Greek world, or the means by which such texts moved around the Mediterranean more generally. At this point, however, this is likely as exhaustive a study of this document as can be.

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Traversing the ancient Egyptian skies

Astronomy of Ancient Egypt: A Cultural Perspective. Edited by Juan Antonio Belmonte and José Lull (Springer, Cham, 2023). Pp. xxxviii + 588. $180. ISBN 9783031118289.

Books that aim to cover an entire field of study often require the collective expertise of multiple authors, yet this volume has been accomplished by just two scholars. The monograph under review presents a synthesis of Egyptian astronomy, making it one of the first works to address the subject from a holistic perspective. The volume, largely a summary of the authors' earlier work, reviews and discusses a wide range of topics related to Egyptian astronomy, including astronomical chronology, calendrical issues, the identification of Egyptian constellations, archeoastronomy, and the observational practices of the ancient stargazers. This broad scope requires deep insight into various aspects of ancient Egyptian culture and a thorough understanding of astronomy. The authors meet these requirements, particularly through their collaboration. J.A. Belmonte is an astronomer and astrophysicist with extensive knowledge of ancient Egypt, while J. Lull is an Egyptologist with considerable expertise in astronomy.

Although the book considers the entire history of ancient Egypt, from early dynastic times to the Roman period, its primary focus is on the Pharaonic period, emphasizing indigenous traditions rather than zodiacal astronomy, even when discussing later periods. While the zodiac and its use in astronomy are addressed, there is little mention of mathematical astronomy, which followed the introduction of the uniform zodiac by the Ptolemaic period. The authors take the reader on a journey through a diverse selection of topics, discussing major sources, reviewing previous research, and often offering their own views on numerous questions. An interesting aspect of the book is its willingness to engage with outlier theories, which are duly described and often properly dismissed. Including these theories provides the reader with valuable insight into the various discourses surrounding Egyptian astronomy.

The book begins with a foreword and an introduction, followed by seven main chapters. It concludes with an appendix containing a glossary of both Egyptological and astronomical terms to assist readers, regardless of their familiarity with either field. Each of the seven chapters addresses a specific aspect of astronomy.

The first chapter focuses on cosmology, offering insight into the Egyptian worldview and their conception of the universe's structure. The authors review various creation myths from different localities and periods, including the Heliopolitan, Memphite, Theban, Hermopolitan, and Esna cosmogonies. This chapter highlights the concept of the primordial waters (*nwn*), which encircle the created and finite world, comprising the sky (*p.t*), the netherworld (*dwꜣ.t*), and the earth (*tꜣ*). A notable strength of this chapter—and the book as a whole—is its integrated analysis of textual and iconographical sources alongside material culture and architecture. For example, the authors examine how the layout and elements of temples reflect the Egyptian concept of the universe.

The second chapter concerns astronomers and provides a brief overview of astrologers, including the legendary figures Nechepsos and Petosiris. It covers various sources from the Old Kingdom to the Roman period and offers some insights into celestial divination and astrology. However, the discussion of the context, role, and development of astronomers is somewhat limited, with only brief mentions of the role of astrologers through a discussion of the inscription of Harentebo and a passing reference to the inscription of Senty, son of Pensuchos.[1] The graffiti inscribed at Philae and Dakka by Kushite astronomers in the 3rd century CE are also cited, though perhaps too concisely. It would have been beneficial to elaborate on the type of astral knowledge referenced in these later sources. These inscriptions serve as a primary example of how astronomical practices evolved during the Graeco-Roman period. The texts suggest that these individuals were engaged in astral practices related to the zodiac, rather than traditional astronomy.[2]

The chapter also includes a brief survey of astronomical instruments, such as the gnomon (*mrḫ.t*), the palm branch (*bꜣ*), and a trident-like implement. The latter is only mentioned as an astronomical tool but has recently been identified as an instrument for observation used in tandem with the so-called Ramesside star-clocks.[3] These star-clocks are found in the tombs of several kings from the 20th Dynasty (Ramesses VI, VII, and IX). They use the positions of stars to mark the hours of the night, with the information displayed in tables—one for each fortnight. The hour-marking stars are plotted into one of seven zones for each hour, with the zones being compared to different parts of a human face. The instrument aids the observer in locating the stars within these zones. Since the "trident" is attested up until the Ptolemaic period, it is reasonable to assume that this type of star-clock was still in use, or at least known, during that time.

A more in-depth analysis of astronomical tools and instruments is provided in the third chapter. Here, the authors explore various astronomical instruments and time-measuring devices, star-clocks primarily attested in the second millennium BCE, clepsydras, and sundials. The authors provide thoughtful analyses of these time-determining devices. The chapter also covers the use of seasonal and equinoctial hours in ancient Egypt. This reviewer found the discussion of the Plough (*msḫt.jw*) and its rotation in the heavens as a time indicator, as depicted on a bull sarcophagus from Kom el-Yasin,[4] particularly interesting, especially given the use of the same constellation for similar purposes by more recent European seafarers.

The fourth chapter is one of the more stimulating sections of the book. The authors discuss perceptions of celestial bodies, including Egyptian constellations, comets, and shooting stars, and they touch upon the role of observational astronomy. The chapter begins with an exploration of the two luminaries, their terminology, iconography, and cultural significance, with special reference to eclipses. Eclipses are primarily mentioned in religious or literary texts from before the Graeco-Roman period. However, from that time onward, Egyptian astronomers became acquainted with methods, influenced by Mesopotamian techniques, to predict eclipses with some accuracy. Divination based on eclipses, however, is older.[5]

The section treating planets provides an account of their names, associations with deities throughout Egyptian history, and collective designations. This is followed by a discussion of comets and shooting stars. The latter topic is explored in depth through the "Miracle of the Star" episode (*Urk.* IV, 1238.8–19) in the Gebel Barkal Stela of King Thutmose III. The episode is richly contextualized with other textual references to such phenomena. In Egypt, shooting stars were generally considered destructive. Building on an idea originally proposed by J.M. Galán in 2002,[6] the authors discuss the shooting star as a symbol of the pharaoh's destructive power and take the reference on the Stela as another case that highlights his martial qualities rather than as a description of a celestial event, which is the dominant interpretation of the passage among historians. This interpretation of the event, along with most of the examples used by the authors to illustrate these aspects, was also presented by this reviewer in a 2013 paper.[7] Although the reviewer at that time was unaware that Galán had mentioned this idea in a footnote to a Spanish translation of Egyptian texts, the authors appear to be unfamiliar with the reviewer's paper but still arrive at similar conclusions using the same sources. The validity of the interpretation is thus strengthened by this sort of replication of results.

The chapter also discusses the goddess Nut as the Milky Way[8] before considering the contentious debate over the identification and development of various Egyptian constellations. This part of the chapter is intriguing and provides much food for thought. Evaluating every argument in detail would require a more extensive analysis than is possible in this review. Worthy of special note is the claim of the authors that the Egyptian asterism known as *rw-ntry* largely overlaps with the constellation today recognized as Leo. Were this correct, it would mean that the Egyptians identified it as early as the end of the third millennium BCE, whereas it is only clearly attested in Mesopotamian cuneiform sources from the early to middle of the second millennium BCE.

The chapter also surveys celestial diagrams, which, although attested as early as the Middle Kingdom, are primarily known from the New Kingdom and later periods.[9] In this context, the authors also discuss the round Dendera zodiac, constructed sometime during the 1st century BCE.[10] In addition to discussing the constellations represented, they review various arguments for and against the interpretation that it depicts the solar eclipse of March 7, 51 BCE, an interpretation they seem to accept. However, the chapter does not explain why the priesthood of Dendera would have chosen to immortalize a solar eclipse, especially since these events were generally seen as omens of misfortune. In this case, if the eclipse is indeed commemorated in the zodiac, it must be taken as an indication of a change in the occupant of the Egyptian throne. Ptolemy XII is often believed to

have died in March of that very year. However, if the eclipse were interpreted as a sign of his death, it would likely have been explicitly mentioned in at least some of the ancient sources discussing his reign.

While discussing the round Dendera zodiac, the authors offer several insightful observations. For example, Sothis (Sirius), often depicted as a reclining cow in the Graeco-Roman period, appears to be represented twice; alongside the reclining bovine is a woman with a bow and arrow. This figure is traditionally understood as the goddess Satet, who is associated with arrows and seen as an alternative depiction of Sothis. However, the authors suggest that this image might reflect two Mesopotamian constellations known as the "Arrow" and the "Bow," with the former representing Sirius and the latter being part of *Canis Major*. Although the authors do not elaborate on this idea, it highlights how the Dendera zodiac was influenced by cuneiform astronomy, particularly by works such as the astral compendium known as MUL.APIN.[11] The so-called uranologies must also have inspired the imagery, as these texts describe the images associated with various stellar constellations.[12] While the authors acknowledge a general Mesopotamian influence on the monument, with occasional references to MUL.APIN, they still seem to consider Greek astronomy as influential in the representation. However, there is little evidence to support that interpretation.[13]

The authors draw numerous parallels between Mesopotamian descriptions and those found in the Dendera zodiac, including some that have long been recognized. In addition to the zodiac constellations and the "double representation" of Sothis, examples include Hydra and Corvus, as well as the field near Pisces, which in the Hellenic tradition is part of Pegasus. The authors interpret the woman behind Leo, holding the animal's tail, as another potential case of a "double representation," this time of Virgo. While the figure could be conflated with Virgo, the image is originally inspired by the goddess Eru, who is sometimes described by cuneiform texts as holding a frond or a whip. In Egypt, this whip can be replaced with a flail, which appears in the linear Dendera zodiac and has been interpreted as representing *Coma Berenices*.[14] These examples illustrate the close connection between cuneiform sources or Mesopotamian imagery and Egyptian representations. This does not imply that this knowledge transfer predates the Graeco-Roman period. Instead, it suggests direct interaction between Egyptian scholars and cuneiform scholarship, which continued to be actively produced for a few decades beyond the turn of the Common Era.

The fifth chapter, devoted to Egyptian calendars, begins by addressing the simultaneous existence of multiple calendars, both lunar and solar. The authors argue that, contrary to common assumption, the ancient Egyptians throughout history only made use of one solar calendar of 365 days per year. This is the so-called wandering year, which falls one day behind the solar period every fourth year. The authors appear to partially base their case for the single calendar on its canonicity. In this context, they bring up a quote attributed to the 1st-century BCE Roman scholar Nigidius Figulus, which they claim illustrates that the Egyptian king had to take an oath not to challenge the *annus vagus* of 365 days: "They (i.e., the kings) are bound to swear an oath that neither a month nor a day will be intercalated, and furthermore that they will not change any festal day, but will complete 365 (days), as has been established by the ancients" (*. . . iure iurando adiguntur neque mensem neque diem intercalandum iurare neque minus festum diem <non> immutaturos, sed CCCLXV peracturos, sicut institutum sit ab antiquis*).[15] While the

claim that the king took such an oath cannot be substantiated, the quote is often used to underscore the Egyptian priesthood's aversion to calendrical changes.[16] Given that the text mentions intercalary days, it can be understood as having been formulated in response to the largely unsuccessful calendar reform of Ptolemy III, which introduced a leap day every four years to align the calendar with astronomical reality.[17] Moreover, the reference to an intercalary month implies the existence of a lunar calendar. If not an Egyptian one, then perhaps the passage indicates opposition to the Macedonian calendar used in Egypt at the time.

Although the civil calendar was dominant, the Egyptians observed lunar cycles for religious and cultic activities. The authors argue that this did not constitute a separate lunar calendar. It was rather a lunar timekeeping system integrated within the civil calendar, functioning similarly to the Christian tradition of determining Easter based on lunar phases.[18] The chapter also considers the Egyptian month names in detail, arguing that the different names constitute merely an onomastic development, not a change of lunar calendars. The authors also survey the role of astronomical observations in the development of the calendar, discussing the significance of the heliacal rising of Sothis and its connection to the New Year, along with the possible use of solstices, equinoxes, and the Nile flood as time markers.

The penultimate chapter examines the astronomical alignments of tombs, including the names of funerary complexes, and temples throughout Egyptian history. The authors discuss the ritual of stretching the cord, which they explain as a measuring technique to achieve alignment between an edifice and the celestial sphere. For instance, the Graeco-Roman temples at Dendera (Hathor) and Edfu (Horus) as well as the Abydos royal cemetery were all aligned with *msḫt.jw*, whereas a temple of Isis took into consideration the helical rising of Sothis, given the star's association with the goddess. This analysis reveals that many monuments were intentionally planned with astronomical considerations in addition to those of local geography. Some rather bold ideas are presented here. For example, they propose that the pyramids built during the reign of Sneferu were deliberately designed as a series of edifices, rather than being experimental phases where failed attempts at constructing a "perfect" pyramid were abandoned. Similarly, they suggest that the pyramids of Cheops and Chephren were originally conceived as a single monument consisting of two interconnected complexes. Although intriguing, this hypothesis is not without complications. The authors also see Egyptian influences in the Nubian temples in that they could be constructed so as to be aligned with the celestial sphere.

The final chapter addresses astronomical chronology and how astronomy can enhance our understanding of Egyptian history. It explores dates that can be confirmed through astronomical methods, including the much-debated Sothic dates, and their relation to other dating methods, specifically carbon-14 dating. The chapter also examines the calculation of regnal years according to cattle counts and the array of problems posed by our relatively limited understanding of the practices behind this system.[19]

This review can touch on only a fraction of the many stimulating discussions presented in the monograph. Although we have mentioned a few points where alternative interpretations might be considered, the work by Belmonte and Lull remains an impressive achievement and represents a significant contribution to both Egyptology and the history of astronomy. The results presented by the authors will surely engage scholars for many years to come.

It is disappointing, however, that the text appears to have been poorly proofread. Minor misspellings are inevitable in any publication, but this book suffers from many typographical errors, particularly in Egyptian transliteration, and incorrect font usage appears throughout. All too frequent are mistakes such as *A* for *ꜣ*, *a* for *ꜥ*, *S* for *š* and *D* for *ḏ* or vice versa. Although an Egyptologist might overlook these errors as mere aesthetic flaws, they may puzzle readers unfamiliar with Egyptian transcription conventions. Given the price of this volume, one might have expected more from the publisher.

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Notes

1. The latter, however, relies on the erroneous interpretation of M. Clagett, *Ancient Egyptian Science: A Source Book. Volume Two: Calendars, Clocks, and Astronomy* (Philadelphia, PA: American Philosophical Society, 1995), p. 490. For a correction, see A. Winkler, "Stellar Scientists: The Egyptian Temple Astrologers," *Journal of Ancient Near Eastern History*, 8 (2021), 114–5.
2. See Winkler, *op. cit.* (Note 1), pp. 121–4.
3. R. Birk, "Thebanische Astronomen der Ptolemäerzeit (I): Das Dossier des Harmais (Kairo, TR 25/10/17/5 und JE 43562)," in C. Thiers (ed.), *Documents de Théologies Thébaines Tardives* (Montpellier: Université Paul Valéry, 2021), pp. 6–10.
4. D. Mendel, "Die Sternuhren des nördlichen und des südlichen Himmels: Überlegungen zu den beiden Konstellationen des nördlichen und des südlichen Himmels," in Ph. Collombert, L. Coulon, I. Guermeur, and C. Thiers (eds), *Questionner le sphinx: mélanges offerts à Christiane Zivie-Coche,* vol. 1 (Cairo: Institut français d'archéologie orientale, 2021), pp. 23–52; ead., *Die Geographie des Himmels: Eine Untersuchung zu den Deckendekorationen in ägyptischen Tempeln der griechisch römischen Zeit und zeitgleichen Darstellungen auf Särgen und in Gräbern* (Wiesbaden: Harrassowitz, 2022), pp. 5–8.
5. The oldest text known to make predictions based on solar and lunar eclipses is still the one published by R.A. Parker, *A Vienna Demotic Papyrus on Eclipse- and Lunar-Omina* (Providence, RI: Brown University Press, 1959). Examples of a similar genre of text (Egyptian renderings of cuneiform divinatory treatises) are known already from the New Kingdom. See, for example, A. Roccati, "Lessico metrologico," in F. Junge (ed.), *Studien zu Sprache und Religion Ägyptens: zu Ehren von Wolfhart Westendorf, überreicht von seinen Freunden and Schülern* (Göttigen: Seminar für Ägyptologie und Koptologie, 1984), pp. 343–54; P. Collombert, "Omnia brontoscopiques et pluies de grenouilles," in M. Depauw and Y. Broux (eds), *Acts of the Tenth International Congress of Demotic Studies: Leuven, 26-30 August 2008* (Leuven: Peeters, 2014), pp. 15–26. For a selection in English translation, see J.F. Quack, "'Assur will Suffer': Predicting Disaster in Ancient Egypt," in G.J. Schenk (ed.), *Historical Disaster Experiences: Towards a Comparative and Transcultural History of Disasters Across Asia and Europe* (Cham: Springer, 2017), pp. 189–206.
6. J.M. Galán, *El imperio egipcio: Inscripciones, ca. 1550-1300 a.C.* (Madrid: Trotta, 2002), p. 123, n. 13.

7. A. Winkler, "A Royal Star: On the 'Miracle of the Star' in Thutmoses III's Gebel Barkal Stela and a Note on the King as a Star in Personal Names," *Revue d'égyptologie*, 64 (2013), 231–42.
8. See also the recent discussion by O. Graur, "The Ancient Egyptian Personification of the Milky Way as the Sky-Goddess Nut: An Astronomical and Cross-Cultural Analysis," *Journal of Astronomical History and Heritage*, 27 (2024), 28–45.
9. A monograph dedicated to this topic has recently appeared: L. Guardiano, *Il cielo dei faraoni: i soffitti astronomici nell'Egitto del Nuovo Regno* (Milan: Milan University Press, 2024).
10. Now also see Mendel, *Geographie des Himmels* (Note 4), pp. 258–426.
11. See, for example, H. Hunger and J.M. Steele, *The Babylonian Astronomical Compendium MUL.APIN* (London: Routledge, 2019).
12. The most recent comprehensive edition, with discussion, is by P.-A. Beaulieu, E. Frahm, W. Horowitz and J.M. Steele, *The Cuneiform Uranology Texts: Drawing the Constellations* (Philadelphia, PA: American Philosophical Association, 2018). A new fragment of this genre was recently published by A. Hätinen, "BM 33878: A Uranology Text from Babylon," *Journal of Cuneiform Studies*, 75 (2023), 189–95. The reviewer is discussing the connection between the uranologies and the Egyptian zodiacs in a forthcoming study.
13. See, for example, F. Hoffmann, "Internationale Wissenschaft im hellenistischen Ägypten," in F. Hoffmann and K.S. Schmidt (eds), *Orient und Okzident in hellenistischer Zeit: Beiträge zur Tagung „Orient und Okzident – Antagonismus oder Konstrukt? Machtstrukturen, Ideologien und Kulturtransfer in hellenistischer Zeit", Würzburg 10.–13. April 2008* (Vaterstetten: Broze, 2014), pp. 83–4; J.F. Quack, "Egypt as an Astronomical-Astrological Centre Between Mesopotamia, Greece, and India," in D. Brown (ed.), *The Interactions of Ancient Astral Science* (Bremen: Hempen, 2018), pp. 83–4.
14. The flail in the hand of the female figure was interpreted as an Egyptian version of *Coma Berenices* by C. Leitz, "Die Sternbilder auf dem rechteckigen und runden Tierkreis von Dendara," *Studien zur Altägyptischen Kultur*, 34 (2006), 313, given the implement's shape and the typical form attributed to this asterism. The authors, however, only discuss *Coma Berenices* in terms of their identification of it in older sources: as *sbꜣ.w ḫꜣ.w*, "Multitude of Stars".
15. See D. Liuzzi, *Nigidio Figulo: «astrologo e mago»* (Lecce: Miella, 1983), pp. 68–9.
16. See, for example, S. Schott, "Thot, le dieu qui vole des offrandes et qui trouble le cours du temps," *Comptes rendus des séances de l'Académie des Inscriptions & Belles-Lettres*, 114 (1970), 547–56, for the mythological justification of the traditional calendar, something the new one lacked.
17. For the calendar reform, see, for example, S. Pfeiffer, *Das Dekret von Kanopos (238 v. Chr.)* (Munich: K.G.Saur, 2004), pp. 131–44 and 249–57. For the partial realisation of the new calendar, see C. Bennett, *Alexandria and the Moon: An Investigation into the Lunar Macedonian Calendar of Ptolemaic Egypt* (Leuven: Peeters, 2011), pp. 179–86.
18. Another contribution on the same topic that might have been noted is S. Stern, *Calendars in Antiquity: Empires, States, and Societies* (Oxford: Oxford University Press, 2012), pp. 125–66, who takes a different position from Belmonte and Lull.
19. See now also A. Ciavatti, "Le règne de Snéfrou: nouvel examen des sources chronologiques," *Bulletin de l'Institut Français d'Archéologie Orientale*, 122 (2022), 107–53.