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Signs and Causes

Astro-Meteorology in Early Islamic Centuries

Cropped from the page of disasters in *Tārīkh-i alfī* (History of the Thousand [Years]).

Before the existence of weather stations, people relied on a variety of visible and invisible signs to predict the weather. Among Arabs, observing the regular motions of the stars was a common method for weather forecasting, both before and after the rise of Islam. How did they perceive the connection between cosmic and atmospheric phenomena?

In many past societies, including pre-Islamic Arabia, astronomy and weather forecasting were closely connected, and this knowledge played a crucial role in the region's economic considerations. [1] After the advent of Islam, this understanding was further enriched by the rapid exchange of ideas with neighboring cultures, blending climatic and environmental concepts with astronomical principles, a synthesis that is evident in the literature from that era. While there is some continuity in Arabian knowledge of astronomy and weather between the pre-Islamic and Islamic periods, notable differences also stand out.

Pre-Islamic records are primarily archaeological, such as stone inscriptions, [2] and fragmented poetry, much of which was preserved through Islamic manuscripts. [3] In contrast, sources from the Islamic period, particularly from the late eighth century onward, are far more diverse and extensive. [4] Another significant difference lies in how this knowledge was created and used. In the Islamic period, knowledge production was primarily state-supported, leading to a more formal and elite-driven approach tied to political and administrative needs. On the other hand, pre-Islamic knowledge of the environment was less structured, based largely on individual observations and regional traditions. Modern scholarship commonly refers to this body of astro-meteorological knowledge in Arabia, as "folk astronomy" to emphasise its informal, observational character compared to the more advanced and systematic studies that emerged in Islamic societies. However, this lable should not obscure the dynamic encounters between different approaches and practices across changing religious and intellectual contexts. [5]

Early Islamic *ḥadīth* literature (prophetic statements) offers a critical view of pre-Islamic methods of weather prediction, suggesting that these earlier practices often attributed divine authority to specific *naw'* (plural: *anwā'*) as causes of weather events, such as winds and rain. [6] There is no consensus among scholars about the original meaning and practice of the *anwā';* however, Islamic sources describe them as associated with specific stars or asterisms primarily envoked in relation to rainfall. The Qur'an critiques those who, while acknowledging Allah as "the Lord of the seven heavens, and of the Glorious Throne" (23:86), [7] failed to fully adopt the Qur'anic view of faith and continued to believe in other influences over natural phenomena. This statement aligns with some pre-Islamic poetry that invoked divine intervention beyond natural processes to bring rain. [8]

> Thus, while both pre-Islamic and Islamic perspectives reflected a mix of natural and divine causation, their theological interpretations and explanations of these events differed significantly.

As just mentioned, the term *anwā'* does not have a clearly defined meaning. Its literal meaning, "fall" or "descent", is commonly understood in surviving Islamic sources to refer to the setting of one star just before dawn as another rises, and it was predominantly associated with rainfall or the timing of rains. Alongside these sidereal observations, Muslims also employed other cosmic systems to manage aspects of daily life. Although the Islamic religious calendar was based on the lunar cycle, the solar zodiacal circle was adopted as a universal framework for measuring time following the expansion of Islamic political rule. [9] For observers

on Earth, many zodiacal stars align with the Moon's orbit as it moves near the Sun's apparent path. Although the Moon's rotation changes slightly over the course of a month and from month to month, it consistently passes through a set pattern of stars. Islamic astronomical literature exhibits a formalisation of this observation into a system of 28 lunar stations, known as lunar mansions or *manāzil* (singular: *manzil*). These stations formed a lunar zodiac, a circuit of stars that the Moon would occupy each night during its sidereal revolution, a journey lasting approximately 27 days and one-third of a day.

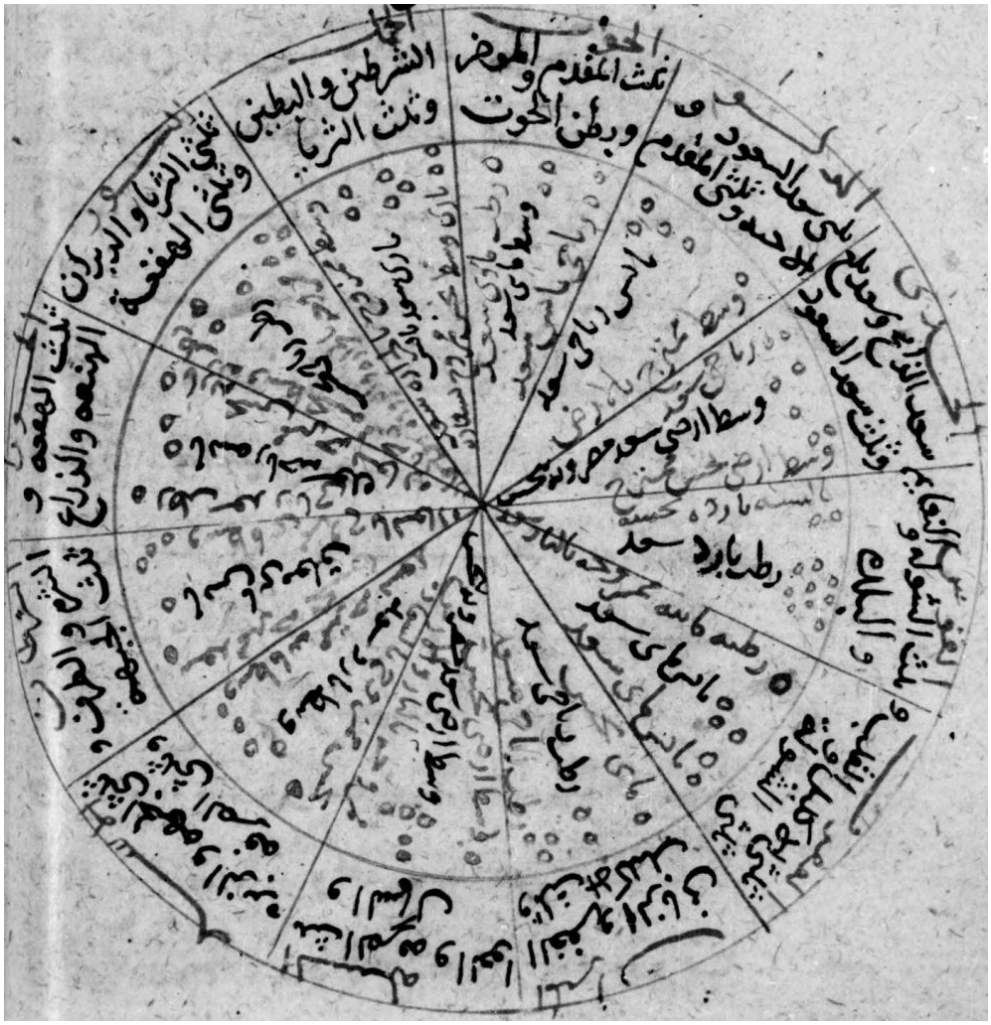

Figure 2: A popular pie chart in Islamic literature illustrating the correspondence of the 12 zodiacal signs to the 28 lunar mansions, along with notes on their astrological attributes in terms of good versus evil, as well as their elemental natures (Earth, water, air, and fire). This diagram also provides visual aids for identifying the asterisms, albeit drawn somewhat carelessly, possibly to aid observation or as distinct markers.

While the mansions were not perfectly precise due to variations in the Moon's motion and the mismatch between the sidereal revolution and the lunation (the time between consecutive new moons or similar phases), they provided an approximate astronomical clock each night. However, these lunar stations were not accurate enough to serve as a tool for the Islamic lunar calendar. Their main application lay in astrology, where they held significant value (Figure 2). The

origin of this lunar zodiac system, which existed in ancient Indian and Chinese astronomy, remains somewhat unclear. Some modern studies suggest that the concept of lunar mansions was derived from Indian astronomy, though it may have incorporated elements of pre-Islamic Arabian traditions. [10]

The relationship between the concepts of lunar mansions and *anwāʾ* prior to their documentation in Islamic sources remains unclear. It is possible that these mansions were plotted relative to the Sun's position, independent of the Moon, to track the heliacal rising and setting of specific stars. This approach seems closer to the pre-Islamic practice of *manāzil*, as suggested by the available evidence. This system likely functioned as a method for reckoning seasons, though the reasoning behind dividing the sky into 28 mansions remains uncertain. [11]

> According to *anwāʾ* texts, each mansion corresponded to a 13-day period that recurred annually at fixed times, making the mansions a practical tool for seasonal planning.

They were used to guide agricultural activities, such as anticipating rainfall and other weather changes, as well as pastoralism and further environmental needs. [12] However, the limited sources we have do not indicate any connection between these Arabic mansions and the lunar zodiac systems that prevailed in East Asian cultures.

It is suggested that the knowledge of *manāzil*, as preserved in Islamic literature, intentionally distanced itself from the pre-Islamic sacred practices that associated star observations with rituals for seeking rain. These older customs, such as the rain cult in Mecca where prayers were offered for rainfall, were reinterpreted and stripped of their religious connotations. This shift aimed to refine the theological context, transforming meteorological knowledge into a practical, secular framework while aligning it with Islamic theology. [13] Encounters with the lunar zodiac system in Indian astronomy may have further influenced these changes, offering new ways to understand and interpret natural cycles. Early Muslims seemed to recognise that beneath theological explanations of natural events lay a universal, independent foundation; one that transcended religious boundaries and was seen as a creation of God. The ninth-century Arab scholar Ibn Qutayba, in his writings on *anwāʾ*, emphasised the practical value of pre-Islamic traditions and used them to support his efforts to adapt and integrate this knowledge into an Islamic context. [14] Over the centuries, the connection between knowledge of lunar mansions and Islamic legal and literary traditions became increasingly apparent. Arabic lexicographies reveal that the seasons of the Arabia were predominantly categorised and named based on rainfall patterns. [15] The more

familiar division of the year into four seasons, based on equinoxes and solstices, likely entered the Islamic world later through influences from Greek astronomy and other foreign sciences. [16]

> In addition to understanding rainfall, knowledge of winds was an essential component of anwāʾ texts for interpreting concepts of time and space.

The rectangular architecture of the Kaaba in Mecca may reflect influences from pre-Islamic astral and weather traditions, as supported by the way Islamic sources later interpreted its features. [17] Winds were seen as intermediaries between the Earth and the heavens, originating from specific directions depending on their type and seasonal patterns. This made them integral to defining territorial boundaries in relation to celestial positions, forming a compass-like structure. [18] Hundreds of names existed to classify winds based on their effects, characteristics, and directions. While some winds were specific to particular regions, others were considered universal. [19] In various Islamic geographical works, often referred to as "sacred geography", the Earth was divided with Mecca at the center, and the directions of the winds were used to help people in different cities determine the *qibla* (prayer direction to Kaaba). [20] Although it is uncertain whether the Kaaba was intentionally aligned with wind patterns, the archaeoastronomical interpretations found in Islamic sources suggest a percieved close connection between natural phenomena and religious practices. [21] However, this does not mean that prayer directions were always dependent on aligning mosques with the winds. For example, the orientations of early mosques in al-Andalus indicate that their alignments were more likely based on the rising and setting of specific celestial bodies. [22] Over time, Muslim scholars developed advanced mathematical methods for accurately determining the *qibla*, many of which are preserved in historical texts. Despite this, the traditional methods recorded in *anwāʾ* texts remained widely used and are still practiced in some rural communities in Islamic countries today. [23]

In the concluding section of his renowned work, *The Chronology of Ancient Nations*, the distinguished eleventh-century Muslim scholar al-Bīrūnī examines various methods of understanding seasonal changes and weather forecasting. He contrasts the Indian emphasis on astrology with the Arab reliance on *anwāʾ*, a system focused on observing the stars to determine seasons and predict weather. Al-Bīrūnī highlights the practicality of this knowledge, noting that even those without formal education could recognise the rising and setting of certain stars across seasons. To make this knowledge more accessible, these rules were often composed in rhymed sayings, examples of which al-Bīrūnī includes in his work.

He also provides astronomical explanations to support the approximate accuracy of these observations but warns that such methods are not universally reliable. He stresses the need for ongoing updates and calculations to maintain their relevance. [24]

> The pre-modern fascination with the relationship between astronomical phenomena and seasonal atmospheric changes reflects a broader effort to understand nature as a balance between a system of signs and causes.

This scientific inclination to seek universal explanations for climatic and environmental patterns, often at the expense of local variability, requires careful consideration when using such evidence in environmental history studies. Recent research highlight the importance of an interdisciplinary approach, integrating archaeological, palaeoclimatological, and other types of evidence, to provide a fuller picture of historical records. [25] As explored here, the discussion of theological interpretations of cosmic and atmospheric phenomena and their presumed connected predictability, features the complexity of human resilience in the face of environmental challenges. It also reveals the limitations of viewing history through an environmentally deterministic lens, instead emphasising the diverse ways societies understood and adapted to their natural surroundings.

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Fußnoten

1 The present essay offers an introduction to an ongoing project by the author on the history of weather forecasting in Islamic societies. It was researched and written during her postdoctoral position at the Max Planck Institute for the History of Science in Berlin, funded by DFG-Collaborative Research Center 980 “Episteme in Motion”. The author later had the opportunity to receive general feedback on the text from her former colleagues in the ERC project SSE1K at Ca‘ Foscari University of Venice.

2 As indicated by some rain-invocation stone inscriptions, the association between rainfall timing and the yearly motions of particular stars or asterisms appears to have been a recognised feature of tribal traditions of pre-Islamic Arabia. For further context and inspiring insights, see Ahmad Al-Jallad, “An Ancient Arabian Zodiac: The Constellations in the Safaitic Inscriptions”, Part II. *Arabian archaeology and epigraphy* 27 (2016), 84–106.

3 For examples and further information, see Nicolai Sinai, *Rain-Giver, Bone-Breaker, Score-Settler: Allāh in Pre-Quranic Poetry* (New Haven: American Oriental Society, 2019), 27–30.

4 For a helpful and general account of traditions and practices of weather forecasting in the Islamic world, see Charles Burnett, "Weather Forecasting: Traditions and Practices in the Medieval Islamic World", in *Prognostication in the Medieval World: A Handbook*, eds. M. Heiduk, K. Herbers, and H.-Ch. Lehner, 689–695 (Berlin: De Gruyter, 2021).

5 On the so-called folk Astronomy in the Islamic world, see Petra G. Schmidl, "Islamic Folk Astronomy", in *Handbook of Archaeoastronomy and Ethnoastronomy*, ed. C. Ruggles (New York: Springer, 2015). Available **online** (accessed on 6 May 2025). Through providing compelling examples and analysis, Schmidl maintains that folk astronomy was not separate from scholarly tradition in pre-modern Islamic societies but often addressed similar problems as mathematical astronomy, differing mainly in methods, textual genres, and scholarly affiliations. She argues that emphasising a strict division between the two may reflect modern research interests more than the historical context in which these practices developed.

6 On this topic, in the context of the Islamic prayer for rain traditionally performed during times of drought, see the article "Istisḳāʾ" by T. Fahd and P. N. Boratav in *Encyclopaedia of Islam*, New Edition (EI-2 English).

7 English translation from N. J. Dawood, *The Koran: A New Translation* (London: Penguin, 1956).

8 See Sinai, *Rain-Giver*, 27–30.

9 For a study highlighting the significance of the solar calendar in ninth-century Islamic astronomical writings, see Razieh S. Mousavi and Jannis Niehoff-Panagiotidis, "Harmonization of Calendars in the Early Islamic World as Reflected in al-Farghānī's *Elements of Astronomy*", *Antigüedad y Cristianismo* 38 (2021), 203–209.

10 For a rich analysis of the origin of *anwāʾ* in the Islamic tradition, see Daniel Martin Varisco, "The Origin of the *anwāʾ* in Arab Tradition", *Studia Islamica* 74 (1991), 5–28.

11 For a discussion of the adaptation of the lunar zodiac to the solar year, see Varisco, "The Origin", 7–10. For further insights, see Al-Jallad, "An Ancient Arabian Zodiac".

12 For an in-depth study of the rain periods recognised by Bedouin communities of the Arabian Peninsula, see Daniel Martin Varisco, "Rain Periods in Pre-Islamic Arabia", *Arabica* 34 (1987), 251–266. For the perceived connection between weather forecasting and price prediction as two prognostic practices in the pre-modern Islamic literature, see Petra G. Schmidl, "Al-Ašraf ʿUmar's 'Tabṣira', Chapter XXXV: Forecasting Weather and Predicting Prices", in *Verschränkte Welt. Medien, Modelle und Diskurse mittelalterlicher Meteorologie* (Das Mittelalter 29.1), eds. B. Fricke and A. Lammer, 37–66 (Heidelberg: Heidelberg University Publishing, 2024).

13 See Varisco, "The Origin", 26–27; Fahd and Boratav, "Istisḳāʾ".

14 Ibn Qutayba, *Kitāb al-Anwāʾ*, eds. M. Hamidulla and Ch. Pellat (Hyderabad: Dāʾirat al-Maʿārif al-ʿUthmāniyya, 1956), 1–2.

15 See Varisco, "Rain Periods".

16 For an example and discussion of the interconnected perception of seasons, rain periods, and agricultural activities in the pre-modern Islamic world, see Razieh S. Mousavi and Petra G. Schmidl, "Al-Ashraf ʿUmar's Tabṣira, Chapter xxxvi: Rainfalls, Winds, and Agricultural Activities", *Zeitschrift für Geschichte der Arabisch-Islamischen Wissenschaften* (forthcoming).

17 On the alignment of the Kaaba's rectangular structure in relation to the rising and setting of the Sun, certain stars, and directions of the winds, as described in Islamic sources, see David A. King, "Islamic Sacred Geography and Finding the *Qibla* by the Sun and Stars: A Survey of the Historical Sources. With an Appendix on Some Recent Fallacies Concerning Mosque Orientations", *Zeitschrift für Geschichte der Arabisch-Islamischen Wissenschaften* 22 (2020), 91–141. For the author's helpful diagram illustrating these connections, see p. 95.

18 For an example of a Yemeni wind-compass, see Mousavi and Schmidl, “Chapter xxxvi”.

19 See the article “Rīḥ” by Miquel Forcada in *Encyclopaedia of Islam*, New Edition (EI-2 English).

20 On “Sacred geography” and determination of *qibla* according to cosmic and atmospheric phenomena including wind directions, see David A. King, *Astronomy in the service of Islam* (Aldershot: Variorum, 1993); idem, “Islamic Sacred Geography”; Petra G. Schmidl, “Zur Bestimmung der Qibla mittels der Winde“, in *Der Weg der Wahrheit: Aufsätze zur Einheit der Wissenschaftsgeschichte, Festgabe zum 60. Geburtstag von Walter G. Saltzer*, eds. P. Eisenhardt, F. Linhard and K. Petanides, 135–146 (Hildescheim, New York: Georg Olms, 1999).

21 For an insightful study on the multifaceted concept of the *qibla*, see Simon O’Meara, *The Kaʿba Orientations: Readings in Islam’s Ancient House* (Edinburgh: Edinburgh University Press, 2020).

22 For an exhaustive study in this regard, see Mònica Rius, *La alquibla en al-Andalus y al-Magrib al-Aqṣà* (Barcelona: Universidad de Barcelona, 2000).

23 For an in-depth study on the indigenous seasonal, astronomical, and agricultural knowledge as preserved in Gulf almanacs, see Daniel Martin Varisco, *Seasonal Knowledge and the Almanac Tradition in the Arab Gulf* (Cham: Palgrave Macmillan: 2022).

24 Abū Rayḥān Muḥammad al-Bīrūnī, *Kitāb al-Āthār al-bāqiya ʿan qurūn al-khāliya*, ed. by Eduard Sachau (Leipzig: Otto Harrassowitz, 1923), 336–362.

25 For some recent perspectives in this regard, see Adam Izdebski and Michael Mulryan (eds), *Environment and Society in the Long Late Antiquity* (Leiden: Brill, 2019); Razieh S. Mousavi, “Agriculture and Water Practices in Islamic Societies: Interdisciplinary Perspectives from the History of Science and Environmental History”, in ***Geoanthropology and Waterscapes*** (MPI-GEA Working Paper No. 2), eds. A. Bardi, P. D. Omodeo and J. Patkauskas, 74–80 (Jena: Max-Planck-Institut für Geoanthropologie, 2025).

Bildnachweise

Figure 1: Cropped from the page of disasters in *Tārīkh-i alfī* (History of the Thousand [Years]); Mughal school, India, c. 1595; Ink and gold on paper; Cleveland Museum of Art, URL: **https://www.clevelandart.org/art/1932.36.a** (accessed on 21 May 2025).

Figure 2: *Introduction to the Knowledge of Astrology* by Abū Naṣr al-Munajjim (379 H/990 CE). MS Paris, Bibliothèque nationale de France, Arabe 2589. Available online at gallica.bnf.fr / Bibliothèque nationale de France, URL: **https://gallica.bnf.fr/ark:/12148/btv1b10884365k/f31.item.zoom** (accessed on 6 May 2025).

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