The Solar Eclipses of the Pharaoh Akhenaten

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Abstract

We suggest an earlier date for the accession of the Egyptian pharaoh Akhenaten of the New Kingdom: His first year of reign would be placed in 1382 BCE. This conjecture is based on the possible witness of three annular eclipses during his lifetime. Evidence from that era is scarce, though some lateral dependencies can be disentangled implementing the historical course of the subsequent events.

Keywords: solar eclipse, astronomical dating, Akhenaten, New Kingdom, Egypt

1 Introduction

The flourishing time of the 18th to 20th dynasties of the pharaohs, the so-called “New Kingdom”, is not well established. Traditionally it is placed roughly between 1550 and 1070 BCE. In the public awareness this period is known best, since most people associate with it the “classical pharaonic etiquette”. The administrative center was located in Memphis near Cairo, while the former capital Thebes, about 650 km (5°) to the South, remained an important residence of the kings. One of the most prominent pharaohs of the 18th dynasty was Akhenaten (Amenophis IV).

His interval of reign has been subject to much debate. Depending on the method of reckoning, the accession of the illustrious pharaoh is assumed somewhere in the middle of the 14th century BCE. Our attempt will be to investigate his year of accession by some kind of guesswork: We illuminate briefly the political circumstances, and outline distinctive stations of his lifetime. In particular, we ask for his motivation for performing the radical changes in the religious belief abandoning the polytheistic customs in favour of a monotheistic worship of the Sun. A key to the answer will lie in solar eclipses. Although this hypothesis seems speculative, we claim that our result agrees with other incidents in the history of the neighbouring nations.

A crucial element at collating a historical eclipse to a certain geographical region is the clock-time correction, $\Delta T$, that would shift the path due to the deceleration of the rotation of the Earth against a uniform rotation. The error accumulates to more than 9.0±0.5 hours for the period considered here. Though there are many reasons to refrain from this method of dating before 700 BCE, we present arguments that would match the historic timeline, see Section 4. The outcome combines astronomical and historical landmarks better than previously.

2 Worship of the Sun

The adoration of the most important illuminant in the sky played a central role for the old Egyptians, in religion as well as in culture. That civilisation was the first to arrange its calendar after the sun and to disengage from auxiliary solutions with lunar leaps. All the more it seems surprising that there are no obvious mentions about obscurations of their major object of cult. A sudden darkening of the sun must have caused a horrific tremor in their belief. In the same manner, eclipses of the moon must have been noticed, but we do not find anything about worries, dramatic uproars, or attempts of interpretation. A complete ignorance of these natural phenomena appears incomprehensible.

One possible explanation for the absence of eclipse accounts may lie in the governmental structure. The Egyptians lived in an absolute authoritarian society. Only few people were capable of writing, and they were strictly forbidden to announce malfunctions within the system that would equal for a dare over the god-like pharaoh. The ban on speaking affected any kind of turmoils, social tensions, shortages, and, even more, religious affairs. If something should ever leak, then probably in a highly cryptic way — without mentioning of names, nor dates, nor obvious details. The episode of the 10th pharaoh of the 18th dynasty, Akhenaten, is an example for a far-reaching disharmony in the state.

His father, Amenhotep III, favoured the god Aton (Sun) over all other deities and supported the rites. Probably he aimed at a smart change in politics to subvert the local tradition of Amun (creationism) which was sustained by the powerful priests [13]. His son Akhenaten became pharaoh at an estimated age of 18 to 22 years. He carried out those drastic changes in his fifth year of reign. He elevated the Sun over all existing gods and commanded himself as its descendant (“Akhen-Aten” means “the one serving the Sun”). The sun would take over the sole universal mastery in the Egyptian pantheon. As the pharaoh he deprived the priests off their power and ordered to stop the former Amun rites. He tempestuously promoted sculptures, portraits,
Table 1: Suggested reign of Akhenaten (selection).

| Time [BCE]   | Method                  | Ref. |
|--------------|-------------------------|------|
| 1382 – 1367  | Moon visibility + tables | 6    |
| 1380 – 1365  | *Cambridge Ancient History* | 7    |
| 1370 –       | Radiocarbon dating      | 10   |
| 1367 – 1350  | Links to Assyria        | 7    |
| 1356 – 1340  | Geo-political bonds     | 8    |
| 1353 – 1336  | Egyptological Research  | 5, 7 |
| 1350 – 1334  | Dynasty lists           | 12   |
| 1340 – 1324  | Archaeology             | 13   |
| < -1300      | Dendrochronology        | 7    |

and amulets with sun-related features. Moreover, he dedicated a new capital to it: Achet-Aton, today known as Amarna. After a rapid construction he moved there in his 8th year.

The objectives of these acts are quite sketchy, and the background is controversial among Egyptologists. It remains an open question why Akhenaten took the glorification of the Sun to extremes. It seems a case for the stock of legends. One hypothesis is based on solar eclipses.

In any case, the fierce restructure of the religious belief must have run into severe opposition by the priests. Historians call this the “Amarna Period”. It is likely that a few Jews, who were working as slaves in the Egyptian exile at that time, were inspired by Akhenaten’s new monothestic doctrine. They incorporated many ideas into their own philosophy [1]. The Old Testament emerging very much later was re-written in order to retroactively adjust a primordial pagan socket religion with the new thoughts evoked by Akhenaten. Maybe these workers were even constructing Amarna, and, hence, became acquainted with the subject.

The pharaoh died in his 17th year of reign, and the circumstances of his death are obscure. Two of his successors changed quickly. His only son, Tutanchamun, was an infant at an age of four when inaugurated as pharaoh. It is said that Tutanchamun withdraw many changes introduced by his father, most likely upon the pressure of the priesthood. For them, it would be easy to bring an underaged to restore the religious practice back to the old Amun cult. The birthname of the child pharaoh was originally “Tutanchaten”, like all his sisters bearing the syllable for the sun, but he altered it for the sake of the old gods and former rites. In his second year the capital was moved back to Memphis, and Thebes lost significance even more. Tutanchamun died after nine or ten years in power at a maximum age of 20 [13]. After him, the worship of the sun was to be liquidated, and all traces erased. He never stood out politically in any way. For the history of the country Tutanchamen was completely irrelevant. His present-day fame is just based on the sensational discovery of his undamaged tomb in 1922.

The interval of Akhenaten’s reign is located in the middle of the 14th century BCE. Depending on the method of analysis, various time spans for his rulership are proposed, see Table 1. For the entire 18th dynasty there are rumours of co-regencies that would complicate the reckoning [5]. In the case of Akhenaten the claims fluctuate between 8 and 12 years of co-regency, however, they are also vehemently rejected by many historians.

Manifold attempts to give absolute time limits for the 18th dynasty turn out unsteady. Information is patched together from various disciplines and tries to generate a holistic picture. Historians tend to use a “short chronology” for their needs, but the “long chronology” yields better results from the astronomical point of view [6]. The lifetime of Akhenaten throws shadows on the dates of the Hethite king Muršili II, the “Dakhamunzu” episode, and the Battle of Kadesh several decades later.

### 3 Previous Suggestions for Eclipses

The engineer and historian William McMurray expressed the idea that a grave, discovered in Amarna, represents the sketch of a solar eclipse [9]. The tomb is assigned to the high priest Meryra I and is categorised as a major private ones from the 18th dynasty. Meryra’s task was to care for the new Aton service induced by the pharaoh. The tomb is estimated to the 9th or 10th year of Akhenaten’s reign.

Among the countless sketches showing the pharaonic couple beneath the beamy sun, McMurray selected one with arcs (Figure 1). These arcs are still not understood. The interpretations cover a wide range of suggestions: collars, clouds, upside-down rainbows, or atmospheric halos. Also, flying shadow bands were proposed when they appear shortly before totality. Resting his arguments on the latter option, McMurray pleads in favour of the total solar eclipse of 14 May 1338 BCE. It passed just a few kilometers South of Cairo (Memphis) at noonday (Figure 2). The event would have inspired Akhenaten to build the new residence...
halfway between Memphis and Thebes. Thus, it would be no factor of chance that the complex was raised in a deserted area. The accession would have occurred in 1340 BCE because of special festivals that are celebrated at full moon. McMurray asserts a consistency with inscriptions on temples in this regard.

Another eclipse is brought forward by the archaeoastronomer Göran Henriksson [4]. He selected six partial and annular eclipses and constrained them to the horizon, because the small obscurations will be noticed much better than in the glare of the day. A partial eclipse will easily escape attention if the magnitude is smaller than ≈0.8 [8]. Henriksson shows that the annular event of 5 July 1378 BCE was very conspicuous (Figure 3). In Luxor at the residence near Thebes, the sun would have risen with a circular “black hole” inside. It happened in the sixth year of Akhenaten and was the cause for his name change. Three years later, another eclipse (partial, mag = 0.795 in Luxor) would have triggered his decision to construct Amarna. Here, Henriksson deviates from the majority that the idea took shape in the fifth year. Eventually, a third eclipse would have opted his son Tutanchamun for the turnaround: 27 October 1356 BCE. The priests at that time would have urged to evacuate Amarna, and the child pharaoh went with it.

4 An Eclipse Triple?

Following the chronology compiled by Peter Huber, only three years will be suitable for the time of Akhenaten’s accession: 1353, 1378, and 1382 BCE [6]. The years are based on the visibility of lunar months (crescents) which led to a most probable calendar round.

Although a solar calendar was used for indicating dates, the everyday’s life of the common people was guided by the phases of the moon. For keeping pace of the solar days with the lunar month, a “psdntyw day” would be inserted, that operated like a double date, if the lunar visibility fell behind. This “psdntyw day” was introduced by Heinrich Brugsch in 1864, and discussed by Leo Depuydt in 1997, see [6] for details. Huber thoroughly analysed such days on the basis of the visibility of the lunar crescent around conjunction with the sun, and concluded that only the aforementioned three years are viable to Akhenaten’s year 1.

We checked the eclipses in the period from 1420 to 1320 BCE of Espenak’s Five Millennium Canon of Solar Eclipses [2]. Relying on the ancillary information from history, that the construction of the new capital started in Akhenaten’s fifth year, we presume a solar eclipse prior to that. Other eclipses in his childhood could also have influenced his concept of worship, though such things stay rather speculative. Altogether, he could have seen some impressive eclipses before he became regent. His father Amenhotep ruled for 38 years, and it is believed that he died at age of almost 50, as Akhenaten inherited the throne [5].

We meet the very prominent solar eclipse of 1 March 1399 BCE. Being of hybrid type, it had a maximum path width of 10 km (Figure 4). It passed exactly through Thebes which was very close to the turning point from totality to annularity (mag ≈ 0.996). We will never know what sight the occulted sun displayed to the viewer, but one can imagine that Baily’s Beads flickered around a black circle, surrounded by a reddish chromosphere. Whatever it looked like for the observer, if he stood on the central path, the natural phenomenon would have created an stunning light show.

If assuming 1382 BCE the first year of Akhenaten, he must have been a child of ≈ 3±2 years of age at that time. His father would be pharaoh, and surely not less astonished by the glance at the strange sun. The father could even have observed another eclipse 11 years earlier, on 25 September 1410 BCE: also annular, immediately after sunrise in Memphis (mag = 0.923). It must have caught attention unless weather conditions prohibited the sight.

Akhenaten, as a juvenile, might have experienced his second spectacle ten years later: on the evening of 9 February 1389 BCE. Again of annular type, with the black disk passing in front of the sun leaving behind a luminous ring. In this partly occulted state the sun set in Memphis. Thus, two eclipses occurred before his regency. Eleven years later he would have observed a third one in his role as monarch: 5 July 1378 BCE, as suggested by Henriksson. In Thebes it was seen in the morning hours, and in Memphis it had an impressive magnitude of 0.872, too. This happened in his fourth year and inspired him to construct Akhet-Aton or Amarna, respectively. A boundary stone was found at this site bearing an inscript telling that he would never “cross the Southern nor Northern border of his city but wants to be buried towards the sunrise after a million jubilees of regency” [13].

So, Akhenaten could have witnessed three eclipses in his lifetime. For having the eclipse paths central, he would have stayed at different sites, Memphis and Thebes, but this is not required. The impetus of the large obscurations, as these were, suffice to become deeply touched by the incidents that concern the topmost object of belief.

5 Discussion

It is true that celestial phenomena repeat at regular intervals leaving different chronologies. Particularly solar eclipses strongly depend on the location of the observer. His-
historical eclipses are additionally subject to a “clock error”, \( \Delta T \), which is the difference between the strictly uniform time scale (Ephemeris Time) and the actual time (Universal Time). The divergence is based on the long-term slowdown of the Earth’s rotation due to the tidal friction, but other geophysical causes apply, too. This issue has been considered in many publications, see the intensive research by Richard Stephenson [11], or the most recent overview by the author [8]. Though the choice of \( \Delta T \) is decisive, we emphasize that it is the average value of the extrapolation formula being fully adequate to reproduce the coherent scene in the case discussed here.

We tried to date the Egyptian pharaoh Akhenaten with astronomical means. His motive of worshiping the Sun as the sole and supreme deity may rest upon the experience of striking solar eclipses. Two of them (1399 and 1389 BCE) would have occurred in his youth, and a third in his fourth year as regent, in 1378. This prompted him to build a new city, dedicated to the Sun, and to alter his name to please the universal power. Our draft for Akhenaten’s lifetime gets along with any slight fluctuation within the error bars of \( \Delta T \). A small shift would not change much the geographic location of the eclipse paths, but the choice of the historic eclipse will. The benefit of Akhenaten’s accession in the year 1382 BCE is the agreement with the follow-up events after his death in 1365 BCE:

1. His son Tutanchamun will be enthroned a couple of years later and died prior to 1350 BCE at the age of less than 20 years.

2. Tutanchamun’s death in \( \approx 1355–50 \) BCE implies the linkage to the political Dakhamunuza affair with the Hethite king Suppiluliuma. Muršili II, Suppiluliuma’s son, became king shortly thereafter. He was involved in another “solar omen” ten years later, which would be interpreted as an eclipse in Anatolia in 1340 BCE. See Chapter 9.7 of [8] for the extended context.

3. The back-shift of the Egyptian and Hethite kings will distort some of the subsequent historical dates. The Battle of Kadesh between Ramses II, the fifth successor of Tutanchamun, and the Hethites, that is generally positioned in 1274 BCE, needs a re-adjustment, tentatively to 1311 BCE.

Since direct evidence from that era is vague, there is nothing else but mounting the cornerstones through astronomical incidents and fitting an adequate story for the motives. Our scheme satisfies the long count of Near Eastern Chronology and supports the timeline by Huber [6]. The radiocarbon date falls short by a decade, however, the authors state that their average calendrical precision is 24 years for the New Kingdom [10]. They also recommend earlier years than the current consensus.

Many improvements presented here were already put forward by others deploying astronomical dating. Nevertheless, we hope to assist harmonizing the diverging chronologies by the method of eclipses.

Acknowledgments

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References

[1] Assmann, Jan (1997): “Moses und Echnaton”, Dialog 3/4, 1997, p29–48 (in German)

[2] Espenak, Fred (2006): „Predictions for Solar and Lunar Eclipses“, Eclipse maps courtesy of Fred Espenak, NASA/Goddard Space Flight Center; http://www.eclipsewise.com/

[3] Gertoux, Gérard (2013): „Dating the fall of Babylon and Ur thanks to Astronomical Events“, eprint arXiv:1309.2758; https://arxiv.org/abs/1309.2758

[4] Henrikkson, Göran (2007): „Chronology for the Egyptian pharaohs of the Amarna period …“, British Archaeological Reports 1647, ISSN 978-1-4073-0081-8, 2007, p122–148

[5] Hornung, Erik (2006): „The New Kingdom“, in: „Ancient Egyptian Chronology“ ed. Hornung et al., Brill, Leiden/NL, 2006, p197–217; ISBN 978-90-04-11385-5

[6] Huber, Peter J. (2011): „The Astronomical Basis of Egyptian Chronology of the Second Millennium BC“, Journal of Egyptian History 4, 2011, p172–227; doi: 10.1163/187416611X618721

[7] Kelley D.H. & Milone E.F. (2011): „Exploring Ancient Skies“, Springer Science + Business Media, New York/USA, 2011; ISBN 0-387-95310-8

[8] Khalisi, Emil (2020): „Das Buch der legendären Finsternisse“, Habilitation submitted to the University of Heidelberg, 2020, ch. 9.6 (in German)

[9] McMurray, William (2003): „Dating the Amarna Period in Egypt…“, Egyptologists’ Electronic Forum (EEF), On-Line Library (visited 2019); http://www.egyptologyforum.org/EMP/DAPE.pdf

[10] Ramsey C.B., Dee M.W., Rowland J.M. + 7 co-authors (2010): „Radiocarbon-Based Chronology for Dynastic Egypt“, Science 328, 7 June 2010, p1554; doi: 10.1126/science.1189395

[11] Stephenson, Francis Richard (1997): „Historical Eclipses And Earth’s Rotation“, Cambridge University Press, Cambridge/UK, 1997; ISBN: 0-521-46194-4

[12] Wente E.F. & van Siclen III C.C. (1976): „A Chronology of the New Kingdom“, in: „Studies in Honor of George R. Hughes“, Chicago, 1976, p217–263, esp. p249–250

[13] Wikipedia (2020): https://de.wikipedia.org/ (German + English sites), visited in February 2020