

An Interview About Shepseskaf

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An Interview about Shepseskaf

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This paper delves into specific claims made in a recent interview (May 26, 2025) concerning King Shepseskaf (Egyptian Fourth Dynasty) and a supposed solar eclipse, claimed to have caused the end of the IV Dynasty, as well as the architecture of his pyramid, the Mastabat Fara'un. As the case of the alleged Shepseskaf's eclipse and his pyramid has been a focus of my interest, I find it necessary to provide further details and clarifications. It's crucial to reiterate that archaeoastronomy was established well before the "late 1960s", as given in the interview. As noted by archaeoastronomer Clive Ruggles, Heinrich Nissen's *Das Templum* (1869), which examined the orientation of ancient temples and Roman decumani, effectively marks the genesis of modern archaeoastronomy—a century prior to the assertion made by Giulio Magli in the aforementioned May 2025 interview.

Regarding archaeoastronomy's insights, I will show that the Pepi II pyramid and the Mastabat Fara'un are astronomically linked: the sun connects them at both sunset on the summer solstice and sunrise on the winter solstice. This observation provides an opportunity to address the role of solstices and equinoxes in ancient Egyptian civilization, particularly as interpreted by scholars such as Mark Lehner, Juan Belmonte, and Giulio Magli. Concurrently, this discussion allows for a re-examination of the Egyptian civil calendar. Discovered in 2013, the Red Sea papyri contain the earliest written evidence of this calendar in human history, clearly illustrating its structure: twelve months of thirty days organized into three seasons, plus five epagomenal days. Lacking a leap year, the calendar is well-known for its "wandering" nature, meaning it was not anchored to the astronomical seasons. The Red Sea papyri also feature the contemporary hieroglyphic spelling of Khufu's pyramid, 'Akhet Khufu'. This intrinsic 'wandering' characteristic of the civil calendar underscores a long-standing discussions in Egyptology: namely, the precise interplay between fixed astronomical events, such as the heliacal rise of Sothis, and the practical application of a non-anchored civil calendar in ancient Egyptian society.

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The interview is:

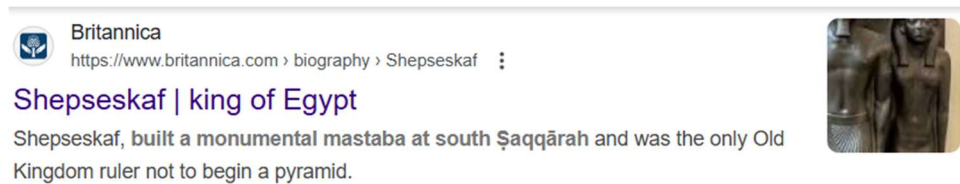
<https://www.frontiere.polimi.it/the-eclipse-that-marked-the-end-of-the-fourth-egyptian-dynasty/?lang=en>

<https://web.archive.org/web/20250604101150/https://www.frontiere.polimi.it/the-eclipse-that-marked-the-end-of-the-fourth-egyptian-dynasty/?lang=en>

The name of the king

In the interview the name of the king is written as “Shepseska” and “Shepsekha”, The name of the king is **Shepseskaf** (His soul is noble) as given by: Miroslav Verner, 2014, Norah Romney, 2021,

Joyce Tyldesley, 2023, Lisa Sabbahy, 2020, Kathryn A. Bard, 2015, and many others, such as Britannica.



For Shepseskaf in hieroglyphs: <https://pharaoh.se/ancient-egypt/pharaoh/shepseskaf/>

The title

The interview, titled "The eclipse that marked the end of the fourth Egyptian dynasty" by Gaia Ferrari Aggradi, presents this occurrence as a definitive event. However, it is important to clarify that this remains a hypothesis, not an established fact.

I have discussed the eclipse in my (2 January 2025): <https://arxiv.org/abs/2412.20407> "Two Egyptian Kings, Shepseskaf and Userkaf, and a solar eclipse (2471 BC)". This paper critically examines claims made by G. Magli in a recent work (arXiv/2412.13640) concerning a solar eclipse on April 1, 2471 BC. Magli's paper designates this event as the 'Shepseskaf eclipse,' suggesting its supposed influence on the end of the Fourth Egyptian Dynasty and the beginning of the Fifth. However, in contrast to Magli's assertion that this eclipse occurred during the reign of "the last ruler of the 4th dynasty, Shepseskaf," our analysis (<https://arxiv.org/abs/2412.20407>) demonstrates that other scholarly literature links the same 2471 BC eclipse to King Userkaf of the Fifth Dynasty. This necessitates therefore a closer examination of the chronological data proposed by Magli.

A further point of contention arises regarding the hieroglyph 'Akhet' as it appears in 'Akhet Khufu' (generally translated as 'Khufu's horizon') and its association with Gardiner N27, the 'solarized horizon,' within Magli's paper. My work emphasizes that the word 'Akhet' was, in fact, written with the crested ibis (Gardiner G25), as unequivocally shown by the Wadi al-Jarf papyri, which are contemporary to Khufu's reign. Mark Lehner, recognizing a translational issue with the N27 interpretation, rendered 'Akhet Khufu' as the 'Spirit of Khufu' (Lehner, 1997). Moreover, the use of the crested ibis (G25) in the locution translated as 'dwellers of the horizon' is attested in a letter from Pepi II to his vizier Herkhuf, dating approximately three centuries after Khufu's reign.

Through this detailed analysis, my paper aimed to clarify critical historical and philological interpretations related to the alleged eclipse and the true nature of the 'Akhet' hieroglyph, thereby offering a more nuanced understanding of this pivotal period in ancient Egyptian history.

Archaeoastronomy

In the abovementioned May 2025 interview, the topic of archaeoastronomy was introduced with the question: "Those unfamiliar with archaeoastronomy may not find it easy to understand what it is about. How would you explain it in lay terms?" Giulio Magli's response defines it as "a scientific discipline, albeit a relatively young one: it was conceived in the late 1960s, so it has been around for

little over fifty years now. The main purpose is to study the presence – or absence – of astronomical alignments."

This assertion regarding archaeoastronomy's origins is factually inaccurate. Far from being conceived in the late 1960s, the discipline traces its roots back a century earlier, to Heinrich Nissen's seminal work *Das Templum* (1869). In this pioneering study, Nissen meticulously investigated the alignments of Greek, Etruscan, and Roman temples with sunrise on specific festival days, and also noted the astronomical orientation of Roman decumani. Indeed, prominent archaeoastronomer Clive Ruggles explicitly recognizes Nissen as the father of modern archaeoastronomy.

Furthermore, it is noteworthy that an approach to the orientation of Roman decumani, strikingly similar to Nissen's, was proposed by G. Magli in 2007, yet without explicit mention or attribution to Nissen's earlier work. This historical approach by Nissen was well-known in scholarly circles and had, in the past, faced criticism, particularly concerning the notion of a Roman town being treated akin to a templum for orientation purposes.

The TOWN, the TEMPLUM and the ARCHAEOASTRONOMY

(<https://zenodo.org/records/15181795>)

According to Heinrich Nissen's *Das Templum* (1869), the Roman town is a templum, an inaugurated space with its main axis, the decumanus, oriented towards the rising sun. Nissen posited that the decumanus' direction was established on the town's Dies Natalis, associated with a specific Roman calendar festival, and appears to be the first to connect these elements. This thesis was notably endorsed by Friedrich Nietzsche in his *Der Gottesdienst der Griechen* (1875-1878 lectures on Greek cult).

A fundamentally different position is presented by Isaac Valeton in his *De Templis Romanis* (1983). Valeton argues that a town is not a templum, thus refuting the notion that the decumanus possessed any specific ritualistic alignment to the sun. He demonstrates that, according to Roman law, town soil is profane, governed by magistrates, and not subject to augur priests, thereby directly criticizing Nissen's theory.

My paper in Zenodo further examines Pierangelo Catalano's detailed discussion (1978) on the spatial aspects of the Roman juridical-religious system. Catalano likewise reiterates that the town does not constitute a templum, concluding there is no basis for ritually orienting the decumanus with the sunrise. The works of other scholars, such as F. Castagnoli and J. Le Gall, are also referenced, reinforcing the consensus that the city is not a templum, nor are centuriations (subdivisions of agrarian land) to be considered templa. This widely demonstrated scholarly consensus—that neither Roman towns nor centuriations constitute templa—is crucial. It must be stressed because certain archaeoastronomical approaches continue to infer conclusions about the Roman world without adequately engaging with the established criticisms put forth by Valeton, Catalano, Castagnoli, Le Gall, and other prominent scholars.

Archaeoastronomy and Roman Urban Planning

Archaeoastronomical approaches sometimes assert the ability to date Roman towns based on their orientation. However, this claim often overlooks fundamental aspects of Roman founding rituals and juridical-religious systems. A significant issue arises from a demonstrated lack of engagement with

the specific scholarly literature concerning the Dies Natalis (foundation day) of Roman cities. Our work, "Il giorno di fondazione, Dies Natalis, delle città romane (Piacenza, Bologna, Brindisi, Treviri, Aosta e Jesi)" (https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4877336), directly addresses this oversight.

Furthermore, as discussed in our paper entitled "Àuguri, Aruspici e l'Archeoastronomia di Augusta Praetoria (Augurs, Haruspices and the Archaeoastronomy of Augusta Praetoria)" (https://papers.ssrn.com/sol3/papers.cfm?abstract_id=5166637), and drawing from Pierangelo Catalano's seminal 1978 study, regarding the spatial aspects of the Roman juridical-religious system (and specific concepts such as mundus, templum, urbs, ager, Latium, Italia), the concept of templum as an inaugurated space requiring divine approval cannot be applied to the profane space of a Roman town (urbs). Catalano meticulously details the pomerium, the legal boundary distinguishing the urbs from the ager, emphasizing that "from the sources it does not appear that the Etrusci ritus demanded, for the inauguration of the pomerium, a limitation according to the decumanus and the cardo," nor that it required a specific orientation. This concordance between written sources and archaeological data contradicts archaeoastronomical claims (such as those suggested by G. Magli in 2007, echoing Heinrich Nissen's 1869 theory) that insist on the ritualistic orientation of the decumanus (or cardo) to sunrise on a festival day.

A crucial distinction also needs to be made regarding the roles of Roman diviners. While G. Magli (2007) and Bertarione and Magli (2015) emphasize the Haruspices and link them to bird observations and the auguraculum, it is essential to remember that in Rome, it was the Augurs who were responsible for interpreting Jupiter's will from the flight of birds (aves) and overseeing the auguracula. The Augurs were also specifically tasked with matters concerning the pomerium; Romulus himself served as both King and Augur. Magistrates dealing with the urbs-ager boundary were subsequently assisted by Augurs. Our paper (https://papers.ssrn.com/sol3/papers.cfm?abstract_id=5166637) dedicates ample space to comparing the divinatory activities of Augurs and Haruspices, drawing on authoritative texts by Attilio Degraffi and Jerzy Linderski. Cicero's words highlight this distinction: "Quid enim scire Etrusci haruspices aut de tabernaculo recte capto aut de pomerii iure potuerunt?" (What could the Etruscan haruspices know about how the tabernacle is properly prepared and the law relating to the pomerium?).

The latter part of our discussion in the aforementioned paper also addresses the assertion by Bertarione and Magli (2015) regarding the auguraculum of Aosta being positioned near the Torre dei Balivi, which they also claim was the optimal point for land surveying by Roman mensores. This contradicts the choice of the Croce della Città for observing the winter solstice sunrise, further highlighting the disconnect between some archaeoastronomical claims and established Roman juridical-religious practices.

Ultimately, when certain archaeoastronomical approaches claim to date Roman towns through their orientation, they are essentially replicating the methodology Nissen employed in 1869 – a methodology that has since been subjected to extensive and well-founded scholarly critique regarding its foundational assumptions about Roman urbanism and ritual.

Magli, in the interview, is mentioning interdisciplinarity

YES, in the archaeoastronomy of the Roman World, the knowledge of Augural Laws is fundamental. Amelia Carolina Sparavigna studied it, and she is able of distinguishing augurs from haruspices. She has also studied the scholar literature about Dies Natalis. She has also studied the cases of the roman

towns, of which we know the Dies Natalis. Yes, she has also studied the constitution and dedication of Ara Pacis. <https://iris.polito.it/handle/11583/2985786> And in this case, let us stress a fundamental fact, that in 9 a.C., the roman civil calendar was differing of three days with respect the astronomical calendar (Polverini, 2016). Then, in the case of the Roman such as in the Greek world, we have differences between historical dates and solar dates. When Nissen published his book in 1869, Giulio De Petra, who was directing the archaeological museum of Naples, observed that it was interesting the comparison of the long axes of the temples with calendar festivals, but that the practical application was impossible, due to the use of luni-solar calendars.

My perspective underscores a crucial aspect of archaeoastronomy: its inherent interdisciplinarity. No single researcher can master every facet of ancient history, philology, and astrophysics simultaneously. Just as a theoretical physicist deeply understands abstract principles while an experimental physicist excels in laboratory execution, effective archaeoastronomy thrives on collaboration. It is precisely the convergence of diverse expertises – like physics and Egyptology, in the case of Giulio Magli – that allows for a comprehensive and robust understanding of complex ancient phenomena, facilitating dialogues that transcend traditional disciplinary boundaries and ultimately enriching our knowledge. We therefore appreciate the readiness of researchers like Professor Magli, a physicist, to engage with a field as vast and intricate as Egyptology, where navigating its complexities requires profound diligence to avoid pitfalls of interpretation and unfounded claims. Indeed, while respecting the profound depth of knowledge accumulated within specialized fields such as Egyptology, it is equally vital for scholarly progress to foster open dialogue. A genuine commitment to understanding the ancient world calls for embracing insights from diverse disciplines, recognizing that a truly comprehensive perspective often emerges from the integration of complementary expertise, rather than from a narrow adherence to traditional boundaries or the dismissal of external contributions.

It is indeed self-evident that a physicist, delving into ancient history, will necessarily have gaps in a discipline as vast and specialized as Egyptology; this is inherent to interdisciplinary work. However, a physicist brings a unique set of analytical competencies, particularly in mathematics—a fundamental symbolic language—which can prove invaluable for the rigorous comprehension of ancient symbols and systems. It is, paradoxically, more surprising to encounter a general disregard for mathematics within certain circles of humanistic studies today. In an era where mathematical understanding underpins fields from quantum mechanics to artificial intelligence, dismissing its foundational role in analyzing complex symbolic or structural systems appears to limit scholarly ambition. While criticism is readily offered, a deeper engagement with the methodological tools that drive modern scientific discovery often seems less appealing.

One should indeed appreciate the dedication of a physicist, whose primary passion arguably remains within the rigorous frameworks of physics—a conviction I hold regarding Professor Magli—to venture into aspects of Egyptology connected to celestial observations. While the formidable challenges of Egyptian philology are acknowledged, and Professor Magli is noted for addressing them, it remains a persistent concern that he continues to assert 'Akhet' is written with N27. I am, however, confident that the elegance of a metric tensor or a Cauchy integral would elicit a far more profound resonance for him. Conversely, while physics can independently advance without direct engagement with ancient Egypt, it is genuinely regrettable that a significant portion of the humanities largely refrains from engaging with STEM sciences, despite the fact that archaeoastronomy, by its very nature, is not exclusively a STEM discipline.

The Mastabat Fara'un: Pyramid or Mastaba?

In the May 2025 interview, Giulio Magli states: “Secondly, he [Shepseskaf] did not build a pyramid. He had an elaborate tomb made of carefully worked granite – 80-tonne lintels transported from Aswan, 800 km to the south, to be precise – but it was not a pyramid. It was more like a mastaba: of a lower, rectangular shape, typical of the tombs of officials. Although it was immense, formed of pyramid blocks and with the internal layout typical of pyramids, it did not have the symbolic value of the pyramid, which represented the ascent to heaven.”

This assertion is directly challenged by our recent research, particularly detailed in 'Orientation of Entrance and Burial Chamber in the Pyramids of the Egyptian Fourth and Fifth Dynasties' (arXiv:2503.22682) and 'King Shepseskaf and his Pyramid, the Mastabat Fara'un' (Zenodo:14845722). We contend that the Mastabat Fara'un, despite its rectangular base, exhibits clear architectural and symbolic continuity with the royal pyramids of its era.

Our analysis of Fourth and Fifth Dynasty funerary architecture reveals a consistent internal layout. Beginning with Snefru, the first Fourth Dynasty ruler, whose pyramid development (Seila, Meidum, Bent, and Red Pyramids) culminated in the Red Pyramid's substructure featuring a north entrance and an east-west oriented burial chamber. This specific orientation persisted throughout the Fourth and Fifth Dynasties, and beyond. The Mastabat Fara'un adheres to this architectural blueprint; its substructure is oriented consistent with Fourth Dynasty pyramids, and its internal layout is notably closer to that used by the subsequent Fifth Dynasty, demonstrating architectural continuity rather than a break. For comparative purposes, earlier burial monuments, such as the Sekhemkhet (Djoserty) pyramid of the Third Dynasty, are also examined. Our discussion in arXiv:2503.22682 also investigates the precise positioning of the sarcophagus (typically with a north-south axis) and the deceased king's body (lying on its left side, head to the north, face towards the east) within these structures, further emphasizing the continuity of funerary practices. In this framework, we also revisit our earlier findings from 2016 (arXiv:1604.05963) regarding the layout of pyramids with respect to sunrise on solstices, underscoring their astronomical significance.

Furthermore, the claim that the Mastabat Fara'un "did not have the symbolic value of the pyramid, which represented the ascent to heaven," is also inaccurate. In 'King Shepseskaf and his Pyramid, the Mastabat Fara'un' (Zenodo:14845722), we address the notion, sometimes propagated in media, that the solar cult ended with the Fourth Dynasty, supposedly due to a solar eclipse witnessed by Shepseskaf. On the contrary, the solar cult became dominant during the ensuing Fifth Dynasty, whose kings not only built pyramids but also dedicated solar temples. Crucially, despite popular media reports, no ancient Egyptian text refers to the 2471 BC eclipse, undermining any notion of its historical impact on cultic practices. Moreover, contemporary evidence unequivocally confirms the monument's classification: the Mastabat Fara'un was restored by Khaemwaset, the fourth son of Ramesses II, and an inscription from this restoration explicitly defined Shepseskaf's burial place as a pyramid. This historical designation, alongside its intricate internal layout and demonstrable astronomical connections, firmly establishes the Mastabat Fara'un as a royal pyramid in both form and symbolic intent, contradicting its dismissal as a mere "mastaba."

Let us emphasize that the designation of the Mastabat Fara'un as a "pyramid" is rooted in ancient Egyptian terminology, not merely the later Greek term. This identification is explicitly documented in the inscription by Khaemwaset, dating to the time of Ramesses II. Further details regarding the Egyptian name of Shepseskaf's monument and its corroboration in scholarly literature can be found in our work (<https://arxiv.org/pdf/2503.22682>). The name of the pyramid is also recorded on the Palermo Stone, further supporting its classification.

In his 2024 arXiv paper, Giulio Magli presents the "unprecedented and unequalled shape of the Shepseskaf tomb" as "really a mystery," adding that "A number of proposed solutions for this mystery is available, most of them being frankly very weak, or even untenable." He notably dismisses alternative opinions without providing specific references for these other views. Magli continues: "For instance, it has been proposed that it was a temporary backup for his own tomb while the king was finishing Menkaure's complex (Verner 2002) – but this blatantly conflicts with the raffinate interiors."

Magli's dismissal of Verner's hypothesis (Verner 2002) based on the "raffinate interiors" of the tomb is illogical. The interior (substructure) of any such monumental tomb, whether pyramid or mastaba, would inherently be constructed and finished before the external covering was completed. Therefore, the refined nature of the interior does not contradict the possibility of it serving as a temporary backup or a phased construction; indeed, Verner's opinion is perfectly consistent with standard Old Kingdom construction practices.

Furthermore, we possess direct textual evidence supporting the notion that Shepseskaf had to complete Menkaure's pyramid complex, before completing his tomb. As detailed by Vicky Almansa-Villatoro (2022), "The decree of Shepseskaf, shattered to fragments when Reisner found it in the Menkaure's pyramid temple, is one of the Old Kingdom decrees concerned with the exemption of a estate from being taxed by the central government. Moreover, the decree also states that Shepseskaf completed Menkaure's pyramid's complex, and that cultic activities would immediately follow. In this sense, Shepseskaf's decree can also be qualified as a foundational text inasmuch as it inaugurated a ritual complex and secured support to the community that would live there for multiple generations" (Almansa-Villatoro, 2022). This decree strongly supports the plausibility of Verner's interpretation regarding Shepseskaf's immediate focus on Menkaure's complex. Given the case of Menkaure who had died before the pyramid was finished, Shepseskaf opted for a faster worksite, in a place very close to a stone quarry, near the pyramid of Snefru. This is what Verner says in 2014.

Magli also states in his 2024 arXiv paper: "As far as the interior is concerned, I was granted several years ago by the Egyptian authorities (former SCA) of the permission of visiting it (the whole area is closed to the public) and I can testify that it is really a IV dynasty royal monument also inside." While we acknowledge Magli's personal testimony and the importance of direct observation, the intricate and refined nature of the Mastabat Fara'un's interior, fully consistent with a Fourth Dynasty royal monument, is also evident through publicly accessible visual documentation (please visit the following links).

<https://laciviltaegizia.org/2021/02/02/lamastabat-el-faraun/> ,

<https://web.archive.org/web/20250204155054/https://laciviltaegizia.org/2021/02/02/la-mastabat-el-faraun/> ,

<https://www.meretsegerbooks.com/gallery/451/shepseskaf-mastabafaraun> ,

https://isida-project.ucoz.com/egypt_mar_2013/saqqara_shepseskaf.htm ,

https://web.archive.org/web/20250204154520/https://isida-project.ucoz.com/egypt_mar_2013/saqqara_shepseskaf.htm

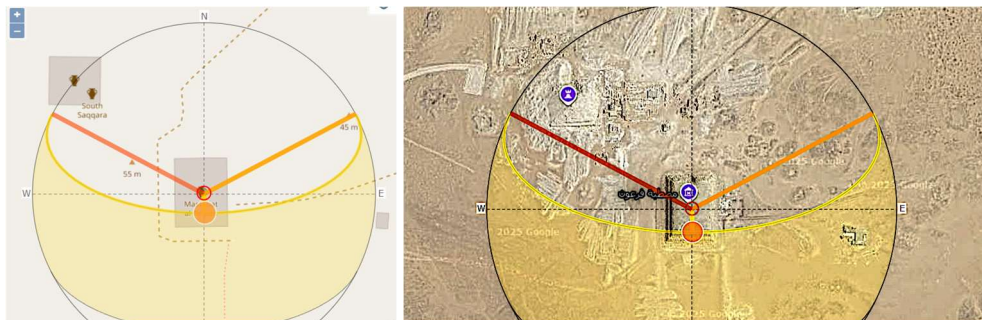
This last web site writes: "The interiors of the Mastaba resemble the internal structure of the pyramids, in particular the Userkaf pyramid in Saqqara." And "The internal structures of Shepseskaf Mastaba have granite masonry. In this connection there is another parallel - with ancient buildings. The internal rooms of Mastaba were made with the same technique and the same material as the Granite Temple in Giza."

It is crucial to emphasize that the conventional subdivision of ancient Egyptian history into distinct dynasties is a non-Egyptian concept, largely a retrospective construct for modern historical periodization, most notably derived from later sources like Manetho. From the perspective of an Egyptian king, and within their own political theology, each ruler was an integral element of an uninterrupted, singular, and divine lineage of kingship, ensuring the continuous and eternal nature of royal rule.

A Theory or a Fact? Unpacking Magli's Claims

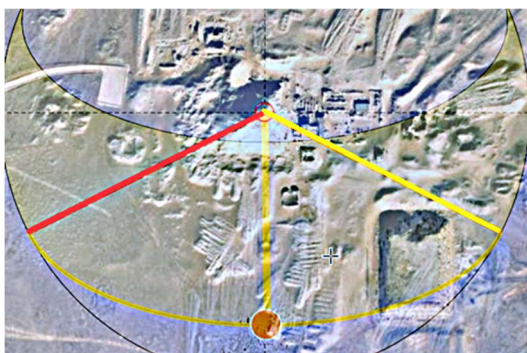
In the interview, Giulio Magli describes his assertion as "only a theory. We cannot know for sure whether this was indeed the case. But there is hope we can find confirmation of it." This statement is particularly striking given the interview's unequivocal title: "The eclipse that marked the end of the fourth Egyptian dynasty." The title presents the eclipse and its dynastic impact as an established fact, creating a significant discrepancy with Magli's later characterization of it as a mere hypothesis.

Magli also states his intention to be present "on 21 June, while the Polish archaeological mission to the Mastaba al-Faragun, the tomb of Shepsekhaef, is underway. I hope something will come of it." It's noteworthy that June 21st marks the summer solstice, a key astronomical event. Magli's planned presence on this date suggests an interest in archaeoastronomical observations, perhaps to capture the image of the sun setting near the Pepi II pyramid from the Mastabat Fara'un – a potential observational alignment that aligns with the very field he claims was conceived "in the late 1960s."



Pepi II pyramid and Mastabat Fara'un. <https://www.suncalc.org/#/29.8389,31.2153,17/2025.06.21/12:56/1/1>

<https://www.suncalc.org/#/29.8389,31.2153,17/2025.06.21/12:56/1/0> Sunrise and sunset on Summer Solstice. Shepseskaf can see the sunset, round the year. The view is not obstructed by the Pepi II pyramid. Sunrise and sunset directions given by Suncalc.org.



Sunrise and sunset on Winter Solstice. Pepi II can see the sunrise, round the year. Sunrise and sunset directions given by Suncalc.org.

Pyramids of Pepi II and Shepseskaf: Solstitial Alignments

Our recent work, "Orientation of Entrance and Burial Chamber in the Pyramids of the Egyptian Fourth and Fifth Dynasties" (arXiv:2503.22682), builds upon previous findings detailed in "Khufu, Khafre and Menkaure Pyramids and the Sun" (arXiv:1604.05963). In this recent discussion, we specifically focused on the tomb of King Shepseskaf, the Mastabat Fara'un.

After analyzing the substructure orientations of the Fourth and Fifth Dynasty pyramids, we demonstrated that the Mastabat Fara'un's substructure is oriented in a manner consistent with Fourth Dynasty pyramid architecture, while also exhibiting a layout that aligns closely with practices adopted by the subsequent Fifth Dynasty. Following a detailed review of scholarly literature, our 2025 work (arXiv:2503.22682) reiterates the astronomical significance of pyramid layouts, specifically their linkage to sunrise on solstices. This includes a notable alignment between the pyramids of King Pepi II (Sixth Dynasty) and King Shepseskaf (Fourth Dynasty) with the sunset of the summer solstice.

In my 2016 paper, <https://arxiv.org/abs/1604.05963>, I discussed the astronomical orientation of the Giza pyramids using specialized software. This analysis revealed that the pyramids of Khufu and Khafre were meticulously positioned. From each of these pyramids, it was consistently possible to observe the precise points on the horizon where the sun rose and set throughout the entire year.

This deliberate orientation extended to the internal layout of the burial chambers. The sarcophagus was invariably placed with its axis aligned north-south. The deceased king's body was typically laid on its left side, extended, with the head positioned to the north and the face oriented towards the east. This specific alignment ensured the king was perpetually looking towards the sunrise, regardless of the time of year.

The orientation of the pyramids relative to the sun, which I have shown earlier through simulations, has its roots in a discussion proposed by Magli (pre-2016, arXiv), which in turn originated from a 1985 article by Mark Lehner. Mark Lehner continued to present his theory in his text, *The Complete Pyramids*, where we can read:

“At the summer solstice the sun sets in the same place on the horizon for three days before its setting position begins to move back towards the south again. During those three days, viewed from the Sphinx Temple, it sets mid-way between the two largest Giza pyramids. Whether by chance or by design, the pattern this form is the hieroglyph for horizon, akhet, the sun between two mountains, writ very large indeed across the Giza skyline. Akh meant ‘to glorify’; akhet was ‘the place of glorification where the sun sets’ and also a circumlocution for ‘tomb’. Akhet, or horizon, was the name given to the Great Pyramid of Khufu and, in certain textual contexts, also to the entire Giza necropolis.”

Lehner told previously: “The names of pyramids show that they were perceived as places of ascension and transformation. Khufu’s was Akhet, the ‘Horizon’, of Khufu. Built on the word akh, the name signified not just the horizon but the ‘radiant place’ of glorification. ... Akhet is usually translated as ‘horizon’, where land and the skies touch, but it meant much more in the Egyptian world concept. Written with the same root as the word akh, the Akhet was where the dead were transformed into effective inhabitants of the world beyond death. As part of the sky, it was also the place into which the sun, and therefore the king, was reborn from within the Duat. It is not hard to imagine the early Egyptians being inspired by the pre-dawn glow in the

eastern horizon, and by the sunset flaming in the west, to see the area just below the horizon as the place of glorification.”

Mark Lehner, an Egyptologist, is here highlighting the significance of the solstice and, moreover, links the solstice to a specific form of the hieroglyph used to write Akhet. It is notable that Mark Lehner is an Egyptologist, and Giulio Magli, a physicist, has drawn upon an Egyptologist's insights in this regard. Indeed, Magli continues to present the Lehner's concept of Akhet in his archaeoastronomical discussions, as evidenced by his recent lectures.

<https://www.facebook.com/step2thefuture/videos/forse-non-conosci-ancora-larcheoastronomia-ma-dopo-aver-sentito-lastrofisico-giu/1361326008446561/>

However, in his book, Lehner tells that “Khufu's pyramid was Akhet Khufu. Here, and in the Pyramid Texts, *Akhet is written with the crested ibis and elliptical land-sign, not with the hieroglyph of the sun disk between two mountains that was used later to write 'horizon'*. As the place where the deceased becomes an akh, a suggested translation is ‘Spirit’ or ‘Light Land’”.

The Calendar and its Astronomical Implications

Pierre Tallet and Gregory Marouard are archaeologists most known for their work at Wadi al-Jarf, a site on the Egyptian Red Sea coast, where they discovered a significant collection of papyrus fragments, including the Diary of Merer (in it, Akhet Khufu is written with the crested ibis). The Diary of Merer reveals the Egyptian calendar structure, consisting of 12 months of thirty days each. Each month is divided into three ten-day periods, and the months are organized into three seasons of four months each. The calendar used by Merer, as evident from an article by Pierre Tallet, incorporates five epagomenal days, which are added to the 360 days organized into the twelve months.

This is the Egyptian 'civil' calendar, which was used for administrative purposes and was known as a wandering calendar. It is termed 'wandering' because, lacking a leap year, it is not anchored to the solar year; consequently, the seasons do not remain synchronized with the astronomical seasons. This has often led to the conclusion that solstices and equinoxes therefore did not hold the same significance for the Egyptians as they do for us today. However, our contemporary timekeeping is dictated by the reform of the lunisolar calendar initiated by Julius Caesar, corrected by Augustus, and subsequently refined into the Gregorian calendar. Simultaneously, it is evident that lunar calendars remain very alive in human society.

Regarding the literature on the Egyptian calendar, I extensively discussed it in my 2024 paper, specifically concerning the Diary of Merer. My objective, as a physicist, was to disseminate the discovery of these papyri and what represents the earliest written form of the Egyptian calendar. And, I emphasize, I did so with the utmost care to consult the scholarly literature regarding the Egyptian calendar. Indeed, in that November 2024 work, <https://arxiv.org/abs/2411.08061>, I did not merely report the news. I sought to understand how this calendar measured time in a way very similar to our 365 days, but I also highlighted that its division into three seasons, rather than our four, led to a distinct *forma mentis* regarding the segmentation of time.

The complexities of the ancient Egyptian calendar are often discussed, with insights from prominent archaeoastronomers such as Juan Antonio Belmonte. In a December 2024 article from LiveScience (<https://www.livescience.com/archaeology/ancient-egyptians/how-did-the-ancient-egyptians->

[celebrate-the-new-year](#)), we find a summary of these key aspects, informed by Belmonte's extensive research and publications on the subject. His work suggests that the Egyptians primarily operated with a single civil calendar throughout most of their history, prior to Hellenic influence. The key aspects of his views include: a) the civil calendar comprised 12 months of 30 days each, organized into three seasons, b) he acknowledges the civil calendar's "wandering" nature, meaning it was not anchored to the solar year due to the absence of a leap year, and c) Belmonte contends that the overall Egyptian calendrical system is "simpler than usually maintained," expressing skepticism about the significant role of lunar calendars outside of specific feasts.

As previously mentioned, the Wadi al-Jarf papyri showcase the civil calendar. Specifically, Papyrus H, studied by Tallet (2017) in his work 'Du pain et des céréales pour les équipes royales: Le grand papyrus comptable du ouadi el-Jarf (papyrus H),' explicitly details the five epagomenal days. Despite this striking discovery—that the papyrus presents the earliest written evidence of the Egyptian civil calendar—in their 2023 book, 'Astronomy of Ancient Egypt,' Belmonte and Lull discuss it as follows: mentioning Tallet and Lehner (2021), Belmonte and Lull merely state that surprises are always possible, as “demonstrated by the recent discovery of papyrus fragments of Khufu’s pyramid accountancy in a barren spot of the Red Sea coast (Tallet & Lehner, 2021)”. No further detail is provided regarding the calendar's specifics. The “barren spot” is Wadi al-Jarf, which hosted the artificial harbor of Khufu, where phyles linked Egypt to Sinai.

Belmonte has also contributed to research on the astronomical orientations of ancient Egyptian temples and other structures. On the portal <https://web.astronomicalheritage.net/> , we find a picture of the “winter solstice sunrise at Karnak, showing the alignment hierophany as it appears today and the precision of the original alignment in c. 2000 BC, when the winter solstice sun rose about one solar diameter further to the right. (Photograph © Juan Belmonte)”. This brings us back to the previously alluded problem, relevant to Lehner, Magli, and ultimately to the simulations now proposed. Given that the Egyptians had a calendar not anchored to the sun, and therefore also not anchored to the heliacal rising of Sirius, how then can we truly assess the importance of solstices and equinoxes for them? While it is natural for us to have a calendar where seasons commence with equinoxes and solstices, this was not the case for the ancient Egyptians.

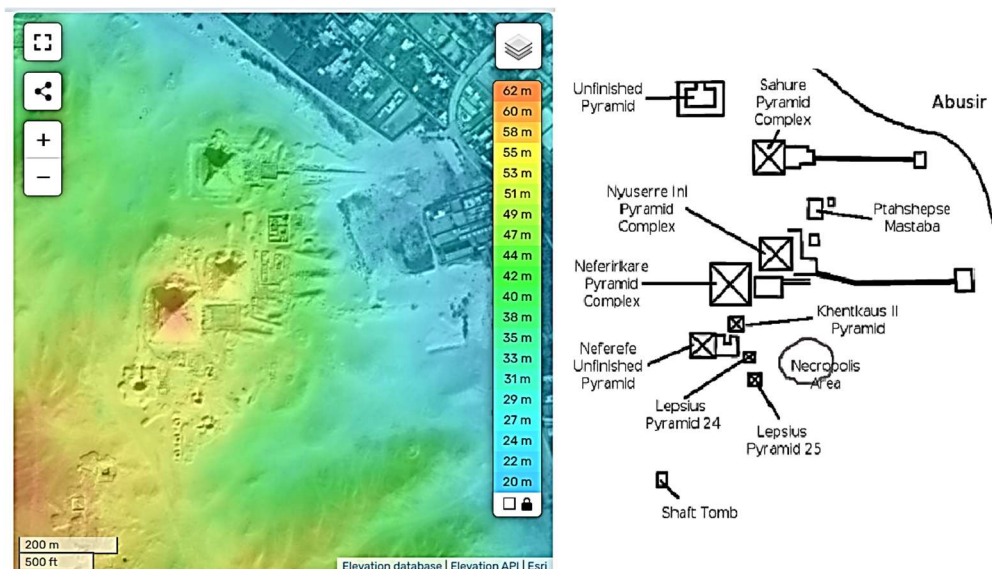
Regarding ancient calendars and seasons, as noted by Varro, the Romans did not delineate seasons based on solstices and equinoxes either; instead, their seasonal divisions were anchored to astronomical phenomena occurring approximately on what are known as 'cross-quarter days.' Varro highlights seasons linked to astronomical phenomena (Appendix), but the Roman calendar itself was lunisolar before Julius Caesar's reform. In this instance too, astronomical seasons were not strictly tied to the calendar, though it's important to note this period is considerably later than the time of Merer's Diary. A remnant of this Roman practice can still be found in popular proverbs, for instance, in sayings that link the end of winter to Candlemas.

Therefore, while the characteristics of the Egyptian civil 'wandering' calendar are well-established and accurately described – illustrating a system adapted for administrative regularity rather than strict astronomical alignment – it is a demonstrably incomplete interpretation to conclude that fixed astronomical events held no profound significance for ancient Egyptians. Such narrow focus fails to account for the body of evidence derived from architectural alignments, which attest to a possible ritualistic engagement with celestial cycles. The insistence on divorcing observational astronomy from cultural meaning, based solely on the civil calendar's drift, overlooks the multifaceted nature of ancient Egyptian timekeeping and worldview (I am referring to the Sothic cycle). A truly comprehensive analysis necessitates acknowledging the interplay between these different systems,

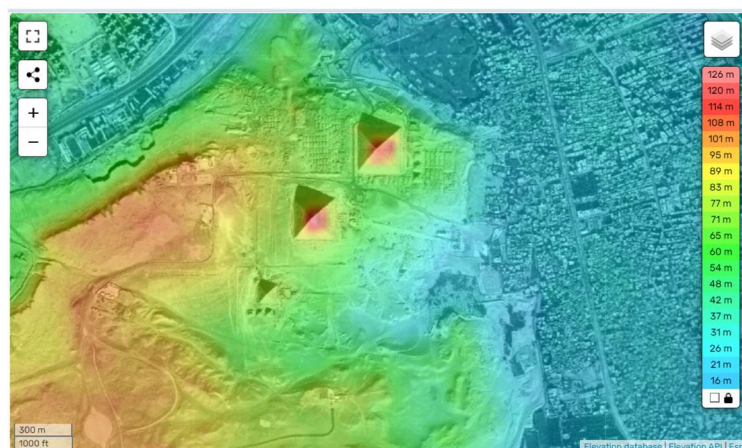
rather than allowing the properties of one to negate the undeniable evidence of others, as illuminated by current archaeoastronomical research.

It is certainly not within the scope of this work to deny the relevance of archaeoastronomy for the study of ancient Egypt. Rather, if Egyptology as a discipline finds itself struggling to fully reconcile the evident architectural alignments—explicitly highlighted by leading Egyptologists such as Mark Lehner—then, even acknowledging the inherent interdisciplinary complexities and occasional internal debates within archaeoastronomy itself, the onus is on the field itself to provide a coherent explanation for these precise orientations. To simply dismiss such robust empirical evidence, which stems directly from recognized scholarship within their own discipline, demands serious introspection rather than simple dismissal.

Returning to pyramids, here in the following the TessaDEM satellite elevation maps, which show how the pyramid builders adapted the structure to the elevation terrain.



On the left, TessaDEM elevation map Courtesy <https://it-it.topographic-map.com>, on the right a map Courtesy to Commons by Maksim. https://commons.wikimedia.org/wiki/File:Abusir_map.png. Then, let us conclude by showing the case of Giza.



TessaDEM, Courtesy <https://it-it.topographic-map.com/>

Shepseskaf likely chose his burial site due to the limited space available near Khufu's pyramid. He opted for an open area closer to Snefru's Bent and Red Pyramids, which also offered his builders the opportunity to expand the perimeter of the burial site. This understanding of Shepseskaf's decision is not merely our interpretation but aligns with the prevailing consensus among Egyptologists.

Shepseskaf's Burial Site: A "Deliberate Break from the Norm"?

In the interview, Giulio Magli states: "Thirdly, he [Shepseskaf] chose a very special place. His predecessors before him used to build their tombs on the west bank of the Nile (where the sun sets and the dead come together to rise), looking towards the temple of the Sun at Heliopolis. He, instead, decided to build it on a site to the south, at Saqqara, from which Heliopolis, the sacred and symbolic landmark of the entire Fourth Dynasty, could not be seen. It was a deliberate break from the norm." This assertion prompts a critical examination of what constitutes this purported "norm" regarding pyramid alignment and the visibility of Heliopolis.

Heliopolis, as described by various sources, was indeed a major ancient Egyptian city and a significant cult center for the god Atum/Ra. The concept of "Pyramid Alignment Towards Heliopolis" suggests that many Fourth and Fifth Dynasty pyramids were positioned with their corners aligned towards this city. This theory, initially proposed by Hans Goedicke in a newspaper in 1983 and not in a peer-reviewed journal, has been perpetuated by various Egyptologists (including Mark Lehner and Kate Spence) and archaeoastronomers (such as Juan Belmonte and Giulio Magli) who claim a "Giza Diagonal" symbolically connected the Giza pyramids to Heliopolis (Bauval, 2013). Joseph Hekekyan (1852) had also noted a diagonal alignment from the Great Pyramid's apex extending towards the Sesostri I obelisk at Matareya-Heliopolis.

However, the notion of a consistent and deliberate "norm" of pyramid alignment towards Heliopolis does not withstand serious scholarly scrutiny. As Bauval (2013) extensively discusses, theories such as the "Giza diagonal" (where the southeast corners of the three Giza pyramids purportedly form a diagonal leading to Heliopolis) and the idea that Khufu and Khafre's pyramids were designed to represent the hieroglyph N27 present significant problems and do not hold to serious scrutiny. Our own work (arXiv:2412.20407; Zenodo:14587114, "The Egyptian Hieroglyph of the Crested Ibis...") has already addressed the N27 theory, emphasizing that 'Akhet Khufu' is written with the crested ibis (G25), not the N27 sign, thereby fundamentally challenging the proposed symbolic link.

Furthermore, Nell and Ruggles (2014) explicitly highlight "several problems with this hypothesis." While Magli has, among others, extended this "master plan" concept to pyramids at Saqqara, Abu Sir, and other sites, linking them to Heliopolis via corner alignments, Nell and Ruggles (2014) critically point out that "the view of Heliopolis from Abu Sir was obstructed: those standing at Abu Sir could not even see the 'Sun City' [Heliopolis]." They also identify "familiar problems of selection," observing that the putative alignments involve different corners (e.g., NW corners for Teti's and Semerkhet's pyramids, SE corners for Userkaf's and Djoser's, and a complete diagonal for Unas') across various necropolises, which undermines the consistency and methodological rigor of the proposed "norm." The TessaDEM satellite elevation maps can further illustrate the physical limitations of sightlines in the region.

Given these substantial criticisms and the demonstrated lack of consistent evidence across various sites and orientations, it becomes clear that the "norm" of pyramid alignment towards Heliopolis, as

presented by Magli, is unsubstantiated by prevailing scholarly consensus. Therefore, Shepseskaf's strategic choice of burial site cannot logically be interpreted as "a deliberate break from the norm," as such a pervasive and consistently applied norm appears not to have existed.

The Giza Diagonal and the 'Akhet Khufu' Hieroglyph: A Persistent Misinterpretation

Giulio Magli continues to advocate for the "Giza diagonal" theory, which, while deemed plausible by some, remains unproven. Concurrently, he asserts that the two main Giza pyramids, Khufu's (Cheops) and Khafre's (Chefren), were part of a single project by Khufu designed to monumentalize the 'solarized horizon' (Gardiner N27) hieroglyph on a massive scale, thereby realizing the "Akhet Khufu," or "Khufu's horizon."

However, direct textual evidence provides absolute certainty that the symbol used for Khufu's pyramid name during his reign was Gardiner G25. The term 'Akhet' is indeed written with the crested ibis hieroglyph (G25) from Gardiner's list, which translates to 'spirit,' 'brightness,' or 'glory,' not with the 'sun on the horizon' symbol (Gardiner N27). This certainty stems from the contemporaneous Wadi al-Jarf papyri, discovered in 2013 by Pierre Tallet and Gregory Marouard, where the pyramid's name is clearly and unequivocally written with the crested ibis. Despite this conclusive evidence, Magli persists in rendering "Akhet Khufu" as "Khufu's horizon," aligning it with the N27 symbol. This interpretation is particularly perplexing, given Magli's explicit claim in the interview: "I also learned to read hieroglyphs, for example," suggesting a basic familiarity with the script that would clarify the distinction between G25 and N27.

Furthermore, even prior to the discovery of the Wadi al-Jarf papyri, inscriptions in the Giza necropolis already indicated that 'Akhet' was written with the crested ibis. Interestingly, in 2014, when responding to a comment by Bauval (2013)—though notably without citing him—Magli asserted that such existing evidence was insufficient and demanded proof from a text contemporary with Khufu. That precise text now demonstrably exists in the Red Sea Papyri. Yet, despite having obtained the very contemporary proof he once demanded, Magli continues to maintain his interpretation based on N27. This highlights a critical inconsistency in his engagement with primary source evidence and established philological data.

Disputed Symbolism: The 'Akhet Khufu' Hieroglyph and Scholarly Interpretations

Mark Lehner, in 1985, notably posited that "a dramatic effect is created at sunset during the summer solstice, viewed... from the eastern niche of the Sphinx Temple. At this moment, and from this viewpoint, the sun sets almost exactly halfway between the pyramids of Khufu and Khafre, thus interpreting the image of the hieroglyph Akhet for 'Horizon' on an acres scale." Significantly, Lehner later revised his position (1997). Acknowledging that 'Akhet' is not written with Gardiner N27 but with G25 (the crested ibis), he subsequently proposed the philologically corrected translation of 'Akhet Khufu' as "the place where the king (Khufu) becomes an Akh (luminous spirit)."

Despite this clarification by a leading Egyptologist, Giulio Magli has consistently maintained the N27 interpretation. An article in *Corriere della Sera* from 2007, written by Magli, visually depicts the sun setting between Khufu's and Khafre's pyramids, with a decorative version of the Gardiner N27 symbol conspicuously inserted above the sun and between the two structures. Magli continues this assertion even in his 2024 writings, stating that "Khufu will indeed build his pyramid on the Giza plateau... and will make an explicit reference to sun worship with the spectacular hierophany that occurs at Giza at

the summer solstice, recreating the 'solarized' version of the two-mountain sign, Akhet," which he identifies as Gardiner N27.

The significance of the Wadi al-Jarf papyri, which definitively confirm the G25 spelling, cannot be overstated. Mark Lehner himself has publicly stated that this discovery was the most exciting moment of his career as an Egyptologist, and he subsequently co-authored a book with Tallet, underscoring its pivotal importance to the field. For Magli to continue with the N27 interpretation effectively dismisses this groundbreaking discovery and the updated scholarly understanding it provides. We have thoroughly critiqued Magli's 'single project' theory for Khufu, including this aspect, in our work (<https://zenodo.org/records/15105280>).

For Akhet, even acknowledging the nuances that Lehner discusses (and how 'Akhet Khufu' remains untranslated in his work with Tallet, 2021, instead of the usual 'horizon of Khufu'), the crucial point, reiterated here, is that the symbol consistently used is the crested ibis, not the solarized horizon. This fundamental distinction, clearly attested in the iconographic and textual record, is foundational for any accurate interpretation of Egyptian symbolism, making its persistent misunderstanding particularly puzzling for those who claim expertise in the field.

Akhet is usually translated as 'horizon', where land and the skies touch, but it meant much more in the Egyptian world concept. Written with the same root as the word *akh*, the *Akhet* was where the dead were transformed into effective inhabitants of the world beyond death. As part of the sky, it was also

This is Akhet, according to Mark Lehner.

Clarifying the Translation of 'Akhet'

It is important to clarify a misunderstanding regarding the translation of 'Akhet'. I have never asserted that 'horizon' is an incorrect translation for 'Akhet'. In fact, the polysemic nature of this hieroglyph, capable of conveying multiple meanings, has been thoroughly demonstrated by scholars such as Mark Lehner. My critique, rather, has consistently focused on the incorrect use of the Gardiner N27 hieroglyph to represent 'Akhet' in the name 'Akhet Khufu'. This is a distinct philological point. While I leave the intricate philological subtleties to experts like Giulio Magli—who has publicly stated his specific interest in hieroglyphs—my emphasis has been on the factual certainty that 'Akhet Khufu' is written with the G25 (crested ibis) hieroglyph, not N27. This is a crucial distinction, as the contemporary evidence from the Red Sea papyri unequivocally confirms the G25 spelling for the pyramid's name.

Conclusion

The preceding examination has meticulously detailed discrepancies between the interview's claims and the wealth of established Egyptological and archaeoastronomical research. Whether concerning the true genesis of archaeoastronomy, the specific naming conventions of pharaonic monuments, the interpretation of ancient calendars, or the proposed 'Giza diagonal' and its links to Heliopolis, a recurring disregard for documented facts and existing scholarly critiques becomes apparent. It is imperative that academic discourse prioritizes factual accuracy and acknowledges the contributions

of all researchers who rigorously strive to illuminate the past, rather than perpetuating interpretations that stand in stark contrast to the available evidence.

Appendix: Julian Calendar and Egyptian Wandering Calendar

Roman scholar Marcus Terentius Varro described the Roman seasons starting on ‘Cross Quarter’ days rather than the ‘Quarter’ days we use today.

[https://penelope.uchicago.edu/Thayer/E/Roman/Texts/Varro/de Re Rustica/1*.html](https://penelope.uchicago.edu/Thayer/E/Roman/Texts/Varro/de_Re_Rustica/1*.html)

"28.1. The first day of spring occurs [when the sun is] in Aquarius, that of summer when it is in Taurus, of autumn when it is in Leo, of winter when it is in Scorpio. As the twenty-third day of each one of these four signs is the first day of the four seasons,⁷³ this makes spring contain 91 days, summer 94, autumn 91, winter 89, which numbers, reduced to the official calendar now in force,⁷⁴ fix the beginning of spring on February 7, of summer on May 9, of autumn on August 11, of winter on November 10. 28.2 But in the more exact divisions certain things are to be taken into account, which cause an eightfold division: the first from the rising of the west wind to the vernal equinox, 45 days, thence to the rising of the Pleiades 44 days, thence to the solstice 48 days, thence to the rising of the Dog Star 27 days, thence to the autumnal equinox 67 days, from there to the setting of the Pleiades 32 days, hence to the winter solstice 57 days, and back to the rising of the west wind 45 days."

⁷³ i.e. the beginning of each of the four seasons is the twenty-third day after the sun enters the

⁷⁴ The Julian calendar, which took effect on January 1st, 45 B.C., eight years before this was written.

Let us note that in Varro's text, the winter solstice is 'bruma' (quod brevissimus tunc dies est), whereas the summer solstice is 'solstitium dies'.

While modern understanding places start the four seasons at the solstices and equinoxes, ancient Romans and other past civilizations did not calculate seasons in the same way. Nevertheless, these astronomical points held significant importance. Fortunately, authors like Varro and Pliny the Elder documented their conception of seasonal changes. These shifts typically occurred approximately halfway between the equinoxes and solstices, often coinciding with the heliacal rising or setting of constellations such as the Pleiades (known as Vergiliae) or Lyra. According to these ancient references: 1) Spring began around February 7th or 8th. 2) Summer began around May 9th or 10th. 3) Autumn began between August 10th and 11th. 4) Winter began between November 10th and 11th. Minor discrepancies between authors are attributed to the fact that their works were separated by about a century, during which these dates slightly shifted within the calendar (Marqués, 2019). Ultimately, Marqués states that solstices and equinoxes began to be considered the start of the seasons (rather than their midpoint) around the 4th century BCE, and this convention has persisted to the present day.

The text written by Marqués highlights that the ability to make precise calculations linking seasons to the calendar was significantly enhanced by the institution of the Julian Calendar (45 BCE). This reform provided a robust framework that allowed for the easier alignment of natural cycles (astronomical seasons) with civil ones (the calendar). Crucially, the text points out that even after the Julian Calendar reform, and certainly before it, not everyone adhered strictly to astronomical definitions. For those who prioritized meteorology and practical observations over precise celestial calculations, seasonal changes were perceived as occurring a bit later than the astronomical points. These dates were often less rigidly fixed, perhaps because extreme precision was neither possible nor

deemed important for their everyday lives and agricultural practices. This underscores the idea that the "start of a season" was not a monolithic concept for all people in ancient times.

The shift to solstices and equinoxes as official season beginnings reflects an increasing sophistication in astronomical observation and the development of more precise calendrical systems (like the Julian Calendar). However, the lingering influence of weather-based or traditional "cross-quarter" definitions, even after calendrical reforms, highlights the enduring practical and cultural significance of these more experiential markers of time. It's a clear example of how scientific understanding gradually overlays, but doesn't always completely erase, deeply ingrained cultural practices and observations.

We have mentioned in the text the Egyptian Wandering Calendar (*Annus Vagus*)

As highlighted by Depuydt, prior to the invention of writing (in the fifth and fourth millennia BCE), the calendar of daily life in Egypt was based on the lunar calendar (in one or more of its variations). The invention of writing, in the early third millennium BCE, coincided with the creation of a new calendar, independent from the moon:

"Before writing, in the fifth and fourth millennia BCE, the calendar of daily life in Egypt was the lunar calendar in one or more of its possible variations. Sometimes early in the third millennium, writing was invented. Also invented around the same time was a calendar that was independent from the moon. It was inspired by the lunar calendar as the lengths of its months show. The new calendar consisted of 12 months of 30 days and 5 epagomenal days for a total of 365 days. This simple calendar, now known as the civil calendar, became the calendar of daily life for the entire course of the Egyptian history. Being 365 days long, it was designed to run parallel to the solar year. But because it was about a quarter day shorter, it wandered in relation to the solar year" "At the same time, in spite of the dominance of the civil calendar, there was always lunar time reckoning. But the lunar calendar, once the popular calendar of Egypt in the prehistorical period, was now reduced to the role of a religious calendar and restricted mainly to life in the temple" (Depuydt, 1997, *Civil calendar and Lunar calendar in Ancient Egypt*).

This 365-day civil solar calendar, composed of 12 months of 30 days each, plus 5 "epagomenal" (or intercalary) days added at the end of the year, became the primary calendar throughout Egyptian history. We have the first written evidence of this calendar in the Red Sea papyri. While a remarkable innovation for its time and very close to the true solar year, this structure had a fundamental flaw: it did not include a leap day.

Because the true solar year is approximately 365.25 days, the Egyptian calendar lost about a quarter of a day each year. This meant that, over time, the start of the civil year and fixed calendar dates progressively shifted relative to actual astronomical and seasonal events. For example, a festival falling on a certain civil calendar date in one year would, after 4 years, fall one day earlier in relation to its astronomical/seasonal position. This complete cycle of "wandering" (i.e., the time it took for a civil calendar date to realign with the same astronomical point) lasted approximately 1460 years, a period known as the Sothic cycle (named after the heliacal rising of the star Sirius, *Sopdet* in Egyptian).

Unlike the Romans, who, as we've seen, had an agricultural conception of seasons that often coincided with "cross-quarter days" but gradually moved towards astronomical points, the Egyptians had a seasonal system much more tied to a specific and vital natural phenomenon: the Nile floods. The Egyptian civil calendar was divided into three seasons of four months (120 days) each, with names

reflecting the Nile cycle and associated agricultural activities: 1) Akhet (Inundation): The season of the Nile flood, when fields were submerged and fertilized by silt. It corresponded approximately to our months of July-November, but due to the wandering calendar, this correspondence shifted over time. It was a period of forced "rest" from agriculture, during which peasants might be employed in public works (e.g., monument construction). 2) Peret (Emergence/Growth): The season when the waters receded, leaving fertile silt, and cultivation and crop growth proceeded. It corresponded approximately to our months of November-March. 3) Shemu (Harvest/Low Water): The harvest season, when the Nile was at its lowest level. It corresponded approximately to our months of March-July. Therefore, solstices and equinoxes as fixed markers of seasons are absent.

Unlike the Greeks and later the Romans (with the Julian Calendar), the Egyptian civil calendar did not fix the start of seasons to solstices or equinoxes. Their conception was primarily phenological and practical, directly linked to the hydrological cycle of the Nile, which was the essence of their agriculture and survival. The fact that the civil calendar was not perfectly synchronized with the solar year (and thus with the actual Nile flood) created a progressive misalignment. While the nominal season of Akhet always began on the same civil calendar day, the actual Nile flood did not always coincide with that date, due to the calendar's drift. This meant that, at times, the "inundation season" on the calendar might fall during a period when the Nile had not yet flooded or had already begun to recede.

A crucial element for the Egyptians was the heliacal rising of Sirius (its first appearance at dawn before the sun, after a period of invisibility). This astronomical event was of great importance and, for a long time, quite closely coincided with the beginning of the Nile flood. It was considered a reliable marker for the start of the agricultural year. However, even this alignment slowly drifted out of sync with the civil calendar precisely because of the "wandering calendar."

It's important to note that, according to some scholars, the Egyptians often maintained more than one calendar in simultaneous use. Alongside the 365-day civil calendar (used for administration, taxes, and daily life), they had a lunar calendar (often used for religious festivals) which, through the occasional intercalation of a thirteenth month, maintained a closer alignment with the actual agricultural seasons, though it was more difficult to manage for long-term administrative purposes. However, in Stern, 2012, we can find told that "A frequent model in the study of ancient calendars is that of the dual (or multiple) calendar, which posits the coexistence of two or more calendars in any given society, typically a 'civil' and a 'religious' calendar". The origin of this terminology seems to be in Censorinus (third century CE). "But the contrastive pairing of 'civil' with 'religious' is most likely the product of early modern scholarship, and as most ancient historians would now acknowledge, an anachronism". "More importantly", the hypothesis of concurrent calendars "is in many cases not grounded on any evidence, but only an awkward purpose-made solution to apparent inconsistencies in the primary sources". "The dual or multiple calendar model" "has been invoked by modern scholars in the context of just about every ancient society", that is, in Egypt, Mesopotamia, Israel and Judaea, Classical and Hellenistic Greece (Stern, 2012).

"Another well-established belief in ancient calendar studies is that modern astronomy can enable the date of institution of ancient calendars to be precisely worked out. Accordingly, the institution of the Egyptian civil calendar has been dated precisely to 2781–2778 BCE, when modern astronomy tells us that the Egyptian New Year coincided with the heliacal (late morning) rising of the star of Sothis" (Stern, 2012). "Related to these astronomical arguments is what I [Stern] would call 'scientific reductionism', which consists in reducing ancient calendars (and hence their study) to a purely scientific discipline. Fostered by a nineteenth-century tradition of handbooks of so-called

mathematische und technische Chronologie, [and Stern is mentioning in a note Ideler and Ginzel] this approach assumes that calendars were constructed and regulated on the sole basis of scientific, especially astronomical and mathematical, knowledge, and hence that their development was driven by scientific progress” (Stern, 2012).

“The inaccuracy of the Egyptian civil calendar as a solar calendar was evident to Egyptian astronomers and could easily have been corrected with the insertion of an additional day every four years, as in fact was proposed in the mid-third century BCE in the decree of Canopus; but” the Egyptian calendar remained “unchanged for several millennia, until the arrival of the Romans”, and Romans acted “for political rather than astronomical reasons” (Stern, 2012).

“The Egyptian calendar was probably the simplest calendar of the ancient world. In contrast to the irregular, unpredictable calendars of Babylonia and Greece, ***it was regular, changeless, and fixed.*** Its structure was almost completely uniform: all months were of 30 days, and all years of 12 months. The only anomaly was the addition of 5 days (the ‘epagomenal’, i.e. additional, days) at the end of each year, so as to bring its total length to 365 days” (Stern, 2012). “The average or approximate solar year-length of 365 days is not very difficult, empirically, to work out, hence not much of an intellectual feat” (Stern, 2012). The Egyptian calendar has not an equivalent of the present leap years and therefore “this calendar drifted away from the solar year by one day every four years. The excessive praise that is commonly bestowed on this calendar, by Nilsson as well as other scholars, reflects to some extent a modern bias. The modern attraction to the Egyptian calendar is partly due to its structural and functional similarity to the present-day Gregorian calendar ... This, however, is no historical accident, as the origins of the Gregorian calendar go back to the Egyptian” (Stern, 2012)

“The civil calendar was extremely ancient, as evidence goes back to the third millennium BCE; but its origins are shrouded in mystery. On the one hand, the subdivision of its year into 30-day periods (‘months’) suggests that the calendar may have been originally lunar, ... the addition of five epagomenal days would have represented an attempt to bring this calendar in line, albeit approximately, with the solar year. On the other hand, the Egyptian names of months suggest that this calendar may have been originally seasonal. ... It is also possible that the calendar originally combined both features, i.e. lunar months, but with a system of intercalation that maintained these months in the same seasons. In the absence of evidence, the question remains open” (Stern, 2012).

More excerpts from Stern’s book in my <https://arxiv.org/abs/2411.08061>, November 2024. In this ‘Timekeeping at Akhet Khufu, as shown by the Diary of Merer’, the reader can find references to other scholar texts about the wandering calendar. Moreover, the calendar applied to the Merer’s Diary is evidenced.

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