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Featured Article

A Computer-Aided Interpretation of the Nabta Playa Stone Circle

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Abstract

The Nabta Playa stone circle is located approximately 100 km west of Abu Simbel in southern Egypt. The site features stone alignments that a record of UNESCO World Heritage Convention merited as having "hypothetical solar and stellar alignments." These alignments are said to indicate the rising of certain stars and the approximate direction of summer solstice sunrise. Doubts followed this assertion alleging the spaces between the pairs of stones in the gates are a bit too wide or too short for accurate calendar measurements. Lack of plausible interpretation of the alignments reinforced the doubt. In this paper, we present a credible computer-aided interpretation of the stone configurations, which showed remarkable similarity to the ancient Eastern Cushitic calendar discovered in 1978 at Namoratunga II, northern Kenya.

Introduction

Located in the Western Desert of southern Egypt, Nabta Playa is a unique archaeological site offering remarkable insights into the lives and intellectual achievements of prehistoric African populations. Dating back to the early Neolithic period (circa 7500 BC), the site predates Stonehenge by several millennia and provides compelling evidence of structured settlements and advanced astronomical knowledge, challenging conventional narratives about the origins of complex societies and early astronomy [1].

The site comprises numerous tumuli (burial mounds), stelae, and megalithic structures spread across a broad area [2]. Among its most notable features is the "calendar circle," a ring of stones aligned with significant celestial events.

Nabta Playa's occupation history is closely tied to episodic periods of increased rainfall in the Sahara [3]. These climatic shifts transformed the arid desert into habitable land with seasonal lakes and grasslands, allowing intermittent human settlement. Around 9,000 years ago, settlements expanded, featuring huts, hearths, and wells. This period also likely saw the early domestication of goats and sheep. Between 8000 and 7000 years ago, a series of droughts led to site abandonment [4]. The calendar circle and other megalithic structures were primarily constructed during a reoccupation phase around 7000 years ago, marking the site's peak activity.

The stone circle, aligned to the summer solstice sunrise, reveals an advanced understanding of celestial cycles [5]. Such knowledge was likely crucial for timing agricultural practices, particularly for planting crops near lakeshores at the beginning of the wet season.

Stone alignments within the circle suggest awareness of stellar movements. Some researchers propose that the stones correspond to the positions of stars such as Orion's Belt, hinting at knowledge

of astronomical precession [1,2]. These observations position Nabta Playa as a critical site in the study of early astronomy.

Beyond its astronomical significance, Nabta Playa offers evidence of early social organization and ritual life. The transportation and erection of megaliths weighing several tons imply coordinated labor and complex social structures. The burial of whole cattle within tumuli indicates the cultural and possibly religious significance of livestock. The discovery of sorghum, millet, and other edible plants suggests the early adoption of agriculture, further supported by the alignment of seasonal planting with the solar-lunar calendar marked by the stone circle.

The site's history of intermittent occupation illustrates human adaptability to environmental change. During arid periods, inhabitants likely migrated to more habitable regions such as the Nile Valley, returning when conditions improved. Accurate anticipation of seasonal rainfall likely inspired the creation of the calendar circle. This pattern suggests a possible cultural linkage between Nabta Playa and emerging Nile Valley civilizations [6], perhaps forming the core of early Cushitic civilization. In fact, there are some parallels between Nabta Playa stone circle and the ancient Cushitic calendar as revealed in this paper, which opens new avenues for archaeoastronomical and historical research in the region.

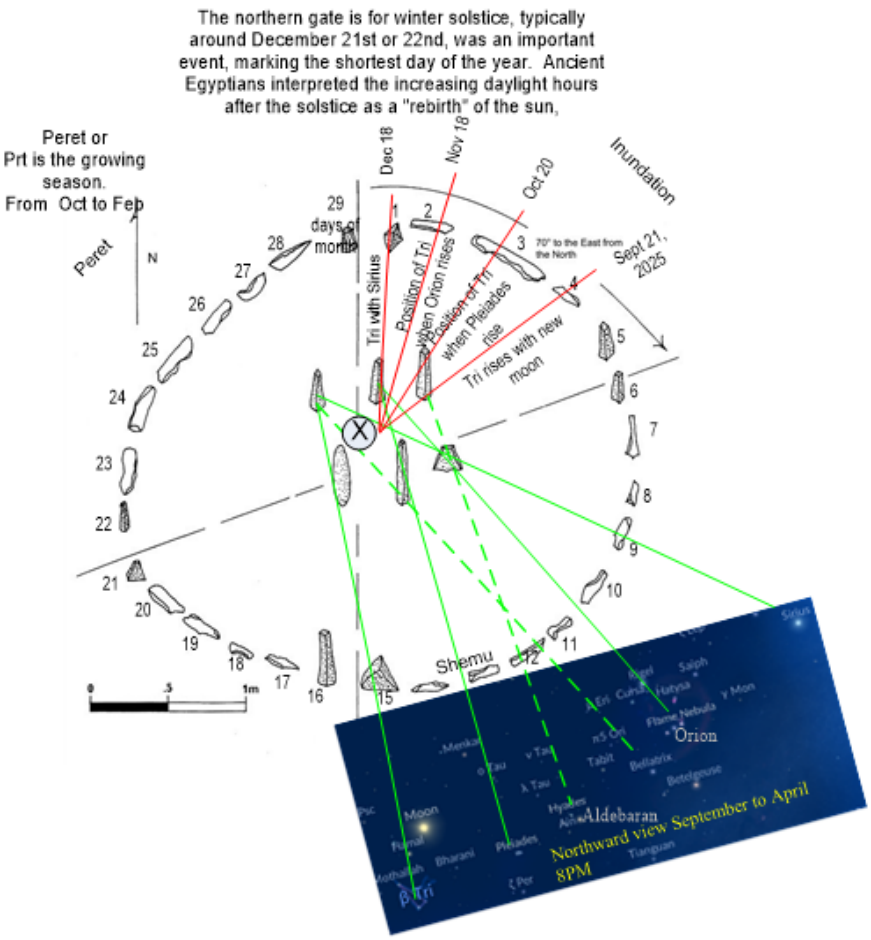

Figure 1: Interpretation of the Nabta Playa site at 7:30 P.M. Green lines indicate the alignments to Triangulum, Pleiades, Aldebaran, Bellatrix, Orion, and Sirius. Only four - Triangulum, Pleiades, Orion, and Sirius - are used to mark new months from September through December. Red lines represent the northward view for these months. Site map is adopted from [7].

Interpreting the Stone Configuration

To obtain consistent results during time reckoning using stars as references, the period of daily observations must be kept around the same time. In Nabta Playa, sunset occurs between approximately 6:04 PM and 7:16 PM in April, and between 5:36 PM and 6:06 PM in September. To account for these seasonal variations, we standardize observation times at 6:30 PM from April through August, and 7:30 PM from September through December. These times are deliberately set for early evening, shortly after sunset, which offers two key advantages:

a. Consistency: Without mechanical timekeeping, anchoring observations to a visually noticeable event like sunset ensures a moderately consistent reference point.

b. Practicality: Early evening provides sufficient twilight to prepare for stargazing while still aligning with natural cues observable to Neolithic peoples.

Steps for Drawing the Red Lines in Fig. 1 (indicating new months of Inundation):

I. Set the location in Redshift to near Nabta Playa and configure the date and time to 7:30 PM on September 21, 2025.

II. Set the reference direction to "N" for North, ensuring it appears at the bottom of the screen. East should be on the right, and West on the left. Under "Object Settings." Increase the number of visible stars if needed.

III. With these settings, the Triangulum constellation should appear just above the northeast (NE) horizon. Using a ruler, draw a straight line from "N" to Triangulum.

IV. In a graphics software program, replicate this straight line digitally, matching the one created with the ruler.

V. Superimpose the digital line onto the Nabta Playa map without rotating it. The line should start from the assumed observation point marked "X" at the center of the map.

VI. Observe that the line intersects Stone 4.

VII. Repeat the process by changing the date to the next new moon, October 21, keeping the time at 7:30 PM. You should now see the Pleiades just above the NE horizon.

VIII. Again, use a ruler to draw a line from "N" to Triangulum.

IX. Repeat steps 4 through 8 for November and December. As Orion and Sirius appear with new moons, the resulting lines created from the reference point to Triangulum's new positions will intersect stones 2 and 1, respectively.

The steps illustrated above lucidly demonstration that at Nabta Playa, alignments of Triangulum with specific stones mark the appearance of new moons, correlating to the lunar months from September through December. For instance, when Triangulum aligns with stone 4 in September, it signals a new moon as shown in Fig. 1. In October, Triangulum aligns with stone 3 as the Pleiades appear signaling the beginning of October. Stones 2 and 1 aligned with Triangulum mark the appearances of Orion and Sirius with new moons in November and December, respectively. The gap between stones 29 and 1 possibly marks the solstice. It may also signal the need to reconcile the lunar year (354 days) with the solar year (365 days). Thus, the red lines in Fig. 1 indicate the position of Triangulum during its first appearance with the new moon, marking the beginning of a new month. The months of September through December correspond with Akhet, the Egyptian season of inundation, the first of the three main seasons in the ancient Egyptian calendar [8]. Simulations using RedShift software confirm that this season began with the heliacal rise of Triangulum and ended with Sirius. As the inundation season closes, Arcturus becomes the dominant evening star, guiding calendrical references for the rest of the year.

The six green lines drawn through the tall stelae at the center of the circle (Fig. 1) align precisely with the six stars featured in the ancient Cushitic calendar as directional markers. The star map, taken directly from Redshift, has been oriented to match lines passing through at least two stelae. Remarkably, each line intersects exactly with one of the six stars. The red lines in Figure 1 indicate the position of Triangulum during its first appearance with the new moon, marking the beginning of a new month. The six central stones form lines - shown in green - that align with stars and constellations used to determine new months.

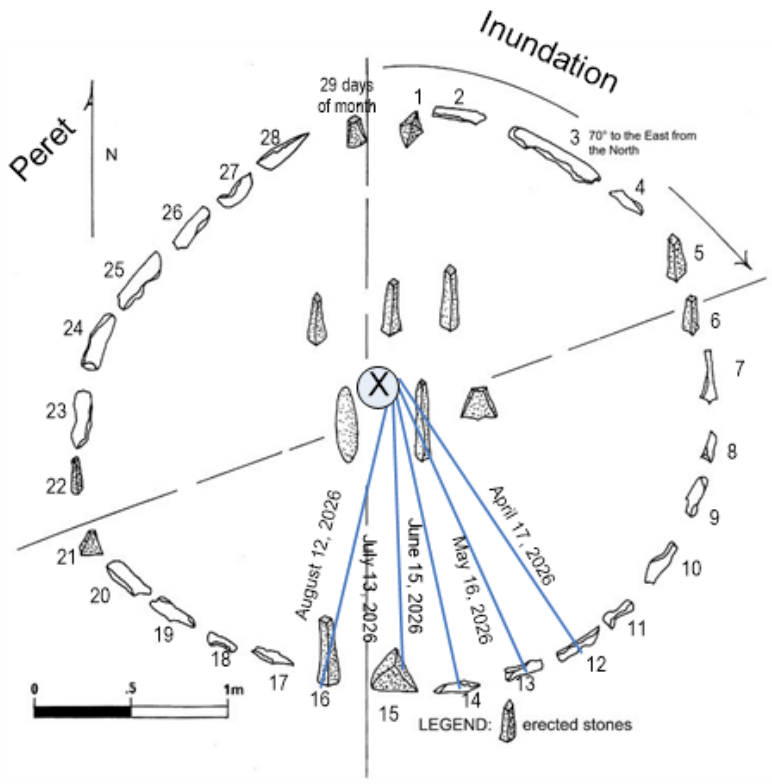

Figure 2: Interpretation of the Nabta Playa site at 6:30pm, 2026, Arcturus is observed April through August - until Triangulum appears. Site map is adopted from [7].

The following steps are followed to draw the blue lines in Fig. 2, which indicate the new moons from April through August and correspond to the Shemu and Akhet seasons:

I. Set location and time: In Redshift, set the observation location near Nabta Playa. Choose a date and time - 6:30 PM on April 17, 2026 - which corresponds to a new moon.

II. Adjust Viewing Orientation in Redshift: Set the reference point to "S" (South) for a southwest-facing observation. "S" should appear at the top of the Redshift screen. Ensure east is on the right and west on the left. Increase the visibility of stars under "Object Settings."

III. With these settings, Arcturus should appear on the eastern side of the screen. Use a ruler to draw a straight line from "S" to Arcturus.

IV. Draw a digital dine: Using graphic software, draw a straight line matching the ruler's line on the screen.

V. Superimpose the line on the map: Overlay the digital line (without rotating it) onto the Nabta Playa map. Align it so that the line begins at the assumed observation point, marked "X" at the center of the map.

VI. Note the stone intersection: The line will intersect the stone numbered 12 proving it is indeed a reference stone.

VII. Repeat for May: Change the date to the next new moon - May 16 - while keeping the time at 6:30 PM. Repeat steps 3 - 6. The new line should intersect stone number 13.

VIII. Continue for June to August: Repeat the process for the new moons in June, July, and August, keeping the time at 6:30 PM. The resulting lines should intersect stones numbered 14, 15, and 16, respectively.

Arcturus appears after Sirius exits the evening sky and remains dominant for months, making it a natural seasonal guide in ancient astronomy. Mentioned in the Bible [9] and the classical works of Hesiod, Hipparchus, and Ptolemy [10], Arcturus also features in Homer's Odyssey as a navigational star [11]. Its path across stones 12 to 16 at Nabta Playa may represent the remaining months after Akhet. The gap between stones 15 and 16 corresponds to the summer solstice and may have also served to reconcile the lunar and solar calendars - paralleling the interpretation for December.

Nabta Playa and the Eastern Cushitic Archaeoastronomy

The Nabta Playa circle consists of 29 stones - an unmistakable nod to the lunar month - that surround taller central stelae. The circle's small radius (about 4 meters) limits linear projections, yet central stone alignments accurately point to significant stars, including Triangulum, Pleiades, Aldebaran, Bellatrix, Saiph, and Sirius.

The Namoratunga II site near Lake Turkana, Kenya, dated to 2398 ± 44 BC, is believed to be a Cushitic archaeoastronomical site [12]. Its pillar alignments have been interpreted using modern simulations to show the use of eight stars - Triangulum, Pleiades, Bellatrix, Betelgeuse, Aldebaran, Central Orion, Saiph, and Sirius - for synchronizing lunar months with the solar year [13]. These same stars appear in modern Oromo traditions and provide a clear link to Cushitic timekeeping systems [14].

In Nabta Playa, the appearance of Bellatrix and Aldebaran overlaps the nearest reference stars when viewed from that location, and are not used to mark new lunar months, although the stellar configurations point at these stars. While only Triangulum, Pleiades, Orion, and Sirius were used to mark new lunar months at Nabta Playa, the inclusion of Aldebaran and Bellatrix - though visually redundant due to their proximity to Pleiades and Orion - may reflect inherited traditions from Eastern Cushitic astronomy. This overlap supports the theory of shared star catalogues across different cultures, even if not all markers served calendar functions at Nabta Playa. The use of the same several stars as time-reckoning references both in Nabta Playa's and Cushitic astronomies is a remarkable subject of interest requiring further investigation.

Although Nabta Playa's calendar uses only a subset of the Cushitic calendar stars, the alignment patterns reflect a similar astronomical logic. Notably, in the Cushitic system, the appearance of Triangulum with a new moon marks the beginning of the solar year. Sirius concludes the visible seasonal star sequence by late November, just before Arcturus takes over in Nabta Playa.

Conclusion

Nabta Playa stands as a seminal archaeological site that redefines our understanding of prehistoric African cultures. Its stone structures, particularly the calendar circle, demonstrate a profound grasp of astronomy and timekeeping. The precision of its celestial alignments and integration with lunar and solar cycles suggests a calendrical system sophisticated enough to guide agricultural and ritual activities.

Computer-aided studies now confirm Nabta Playa's alignment with traditions observed by Eastern Cushitic communities, reinforcing its importance in the evolution of archaeoastronomy.

Beyond its scientific significance, the site also reveals evidence of complex social organization, ritual cattle burials, and early food production strategies. As such, Nabta Playa offers a compelling glimpse into the cognitive, cultural, and technological sophistication of early African societies. It remains a powerful testament to humanity's ancient connection with the cosmos and the enduring interplay between landscape, sky, and civilization.

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Conflict of Interest

The authors declare no conflicts of interest.

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