RUTTER
MAKING THE EARTH GLOBAL

# The Stars of Indian Ocean Arab Navigation

# النجوم الملاحة العربية في المحيط الهندي

*TN no. 8, Version 1, Lisbon 31 May 2021*

Juan Acevedo
Inês Bénard

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).



Citation:
Acevedo, Juan, and Inês Bénard. 2021. "The Stars of Indian Ocean Arab Navigation." *RUTTER Technical Notes* 8. Lisbon: ERC RUTTER Project, University of Lisbon. doi: 10.6084/m9.figshare.14758605

# Contents

**Abbreviations**

Curiosities :: Rapoport and Savage-Smith (eds.), *Kitāb gharāʾib al-funūn/The Book of Curiosities*, 2014.

*Fawāʾid* :: Khoury (ed.), vol. 2 of *al-ʿUlūm al-baḥrīyah ʿinda al-ʿarab*, 1971. Cited by Roman number for the chapter, followed by page number.

Kunitzsch :: Kunitzsch, *Untersuchungen zur Sternnomenklatur der Araber*, 1961.

*Muʿjam* :: Khoury (ed.), vol. 1-3 of *al-ʿUlūm al-baḥrīyah ʿinda al-ʿarab*, 1971, pp. 142–434.

Staples :: Al-Salimi and Staples, *Maritime Lexicon*, 2019.

Stellung :: Kunitzsch, "Zur Stellung der Nautikertexte Innerhalb der Sternnomenklatur der Araber", 1967.

Tibbetts :: Tibbetts, *Arab Navigation in the Indian Ocean before the Coming of the Portuguese*, 1971.

## Preface

فيتفقّد المعلّم الماهر في وسع الفلك وضيق وبعد النجوم وقربها ونقصان النجوم وزيادتها فيترقى ويبلغ الغاية ويصوّر العلوم في قلبه ويعرف كيف دوران الفلك وقياسته على الأنجم في طلوعها وغروبها

> "…for the discerning pilot to study the expanse and the compact of the heavenly spheres, the distance and proximity between stars, their increase and their decrease; and thus to reach the ultimate degree, for the sciences to take shape in his heart; and to comprehend the turning and dimensions of the spheres through the stars, as they rise and set."
> Aḥmad ibn Mājid, *Fawā'id* III.

This document has been conceived as a practical and sufficient reference catalogue of the stars, asterisms, and sundry celestial bodies used by early modern Indian Ocean Arab navigators. It is based directly and substantially on the corpus of the two classical representatives of the genre, Aḥmad ibn Mājid and Sulaymān al-Mahrī, but formally it follows closely the organisation and scope of *The Stars of Arab Navigation in Ibn Māǧid Works*, a memorable 1990 publication by Ibrahim Khoury.[1]

Our primary intention was to digitise the contents of Khoury's work, in order to make it simply more accessible and searchable, bringing the transliteration up to date and correcting some misprints. Eventually we decided to make the best of some key developments in the field, and we opted for a certain reorganisation of the material and for the introduction of minor additions, drawing from new sources, clarifying information, and hopefully making even more useful what was already a helpful guide. In a way, this is our tribute to Ibrahim Khoury, who is himself a bright star among the scholars of Indian Ocean nautical studies. The following pages draw from his own Introduction to situate the contents of our work.

We would like to thank our colleagues at the RUTTER Project in Lisbon, especially Henrique Leitão, José Manuel Malhão Pereira, and Luis Ribeiro of the Astra Project, for their help in the development of this work. We are also grateful to our CIUHCT colleague Samuel Gessner for his insightful comments and suggestions. The weekly meetings of our Lisbon Arabic Reading group have provided us with an invaluable opportunity to discuss

[1] See Bibliography below for all full references. This separata was digitised in October 2020 by Inês Bénard and Juan Acevedo, and it is available in PDF format following this link. For the transliteration, we follow as closely as possible the ALA-LC Romanization tables.

many of the astronavigation issues at the basis of this work, and we are particularly grateful to our fellow readers for their enthusiasm and generous expertise. Special thanks to our regulars, Charles Burnett, Eric Staples, Vivian Brown, Razieh-Sadat Mousavi and Nadine Löhr.

Juan Acevedo
Inês Bénard

## Introduction

Ibn Mājid and al-Mahrī were from today's Oman and Yemen respectively, and they were active through the 10th century AH, that is, late 15th and early 16th century AD. They wrote numerous and influential works on maritime sciences in verse and prose,[2] detailing the principles and application of a very star-centered nautical art. It was a shared Indian Ocean heritage of stellar navigation knowledge, the multinational contours of which are right now being defined by new scholarship, but it is clear that some key features of this early modern system of celestial navigation were articulated and in use, from at least the tenth century, among Persian, Chinese, Indian, Southeast Asian and Arab sailors.[3] This transnational knowledge of stellar astronomy trickled into Portuguese nautical literature, and from there it started making its way into French and eventually English and Dutch treatises.[4] It was approximately one hundred years after Ibn Mājid's acme, in 1574, that William Bourne published his sea manual, the *Regiment for the Sea* or *Rules of Navigation*, explaining what he called "the new navigation" because it used mathematics and astronomy.[5]

As a matter of fact, Ibn Mājid and al-Mahrī had preceded Bourne and promoted just such "new navigation" before him, approximately between 1462 and 1520, transmitting a wealth of mathematics and astronomy with their nautical art. Ibn Mājid made a very similar claim indeed: "I am writing a new navigation," he said, "a navigation you never heard of before me".[6]

This new navigation of Ibn Mājid required, according to himself, a technical knowledge, a good geographical knowledge, including land and seamarks, and especially astronomical learning. In fact, astronomy had extremely varied applications in Ibn Mājid's New Navigation. The altitudes of stars, their risings and settings, and their relative positions in a rich variety of possible configurations were used: to determine the latitude and thus establish the position of the ship; to estimate the distance that the vessel had travelled; to keep track of time, as a sort of celestial clock; to ascertain the all-important seasons for navigation; and finally, as referents of the nautical compass rhumbs, they were used to determine the course.[7]

We do not intend to examine all these aspects here. Our only purpose is to present

[2] References to all the related sources and relevant secondary literature can be found in our RUTTER Technical Note, Indian Ocean Arab Navigation Studies Towards a Global Perspective: Annotated Bibliography and Research Roadmap.
[3] See Shafiq 2013, 99–104; Beaujard 2019, II, 466–7, 479; Varadarajan 2004, 3–18.
[4] See Bourne 2017, 26-7; Schotte 2019, 100–105.
[5] "Mathematics", in this context, means basic notions of cosmography, including calendrical notions, and various types of distance measuring.
[6] See *al-Balīghah fī qiyās al-suhayl wa-al-rāmiḥ*, l. 44—Khoury's translation.
[7] See Constable 2012, *passim*; Shihāb 2012, 21–22.

a comprehensive list of the stars mentioned in Ibn Mājid's and al-Mahrī's texts and thus presumably familiar to early modern Arab pilots. Specific textual references are given in the astronomical glossaries of Khoury's publications as mentioned below, particularly his Damascus critical editions of the *Fawā'id* and the *ʿUmdah al-mahrīyah*.

In practice, the astronavigation system is organically tight-knit, interconnected and imbricating in a great many ways, but the two basic sub-systems of reference are the twenty-eight Lunar Stations (*manāzil al-qamar*) and the thirty-two Stellar Rhumbs (*akhnān*). For the purpose of our exposition, we will however classify the celestial objects under the following four categories:

1. The Brightest Stars of the Sky
2. The Stations of the Moon
3. The Stars of Lesser Magnitude
4. The Magellanic Clouds

The main astronomical and uranographic passages in the corpus are: for Ibn Mājid, Chapters 3 and 4 of the *Fawā'id*, and about half of his extant poems, some of which treat of very specific astronavigation issues;[8] al-Mahrī is notably less astronomical than Ibn Mājid, or rather, often more concerned with calendrical and computus-related questions, and he is certainly less indebted to the medieval uranographical literature. Chapter 2 of his *ʿUmdah*, and Section 2 of his *Minhāj* contain some of the astronomical passages, which are mostly practical in nature, without the often rambling, if engaging, star-lore digressions of Ibn Mājid's *Fawā'id*. The best compendium of these basic sources is Khoury's own *Muʿjam nujūm al-milāḥah* (*Glossary of Navigation Stars*), i.e. pp. 142–434 of the third volume of his *al-ʿUlūm al-baḥrīyah ʿinda al-ʿarab*. This is a mostly untapped mine of information which contains comprehensive lists and tables of stars, asterisms and constellations, including discussions of Latin and Greek names and Bayer designations. It is in fact quite evident that the Coimbra booklet used as the basis of this technical note is Khoury's own English summary of the material in his *Muʿjam*.

**Main Additional Sources**

Apart from Khoury's, some very valuable works have appeared over approximately the last half century, and we have relied on them to help us tackle the often puzzling identification questions. Some treat specifically nautical sources, but others are historical contributions towards clarifying doubts that have been accumulating over many centuries of overlapping astronomical traditions.

[8] For details, please refer to our previous RUTTER Technical Note, *Indian Ocean Arab Navigation Studies Towards a Global Perspective*, v. 3, Dec. 2020.

Paul Kunitzsch's 1961 *Untersuchungen zur Sternnomenklatur der Araber*, and his 1959 *Arabische Sternnamen in Europa*, are essential references which have remained untranslated, but they address general astronomical topics. Only in some of his later articles did Kunitzsch address specifically the nautical tradition, as shown by an all too brief list of nautical stars published in his 2017 variorum, *The Arabs and the Stars*.

In his 1985 opuscule, "Astronomy for Landlubbers and Navigators: The Case of the Islamic Middle Ages", David King draws attention to some unstudied manuscript sources and to what he calls "Islamic aspects of Islamic science", namely the relations between nautical astronomy and the determination of the qibla, the start of the lunar month and the times of prayers. He also draws attention to the three main historical branches of Arabic astronomy: what he calls mathematical, folk and navigational astronomies. It is unfortunate that no reference to the works by Kunitzsch is made in this work, which addresses so similar topics.

In 2001, Ḥaṣan Ṣāliḥ Shihāb published his *al-Milāḥah al-falakīyah ʿinda al-ʿarab* (*Celestial Navigation Among the Arabs*), a small volume which goes over the main features of the system in a concise way, but which in our opinion fails to take full advantage of previous scholarship. One valuable observation worth retaining is the importance of having a proper understanding of pre-modern cosmography in order to study the Arabic nautical tradition.[9]

The 2014 monumental publication of *An Eleventh-century Egyptian Guide to the Universe: the Book of Curiosities* (*Kitāb gharāʾib al-funūn*) was a spectacular addition to the knowledge of early Arabic uranography. Not only is the organisation of the material remarkably close to the organisation of nautical treatises, but from a scholarly point of view it benefited greatly from the accumulated experience of Kunitzsch at every step, and thus constitutes in a way his last word on Arabic star nomenclature. Though the astronomical scope of this *Guide* goes far beyond astronavigation concerns, we have benefitted from its conscientious explanations at every turn.

In 2017, a major contribution to this field of studies was launched online by Danielle Adams (now at the Lowell Observatory), the "Two Deserts, One Sky" website, financed by NASA, the University of Arizona and other institutions. Adams draws extensively from the "folk" branch of Arabic astronomical literature, or "Arabian cultural astronomy", including a wealth of pre-Islamic material related to the *anwāʾ* literature,[10] translating for the first time much early material, and thus giving some context to other parts of the literature which had for decades appeared somehow orphaned in the specialised literature.

Even more recently, Al Salimi and Staples have devoted to "Navigation/*ʿIlm al-milāḥah*"

[9] P. 14. We are most grateful to the Library of the Oxford Centre for Islamic Studies for helping us access this rare source in spite of the Covid lockdown limitations.

[10] Early genre dealing mostly with meteorological and seasonal astronomy and astrology.

an important chapter of their 2019 *Maritime Lexicon*. They have drawn from an impecable selection of primary and secondary sources, and added besides very useful and comprehensive illustrations which make directly understandable some of the observational subtleties. Running to more than a hundred pages, this chapter can be considered the most up-to-date addition to our topic in the narrow sense: it is the only English publication devoted specifically to Arabic nautical astronomy. In comparison, and while drawing freely from their work, our present Technical Note means to be a more wieldy and single-minded publication, a quick-reference list, adding a few astronomical precisions here and there and generally a different organisation of the material which we hope will be of immediate practical utility. That is, apart from scholars of the narrowly defined field of Arabic-language nautical literature, we have in mind readers within the field of medieval and early modern Islamicate science and culture in general, of the history of astronomy and medieval science more broadly, and of a number of related fields like history of Arabic lexicology and literature; it is a well-known fact that Arabic celestial nomenclature is an important component of astronomical nomenclature in general. With this expanded scope in view, we have added at the end an Astronomical Index which should make it easier to refer to specific celestial objects.

**A Reflection on Stellar Navigation Generally**

In line with the general aims of the RUTTER Project, a brief reflection on the importance and reach of our theme shall not go amiss. We speak here indistinctly of "astronavigation", "celestial navigation", "nautical astronomy" or "astronomical navigation"—the relation established by the pilot between the observation of celestial phenomena and the practical aim of wayfinding—and we have in mind in particular how this conjunction between "what is above", up in the sky, relates practically to "what is below", our need for orientation, and how it relates to the concept and the experience of globality.

While it is rightly pointed out that astronomy and navigation have gone hand in hand from their very origins, we have in the European cultural horizon a striking example to bring this notion home: the first work with the explicit title of "Nautical Astronomy" (Ναυτική ἀστρολογία) is attributed to Thales of Miletus (ca. 7th century BC), who is widely considered one of the foundational figures, if not outright "the Father", of the timeless scientific endeavour we refer to as "philosophy". This work is sadly not extant, but it is known that it referred to principles of cosmography, to the point that some identify it to a work "On the Solstice and the Equinox". It is also reported that it spoke of asterisms and nautical distances. This simple fact, even in its vagueness, puts the beginning of Western science right at the door of astronavigation.

This is quite in line with the Platonic view of the importance of astronomy, articulated at its clearest in the *Epinomis*, the *Timaeus* and the *Laws*. For one single example which

should suffice:

> "Had we never seen the stars, and the sun, and the heaven," Timaeus says, "none of the words which we have spoken about the universe would ever have been uttered…. The Divine invented and gave us sight," he continues, "to the end that we might behold the circuits of the Intellect in the sky, and apply them to the revolutions of our own intelligence, which are akin to them, the unperturbed to the perturbed; and that we, learning from them and partaking by nature of the veracity of calculations, might imitate the utterly unerring circuits of the Divine and regulate our own vagaries." (*Tim.* 47b5 c4)

In *Epinomis* 976d-e, as in *Timaeus* 47a4, it is made quite clear that the concept number (ἀριθμός), no less, derives from the observation of the heavenly bodies.

This is not the place to elaborate further on the many epistemological consequences of such high regard for stargazing and astronomy, but we shall mention one aspect of it which is too often left aside, probably because we still read Plato with eyes of the Enlightenment, which do away with contemplative dimensions. This, an intimate aspect of celestial navigation is spelt clearly above, as "imitating the circuits… and regulating our own vagaries," that is, a personal relation between the course of invidual life and the observation of the stars. There is undoubtedly, and naturally, a broad human spectrum of possibilities between the cumulative, rational, methodical study of the stars and their inspirational, metalogical and enraptured contemplation.

On this warmer end of the spectrum there is the towering medieval image of Dante, who completes every book of his *Commedia* with the word *stelle*, "stars". It has been noted that Galileo "considered Dante a peer", and that for him "the *Divine Comedy* was not a graveyard of discarded astronomical theories, but a poetic prologue to future discoveries."[11]

Thinking of early modern times, we may recall the solitary figure of Ignatius of Loyola, a life-long stargazer who looked at the night sky often and for long periods, deriving from the night sky "the greatest consolation."[12] We should remember that Ignatius' order, the Society of Jesus, was instrumental in the European consolidation and diffusion of high-level astronomical and cosmographical teachings, contributing directly towards the advent of modern science. The boundary between the two approaches to the night sky is often hard to decide, and it is porous, as many a learned astronomer would acknowledge. In the Islamic tradition—coming back to our Arab authors—the stars are revered as divine signs and followed as guides "through the dark of land and sea" (Qur'ān 6:97). Only if we keep in mind this dual approach to the night sky, by bringing observation and observance back to

[11] Daugherty 2019, 26.
[12] McEvoy 2021, 17.

their common origin,[13] only then can we start to understand the fundamental pre-modern attitude towards the stars, either East or West, ancient or medieval, and to make sense of our epigraph by Ibn Mājid, and those "sciences taking shape in the heart".

"*E quindi uscimmo a riveder le stelle*"
("And then did we emerge to see the stars," *Commedia* XXXIV, 139)
Bodleian Library MS. Holkham misc. 48, p. 54.

[13] With thanks to Samuel Gessner for bringing this to our attention.

THE FOLLOWING LISTS of 155 stars, combined in 111 asterisms and celestial objects, are meant to show the richness of the "material" of early modern Arab pilots. We hope they may also give glimpses into the complexity of the astronavigation system which put these elements into many relations of different kinds. Details of the historical developments and variations within this transmitted mass of astronomical lore can be found mostly in the works by Kunitzsch. Details of their practical usage for sailing, including 19th and 20th-century examples and references, can be found primarily in Al Salimi and Staples' *Lexicon*, 2019; Harriet *et al.*, 2017; and Facey and Constable (eds), *The Principles of Arab Navigation*, 2012.

## 1 Brightest Stars of the Sky

The following Arabic names correspond to twenty-three of the brightest stars of the sky, as they were used by Arabic navigators in the fifteenth century.[14]

1. al-Shiʿrá الشعرى: α CMa, Sirius. Also known as al-Shiʿr and al-Shiʿrāʾ; most often al-Shiʿrá al-ʿAbūr الشعرى العبور (The Sirius Which Passed Over [the Milky Way]) or al-Tīr التير; rarely, al-Bājis الباجس or al-Bājis al-Awwal. According to Ibn Mājid (IV, 153), al-Tīr was an Arabicized Persian name used by the *ahl al-baḥr*, "the people of the sea".[15] Al-Bājis (The Stream Opener) was the name given by the people of Yemen.
2. Suhayl سهيل (The Little Easy One): α Car, Canopus. Also known as Miqdāf al-Safīnah مقداف السفينة (The Oar of the Ship), or Miqḍāf al-Safāʾin مقداف السفائن (The Oar of the Ships).
3. al-Maʿqil المعقل (The Fortress): β Cen, Hadar, but sometimes also α Cen, Rigil Kentaurus, i.e., one of the Ḥimarān. It therefore corresponds to either al-Wazn الوزن (The Weight) or al-Ḥaḍarī الحضري (The Settled One), from which the modern name Hadar derives. al-Maʿqil seems to be a specifically nautical name, not found in astronomical sources.
4. al-Simāk al-Rāmiḥ السماك الرامح (The Spear-Bearing Sky-Raiser): α Boo, Arcturus. Also known as al-Rāmiḥ al-Janūbī (The Southern Spearman), or al-Muʿtalī المعتلي (The Raised One), or simply as al-Rāmiḥ (The Spear-Bearing), and also as al-Uḥaymir الأحيمر (The Little Red One) and Simāk al-Shamālī (The Northern Sky-Raiser).
5. al-Kāsir الكاسر (The Falling One): α Lyr, Vega. Also known as: al-Nasr al-Kāsir نسر الكاسر (The Falling Eagle), al-Nasr al-Kabīr (The Big Eagle), al-Nasr al-Kafīt (The Open-

[14] Khoury refers to *Norton Atlas*, 17th edition, 1978, p. 89, for this choice of "the twenty-five stars", but the question of a specific number of "nautical stars" is a sprawling topic in itself. In modern recensions, the decisive influence seems to have been Maskelyne's 1767 publication of the first *Nautical Almanac*, and specifically the *Requisite Tables*, listing fifty-eight or sixty "selected stars". See our Bibliography below for further details.

[15] See Tolmacheva 1980, 186–89, for more on the linguistic Persian influence.

Winged Eagle), al-Nasr al-Wāqiʿ (Standing Eagle), al-Wāqiʿ (The Standing One), Najm al-Nasr (Star of the Eagle), al-Nasr (The Eagle), Nasr al-Shām (Northern Eagle). There is a philological case for translating *nasr* as "vulture" (Adams; Lane), but using *nasr* takes into account also the ancient Greek related constellation of the Eagle. According to Khoury's glossary on al-Mahrī, and to Tibbetts, this star was also called al-Kāthir الكاثر (The Abundant).

6. al-Nājid al-Barrāq الناجد البرّاق (The Supporting Bright One): β Ori, Rigel (Foot), though sometimes it can refer to Rigel and Saiph (βκ Orionis), which together represent the two feet of Orion. Other names: al-Barrāq al-Nājid, Rijl al-Jawzāʾ رجل الجوزاء (Foot of Jawzāʾ).[16]
7. al-ʿAyyūq العيّوق (The Goat): α Aur, Capella: Other names for this star: al-Bārr البارّ (The Devotee), Bārr al-Thurayyā بارّ الثريّا (The Devotee of Thurayyā), ʿAyyūq al-Thurayyā (The Goat of Thurayyā). Curiosities gives the unusual reading al-Bāz الباز (The Falcon). The meaning of "goat", as in the Latin and Greek names, may go back to early Semitic star-lore (see Kunitzsch).
8. al-Shiʿrá al-Shāmīyah الشعرى الشامية (The Northern Sirius): α CMi, Procyon, called also al-Shiʿrá al-Ghumayṣāʾ الشعرى الغميصاء (The Bleary-eyed Sirius), or simply al-Ghumayṣāʾ. Counted together with Sirius, these two stars receive the unexpected title of al-Shiʿrayān الشعريان, "The Two Shiʿras", i.e. "The Two Sirii" ("Siriuses" perhaps?).
9. al-Muḥannith المحنّث (The Oathbreaker): α Eri, Achernar. In nautical literature it is uniquely called also Sillibār سلّبار.[17]
10. Ḥaḍār حضار (meaning unknown): β Cen, Hadar or Agena. Also as Ḥaẓār حظار (The Breakwater), or called al-Ẓalīm الظليم (The Male Ostrich), Ẓalīm al-Maʿqil (The Ostrich of the Fortress), Ẓalīm al-Ḥimārayn (The Ostrich of the Two Donkeys), al-Ḍifdiʿ al-Muʾakhkhar الضفدع المؤخّر (The Trailing Frog). It is often paired with al-Wazn, α Cen; see below the entry for al-Ḥimarān.
11. al-Ṭāʾir الطائر (The Flying One): α Aql, Altair. It is also known by these other names: al-Nasr al-Ṣaghīr النسر الصغير (The Small Eagle), al-Nasr al-Ṭāʾir (The Flying Eagle), al-Nasr al-Ṭalīq النسر الطليق (The Outstretched Eagle), al-Nasr al-Yamānī (The Southern Eagle), and al-Hīrān الهيران (meaning unknown).
12. al-Dabarān الدبران (The One Behind): α Tau, Aldebaran. It has many other names: al-Tābiʿ التابع (The Follower) or al-Tuwaybiʿ (The Little Follower), al-Burkān or Barkān البركان (The Volcano), al-Baʿīr الباعر (The Camel), Tālī al-Najm تالي النجم (Follower of the Pleiades) and just short al-Tālī, al-Ḥādī الحادي (The Camel Driver), Ḥādī al-Najm (The Driver of the Star), al-Dubayr (The Little One Behind), al-Mijdaḥ or al-Mujdaḥ

[16] See below, Gemini, about the ancient Arabic name of Jawzāʾ.
[17] This is Khoury's vocalisation, but also found as Silibār, Sulbār and Salbār. See Kunitzsch 1977, an article solely devoted to this star.

المجدح (The Rain Stirrer). There is a related variant al-Miḥdaj المحدج in some of Ibn Mājid's works which appears to be a compounded scribal mistake (*taṣḥīf*), see Khoury (*Muʿjam* 352). Together with α Ori, Betelgeuse, they are both referred to as al-Aḥmarān الأحمران (The Two Red Ones).

13. al-Murabbaʿ المربّع (The Square): α Cru, Acrux. Ibn Mājid said it is called al-Taḥtānī التحتاني (The Lower One), al-Murabbaʿ al-Taḥtānī (The Lower Square), al-Murabbaʿ al-Taḥtī (same meaning), al-Najm al-Taḥtānī min al-Murabbaʿ (The Lower Star of the Square), Anjum al-Murabbaʿ al-Qarībāt min al-Māʾ أنجم المربّع القريبات من الماء (The Stars of the Square Which are Close to the Water).
14. al-Mirzam المرزم (meaning uncertain): mostly refers to γ Ori, Bellatrix, but occasionally identified with α Ori, Betelgeuse too. Called also Mirzam al-Jawzāʾ مرزم الجوزاء, Najm al-Jawzāʾ (The Star of Jawzāʾ), Yad al-Jawzāʾ al-Yamanī يد الجوزاء اليمني (The Southern Hand of Jawzāʾ), or al-Marām المرام (Longing). Both stars were also called Yadā al-Jawzāʾ (The Two Hands of Jawzāʾ). Mirzam is an ancient name which seems to have been used for any of three different stars that accompanied one of three "Siriuses" (Shiʿrá), on the principle that "each Sirius has a Mirzam"; this means it was β CMa or β CMi or γ Ori (see Kunitzsch 78).
15. al-Qalb القلب (The Heart): α Sco, Antares, named also Qalb al-ʿAqrab قلب العقرب (The Heart of the Scorpion), al-ʿAqrab (The Scorpion) and Najm al-Qalb (The Star of the Heart).
16. al-Simāk al-Aʿzal السماك الأعزل (The Unarmed Sky-Raiser): α Vir, Spica. Also al-Aʿzal (The Unarmed), al-Aʿzal al-Ṭayyāsh الأعزل الطيّاش (The Most Fickle Unarmed One ??), and al-Janūbī (The Southern One). It is associated with α Boo, Arcturus, al-Simāk al-Rāmiḥ السماك الرامح (The Armed Sky-Raiser). The name Simāk is explained by the eminent grammarian and lexicographer Sibawayh as related to its "elevation" (*irtifāʿ*, probably both in a subjective and objective meaning); this meaning is confirmed by Ibn Mājid (*Fawāʾid* III, 73–80).
17. Raʾs al-Tawʾam al-Muʾakhkhar رأس التوأم المؤخّر (The Head of the Rear Twin): β Gem, Pollux. It forms part of the 7th lunar station, al-Dhirāʿ.
18. Ākhir al-Nahr آخر النهر (The End of the River): α PisA, Fomalhaut. Known by several other names: Awākhir al-Māʾ أواخر الماء (The Last Ones of the Water), Awākhir al-Nahr, Awwal al-Nahr (The First One of the River), al-Sākib الساكب (The Pourer), Sākib al-Māʾ (The Water Pourer), al-Ḍifdiʿ al-Awwal الضفدع الأوّل (The First Frog) or Ḍifdiʿ al-Muqaddam (Foremost Frog), Ḍifdiʿ al-Sākib (The Frog of the Pourer), Ḍifdiʿ Sākib al-Māʿ (The Frog of the Water Pourer), al-Ḍafādiʿ (The Frogs), Fam al-Ḥūt al-Janūbī فم الحوت الجنوبي (The Mouth of the Southern Fish), Fam al-Ḥūt al-Yamānī (The Mouth of the Southern Fish), Fam al-Samakah al-Janūbiyyah (The Mouth of the Southern Fish),

al-Ẓalīm al-Fard الظليم الفرد (The Solitary Ostrich), al-Ẓalīm Sākib al-Māʾ (The Ostrich of the Water Pourer). It must be noted that the modern name Achernar, though derived from this star, was assigned in fact to α Eridani, known in Arabic as al-Muḥannith and as Sillibār, see above.

19. al-Ridf الردف or al-Radīf الرديف (The Follower): α Cyg, Deneb. Synonyms: Ridf al-Dajājah ردف الدجاجة (The Chicken's Follower), Ridf al-Majarrah ردف المجرّة (The Galaxy's Follower), al-Ridf al-Munīr (The Bright Follower), al-Ridf al-Muʾakhkhar (The Latter Follower), al-Munīr min Nujūm al-Dajājah (The Brightest of the Chicken's Stars), al-Ridf al-Fawāris الردف الفوارس (The Follower of the Riders [i.e. δγεζ Cyg]), Najm al-Dajājah (The Star of the Chicken). This star is also called sometimes Shalyāq شلياق (Lyre) by Ibn Mājid.
20. Najm al-Ṣalīb al-Sharqī نجم الصليب الشرقي (The Eastern Star of the Cross): β Cru, Mimosa, one of al-Mashriqīyāt min al-Murabbaʿ المشرقيات من المربّع (The Eastern Ones of the Square).
21. al-Fuʾād الفؤاد (The Liver): in nautical literature it refers to α CVn, Cor Caroli, and not to Regulus. The confusion arises from the existence among early Arabs of a megaconstellation called al-Asad (see Adams) which was then eventually assimilated to a certain extent with the Ptolemaic Lion. It is also called Fuʾād al-Asad فؤاد الأسد (The Liver of the Lion), Qalb al-Asad (The Heart of the Lion); Fuʾād al-Layth فؤاد الليث (The Liver of the Lion), and al-Malakī الملكي (The Royal One).
22. al-Shawlah الشولة (The Raised Tail): λ Sco, Shaula. Also Shawlat al-ʿAqrab (The Raised Tail of the Scorpion), al-Shawl (The Raised Tail), al-Ibrah الإبرة (The Sting). See below, Lunar Station 19 of the same name.
23. Kalbā al-Dabarān كلبا الدبران (The Two Dogs of Aldebaran): υκ Tau, "two little stars between the Pleaides and Aldebaran" (see Kunitzsch 74). Also called simply al-Kalbān (The Two Dogs).

## 2 The Lunar Stations (*Manāzil al-Qamar*)[18]

As is customary in astronomical literature, Ibn Mājid divides the Stations into Northern and Southern, giving the number of stars in each of them. These descriptions occasionally vary across his different works, as will be evident below. Remarkably, al-Mahrī elaborates significantly less on this topic, with only one section in his *Minhāj* devoted to it.

The main Arabic nautical sources for the *Manāzil* are Chapter 3 of Ibn Mājid's *Fawāʾid*, Section 2 of his *Ḥāwiyah*, his poems *Manāzil al-qamar*, and *Al-Qāfīyah fī maʿrifat al-*

[18] The use of English "mansion", though customary, is an overly literal translation of the Latin *mansio*, meaning simply a stopover, a way station, even an abode or lodge, but without connotations of grandeur. By perhaps significant contrast, the twelve solar zodiac constellations are called *burūj*, "castles, fortresses".

*majhūlāt min al-nujūm*. For al-Mahri, we refer to Section 7 of his *Minhāj*.

A general alternative name for the Lunar Stations is Nujūm al-Akhdh, "stars of entrance", because every night the moon enters (*ya'khadhu fī*, see Lane *s.v.* ʾ-*kh-dh*), seizes, comes into temporary possession of, a part of the sky.

### 2.1 The Northern Stations

They are fourteen:

1. al-Sharaṭān الشرطان (The Two Beginnings):[19] βγ Ari or, less commonly, αβγ Ari. Most authors agree it refers to βγ Ari, only two stars (*kawkabān*), which not only explains the dual form of the name, but also agrees with the corresponding Indian *nakshatra*, Ashvini. Ibn Mājid does not apparently distinguish al-Sharaṭān from al-Nāṭḥ (The Butting), or al-Nāṭiḥ (The Butting One), as the astronomers (*viz.* Ibn Qutaybah, al-Ṣūfī and al-Bīrūnī) do; for him al-Naṭḥ النطح is also called al-Fard al-Kabīr (The Big Solitary One) and corresponds to α Ari alone.[20] al-Bīrūnī specifies that when "a third nearby star is added", the proper name should be al-Ashrāṭ (The Beginnings—i.e. not a dual). In modern nomenclature, the name Sheratan is used to refer to β Ari.
2. al-Buṭayn البطين (The Little Belly): εδρ Ari. It was also called Baṭn al-Ḥamal بطن الحمل (The Belly of the Ram), or simply al-Baṭn (The Belly). In modern nomenclature, δ Ari is officially named Botein.
3. al-Thurayyā الثريّا (The Little Abundant One): M45, the Pleiades. The usual alternative name, al-Najm النجم, seems to actually make of the Pleaides "The Star" par excellence. It figures prominently in pre-Islamic poetry. In *Fawā'id* III, 37, it is also called al-Jām الجام and al-Lijām اللجام, which are explained as Persian names. Other astronomical sources call it Alyat al-Ḥamal ألية الحمل (The Tail of the Ram).
4. al-Dabarān الدبران (The One Behind [the Pleiades]): α Tau, Aldebaran. Also known as Tābiʿ al-Najm تابع النجم and Tālī al-Najm (both meaning The Follower of the Star). A number of other alternative names exist, see above, Brightest Stars in the Sky, no. 12.
5. al-Haqʿah الهقعة or al-Haqʿ الهقع (A Tuft of Horse Hair): λφ$^{1-2}$ Ori. This station was also known as Raʾs al-Jawzāʾ رأس الجوزاء (Head of Jawzāʾ). Ibn Majid partly identifies it with "The Giant" (al-Jabbār الجبّار, Orion).
6. al-Hanʿah الهنعة or al-Hanʿ الهنع (The Neck Mark): also called al-Taḥīyah (The Greeting). A group of two to five or six stars in a curved shape "like the letter *nūn* ن": γημνξι Gem or εγζλδ Gem. Earlier astronomical literature, like al-Mahrī, distinguishes between al-Hanʿah as composed of two stars only, γξ Gem, and four other stars called al-Taḥāyī التحايي (The Greeting Ones), ημνι Gem, but this last name is used occasionally also for

[19] See Kunitzsch 110.

[20] It should be noted that according to modern nomenclature, the derived Arabic name, Elnath, refers not to the stars in this lunar station, but to β Tauri.

the previous lunar station, al-Haqʿah. The corresponding Indian *nakshatra*, Ardra, is identified in the earliest system by γ Gem (Abhyankar 1990), the star called Alhena in modern nomenclature, straight after this station's name.

7. al-Dhirāʿ الذراع (The Forearm [of the Lion]): αβ Gem, Castor and Pollux, sometimes with the addition of Procyon and Gomeisa, αβ CMi. There is an astronomical tradition that "The Forearm means always two stars," and accordingly divisions are established between the two pairs meantioned above, al-Dhirāʿ al-Shāmī (The Northern Forearm) and al-Dhirāʿ al-Yamānī (The Southern Forearm). The same distinction is also made between al-Dhirāʿ al-Mabsūṭah الذراع المبسوطة (The Extended Forearm) and al-Dhirāʿ al-Maqbūḍah الذراع المقبوضة (The Drawn-up Forearm). From here to 11, all the station names refer to parts of The Lion.
8. al-Nathrah النترة (The Sneeze): ε Cnc/M44, Praesepe. A station described as dimly visible or nebulous, most likely referring to the lesser magintude stars of Cancer and the Beehive Cluster, M44, compared to the droplets of a sneeze. More specifically found as Nathrat al-Asad (The Sneeze of the Lion). Variations, found in Ibn Mājid and earlier authors, associate the station's name with γδε Cnc, or specify that γδ Cnc are the two nostrils, while ε Cnc would be the tip of the nose.
9. al-Ṭarf الطرف (The Gaze): χ Cnc + λ Leo, or λ Leo + κ Cnc, or also εο Leo. Found explicitly as Ṭarf al-Asad (The Gaze of the Lion), with an explanation that it refers to the smallness of the eyes of the lion. In any case it seems accepted that the station is composed by two stars.
10. al-Jabhah الجبهة (The Forehead): ζγηα Leo, named also Jabhat al-Asad (The Forehead of the Lion). The southernmost star of the asterism is Regulus, α Leo. The official name of γ Leo, Algieba, derives from this station.
11. al-Zubrah الزبرة (The Mane): δθ Leo. Also, Zubrat al-Asad (The Mane of the Lion), al-Khirātān الخراتان, al-Kharātān, or-Khurtān الخرتان, meaning The Two Hollows (on the flanks of the lion), whence the modern official name of θ Leo, Chertan.
12. al-Ṣarfah الصرفة (The Change): β Leo, named al-Ṣarf, Dhanab al-Asad ذنب الأسد (The Tail of the Lion), whence the modern name Denebola; also called al-Qunb القنب (The Sheath of the Penis).
13. al-ʿAwwāʾ العوّاء (The Howler): βηγδε Vir. Ibn Mājid adds οπ Vir to make it seven stars, while others only use four, βηγε Vir, or ηγδε Vir. It is said to resemble the Arabic letters *lām* ل or *kāf* ك. The name al-ʿAwwāʾ has been explained as dogs howling at The Lion, or at the cold (?) weather, or as referring to the curved shape of the asterism. In any case it gave rise to the formal name of δ Vir, Minelauva, an adaptation of *min al-ʿawwāʾ*, "from the ʿAwwā'". Some authors give al-Ṣayyāḥ الصيّاح (The Clamorous Man) as an alternative name for this station, but it is more appropriately used for the

constellation of Bootes.

14. al-Simāk al-Aʿzal السماك الأعزل (The Unarmed Sky-Raiser): α Vir, Spica, sometimes called in Arabic Sunbulah سنبلة, The Ear of Wheat, as a direct translation of the Greek and Latin names. For more details, see above, the Brightest Stars of the Sky, no. 16. Together with the other Simāk, Arcturus, the Simākān سماكان (the two Simāk) are also known as Sāqā al-Asad ساقا الأسد (The Shanks of the Lion).

### 2.2 The Southern Stations

They are fourteen also.

15. al-Ghafr الغفر (The Tail Tuft): this name refers to ικλ Vir,[21] or to λ Vir, Khambalia, alone. The name is explained (Khoury, *Muʿjam*, 237; Kunitzsch 63) as meaning *ghafrah*, "the hair at the tip of the Lion's tail".
16. al-Zubāná الزبانى (The Claw [of the Scorpion]): αβ Lib. Also, with the same meaning, al-Zabn الزبن, al-Zubān الزبان, or al-Zubānayān الزبانيان (The Two Claws), referring to the southern and the northern one, al-Zubāná al-Janūbī and al-Zubāná al-Shamālī. The modern names Zubenelgenubi and Zubenelschamali derive from this station.
17. al-Iklīl الإكليل (The Crown): βδπ Sco, three stars on the forehead of the Scorpion. Named also Iklīl al-Janūbī (The Southern Crown), Iklīl al-ʿAqrab, Iklīl al-ʿAqrabī (The Scorpion's Crown) or al-Tāj التاج (The Crown). These three stars would represent not just the crown, but also the head of the Scorpion which, in some sources, may be defined simply as β Sco—a star called today Acrab, straight from the Arabic *ʿaqrab* (scorpion).
18. al-Qalb القلب (The Heart): α Sco, Antares, named Qalb al-ʿAqrab قلب العقرب (The Heart of The Scorpion) too. Cf. no. 15 of the Brightest Stars in the Sky.
19. al-Shawlah الشولة (The Raised Tail): usually only two stars, λυ Sco, Shaula and Lesath. Named also al-Shūl, Shawlat al-ʿAqrab (The Raised Tail of The Scorpion), and al-Ibrah (The Sting), though this is more propery considered to be "a spot of fog" (*laṭkhat ghaym*), corresponding to M7, the Ptolemy Cluster. Ibn Mājid says that al-Shawlah is a group of small stars shaped like the Arabic letter *nūn* ن, probably λυκιθ Sco. Cf. the Brightest Stars of the Sky, no. 22.
20. al-Naʿāʾim النعائم (The Ostriches) or al-Naʿām النعام: γδεησφτζ Sgr. According to *al-Fawāʾid*, these eight stars represent two groups of ostriches approaching (*al-Wāridah*) and leaving (*al-Ṣādirah*) the river of the Milky Way.
21. al-Baldah البلدة (The Place): most commonly identified with an empty space east of al-Naʿāʾim, and sometimes with al-Udḥī الأدحي, "the nest of the ostriches", which represents a group from four to six stars, roughly ξοπρυ Sgr. This group is also called

[21] Variations like ιχλ or ιθλ Vir do not make sense astronomically and are most likely due to nomenclature confusion.

at times al-Qilādah القلادة, "The Necklace".

22. Saʿd al-Dhābiḥ سعد الذابح (The Omen of The Sacrificer): αβ Cap, Algedi and Dabih. Ibn Mājid explains that Dhābiḥ can also mean "the slaughtered one", and in one of his poems he adds a third faint star. There are ten ancient Arab asterisms called Saʿd (pl. Suʿūdāt), thought to refer to the name of a very early Middle Eastern deity, possibly Babylonian (Kunitzsch 100). The use of "omen" is meant to retain the potential ambiguity as either auspicious or inauspicious.
23. Saʿd Bulaʿ سعد بلع (The Voracious Omen): νμε Aqr, sometimes only με Aqr. Called also simply Bulaʿ (Voracious).
24. Saʿd al-Suʿūd سعد السعود (The Omen of Omens): βξ Aqr. Sometimes a third star is added, either λ Cap or c Cap. Sadalsuud is used in modern nomenclature for β Aqr.
25. Saʿd al-Akhbīyah سعد الأخبية (The Omen of the Woolen Tents): γπζη Aqr. Four stars said to resemble the foot of a duck, or a group of tents. γ Aqr, the first of the four stars, is refered to by modern nomenclature as Sadachbia.
26. al-Fargh al-Muqaddam فرغ المقدّم (The Front Spout [of the Bucket]): αβ Peg, Markab and Scheat, the two western stars of the Square of Pegasus. Also called Farghān al-Muqaddamān (The Two Front Spouts) and al-Fargh al-Awwal (The First Spout). Regarding the image of the Bucket and Pegasus, see below the entry for Pegasus.
27. al-Fargh al-Muʾakhkhar فرغ المؤخّر (The Rear Spout): γ Peg + α And (=δ Peg), Algenib and Alpheratz, the two eastern stars of the Square of Pegasus. Also called al-Fargh al-Thānī (The Second Spout) and al-Fargh al-Akhir (The Last Spout).
28. Baṭn al-Ḥūt بطن الحوت (The Belly of the Fish): β And, Mirach. It is also called Baṭn al-Ḥūt al-Shamālī (The Belly of the Northern Fish), Qalb al-Hūt قلب الحوت (The Heart of the Fish), al-Rishāʾ الرشاء (The Rope), and Baṭn al-Samakah (The Belly of the Fish). Al-Ḥūt is normally used for the Ptolemaic constellation of Pisces.

## 3 Zodiacal Constellations

We list here some zodiacal stars which are of lesser magnitude or which have separate nautical use apart from their asterisms.

**Aries: Ari · al-Hamal (The Lamb), al-Kabsh (The Ram)**

1. al-Aḍlāʿ الأضلاع (The Ribs): 41(c), 39, 35, 33 Ari, called also Aḍlāʿ al-Ḥamal (The Ribs of the Lamb) or Adlāʿ al-Kabsh (The Ribs of the Ram).
2. Awwal Aḍlāʿ al-Ḥamal (The First of the Ribs of the Lamb): 41(c) Ari. Synonyms: al-Ḍilʿ الضلع (The Rib), al-Ḍilʿ al-Saḥābī, al-Ḍilʿ al-Shām (The Northern Rib), al-Ḍilʿ al-Shamālī (The Northern Rib), al-Ḍilʿ al-Kabīr al-Munawwar (The Big Luminous Rib), al-Ḍilʿ al-Munīr (The Bright Rib), or al-Munīr min al-Ḍulūʿ المنير من الضلوع (The Bright

One Among the Ribs). Staples identifies al-Ḍilʿ al-Munīr with γ And, while Tibbetts speculates it may refer to α Per.

3. Fard al-Sharaṭayn فرد الشرطين (The Solitary One of the Two Beginnings): α Ari, Ḥamal. Named also al-Fard al-Kabīr (The Big Solitary One), Fard al-Naṭḥ (The Solitary One of the Butting), al-Fard min al-Naṭḥ (The Solitary from the Butting).

**Taurus: Tau · Thawr (Bull)**

1. al-Ḍayqah الضيقة (The Narrows): χν Tau. Also vocalised as al-Dīqah. Ibn Mājid speaks of "a gap (فرجة *furjah*) between Aldebaran and the Pleiades" which is identified to the "two stars" mentioned above and located in the same place by earlier astronomers (Khoury, *Muʿjam* 324).
2. Qalāʾiṣ قلائص (The Young Camels): Hyades. They are at times described as stars surrounding al-Dabarān, and called Ghanīmāt al-Dabarān غنيمات الدبران (The Spoils of Aldebaran). Khoury specifies (*Muʿjam* 346) that there are two different asterisms of this name; the second is also called Qilādah, in Sagittarius, see below.

**Gemini: Gem · Tawʾamān (The Twins)**

A very common name for Gemini in the medieval astronomical tradition is al-Jawzāʾ الجوزاء, but in the nautical literature, as in early Arabic folk astronomy, this name refers to al-Jabbār الجبّار, The Giant, i.e. Orion.

1. Shāmī al-Dhirāʿ al-Shāmī شامي الذراع الشامي (The Northern One of the Northern Foreleg): α Gem, Castor. Other names are Shāmī al-Shām, and Shāmī al-Shāmī.

**Virgo: Vir · al-Sunbulah (The Ear of Wheat)/ al-ʿAdhrāʾ (The Virgin)**

Using Sunbulah for the name of the constellation seems to be an extension of the name of Spica, its brightest star, but it is also used by the astronomers and Ibn Mājid himself to refer to Coma Berenices (al-Hulbah/al-Ḍafīrah).

1. Ākhir al-ʿAwwāʾ آخر العوّاء (The Last One of the Howlers): ε Vir, Vindemiatrix.
2. Awwal al-ʿAwwāʾ أوّل العوّاء (The First One of the Howlers): o Vir.
3. Zāwiyat al-ʿAwwāʾ زاوية العوّاء (The Corner of the Howlers): γ Vir, Porrima. This name is sometimes associated to η Vir.

**Sagittarius: Sgr · Al-Qaws (The Bow)**

1. al-Sahm السهم or Sahm al-Qaws (The Arrow of the Bow): γ Sgr, Alnasl or Nushaba. The name can also refer to αβ Gruis. The modern name Alnasl derives from the Arabic *naṣl*, "arrowhead" , which would be an abreviation from the Almagest name Naṣl al-Qaws نصل القوس (The Arrowhead of the Bow). Modern Nushshābah would also derive from the Arabic expression *zujj al-nushshābah*, translated as "The Tip of the Arrow".

It is important to note that these "arrows" related to Sagittarius have no relation with the constellation of Sagitta.

2. Sahm al-Awwal (The First of the Arrow): φ Sgr. See Khoury (*Muʿjam* 312) for details of this identification, which in any case seems based directly on al-Mahrī. Kunitzsch ("Zur Stellung der Nautikertexte…", 62–3), however, explains that it has to refer to γ Gru, Aldhanab.
3. al-Ṣādirah الصادرة (The Arriving Ones): σφτζ Sgr, viz. al-Naʿāʾim al-Ṣādirah (The Arriving Ostriches). See also above, Lunar Station 20.
4. al-Qilādah القلادة (The Necklace): ξοπδρυ Sgr. Sometimes also called Qalāʾiṣ (The Young Camels), but see above under Taurus, and Lunar Station 21, al-Baldah.
5. al-Naʿāʾim al-Wāridah النعائم الواردة (The Departing Ostriches): γδεη Sgr. Also simply al-Wāridah (The Departing). See also above, Lunar Station 20.
6. Taḥtah al-Qaws تط القوس (Below the Bow), σ Sgr, Nunki. Khoury (*Muʿjam* 268–9) elaborates in detail about the confusion between this name and Taḥta al-Faras تحت الفرس (Below the Horse) or Fatḥat al-Qaws (The Opening of the Bow).

**Aquarius: Aqr · al-Dalū (The Bucket), Sākib al-Māʾ (Water Pourer)**

The name al-Dalū الدلو is often used in nautical works to refer to the Great Square of Pegasus.

1. Saʿd al-Malik سعد الملك (The Royal Omen): αο Aqr.

## 4 Non-zodiacal Constellations

The stars in this section, all of practical importance in navigation, are grouped according to their position within Ptolemaic constellations, and by their latitude north or south of the ecliptic.

### 4.1 Northern Constellations

**Ursa Minor: UMi · Dubb al-Aṣghār (The Little Bear)**

1. al-Jāh الجاه: α UMi, Polaris. It is named al-Judayy الجديّ (The Little Kid) or Jady Banāt Naʿsh جدي بنات نعش (The Kid of the Daughters of the Bier), thus to distinguish it from the other Jady (i.e. Capricornus), from which the name only differs in vocalisation (see Kunitzsch 62). It is also called al-Sumayyā السميّا (The Little Celestial One), and Najm al-Quṭb نجم القطب (The Star of the Pole).
2. al-Farqadān الفرقدان (The Two Calves): βγ UMi. A very prominent pair of stars, also called al-Ḥājizān الحاجزان (The Two Deterrents), and often found in verse as al-Farāqid الفراقد (The Calves). They are often called The Guardians, because they are said to watch over, to circumambulate (*yaṭūfūna*) the Polar Star.

3. al-Farqad al-Kabīr الفرقد الكبير (The Big Calf): β UMi, Kochab, called al-Kabīr (The Big One), Farqad al-Akbar (The Bigger Calf), al-Farqad (The Calf) and Muqaddam al-Farqad (The Foremost Calf) too.
4. al-Farqad al-Ṣaghīr (The Small Calf): γ UMi, Pherkad. Called also simply al-Ṣaghīr (The Little One).

**Ursa Major: UMa · al-Naʿsh (The Bier); al-Dubb al-Akbar (The Big Bear)**

The first seven stars of UMa, "The Seven Famous Ones", al-Sabʿah al-Mashʾhūrah السبعة المشهورة, are named al-Naʿsh or Naʿsh as Samāʾ (The Celestial Bier), al-Naʿsh al-Kubrá (The Great Bier) or, very often too, Banāt Naʿsh (The Girls/Daughters of the Bier). Some of them are combined into smaller asterisms with particular and rather macabre names: αβ are called Awwalān al-Naʿsh (The Two First of the Bier) or Muqaddamān al-Naʿsh (The Two Foremost of the Bier), or al-Awāʾil al-Nuʿūsh (The First of the Biers). αβγδ are known as al-Sarīr السرير ("a bier before the corpse is carried upon it"), Janāzah جنازة (The Corpse) and al-Ḥawḍ الحوض (The Pool). εζη are sometimes singled out specifically as the "girls" who follow the bier, the Banāt (The Girls), or Banāt Nāʿsh (The Girls of the Bier), or Banāt Nāʿsh al-Kubra (The Girls of the Great Bier), or even Banū Naʿsh بنو نعش (Boys of the Bier).

1. Awwal al-Naʿsh (The First One of the Bier): α UMa, Bubhe. It has many other names: Awwal al-Nuʿūsh (The First of the Bier's Stars), Awwal al-Naʿsh al-Shāmī (The First Northern One of the Bier), Awwal al-Naʿsh al-Muqaddamayn al-Shamāliyayn (The First of the Two Northernmost of the Bier), Muqaddam al-Naʿsh, Muqaddam al-Nuʿūsh مقدّم النعوش (Foremost of the Bier), Muqaddam al-Nuʿūsh al-Shāmī (Northernmost of the Bier).
2. Thānī al-Naʿsh (The Second One of the Bier): β UMa, Merak. Or Thānī al-Nuʿūsh (The Second of the Bier's Stars).
3. Thālith al-Naʿsh (The Third One of the Bier): γ UMa, Phecda, Thālith al-Nuʿūsh (The Third of the Bier's Stars) or, according to al-Mahrī, al-Fard (The Solitary one). This and the next star are also known as The Two Limping Ones (al-Aʿrajān الأعرجان).
4. al-Khāfī الخافي (The Hidden One): δ UMa, Megrez. Also called Akhīr al-Sarīr أخير السرير (The Last one of the Bier), Rābiʿ al-Naʿsh (The Fourth One of the Bier), Rābiʿ al-Naʿsh al-Aʿraj (The Limping Fourth One of the Bier), and simply Rābiʿ al-Aʿraj (The Fourth Limping One).
5. al-Ḥawr الحور (The Black-Eyed Beauty): ε UMa, Alioth. Also al-Ḥawar (The Bull), al-Jawn الجون (The Black Horse), and Khāmis al-Naʿsh (The Fifth One of the Bier). It is unclear to what extent the difference between al-Ḥawr and al-Jawn might have been initially a case of *taṣḥīf* or scribal corruption. This and the next star, ε and ζ UMa, are sometimes called Hīrāb هيراب (The Keel) or Hīrāb al-Safīnah هيراب السفينة (The Ship's Keel), referring to a tradition reported by Ibn Mājid, see below, Safīnat al-Nūḥ.

6. al-ʿAnāq العناق (The She-Kid): ζ UMa, Mizar. It has some other names: Sādis al-Naʿsh (The Sixth One of the Bier), Sādis al-Nuʿūsh (The Sixth of the Bier's Stars), Sādis Nujūm al-Naʿsh (The Sixth Star of the Bier).
7. al-Qāʾid القائد (The Leader): η UMa, Alkaid, called also Ākhir al-Nuʿūsh (The Last Star of the Bier) and Sābiʿ al-Naʿsh (The Seventh One of the Bier).
8. al-Suhā السها (The Overlooked One): 80 UMa, Alcor, a little star next to the second of the tail. It has two names, al-Ṣaydaq الصيدق (The Trusted One) and al-Nuʿaysh النعيش (The Little Bier).
9. Safīnat Nūḥ سفينة نوح (Noah's Ark): γδεζη UMa. A constellation which is superimposed on The Plough and which seems to be described only by Ibn Mājid (*Fawāʾid* I, 10–11), explaining that Noah

> *designed the ship based on the qualities of the five stars of Ursa Major: its stern on the third star, its keel on the fourth, fifth and sixth, and its bow on the seventh star of Ursa Major.*

**Draco: Dra · al-Tinnīn (The Dragon)**

1. al-Tinnīn التنّين (The Dragon): this name is used to refer to either the head of the long constellation of The Dragon, νβξγ Dra, or to its tail and northernmost end, which is between Ursa minor and Ursa major, and includes λκ and a Dra. These three, or the latter alone, were called al-Tinnīn by al-Mahrī, and they were identified with the old name of al-Ḥayyah الحيّة (The Snake). The head was in turn identified by Ibn Mājid with al-ʿAwāʾidh العوائذ (or ʿAwāʾid, The Mother Camels), see next. The modern name Eltanin is currently used for γ Dra alone.
2. Awwal al-ʿAwāʾidh أوّل العوائذ (The First of the Mother Camels): ν Dra. Also Muqaddam al-ʿAwāʾidh (The Foremost of the Mother Camels). Al-ʿAwāʾidh is one of the original early Arabic constellations, called sometimes also Ṣalīb al-Wāqiʿ صليب الواقع (The Cross of Vega, cf. Kunitzsch 108), eventually identified to the head of the Ptolemaic Dragon, γβξν Dra. It appeared in the Renaissance map of Peter Apian as *Quinque dromedarii.*
3. Thānī al-ʿAwāʾidh (The Second of the Mother Camels): β Dra, Rastaban or Alwaid. Its first modern name derives from رأس التنّين *raʾs al-tinnīn*, "the head of the dragon".
4. al-ʿAwhaqān العوهقان (The Two Black Ravens): ζη Dra, named also al-Dhiʾbān الذئبان (The Two Wolves) or al-Ḥurrān الحرّان (The Two Young Gazelles). Two stars in the middle body of the Dragon, located between al-ʿAwāʾidh and al-Farqadān.

**Corona Borealis: CrB · al-Ḥujrah (The Precinct)**

Alternative early names of this constellation include al-Fakkah الفكّة (The Open Ring), Qaṣʿat al-Masākīn قصعة المساكين (The Bowl of the Poor) and Ṣaḥfat al-Masākīn صحفة

المساكين (same meaning).

Muqaddam al-Ḥujrah مقدّم الحجرة (The Foremost of the Precinct): α CrB, Alphecca, derived from al-Fakkah. This star is also called Munīr al-Ḥujrah منير الحجرة (The Bright One of the Precinct), al-Munīr min al-Iklīl al-Shamālī (The Bright One of the Northern Crown), al-Najm al-Munīr min al-Fakkah (The Bright Star of al-Fakkah). See *Muʿjam* 358.

**Lyra: Lyr · Salyāq/Shalyāq (Lyre) or Silaḥfāh (Tortoise)**

1. Salyāq/Shalyāq سلياق / شلياق (Lyre): β Lyr, Sheliak—also vocalised with a *kasrah* as Silyāq/Shilyāq. This name is used by Ibn Mājid to refer to Deneb as well, creating some puzzling identification issues, see *Muʿjam* 306–306.
2. Ridf al-Wāqiʿ ردف الواقع (The Follower of Vega): ε Lyr. Note that the *ridf* is used for other stars in Lyra and in Cygnus, with a number of variations. See above, no. 19 of the Brightest Stars.

**Cygnus: Cyg · al-Dajājah (The Fowl)**

1. Ridf al-Ridf ردف الردف (The Follower of the Follower [of the Chicken]): ω or ζ Cyg.

**Cassiopeia: Cas · Dhāt al-Kursī (The Lady in a Chair)**

In early Arab tradition, portions of Cassiopeia and Andromeda were said to form a constellation called al-Nāqah الناقة (The She-Camel), from which several star names derive.

1. Baṭn al-Nāqah بطن الناقة (The Belly of the She-Camel): β Cas, Caph. Also al-Jamal الجمل (The Camel), al-Sanām السنام (The Hump), Sanām al-Jady سنام الجدي (The Hump of the Kid), Sanām al-Quṭb (The Hump of the Pole), Sanām al-Nāqah (The Hump of the She-camel), Munīr al-nāqah (The Bright One of the She-Camel), al-ʿĪs العيس (The Reddish White Camels), al-Kaff al-Khaḍīb كفّ الخضيب (The Henna-Dyed Hand). Its modern name, Caph, derives from al-Kaff al-Khaḍīb, which sometimes refers to the five brightest stars of Cassiopeia, βαγδε Cas. Sanām al-Nāqah was also used as the name of another group in the same constellation, ζλβγ Cas.

**Auriga: Aur · Mumsik al-Aʿinnah (The Holder of the Reins)**

1. al-Dhubbān الذبّان: β Aur, Menkalinan, or Dhūbbān al-Bār (The Dhubbān of the Devotee), or Dhubbān al-ʿAyyūq (The Dhubbān of the Goat). The word *dhubbān* seems to be a uniquely nautical term, meaning a conventional unit of measure, normally four fingers; see Staples *s.v.*
2. Dhubbān Dhubbān al-ʿAyyūq (The Dhubbān of the Dhubbān of the Goat): θ Aur.

**Ophiuchus: Oph · al-Ḥawwāʾ (The Snake Charmer)**

1. al-Sābiqān السابقان (The Two Racing Horses): ζη Oph. The singular form of the noun gave origin to the official modern name of η Oph, Sabik.

**Delphinus: Del · Dulfīn (Dolphin)**

1. Ṣalīb al-Shām صليب الشام or Ṣalīb al-Shamāl (The Northern Cross): αβγδ Del. This subset of four stars of the Ptolemaic Dolphin was a traditional asterism among the Arabs.

**Pegasus: Peg · al-Faras al-Aʿẓam (The Greater Horse)**

1. al-Fargh الفرغ (The Spout): αβγδ Peg, The Great Square of Pegasus. It must be noted that in contemporary IAU nomenclature, α And is preferred to δ Peg, so this asterism would be αβγ Peg + α And. It has many other names: al-Farghān الفرغان (The Two Spouts), al-Furūgh الفروغ (The Spouts), Furūgh al-Dalū (The Spouts of the Bucket), ʿUrquwat al-Dalū عرقوة الدلو (The Bucket-Carrying Rod). This last name can also refer to a single star, β Peg. Generally, Al-Fargh seems to refer to either one of the two spouts of the well bucket (*al-dalū*). The term alone is not common, but it appears as al-Fargh al-Muqaddam, or al-Fargh al-Muʾakhkhir.
2. Awwal al-Fargh (The First One of the Spout): α Peg, Markab. Called also al-Fargh al-Muqaddam al-Janūbī (The Foremost Southern Spout).
3. Awwal al-Fargh al-Shām (The First One of the Northern Spout): β Peg, Scheat, named also Awwal al-Fargh al-Muqaddam al-Shāmī, Jarīm Awwal al-Naʿsh al-Shāmī جريم أوّل النعش الشامي (The First Massive One of the Northern Bier), al-Muqaddam al-Fargh al-Shāmī (The Foremost of the Northern Spout).
4. Akhīr Fargh al-Shām (The Last One of the Northern Spout): δ Peg, Alpheratz (nowadays α And, as mentioned above). Other names include al-Fargh al-Shāmī al-Muʾakhkhar (The Posterior Northern Spout), al-Fargh al-Muʾakhkhar al-Shāmī (The Posterior Northern Spout), al-Fargh al-Muʾakhkhar al-Shāmālī (The Posterior Northern Spout), Fam al-Faras فم الفرس (The Mouth of the Horse), Fam al-Nāqah فم الناقة (The Mouth of the She-Camel).
5. al-Fargh al-Shamālī (The Northern Spout): α And + β Peg, Alpheratz and Scheat. Also al-Farghān al-Shamālīyān (The Two Northern Spouts), or al-Shamālīyān (The Two Northern Ones).
6. al-Najmān al-Janūbiyān min al-Farghayn (The Two Southern Stars of the Two Spouts): αγ Peg, Markab and Algenib. Also al-Janūbiyān الجنوبيان (The Two Southern Ones).
7. Saʿd al-Humām سعد الهمام (The Auspice of the Aspiring One): ζξ Peg.

**Andromeda: And · al-Marʾāt al-Musalsalah (The Chained Woman)**

1. Fuʾād al-Ḥūt فؤاد الحوت (The Liver of the Fish): β And, Mirach. This is the same as lunar station 28, Baṭn al-Ḥūt, see above.

## 4.2 The Southern Constellations

### Cetus: Cet · Qīṭus

1. al-Ḍifdiʿ al-Thānī الضفدع الثاني (The Second Frog): β Cet, Diphda.

### Orion: Ori · al-Jawzāʾ; al-Jabbār (The Giant)

An alternative name for this constellation, used by al-Mahrī, is al-Mīzān الميزان (The Balance).

1. Tāj al-Dhawāʾib تاج الذوائب (The Crown of Curls): 15($\gamma^2$), 11($\gamma'$) o$^2\pi^{1-6}\delta\varepsilon$ Ori, called also simply either al-Tāj or al-Dhawāʾib. It refers to a string of little stars west of the main frame of Orion, resembling a "flowing lock of hair".
2. al-Naẓm النظم (The String of Pearls): δεζ Ori. Also al-Niẓām النظام, with the same meaning, al-Safāfīd السفافيد (The Skewers), and Minṭaqah al-Jawzāʾ منطقة الجوزاء (The Belt of Jawzāʾ), whence the modern name Mintaka for δ Ori. Sometimes al-Naẓm is used to refer to the whole of Orion. Awwal al-Naẓm is sometimes used to refer to ζ Ori, Alnitak, alone.
3. al-Marāzim المرازم: αβκγ Ori, or Marāzim al-Jawzāʾ. The square of the four bright stars in Orion, i.e. the shoulders and feet of The Giant. *Marāzim* is a plural form of Mirzam, meaning unknown.
4. Marāzim al-Jawzāʾ al-Awwalān: βγ Ori, Rigel and Bellatrix, The First Two Mirzams of Jawzāʾ.
5. al-Mirzamān or al-Mirzamān al-Zawāhir المرزمان الزواهر: αβ Ori. The Two Mirzams, or The Two Bright Mirzams, a group name for the two brightest stars in Orion.

### Canis Minor: CMi · al-Kalb al-Aṣghar (The Lesser Dog)

1. al-Dhirāʿ al-Ghumayṣāʾ الذراع الغميصاء (The Bleary-eyed Foreleg): αβ CMi, Procyon and Gomeisa. Other names are al-Dhirāʿ al-Yamānī (The Southern Foreleg), al-Dhirāʿ al-Maqbūḍah الذراع المقبوضة (The Drawn-up Foreleg), al-Yad al-Maqbūḍah (The Clenched Hand). Some associate al-Ghumayṣāʾ (The Bleary-eyed One) with this pair, but it seems to refer more appropriately to Procyon alone; see above, no. 8 of the Brightest Stars.

### Centaurus: Cen · al-Qinṭūrus

1. al-Ḥimārān الحماران (The Two Donkeys): αβ Cen, al-Wazn (The Measuring Weight) and Ḥaḍār, that is Rigil Kentaurus and Hadar, usually associated in Arab uranography with Suhayl. They are called also al-ʿIraqān عرقان (The Two Borders/Roots?), al-ʿAmūdān العمودان (The Two Columns), al-Fārisān الفارسان (The Two Horses), al-Misḥalān المسحلان (The Two Knives), al-Ḥiṣnān الحصنان (The Two Fortresses), al-Muḥalfān المحلفان (The Two Bound by Oath), al-Muḥannithān المحنّثان (The Two

Oath-Breakers); for this last name, see Brightest Stars no. 8, above, and Staples 395.
2.Rukbah Qinṭūrus ركبة قنطورس (The Knee of the Centaur): β Cen.

**Corvus: Crv · al-Ghurāb (The Crow)**
1. Anjum al-Ghurāb أنجم الغراب (The Crow Stars): αβγδε Crv.

**Puppis: Pup · al-Kawthal (The Stern)**
1. Dhubbān Suhayl ذبّان سهيل (The Dhubbān of Canopus): τ Pup. In spite of its name, and as observed by Staples (409, 432), the distance between this star and Canopus is not four fingers, so the identification remains uncertain.

**Crux: Cru · Ṣalīb al-Janūb (The Cross of the South) or al-Murabbaʿ (The Square)**
1. al-Ṣalīb al-Janūbī الصليب الجنوبي (The Southern Cross): αβγδ Cru. Other appellations for it are Ṣalīb al-Janūb (The Cross of the South), Ṣalīb al-Quṭb (The Cross of the Pole), Ṣalīb al-Yaman (The Cross of the South), al-Murabbaʿāt المربّعات (The Ones of the Square).
2. al-Murabbaʿ al-Fawqānī (The Upper Squared One): γ Cru. Named also: al-Murabbaʿ al-Fawqī (same meaning), Najm al-Murabbaʿ al-Fawqī (The Upper Squared Star), Fawqiyat al-Murabbaʿ (The Upper One of the Square), al-Fūqānī (The Upper One).
3. al-Murabbaʿān al-Awsaṭān (The Two Middle Ones of the Square): βδ Cru. They have many other names: al-Murabbaʿān (The Two of the Square), al-Najmān al-Awsaṭān min al-Murabbaʿ (The Two Middle Stars of the Square), al-Murabbaʿ al-Awsaṭ (The Middle Square), al-Murabbaʿ al-Wusaṭ (The Middle Square), al-Murabbaʿ al-Wusṭānī (same meaning), Nujūm Wasaṭ al-Murabbaʿ (The Middle Stars of the Square), al-Awsaṭān min al-Murabbaʿ (The Two Middle Ones from the Square).
4. al-Murabbaʿān al-Taḥtiyān (The Lower Ones of the Square): αβ Cru.

## 5 Magellanic Clouds

Their joint name is al-Ghamāmah الغمامة (The Veil), or al-Saḥāb السحاب (The Cloud), al-Saḥāʾib السحائب (The Clouds), or al-Saḥābatān al-Janūbiyyatān السحابتان الجنوبيّتان (The Two Southern Clouds). They consist of two nebulae:
1. al-Saḥābah al-Bayḍāʾ السحابة البيضاء or al-Bīḍ البيض (The White Cloud): Large Magellanic Cloud, LMC; Nubecula Major, or the Greater Little Cloud.
2. al-Saḥābah al-Sawdāʾ السحابة السوداء (The Black Cloud) or al-Saḥāyib al-Sawdāʾ, or al-Sawdāʾ: Small Magellanic Cloud, SMC; Nubecula Minor, or Lesser Little Cloud.

## 6 Addendum: Other Useful Celestial Objects

Other stars or combinations of celestial objects mentioned by Ibn Mājid and al-Mahrī.

1. al-Qafazāt القفزاة (The Leaps): ικλμνξ UMa. Also called Qafazāt al-Ẓibāʾ (The Leaps of the Gazelles) or Qafazāt al-Ẓabī (The Leaps of the Gazelle), these are three pairs of smaller stars south of Ursa Major, marking the footprints of the gazelles as they leap.
2. al-Qafazat al-Ulá القفزة الأولى (The First Leap): ξν UMa, or simply al-Ulá.
3. al-Qafazat al-Wusṭá القفزة الوسطى (The Middle Leap): μλ UMa.
4. Ḥawḍ al-Ẓibāʾ حوض الظباء (The Pool of the Gazelles): τhυφθef UMa. With some discrepancies, most authors agree that they are a number, usually seven, of smaller stars west of the brighter part of Ursa Major.
5. al-Ẓibāʾ الظباء (The Gazelles): odπσ¹σ² UMa. A group of even smaller stars west of their Pool.
6. Awāsiṭ al-Nuʿūsh أواسط النعوش (The Middle Ones of the Biers): γδε UMa, Phecda, Megrez, Alioth. Very literally, a group comprising the middle brighter stars of Ursa Major; mentioned as such in Ibn Mājid's poems.
7. al-Fāriṭān الفرطان (The Two Preceding Ones): υθ UMa. The identification varies, also to include ο UM, but according to the sources it refers to two stars that "precede" the Bier on their way to dig the grave. This sub-group overlaps partly with al-Ẓibāʾ and al-Ḥawḍ.
8. al-Mīkh الميخ (The Nail): γ Cep, Errai. This seems to be an exclusively nautical name, also specified as Mīkh al-Jāh (The Nail of Polaris) or Mīkh al-Judday (same meaning). Ibn Mājid explains the name of this star which is of great practical importance: "this name is of Persian origin, it means a nail (*mismār*), because it fixes Polaris to the Celestial Pole" (IV, 116).
9. al-Thawālith الثوالث (The Triads): this name refers to two pairs of northern and southern circumpolar stars; together with their respective pole, each of these pairs forms a triad or ternary. They are β Cas and γ UMa for the North Pole, and β Cen and α PsA for the South Pole.
10. Saʿd al-Bāriʿ سعد البارع (The Omen of the Skilled One): λμ Peg.
11. al-Aʿlām الأعلام, or Tawābiʿ al-Ayyūq (The Signs, or Followers of Capella): βθγ Aur, though sometimes identified as βγ Aur. Note that in our current nomenclature, β Tau is preferred over γ Aur.
12. Dhanab al-Ḥūt ذنب الحوت (The Tail of the Fish): γ Gru, Aldhanab, is the most likely match, but there are variations, and Khoury associates it at some point with "any star in the tail of the Southern Fish". It must be noted that the modern constellation Grus used to be the "tail" of Piscis Austrinus, al-Ḥūt al-Janūbī.

13. al-Majarrah المجرّة (The Track / The Watercourse): The Milky Way. Apart from uts use to determine the relative positions of a number of stars and asterisms, Ibn Mājid explains (*Fawā'id* IV, 149–50) that the Milky Way is useful to understand the basics of the movement of the spheres—we might say, "principles of cosmography".

# 7 Bibliography

There are a number of "nationally sponsored" nautical ephemerides, along the lines of the British *Nautical Almanac* mentioned above, which have a selection of stars for navigation. The French *Ephémérides nautiques*, published by the Bureau des longitudes, use 27 stars. The *Nautical Almanac* itself, published by HM Nautical Almanac Office, uses 57 stars. The Russian set included in the *Nautical Astronomical Almanac* (Морской астрономический альманах) includes 160 stars and a reduced set of 77; it is published bi-annually by the The Institute of Applied Astronomy of the Russian Academy of Sciences. In the present Technical Note we are including 111 stars, asterisms and celestial objects which combine in various ways a total of 155 stars.

## 7.1 Primary Sources

In addition to the two classical Arabic authors mentioned above, we have consulted the following medieval and early modern related works.

Bourne, William. 2017. *A Regiment for the Sea, and Other Writings on Navigation*. Edited by E. G. R. Taylor. London: Taylor & Francis.

Rapoport, Yossef, and Emilie Savage-Smith, eds. 2014. *An Eleventh-century Egyptian Guide to the Universe: the Book of Curiosities* (*Kitāb gharā'ib al-funūn*). Islamic Philosophy, Theology and Science 87. Leiden; Boston: Brill.

Rico y Sinobas, Manuel, ed. 1863–1867. *Libros del saber de astronomia del Rey D. Alfonso X de Castilla*. 5 vols. Madrid: Tipografia de don Eusebio Aguado.

## 7.2 Secondary Sources

Abhyankar, K.D. 1991. 'Misidentification of Some Indian Nakṣatras'. *Indian Journal for the History of Science* 26: 1–10.

Adams, W. B. 2011. 'The Hands of the Pleiades: The Celestial Clock in the Classical Arabic Poetry of Dhū al-Rumma'. *ASP Conference Series 441* (1 June 2011): 311–16.

Beaujard, Philippe. 2019. *The Worlds of the Indian Ocean: A Global History*. 1st ed. Cambridge University Press.

Constable, Anthony R. 2012. 'The Basic Ideas of Navigation in Relation to the Early History of Sailing in the Indian Ocean'. In *The Principles of Arab Navigation*, by William Facey and Anthony R. Constable, 1–20. London: Arabian Publishing.

Daugherty, Tracy. 2019. *Dante and the Early Astronomer: Science, Adventure, and a Victorian Woman Who Opened the Heavens*. New Haven; London: Yale University Press.

Eckart, Andreas. 2021. "Use of The Galaxy as a Tool for Spatial and Temporal Orientation During the Early Islamic Period and up to the 15th Century." *Arabic Sciences and Philosophy*, 31(1), 1–44.

Henninger, Joseph. 1954. "Über Sternkunde und Sternkult in Nord- und Zentralarabien". *Zeitschrift für Ethnologie* 79, 82-117.

Al-Hosani, Naeema. 2005. Arab Wayfinding on Land and at Sea: An Historical Comparison of Traditional Navigation Techniques. Master's diss., University of Kansas.

King, David A. 1985. "Astronomy for Landlubbers and Navigators: The Case of the Islamic Middle Ages." *Separatas Verdes* 164. Lisboa: Instituto de Investigação Científica Tropical.

Kunitzsch, Paul. 1959. *Arabische Sternnamen in Europa*. Wiesbaden: Otto Harrassowitz Verlag.

———. 1961. *Untersuchungen zur Sternnomenklatur der Araber*. Wiesbaden: Otto Harrassowitz Verlag.

———. 1967. "Zur Stellung der Nautikertexte Innerhalb der Sternnomenklatur der Araber". *Der Islam* 43 (1–2): 53–74.

———. 1977. "Arabische Sternnamen — Sternnamen der Araber: Zur Begriffsbestimmung". *Sudhoffs Archiv* 61, no. 2: 105–17.

———. 1977. "On the Mediaeval Arabic Knowledge of the Star Alpha Eridani". *Journal for the History of Arabic Science* 1.

———. 1987. 'Peter Apian and "AZOPHI": Arabic Constellations in Renaissance Astronomy'. *Journal for the History of Astronomy* 18 (2): 117–24.

———and Tim Smart. 2006. *A Dictionary of Modern Star Names: A Short Guide to 254 Star Names and Their Derivations*. Cambridge, Mass: Sky Pub. Corp.

———. 2017 *The Arabs and the Stars*. London: Routledge.

Laffitte, Roland. 2006. *Des Noms Arabes Pour Les Étoiles*. 2nd ed. Paris: Geuthner.

Malhão Pereira, José Manuel. 2003. *The Stellar Compass and the Kamal, An Interpretation of its Practical Use*. Lisboa: Academia da Marinha.

———. 2004. *As técnicas náuticas pregâmicas no Índico*. Lisboa: Academia de Marinha.

McEvoy, Tim. 2021. 'Ignatius and the Stars'. *The Way* 60, no. 2 (April): 8–17.

Morelon, Régis. 1987. "L'astronomie Nautique Arabo-Islamique." *Astronomie* 101: 191–94.

Nash, Harriet, Dionisius A. Agius, Ali H. Al-Mahrooqi, and Said A. Al-Yahyai. 2017. 'Star Use by Fishermen in Oman'. *International Journal of Nautical Archaeology* 46 (1): 179–91.

Pérez Jiménez, Aurelio. 2014. "Las mansiones lunares. Adaptación árabe de una doctrina astrológica antigua", in F. Roldán (ed.), *El cielo del Islám*. Sevilla: Universidad de Sevilla & Universidad de Huelva.

Pimenta, Fernando. 2015. "Astronomy and Navigation". In: Ruggles C. (eds) *Handbook of Archaeoastronomy and Ethnoastronomy*. New York: Springer.

Proverbio, Edoardo. 1994. "Astronomical and Sailing Tables from the Second Half of the

XVth Century to the Middle of the XVIth Century". *Memorie della Società Astronomia Italiana* vol. 65, 469–496.

Pugsley, Richard Marriotte. 1917. "Latitude by meridian altitude of the sun and fixed stars, with complete rules and explanations as required at the United States local inspectors examinations." New York.

Schotte, Margaret E. 2019. *Sailing School: Navigating Science and Skill, 1550-1800. Information Cultures*. Baltimore: Johns Hopkins University Press.

Schmidl, Petra. 2007. *Volkstümliche Astronomie im Islamischen Mittelalter: Zur Bestimmung der Gebetszeiten und der Qibla bei al-Aṣbaḥī, Ibn Raḥīq und al-Fārisī*. Islamic Philosophy, Theology and Science 68. Leiden: Brill.

Sela, Shlomo. 2016. 'Al-Farghānī on the 48 Ptolemaic Constellations: A Newly Discovered Text in Hebrew Translation'. *Aleph* 16, no. 2: 249–365.

Shafiq, Suhanna. 2013. Seafarers of the Seven Seas: The Maritime Culture in the Kitab 'Aja'ib al-Hind by Buzurg Ibn Shahriyar (d. 399/1009). De Gruyter.

Sheriff, Abdul, and Engseng Ho, eds. 2014. *The Indian Ocean: Oceanic Connections and the Creation of New Societies*. London: Hurst & Company.

Shihāb, Ḥasan Ṣāliḥ. 2001. *Al-Milāḥah al-Falakīyah ʿinda-'l-ʿarab*. Al-Kuwait: Markaz al-Buḥūṯ wa-'d-Dirāsāt al-Kuwaitīya.

———. 2012. "Stellar Navigation of the Arabs." In *The Principles of Arab Navigation*, edited by William Facey and Anthony R. Constable, 21–44. London: Arabian Publishing Ltd.

Sundermann, Werner. 1978. 'Einige Bemerkungen zur Lehre von den Mondstationen in der altiranischen Überlieferung'. *Altorientalische Forschungen* 5, no. JG (1 December): 199–204.

Tolmacheva, Marina. 1980. 'On the Arab System of Nautical Orientation'. *Arabica* 27 (2): 180–92.

Varadarajan, Lotika. 1993. "Astrology and Astronomy, The Indo-Portuguese Encounter." Edited by Artur Teodoro de Matos and Luís Filipe F. Reis Thomaz. Actas Do VI Seminário Internacional de História Indo-Portuguesa, 485–99.

Weinstock, Stefan. 1949. 'Lunar Mansions and Early Calendars'. The Journal of Hellenic Studies 69 (November): 48–69.

### 7.3 Websites

Celestial Navigation Net, by Mary Taylor.

History of Astronomy, by Robert Harry van Gent, especially his handy reference for al-Ṣūfī's constellations.

Lisbon Arabic Science & Philosophy Reading Group, a blog by Inês Bénard and Juan Acevedo.

The Manuchihr Globe, on a 17th-century Khorasanian celestial globe.

Two Deserts, One Sky, by Danielle Adams.

### 7.4 Video

Adams, Danielle. 2020. "Multivalent Textures of Arabian Astronomy." *Meet an Astronomer* Series, Lowell Observatory, Arizona.

## Astronomical Index

Star names in Bayer notation, sorted in alphabetical order by constellation.

**Andromeda**
α And: Akhīr Fargh al-Shām
α And + β Peg: al-Fargh al-Shamālī
β And: Baṭn al-Ḥūt
β And: Fuʾād al-Ḥūt

**Aquarius**
αο Aqr: Saʿd al-Malik
βξ Aqr + λ Cap: Saʿd al-Suʿūd
γπζη Aqr: Saʿd al-Akhbīyah
νμε Aqr: Saʿd Bulaʿ

**Aquila**
α Aql: Altair: al-Ṭāʾir

**Aries**
α Ari: Fard al-Sharaṭayn
αβ Ari (also αβγ): al-Sharaṭān
εδρ Ari: al-Buṭayn
41(c) Ari: Awwal Aḍlāʿ al-Ḥamal
41(c), 39, 35, 33 Ari: al-Aḍlāʿ

**Auriga**
α Aur, Capella: al-ʿAyyūq
β Aur: al-Dhubbān
βθγ Aur: al-Aʿlām
θ Aur: Dhubbān Dhubbān al-ʿAyyūq

**Boötes**
α Boo, Arcturus: al-Simāk al-Rāmiḥ

**Capricorn**
αβ Cap: Saʿd al-Dhābiḥ
γδ Cap: Saʿd al-nāshirah

**Carina**
α Car, Canopus: Suhayl

**Cassiopeia**
β Cas: Baṭn al-Nāqah
β Cas + γ UMa: al-Thawālith

**Centaurus**
αβ Cen: al-Ḥimār
αβ Cen: al-Ḥimārān
α Cen: al-Maʿqil
β Cen, Hadar or Agena: al-Maʿqil
β Cen, Hadar or Agena: Ḥaḍār
β Cen, Hadar or Agena: Rukbah Qinṭūrus

**Cetus**
β Cet: al-Ḍifdiʿ al-Thānī

**Cepheus**
γ Cep, Errai: al-Mīkh

**Canis Major**
α CMa, Sirius: al-Shiʿrá

**Canis Minor**
α CMi, Procyon: al-Shiʿrá al-Shāmīyah
αβ CMi: al-Dhirāʿ al-Ghumayṣāʾ

**Cancer**
ε Cnc, Praesepe: al-Nathrah
χ Cnc + λ Leo: al-Ṭarf

**Canes Venatici**
α CVn, Cor Caroli: al-Fuʾād

**Corona Borealis**
α CrB, Alphecca: Muqaddam al-Ḥujrah

**Corvus**
αβγδε Crv: Anjum al-Ghurāb

**Crux**
α Cru, Acrux: al-Murabbaʿ
αβ Cru: al-Murabbaʿān al-Taḥtiyān
αβγδ Cru, Southern Cross: al-Ṣalīb al-Janūbī
β Cru, Mimosa: Najm al-Ṣalīb al-Sharqī
βδ Cru: al-Murabbaʿān al-Awsaṭān
γ Cru, Gacrux: al-Murabbaʿ al-Fawqānī
ε Cru: al-Maghribiyāt al-Murabbaʿ

**Cygnus**
α Cyg, Deneb: al-Ridf

ω or ζ Cyg: Ridf al-Ridf

**Delphinus**

αβγδ Del: Ṣalīb al-Shām

**Draco**

β Dra: Thānī al-ʿAwāʾidh

ζη Dra: al-ʿAwhaqān

ν Dra: Awwal al-ʿAwāʾidh

νβξγ Dra: al-Tinnīn

**Eridanus**

α Eri, Achernar: al-Muḥannith

**Gemini**

α Gem, Castor: Shāmī al-Dhirāʿ al-Shāmī

αβ Gem, Castor and Pollux: al-Dhirāʿ

β Gem, Pollux: Raʾs al-Tawʾam al-Muʾakhkhar

γημνξι Gem (also γξ Gem): al-Hanʿah

**Grus**

γ Gru, Aldhanab: Dhanab al-Ḥūt

**Leo**

β Leo: al-Ṣarfah

δν Leo: al-Zubrah

ζγηα Leo: al-Jabhah

**Libra**

αβ Lib: al-Zubāná

**Lyra**

α Lyr, Vega: al-Kāsir

β Lyr, Sheliak: Salyāq

ε Lyr: Ridf al-Wāqiʿ

**Magellanic Clouds**

Large Magellanic Cloud: al-Saḥābah al-Bayḍāʾ

Small Magellanic Cloud: al-Saḥābah al-Sawdāʾ

**Messier Objects**

Messier 7, Ptolemy Cluster: al-Ibrah

Messier 44, Praesepe: al-Nathrah

Messier 45, the Pleiades: al-Thurayyā

**The Milky Way**

The Milky Way: al-Majarrah

**Ophiuchus**

ζη Oph: al-Sābiqān

**Orion**

αβ Ori: al-Mirzamān

αβχγ Ori: al-Marāzim

β Ori, Rigel: al-Nājid al-Barrāq

βγ Ori: Marāzim al-Jawzāʾ al-Awwalān

γ Ori, Bellatrix (also α Ori): al-Mirzam

δεζ Ori: al-Naẓm

15($\gamma^2$), 11($\gamma'$) $o^2\pi^{1-6}$δε Ori: Tāj al-Dhawāʾib

λφ Ori: al-Haqʿah

**Pegasus**

α Peg, Markab: Awwal al-Fargh

α Peg + α And: al-Najmān al-Janūbiyān min al-Farghayn

β Peg, Scheat: Awwal al-Fargh al-Shām

αβγ Peg+ α And: al-Fargh

αβ Peg: al-Fargh al-Muqaddam

γ Peg + α And: al-Fargh al-Muʾakhkhar

ζξ Peg: Saʿd al-Humām

λμ Peg: Saʿd al-Bāriʿ

**Piscis Austrinus**

α PisA, Fomalhaut: Ākhir al-Nahr

**Puppis**

τ Pup: Dhubbān Suhayl

**Sagittarius**

γ Sgr: al-Sahm

γδεη Sgr: al-Naʿāʾim al-Wāridah

π Sgr: al-Baldah

γδεησφτζ Sgr: al-Naʿāʾim

σ Sgr: Taḥtat al-Qaws

σφζτ Sgr: al-Ṣādirah

φ Sgr: Sahm al-Awwal

τνψωAζ Sgr: al-Qilādah

**Scorpius**

α Sco, Antares: al-Qalb

βδπ Sco: al-Iklīl

λ Sco, Shaula: al-Shawlah

λοτλυ Sco: al-Shawlah

**Taurus**

α Tau, Aldebaran: al-Dabarān

β Tau (?), Elnath: Kalbā al-Dabarān
χν Tau: al-Ḍayqah
Hyades: Qalāʾiṣ

**Ursa Major**

α UMa, Bubhe: Awwal al-Naʿsh
β UMa, Merak: Thānī al-Naʿsh
γ UMa, Phed: Thālith al-Naʿsh
γδε UMa: Awāsiṭ al-Nuʿūsh
γδεζη UMa: Safīnat Nūḥ
δ UMa, Megrez: al-Khāfī (The hidden)
ε UMa: al-Ḥawr
ζ UMa: al-ʿAnāq
η UMa, Alkaid: al-Qāʾid
ικλμνξ UMa: al-Qafazāt
μλ UMa: al-Qafazat al-Wusṭá
ξν UMa: al-Qafazat al-Ulá
odπσ¹σ² UMa: al-Ẓibāʾ
τhυφθef UMa: Ḥawḍ al-Ẓibāʾ
υθ UMa: al-Fāriṭān
8o UMa, Alcor: al-Suhā

**Ursa Minor**

α UMi, Polaris: al-Jāh
β UMi, Kochab: al-Farqad al-Kabīr
γ UMi: al-Farqad al-Ṣaghīr
βγ UMi: al-Farqadān

**Virgo**

α Vir, Spica: al-Simāk al-Aʿzal
βηγδε Vir: al-ʿAwwāʾ
γ Vir: Zāwiyat al-ʿAwwāʾ
ε Vir: Ākhir al-ʿAwwāʾ
ιχλ Vir: al-Ghafr
o Vir: Awwal al-ʿAwwāʾ

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)*