صحّ الثالث وهو المطلوب

٣ قلت ويشترط فيها صحّة الأزوام بين الأخنان

٤ قلت والمسافة على نوعين حسابيّة وتجربيّة

٥ قلت فالحسابيّة ما تقدّم الكلام عليها

٦ قلت والتجربيّة ما أخذت من تجريب المشي لكن التجريب يختلف من أمور

٧ قلت الأوّل قوّة الريح وضعفه

٨ قلت الثاني تفاوت مشي المركب بتقديم القلع و تأخيره وثخنة المركب وخفّته

٩ قلت الثالث تفاوت المركب في المشي

Chapter Six:
On distance

6.1 · I said: "Distance" in the usage of the people of the sea is the number of *zām* between two headlands either eastwards or westwards.

6.2 · I said: The most accurate of them are those produced from two routes with accurate measurements, where the course begins and ends, forming the shape of a triangle. So, if two sides are certain, the third one is too, which is what is sought.

6.3 · I said: This is conditional on the accuracy of the *zām* between the rhumbs.

6.4 · I said: Distance is of two kinds: calculated and empirical.

6.5 · I said: The calculated distance is what has just been discussed.

6.6 · I said: Empirical distance is what is obtained from the experience of sailing. Experience, however, varies according to actual factors.

6.7 · I said: The first factor is the strength or weakness of the wind.

6.8 · I said: The second is the variation in the headway of the ship, due to the sails advancing or hindering, or to the heaviness or lightness of the ship.

6.9 · I said: The third is the deviation of the ship from its course.

١٠ قلت الرابع المُدّ إمّا معك أو عليك إن كان
١١ قلت فالتجريبيّة أضعف من الحسابيّة من هذه العوارض
١٢ قلت والحسابيّة ما كانت من ديرتين أصحّ من ثلاث وما كان من ثلاث أصحّ من أربع وهلُمّ جرًّا
١٣ قلت فلهذا حسبت المسافة ما بين الحدّ وزجد من مطلق الثريّا من الحدّ لكراشي وتركت ديرة البرّين أعني من زرون دير برّ العرب والعجم لأجل الصحّة

6.10 · I said: The fourth is the current, when present, whether with you or against you.

6.11 · I said: The empirical distance is weaker than the calculated one, due to these variables.

6.12 · I said: The calculated distance that is taken from two routes is more accurate than from three, and what is taken from three more accurate than from four and so on.

6.13 · I said: For this reason I calculated the distance between al-Ḥadd and Zajad on the rising of the Pleiades from Ḥadd to Karāshī, avoiding the Hormuzi routes of the two lands, I mean the Peninsula and the Persian coast, for accuracy's sake.

باب السابع في الرياح

١ قلت إعلم أن الريح أصله الهواء
٢ قلت فإذا تحرّك الهواء تموج وذلك هو الريح
٣ قلت ألا ترى أنّك إذا ضربت الهواء بالمروحة حدث لك منه ريح لتموّجه فإذا كانت الحركة شديدة حدثت منها الرياح العواصف القواصف
٤ قلت ويتولّد أيضًا من البرد لنا على ذلك دلائل كثيرة
٥ قلت منها إذا كنّا مثلًا نجري بريح مغيبي عامر فنشأت سحابة

Chapter Seven: On the winds

7.1 · I said: Know that the origin of the wind is the air.

7.2 · I said: When the air moves, there is a stir, and this is the wind.

7.3 · I said: Don't you see that when you hit the air with a fan, a wind passes from it to you because of its stirring? Just so, when there is a strong movement, stormy and thunderous winds arise.

7.4 · I said: The wind is also generated from the cold, and we have many indications of this.

7.5 · I said: Among them is, for example, when we are travelling on a full west wind,

and a rain cloud appears from one side other than the west. When the cloud approaches and its cold reaches us, the first one, i.e. the west wind, calms down.

7.6 · I said: And it is also among the indications that the coastal wind comes from land only at night, and that the sea wind generally only comes during the day, all over the world. This is because of the coldness of the land and the hotness of the sea during during the night. The opposite happens during the day, I mean, the coldness of the sea and the hotness of the land—because of the burning of the sand and the mountains under the heat of the sun.

7.7 · I said: It is also among the indications that sandy land is cooler than the mountains, because sand at night is colder than mountains.

7.8 · I said: And likewise, rainy land is more often wilds than desert, because of the abundance of coldness. Thus, it has become clear that the wind is generated from coldness.

7.9 · I said: And so, if the weather is cloudy there is wind in most cases, especially wandering clouds, because the clouds originate from the cold, or rather they are condensed cold.

Conclusion

1 · I said: Know that the foundation of this art is theory and practice.

2 · I said: What has been tested and agrees with theory is reliably corrrect.

ماطرة من أحدى الجهات غير جهة المغيب فإذا قربت علينا السحابة ووصلنا بردها سكن الريح الأوّل أعني المغيبي

٦ قلت ومن الدلائل أيضًا أن الريح البرّي لا يأتي من البرّ إلّا ليلًا والريح البحري لا يأتي إلّا نهارًا في الغالب في جميع الدنيا وذلك لبرودة البرّ بالليل وحرورة البحر فيه وعكسه بالنهار أعني برودة البحر وحرورة البرّ لتوقّد الرمال والجبال من حرارة الشمس

٧ قلت ومن الدلائل أيضًا أن الأرض الرملية أكثر بردًا من الجبليّة لأنّ الرمل بالليل أقوى بردًا من الجبل

٨ قلت وكذلك الأرض الممطورة أكثر برّيًا من الأرض الممحلة لكثرة البرودة فتبيّن أن الريح يتولّد من البرد

٩ قلت وكذلك إذا كان في الجوّ سحابا يكون الريح موجودا في الغالب خصوصا السحاب السائر لأنّ السحاب معدن البرد بل هو برد متكاثف

خاتمة

١ قلت إعلم أنّ أصل هذا الفنّ العقل والتجريب

٢ قلت فما كان مجربا موافقا للعقل فهو صحيح معتمد

٣ قلت وما كان فيه أحدهما دون الآخر فهو صحيح أيضا لكن ليس بالنسبة مثل الأوّل

٤ قلت فإن قيل أيّهما أصحّ العقل أم التجريب

٥ قلت ففي بعض التجريبي وفي بعض العقلي

٦ قلت أمّا الدير والمواسم تجريب محض وتصوير الكواكب في الأفلاك وقواعد الحساب في الإغزار والإرقاق وما تولّد منها عقل محض والقياسات والمسافات تجريب وعقل

٧ قلت وأمّا المجاري المحسوبة المأخوذة لسفر البنادر المقصودة فهي نتائج الدير القياسات والمسافات فهنّ أمّهاتهم فإنّ كانت الأمّهات صحيحة فالنتيج صحيح وإن كانت فاسدة ففاسد نتيجه

٨ قلت تنبيه علم أن أخذ علم كلّ مكان من أهله فهو أصحّ من الغير إلّا أن يكون الغير قد جرّبه وهو ممّن يعتبر في الفنّ

٩ قلت أو كان ذلك الغير مجربًا محقّقًا وصاحب المكان قليل المعرفة بالفنّ فمن محقّق أصحّ وبالله التوفيق وعليه التكلان

3 · I said: That in which there is one but not the other may also be correct, but not with confirmation like in the first case.

4 · I said: And if it is said “Which of these two is more accurate, theory or practice?”

5 · I said: For some matters it is the practical, and for some it is the theoretical.

6 · I said: Regarding routes and seasons, it is pure practice. The representation of the celestial bodies in their orbs and the principles of calculation for latitudinal sailing, and what derives from them is pure theory. But altitude measurements and distances are both experience and theory.

7 · I said: As for the calculated voyages undertaken to travel to intended ports, they result from routes of altitude measuring and of distances, which are their sources. If the sources are accurate, the result is correct, if they are incorrect, the result is incorrect.

8 · I said: Note: Know that obtaining local knowledge from locals is more accurate than obtaining it from others, unless it happens that the foreigner is experienced and is among those who reflect on this art.

9 · I said: Or when this foreigner is truly experienced while the local has little knowledge of the art, in which case the truly experienced man is more accurate. And success and trust are with God.

قلادة الشموس واستخراج قوائد الأسوس

Qilādat al-Shumūs wa-Istikhrāj Qawā'id al-Usūs

Necklace of Suns and the Calculation of the Rules of the Bases

Introduction

The *Qilādat al-Shumūs* is a short treatise about the mathematical basis (a conversion constant, as far as we have understood) of five different calendars: the "lunar", the "solar" (*viz.* lunar and solar Hijri), the Roman Byzantine (*rūmī*), the Coptic and the Persian (*Nawrūz*). It is not signed nor dated and is extant in one single copy, preserved at the Bibliothèque nationale (Paris).

The connection between this particular work and the other texts by al-Mahrī is established primarily through the *Minhāj*. Although there are no identical passages nor section titles in the two works, the *Minhāj* includes a chapter dedicated to the positions of the sun and the moon in both the zodiac and the lunar mansions.[38] The lunar and solar calendars are associated with one another in that work also in a section explaining how to determine the *Nayrūz*, here meaning, as for Ibn Mājid, the beginning of the nautical solar year based on a Yazdagirdi calendar. The *Qilādah* seems to be an expansion of this. It begins with the determination of the mathematical basis or foundation for the lunar year (its *uss*), which will then be necessary to calculate that of the solar year and the zodiac. This latter is called the foundation of the foundations (*uss al-usūs*) and will be used in the computation of all solar calendars discussed in this work. The *Qilādah* is probably the most mathematical work by al-Mahrī, followed by the *Mir'āt*.

[38] See Mahrī 1970b, 110.

Qilādat al-Shumūs – Table of Contents

مرأة السلاك لكراة الأفلاك

Mir'āt al-Salāk li-Kurāt al-Aflāk

Mirror of Travellers into the Heavenly Spheres

Introduction

The *Mir'āt al-salāk* is an introduction to theoretical astronomy, *'ilm al-hay'a*, most likely meant for non-specialist readers. It is not signed nor dated, and it does not deal with strictly navigational concepts or techniques. The only exception is probably a stellar compass rose appearing rather silently at the end of the only preserved manuscript,[39] with no reference being made to it throughout the text. The relation between this and other works by al-Mahrī is never made explicitly, but it is evident in the sections having nearly the same titles and in some passages identical to the text of the *Sharḥ al-Tuḥfat*. It is possible that the *Mir'āt* had been composed earlier and used as a source for the *Commentary to the Tuḥfat*. This astronomical work further includes a brief sentence that helps elucidate the expression "*qilādat al-shumūs*", used in the title of the above-mentioned work by al-Mahrī[40] but, again, no direct reference is made to it here and vice-versa. Within all works integrating the literary corpus of the author, this is the one that has been neglected by modern scholars the most: there are no editions nor translations and it is mentioned only rarely in secondary literature, with the exception of a recent paper.[41] The text is available in a single manuscript copy kept in Yale University Library.

The literary genre of the *Mir'āt* has been studied significantly in recent years. In Islamic history, there was a tradition of astronomical writings going back to at least the tenth century that was ded-

[39] See Landberg MSS 401, 156r.

[40] See Landberg MSS 401, 129r, line 9: "The Sun is placed first among the celestial bodies and between the superior and inferior planets, in such organization as if the Sun were like a stone in a necklace (*ka'l-shams al-qilāda fī'l-niẓam*)."

[41] See Staples et al. 2023.

icated to understanding *hayʾat al-ʿālam*—meaning the configuration of the world in its entirety, where both the terrestrial and celestial realms were depicted together. *Hayʾa al-basīṭa*, or simple *hayʾa*, was a branch of this tradition aiming at more descriptive explanations on cosmography instead of the mathematical proofs and the numerical parameters sought by astronomers.[42] The composition of the *Mirʾāt* took place within this context. The text itself is very similar—at times identical—to that of the *Mulakhkhaṣ fī ʿilm al-hayʾa al-basīṭa* by Maḥmūd ibn Muḥammad ibn ʿUmar Jaghmīnī (d. 618/1221),[43] one of the most widespread teaching books on astronomy throughout the 16th century, by the time al-Mahrī was writing. The *Mulakhkhaṣ* was copied frequently through the centuries, but—to the best of our knowledge—there is no copy nor version with the same title, text and diagram as that of the *Mirʾāt*. This latter establishes a relation with the remaining corpus of the author that raises immediate questions regarding the kind of education that the Indian Ocean navigator would have received and the way it may have influenced his writings. In that sense, a reflection on the role of theory and experience in navigational practice is also found in the background of this work by al-Mahrī.

[42] See Ragep 2017.
[43] See Ragep 2016.

Mir'āt al-Salāk – Table of Contents

الدائرة الهنديّة وطول البلد وعرضه واستخراج سمت القبلة

١٠ الباب العاشر في معرفة معنى الفجر

١١ الباب الحادي عشر في معرفة الأقاليم السبعة

١٢ الباب الثاني عشر في معرفة قوس النهار والليل والدوائر ومعرفة السنة والشهر واليوم والساعة التي هي مكائل الزمان

الخاتمة في ذكر الكواكب الثابتة وأحوالها

circle, as well as the longitude and latitude of a location; and how to obtain the azimuth of the qibla

Chapter Ten: On the knowledge of the meaning of dawn

Chapter Eleven: On the knowledge of the seven climates

Chapter Twelve: On the knowledge of the arc of daylight, of night and of the circles; and knowledge of the year, the month, the day and hour, which are the measures of time

Conclusion: On the fixed stars and their configurations

Bibliography

Manuscripts

Beinecke Rare Book and Manuscript Library, Yale University, New Haven, Landberg MS 401, Sulaymān al-Mahrī, *Mir'āt al-salāk li-kurāt al-aflāk*, fols 127v–156r. This manuscript contains also *al-ʿUmda*, *al-Minhāj*, *al-Tuḥfa*, and *Sharḥ al-tuḥfa*.

Bibliothèque nationale de France, Paris, MS Arabe 2559, Sulaymān al-Mahrī, *al-ʿUmda al-mahrīyya fī ḍabt al-ʿulūm al-baḥriyya*, fols 11v–59r. This manuscript contains also *al-Minhāj*, *al-Tuḥfa*, *Qilāda* and *Sharḥ al-tuḥfa*.

Leiden University Library, Leiden, MS Or. 8660, Sulaymān al-Mahrī, *alʿUmda al-mahrīyya fī ḍabt al-ʿulūm al-baḥriyya*. This manuscript contains also *al-Minhāj*.

Editions/Studies

Acevedo, Juan, Inês Bénard, and Juliane Müller. 2023. *Indian Ocean Arab Navigation Studies Towards a Global Perspective: Annotated Bibliography and Research Roadmap*. *RUTTER Technical Notes* 2. Lisbon: ERC RUTTER Project, University of Lisbon.

Al Salimi, Abdulrahman, and Eric Staples. 2019. *A Maritime Lexicon: Arabic Nautical Terminology in the Indian Ocean*. Studies on Ibadism and Oman, 11. Hildesheim, Zürich, New York: Georg Olms Verlag.

Facey, William. 1979. *Oman, a Seafaring Nation*. Ministry of National Heritage and Culture, Sultanate of Oman.

Grosset-Grange, Henri. 1997. 'La Science Nautique-Arabe'. In *Histoire Des Sciences Arabes*, edited by Roshdi Rashed. Vol. 1. Paris: Seuil.

Ibn Mājid, Aḥmad. 1971a. *al-Fawā'id fī uṣūl ʿilm al-baḥr wa'l-qawāʿid*. Edited by Ibrahim Khoury. *al-ʿUlūm al-baḥrīyya ʿinda al-ʿarab* 2. Damascus: Maṭbūʿāt majmaʿ lil-lughah al-ʿarabiyya bi-Dimashq.

———. 1971b. 'La Hawiya: abregé versifié des principes de naut-

ique'. Edited by Ibrahim Khoury *Bulletin d'études orientales* 24: 249–386.

———and Teodor Adamovich Shumovsky. 1960. *Três roteiros desconhecidos de Ahmad Ibn-Madjid, o piloto árabe de Vasco da Gama.* Lisboa: Comissão Executiva das Comemorações do V Centenário da morte do Infante D. Henrique.

———. 1985. 'Les poèmes nautiques d'Ahmad Ibn Magid, 2eme partie. Les poèmes à rime unique: *al-Qasā'id*, texte arabe établi avec introduction et analyse en français'. Edited by Ibrahim Khoury. *Bulletin d'études orientales* 37/38: 163–276.

———. 1987. 'Les poèmes nautiques d'Ahmad Ibn Magid, 3eme partie. Les poèmes à rime variable: *al-ʿArāǧiz*'. Edited by Ibrahim Khoury. *Bulletin d'études orientales* 39/40: 191–420, 422, 424.

Lunde, Paul. 2012. 'Sulaymān al-Mahrī: Maritime Routes in the *ʿUmda* and *Minhāj*'. In *The Principles of Arab Navigation*, edited by Anthony R. Constable and William Facey, 61–74. London: Arabian Publishing.

al-Mahrī, Sulaymān. 1970a. *al-ʿUmda al-mahriyya fī ḍabṭ al-ʿulūm al-baḥriyya.* Edited by Ibrahim Khoury. Vol. 1. *al-ʿUlūm al-baḥrīyya ʿinda al-ʿarab* 1. Damascus: Maṭbūʿāt majmaʿ lil-lughah al-ʿarabiyya bi-Dimashq.

———. 1970b. *Minhāj al-fākhir fī ʿilm al-baḥr al-zākhir.* Edited by Ibrahim Khoury. Vol. 2. *al-ʿUlūm al-baḥrīyya ʿinda al-ʿarab* 1. Damascus: Maṭbūʿāt majmaʿ lil-lughah al-ʿarabiyya bi-Dimashq.

———. 1972a. '*Qilādat al-shumūs fī ʿilm al-tawārikh*'. In *Muṣannafāt Sulaymān ibn Aḥmad ibn Sulaymān al-Mahrī*, edited by Ibrahim Khoury, 1:3–11. *al-ʿUlūm al-baḥrīyya ʿinda al-ʿarab* 1. Damascus: Maṭbūʿāt majmaʿ lil-lughah al-ʿarabiyya bi-Dimashq.

———. 1972b. '*Sharḥ tuḥfat al-fuḥūl fī tamhīd al-usūl*'. In *Muṣannafāt Sulaymān ibn Aḥmad ibn Sulaymān al-Mahrī*, edited by Ibrahim Khoury, 3:39–125. *al-ʿUlūm al-baḥrīyya ʿinda al-ʿarab* 1. Damascus: Maṭbūʿāt majmaʿ lil-lughah al-ʿarabiyya bi-Dimashq.

———. 1972c. '*Tuḥfat al-Fuḥūl fī tamhīd al-uṣūl*'. In *Muṣannafāt Sulaymān ibn Aḥmad ibn Sulaymān al-Mahrī*, edited by Ibrahim Khoury, 3:13–37. *al-ʿUlūm al-baḥrīyya ʿinda al-ʿarab* 1. Damascus: Maṭbūʿāt majmaʿ lil-lughah al-ʿarabiyya bi-Dimashq.

———. 2011. *Mahrian Base in Precise Rendering of Navigational Sciences.* In *Махрийская Опора Для Точного Определения [Основ] Морских Наук.* Edited by Teodor Adamovich Shumovsky. Moscow: Mardjani Publishing House.

Müller, W.W. n.d. ‘Mahra’. In *Encyclopaedia of Islam*, edited by P. Bearman, Th. Bianquis, and C.E. Bosworth, Second edition.

Ragep, Sally P. 2017. ‘Fifteenth-Century Astronomy in the Islamic World’. In *Before Copernicus: The Cultures and Contexts of Scientific Learning in the Fifteenth Century*, edited by Rivka Feldhay and Sally P. Ragep, F. Jamil, 143–60. Montreal & Kingston, London, Chicago: McGill-Queen’s University Press.

———. 2016. *Jaghmīnī’s Mulakhkhas: An Islamic Introduction to Ptolemaic Astronomy*. Springer Cham.

Shihāb, Ḥasan Ṣāliḥ. 1989. *Taḥqīq kitāb al-fawā’id fī uṣūl ʿilm al-baḥr wa’l-qawā’id li-Ibn Majid*. Kuwait: al-Jamiyat al-Jughrāfiyya lil-Kuwaytiyya.

Staples, Eric, Juan Acevedo, and Inês Bénard. 2023. “Al-Mahrī’s *Mir’āt al-Salāk li-Kurāt al-Aflāk*: A 16th-century Yemeni Navigator’s Reflections on Astronomical Knowledge.” *Nouvelles chroniques du manuscrit au Yémen*, 16, January, 96–120.

Tibbetts, Gerald Randall. 1971. *Arab navigation in the Indian Ocean before the coming of the Portuguese: being a translation of Kitab al-fawaid fi usul al-bahr wa’l-qawa’id of Ahmad b. Majid al-Najdi*. London: Royal Asiatic Society of Great Britain and Ireland.

RUTTER TECHNICAL NOTES SERIES

No. 1 — Luana Giurgevich

Bibliotheca Roteirística: Edições Impressas em Portugal nos séculos XVII e XVIII

No. 2 — Inês Bénard & Juan Acevedo

Indian Ocean Arab Navigation Studies Towards a Global Perspective: Annotated Bibliography and Research Roadmap

No. 3 — David Salomoni

Jesuits on Board: A Reasoned Bibliography on the Early Modern Jesuit Trans-Oceanic Sailing Experiences

No. 4 — Nuno Vila-Santa

The Portuguese India Run (16th–18th centuries): A Bibliography

No. 5 — José María Moreno Madrid

A Seventeenth-Century Collection of Rutters: Derroteros de los mares de Marruecos, Canarias, América y Filipinas, y otros documentos, *compiled by Ignacio Muñoz*

No. 6 — Carmo Lacerda & José María Moreno Madrid

A Remarkable Collection of Rutters, 16th–18th Centuries: Derroteros que hacía el Piloto Mayor para que llevasen los jefes de las embarcaciones que iban a Indias

No. 7 — Luana Giurgevich

Roteiros portugueses dos séculos XV e XVI (Manuscritos)

No. 8 – Inês Bénard & Juan Acevedo

The Stars of Indian Ocean Arab Navigation

No. 9 – Nuno Vila–Santa

Jan Huygen van Linschoten (1563–1611): An Annotated Bibliography

No. 10 – Joana Lima

Modern Editions of Portuguese Maritime Literature: A Bibliography

No. 11 – Henrique Leitão & Luana Giurgevich

Jesuits and Science in the Portuguese Assistancy: Thirty Years of Studies (A Bibliography, 1993–2023)

No. 12 — Luana Giurgevich

Roteiros portugueses do século XVII (Manuscritos)