

Troy or Amarna? The Oldest Recorded Solar Eclipse

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Summary: *A 2012 study by Göran Henriksson raised the possibility that a solar eclipse was described in the Iliad of Homer. If so then it would be one of the earliest dateable eclipses and of value to astronomers and geophysicists to determine the stability of the Earth's rotation back to the second millennium BC; and thereby confirm circumstances of other ancient eclipses. In 2005-6 I published my own research on the subject of eclipses visible from Amarna, Egypt during the Eighteenth Dynasty and from Anatolia, to investigate whether there was a non-linear change (a wobble or nutation) of the Earth's rotation ongoing at that era, residual from an earlier astronomical event. The possibility of another dateable eclipse observation allows an opportunity to revisit those concepts; together with its potential value in tying early-historical and legendary events to the Julian calendar.*

To begin, it may help to summarise some of the consensus theories, ancient and modern, about the date of the Trojan War. It was used by the Greeks as an epoch from which they would establish the date of other historical and legendary events both before and after the war. The date for the foundation of Rome also depends on it; and even the migration of the legendary eponymous Brutus to Britain is referred back to the Trojan War! We may therefore see how important an identification of its true calendar date could be for historians and archaeologists. This uncertainty is not modern; Various classical historians tried to back-calculate dates for the Trojan War with results ranging between 1135 BC and 1334 BC. Earlier Greek history from the Mycenaean era was lost during the so called [Late Bronze Age collapse](#) around 1200 BC; it is rather as if we could only date modern events by years before or since the Napoleonic War. However, the debate about the date of the Trojan war is an old minefield upon which I shall trespass no further. The focus here lies rather in the potential identification of a *dateable eclipse report* to verify the stability of the Earth's rotation as far back as possible.

Homer's Trojan war is now regarded as at least partly historical, since Schliemann's identification of Troy with the mound at Hissarlik near the Dardanelles. We may discard the interventions of the Greek gods and their influence on the participants; but our difficulty lies in where we should draw the line between the fiction and the reality upon which the story is based. The date of Homer's composition of the Iliad also remains vague but is typically placed around 850 BC; and so we can be confident that it was based on oral tradition in circulation for at least 300 years.

Archaeologists identify nine levels of occupation at Hissarlik. The oldest hill fort (Troy I) dates from 3000 BC or perhaps earlier. The level usually associated with Homer's Troy is the late bronze age layer of Troy VI; this shows clear evidence of burning and warfare that archaeologists date to c.1250 BC. However, even should we accept this destruction as the most likely date, we still cannot rule-out that events and characters of earlier or later conflicts have been conflated and woven into a fictional recreation. Such is the fate of oral history once its true chronology is lost.

Göran Henriksson draws our attention to a possible reference to an eclipse within Homer's description of the final battle of the Trojan war:

...and you would have said that the sun and moon were no longer fixed in the sky, since a fog covered over all that part of the battle where the leading men had made their stand...But the rest... fought in the ease of a bright sky, with the sunlight spreading clear and sharp and no cloud to be seen...but those in the centre were suffering cruelly in the fog and the fighting...

[Iliad, 17, Martin Hammond Translation] [1]

You must decide for yourself whether you think this could be a reference to a solar eclipse.

Henriksson therefore posits that a solar eclipse of 1312 BC took place during the final battle of Troy, which can then be tied to events in the Hittite archives. The [Hittite chronology](#) is in turn dateable (according to Henriksen's summation) via another eclipse that occurred in 1335 BC, the tenth year of King Mursili II. [3] Dating of the Hittite chronology is itself dependent upon links back to Egyptian chronology via the [Amarna letters](#); these would make Mursili II a contemporary of Akhenaten, Tutankhamun and the late Amarna period. However, as one might expect, there are many opinions as to the correct identification and others would prefer that the 1312 BC eclipse was itself the one referred-to in the Hittite text [4] As a proposed date for the Trojan War this is somewhat earlier than the 1250 BC consensus of the archaeologists and the median of the historical dates.

Following Henriksson, Papamarinopoulos and co-researchers preferred to date the battle much later via a partial annular eclipse of [1218 BC June 6](#) based on other potential astronomical references in the Iliad and Odyssey. [2] They would demolish Henriksen's links to the Egyptian chronology via the Hittite archives as too tenuous and prefer their own interpretation of Homer's epics. However, I shall not pursue their (primarily linguistic) arguments in detail here.

The circumstances of historical eclipses are now much easier for historians to study than when Henriksson first considered the matter in 1985, or even for myself 2000-6, due to the availability of retro-calculation software and various websites. The circumstances of these two eclipses according to the NASA website (2022) are slightly different from those originally cited by Henriksson:

[1312 BC June 24](#) 2 mins 48 seconds, total over Anatolia, partial over Egypt (Cat No: 01634)

[1335 BC Mar 13](#) 6 mins 36 seconds, annular/partial over Egypt and over Anatolia (Cat No: 01579)

The date and magnitude of an ancient eclipse can be retro calculated with confidence, however where the shadow fell on the Earth's surface is less easy to determine. This depends upon tidal slowing of the diurnal rotation ($TDT - UT = \Delta T$) due to the pull of the Moon on the Earth's equatorial bulge. The discrepancy ([Delta-T](#)) between clock and calendar due to this tidal slowing amounts to about half a day since 1500 BC. [5] The fall of the shadow can be estimated within an [uncertainty](#) that would shift the path slightly east or west of expectation.

However the present author, being a *catastrophist*, could not trust any retro calculated eclipse tracks prior to mid-first millennium BC due to the possibility that non-linear 'events' could have changed the rotation in ancient times. Before the most recent of such events it would become impossible to determine historical dates in the absence of a contemporary historical chronology dateable by some other means. Such events would include 'glitches' in the length of day, due to variations in the figure and balance of the planet, causing the shadow of an eclipse to fall east or west of the retro calculated path; in addition, nutations of the axis and pole-shifts could also cause a north-south variation. These would arise if the axis of rotation were wobbling slightly, triggered by internal changes to the shape of the Earth (i.e. instances of the [Chandler wobble](#) of a magnitude greater than are experienced today) or even external astronomical forces that might trigger the [core wobble](#).

To summarise my own earlier work as published in [Under Ancient Skies](#) in 2005; [6] and in a [follow-up article](#), one such reset may have occurred during the Greek Dark Age that followed the Trojan War; [7] this being one of a series of such events coincident with earlier dark ages and climate-events. Coincidence is one thing – proving them empirically is quite another.

In order to verify ΔT for a particular date some precise information is needed and ancient reports are seldom so helpful. For accuracy, the specific time of day and the start or end point of the shadow on the ground are needed, together with a precise location where it was observed. [8] Professor F. Richard Stephenson, perhaps the foremost authority on these subjects, found no report of an eclipse that he was prepared to trust prior to that seen at ancient Ugarit (Syrian coast). [9] Originally, he had suggested that this was the eclipse of [3 May 1375 BC](#), later revised to 1223 BC, but the circumstances of the Ugarit text are better reproduced by the eclipse of [9 May 1012 BC](#). [8] The key aspect of this particular report is that it occurred just before sunset – a very conspicuous omen – thus offering both a precise location and time of day to confirm the path of the Moon's shadow. *Note 1

Stephenson also rejected a divination from a Shang Chinese oracle bone dated at [1302 BC](#) because it appeared (inexplicably) to be a whole day out from the Chinese sexagenary cycle. [9] However, astronomers constantly update their calculations and this can be embarrassing for historical researchers who cite them! The [NASA webpage](#) no longer confidently suggests values for ΔT prior to 500 BC in the abbreviated table. [10] I should also mention at this point that Henriksson, in his 2012 paper, disputes some of the methods used by Stephenson to determine the path of ancient eclipses, declaring them: “completely useless for epochs before 700 BC”. The earliest eclipse report currently suggested by historians would be that of [5 March 1223 BC](#). [11] However, for the reasons given herein, I would still prefer the 1012 BC eclipse as the earliest observation that can be reproduced.

The ancient historians, in their various opinions of the date for the final battle at Troy, cannot even agree upon the year or season of the year that it occurred, let alone give a precise time of day. At best it gives us a window of about six to eight hours of daylight. Set this alongside the vague location of the final battle and we may see that the circumstances of the ‘Troy eclipse’ would not provide the precise information needed by astronomers. Here and in the 2006 paper, I am attempting not so much to identify a historical report via retro-calculation, rather to find *an independently dateable event* that cannot be reproduced by uniformitarian retro-calculation methods alone.

In 2005 in *Under Ancient Skies* I proposed that the Atenist heresy of pharaoh Akhenaten was inspired by a statistically rare sequence of eclipses across Egypt during the Eighteenth Dynasty. [12] In parallel around the same time William McMurray independently published theories regarding the [Amarna eclipses](#). [13] In a more recent paper Emil Khalisi [14] preferred to model earlier eclipses. As with Henriksson, these researchers follow *uniformitarian* assumptions that tidal slowing can be retro-calculated indefinitely to estimate the eclipse paths.

My own proposal in 2005-6 was that the construction of Amarna by Akhenaten was inspired by the observation of a *dawn eclipse* from the site of the Aten temple on 30 December 1332 BC, which would fix year 5 of Akhenaten's reign according to inscriptions on one of the boundary stelae. The eclipse would have been observed from the [Amarna temple site](#) as the sun rose in a cleft in the eastern mountains known as the [Royal Wadi](#). [15] Such an identification (an eclipse occurring at dawn) would be of value not just for historical chronology, but could fix both the location and time-of-day to a precision that would be more useful for astronomers. In 2005-6 I experimented with various values for ΔT to find one that would allow the start of the eclipse shadow to fall at Amarna; for this to be valid would require a non-linear step-change to ΔT of about 1500 seconds over a period of 300 years, since the 1012 BC observation. Such a change to the rate of rotation and the inevitable wobble that

must follow it would have occurred during the Greek Dark Age (the Egyptian Third Intermediate Period) and therefore shortly *after* the Trojan War. It should also be coincident with other evidence of *climate and sea-level changes worldwide* consequent upon the wobble of the axis.

The 'evil reports' that inspired Akhenaten to build his new city were recorded on the boundary stela. These give dates to the precise day within the king's reign – but unfortunately this does not help without a true calendar date for his accession.

The king declared that he would build the city in the place *chosen by the Aten himself* and that once established there he would never again leave its boundaries. In a proclamation of *year 8* of his reign, the king records that he came to Amarna in his *year 5* to formally celebrate the foundation of the city. The fragmented inscription was summarised by Egyptologist Cyril Aldred, citing the Amarna Boundary Stelae Project:

...as Father Aten lived, something had been said which was more evil than that which the king had heard in his Year 4...more evil than what he had heard in his year 1...more evil than what King (Amenhotep III?) had heard...more evil than what king Tuthmosis IV had heard... [16]

To reappraise my own conclusions of 2005-6 the identification of the 'evil omens' as eclipses were based on an experimental ΔT *very loosely set at 33000 seconds* rather than the *31593 seconds* used for the 'standard' retro calculation of the 1332 BC eclipse. This would allow the dawn eclipse to commence at Amarna, giving the following evaluation:

- The evil of year 5 was a report of the 1332 BC 'dawn' eclipse
- The evil of year 4 was a report of the 1335 BC eclipse
- The evil of year 1 was a report of the 1338 BC eclipse
- The evil seen by Amenhotep III was the 1352 BC eclipse
- The evil seen by Tuthmosis IV was the 1375 BC eclipse (viewed from Syria)

Note that these are dates when the king received *reports* of the phenomena, rather than their true date of occurrence. It is not essential that the king actually saw the eclipses himself, but he may have experienced at least one of them, or their partial shadow as they crossed the Nile.



The author's crude drawing of a dawn eclipse as viewed from the temple at Tel-el-Amarna (click for a photo link)

It seems likely that the annular eclipse of 1335 BC would also have been reported to Akhenaten and could also have been one of the evil omens – yet another ambiguity to add to the problem of pinning-down the precise dates for the reigns. Other possible reconstructions might perhaps prefer that the eclipse observed from the city of Akhetaten (Amarna) was one of the other dates: 1335 BC or 1338 BC – **but only the 1332 BC eclipse could correspond as the last-of-three reports in the king's proclamation**. So why should this third report be considered more evil than the others?

Some astronomical uncertainty must remain; the 1332 BC eclipse may have begun *just before* or *just after* dawn; the track would not have fallen precisely at the Amarna alignment at mid-winter, but to the south of it; or perhaps only a large partial eclipse was observed from the city itself? *Nevertheless the spectacle must have been sufficiently inspiring that Akhenaten took it to indicate that Aten wished him to build his new capital precisely at that place, which he called 'Akhetaten': "horizon of the Aten"*. The 'evils', as surviving on the boundary stelae, cannot be positively associated with eclipses. [17] We might wish for a more precise hieroglyph that Egyptologists would recognise as an eclipse rather than as a general reference to the sun-god. Unfortunately, the historical record is seldom so helpful. When Horemheb demolished the city to obliterate all memory of the Aten, he had the 'omens' on the stelae chiselled-out, so that we can no longer determine what Akhenaten actually saw.

When considering Egyptian king-lists, not only must we be sceptical of the precise start and end dates of the reigns, but also of their lengths, since overlapping co-reigns and regencies must complicate such estimates. In addition to the short reign of Smenkhkare (Nefertiti?) between Akhenaten and Tutankhamen, there was a [co-regency](#) of uncertain duration at the start of his reign, between Amenhotep IV/Akhenaten and his father Amenhotep III.

If 1332 BC were indeed year 5 of Akhenaten then it would refine the Egyptian chronology just 15 or 16 years *later* than current consensus, with knock-on effects for any other floating chronology that depends on it. Year 1 of Akhenaten would therefore fall *somewhere around* 1335 BC or 1336 BC. There is no point in trying to be more precise when there are so many uncertainties in the Egyptology as to the duration of the co-regnum with his father.

The current consensus [historical dates](#) for the Eighteenth Dynasty would place Akhenaten between 1352 BC and 1334 BC and for Tutankhamun between 1332 BC and 1323 BC. Between these reigns was a short reign of Smenkhkare or Nefertiti, about which Egyptologists hold disputed theories. Radiocarbon dates cannot help to pinpoint the dates either, as there remains a statistical uncertainty for all [radiocarbon dates](#) in the order of 100-200 years. Recent 'fine-tuning' attempts based on seeds from the tomb of Tutankhamun would tend to place his reign slightly later, between about 1320 BC and 1310 BC, adjusting Akhenaten's reign accordingly. [18]. However, a similar radiocarbon study of 2010 had indicated an earlier date. [19] So what are we to believe?

Again, the present author being a *catastrophist*, could never entirely trust radiocarbon dating either. The reasons for the ambiguity of carbon-14 at certain eras has never been convincingly explained by the specialists. It should be apparent that any abnormality of the Earth's rotation must also cause fluctuations in the magnetic field and the cosmic ray flux, thus destroying the assumptions upon which the rate of carbon-14 production in the atmosphere is based.

The proposed revision would then imply that, rather than the 1332 BC eclipse occurring (unrecorded) during the reign of Tutankhamun, it could have been the last in a series of total eclipses across Egypt that occurred during the lifetime of Akhenaten: 1352 BC, 1338 BC and 1332 BC. He may also have seen or heard reports of the annular "ring of fire" eclipse on 13 March 1335 BC. The circumstances of these eclipses according to [NASA \(Espinak 2021\)](#) were as follows:

1375 BC 03 May	2 mins 6 secs; a dawn eclipse at Syria & eastern Anatolia
1352 BC 15 August	3 mins 16 secs; total across southern Egypt, partial across Anatolia
1338 BC 14 May	6 mins 51 secs; total across Egypt, partial across Anatolia
1335 BC 13 March	6 mins 36 secs; annular across Egypt, partial over Anatolia
1332 BC 30 December	4 mins; a dawn eclipse commencing in western Egypt

The eclipse maps in the links above give the astronomical date number rather than the equivalent Gregorian date BC (or BCE) and have been refined slightly from those that I employed 2000-2006.

As for co-ordination with the Hittite chronology, we may well accept the conclusion of specialist Gary Beckman that the absolute dates for the Hittite chronology may never be known. [20] The “omen of the sun” mentioned in the Hittite text, *if the omen were indeed an eclipse*, could be that of 1335 BC or 1312 BC or perhaps one of the other eclipses above, which were partial over Anatolia. The dates for King Mursili II form a floating-chronology that depends crucially on links to Egypt via the *Amarna letters* (tablets in Akkadian cuneiform discovered at the Amarna site) together with archives from the Hittite capital Boğazköy.

Two letters are from a widowed Egyptian queen, begging King Suppiluliuma of Hatti, to send one of his sons to become her new husband. We may wonder whether this widowed-queen was Ankhesenamun, the sister-wife of Tutankhamun; or could the letter have been sent by Nefertiti upon the death of Akhenaten? Conventional Egyptology prefers that the letter was written by Ankhesenamun. However, little is known about [Nefertiti](#); she also had no sons of her own and she too, rapidly disappears from the historical record. The identification depends crucially upon the linguists’ preferred identification of *Bibhuria* or *Nibphuria* as the Babylonian rendering of Tutankhamun’s birth-name rather than that of Akhenaten: *Naphurria*; yet another uncertainty to add to the list. Egyptology researcher Russell Jacquet-Acea has re-analysed this issue and suggested a revised chronology that favours Nefertiti as the widowed queen; and that it was the long eclipse of 1338 BC that inspired the building of Amarna. [21] However, such identification would neglect the two later eclipses; it would not explain the three evil omens, or why the city had to be built at that precise location.

It should be stressed for the benefit of non-astronomers that the fixed-points in time provided by astronomical events remain invariable. An adjustment of the regnal dates in the king lists by 15 or 16 years would relocate the eclipse of 1335 BC within the Hittite chronology, with knock-on effects for other reigns – and therefore for synchronisms to the Trojan War. This becomes a chain of too many ‘ifs’ that makes it fruitless to project eclipse correspondences with any validity. The debate is another minefield. Hence I shall not pursue the Hittite chronology further here; with so many uncertainties it is perhaps best to keep the arguments simple.

From the motivation of my own investigations into *possible catastrophic events* during the Bronze Age and in earlier millennia, my previous conclusions would stand with only slight adjustment due to the refinement of the eclipse data since 2006. If we could once prove that a glitch or nutation has occurred at some point in the past then all retro calculation and historical date assumptions *prior to that event* become unreliable. We can no longer estimate where the eclipse shadows fell. However, acceptance of such an event would open minds to discussion that might prove the validity of other catastrophes earlier in Earth history.

One cannot expect specialist Egyptologists and other academics to cite or even read the work of non-specialist authors such as myself; or to cite catastrophist theories that are published in books aimed

at the popular mass-market. Over the years there has been so much nonsense put out by followers of the 1950s pseudohistory of Velikovsky, that it became almost impossible to publish sensible research on the subject of catastrophism in prehistory. Even the more-restrained authors such as Graham Phillips - who sought to link the 'omens' of Akhenaten with the Thera eruption, or the revised chronology of Egyptologist David Rohl that would place Akhenaten's reign 300 years later – both well argued – do not help to establish credibility. [22] [23] So muddied has the water become! *Note 2

Conclusions

The statistically rare concentration of eclipses crossing Egypt during the Eighteenth Dynasty would fit well with the 'evils' reported to Akhenaten, which inspired him to establish his new solar religion. However, to adopt the dates proposed here would require Egyptologists to abandon the uniformitarian Delta-T constraints and accept a step-change event that affected the diurnal rotation at some point between the 1012 BC and 1302 BC eclipses. The actual change is likely to have been quite modest amounting to less than half-an-hour over 300 years, shifting the fall of the shadow to the west. It should then be possible to apply standard formulae to extrapolate the most likely paths of eclipses before and after the new fixed point. However, this still tells us nothing about any north-south variation due to wobble or pole-shift resulting from the same event.

This brings us back to the possible identification of an eclipse during the final battle of the Trojan War. I recall my own experience of the 1999 eclipse viewed beneath thin cloud as it passed over Cornwall. The sky darkened rapidly; sea gulls flew towards the light and then a few minutes later, as the shadow passed over, the screeching birds flew back the other way. The darkening of the sky through cloud was only significant during the few minutes of actual totality and quite unremarkable during the thin crescent of partial sunlight. This convinces me that the description given in the Iliad was not an eclipse under cloud; and an eclipse certainly would not produce fog at ground level over half the battlefield, with bright sunlight (not eclipsed) over the rest of the plain.

The eclipse of 1312 BC (on any retro calculation) was total for just over two-and-a-half minutes but, as Henriksson accepted, only partial at Troy. Appreciable darkening – such as would be so conspicuous as to be noticed in the heat of battle – could only have lasted for a few minutes. It could not explain a darkening that persisted throughout a long battle, even allowing for the fact that the poet was recording a degraded oral memory. Overall it seems more likely that the mist, *in the very centre of the battle*, was a local weather phenomenon. Regrettably, the description in the Iliad is not sufficiently concise to be trusted as a report of an ancient eclipse, much as a historical researcher might dearly wish it were so.

Homer's description of the fighting would however fulfil my own definition of a 'mythological fossil' as the poet or his source had no need to include a weather references within a fictional account of a battle. It gives us confidence that he based his poetry on oral recollections of a real historical conflict. The date of the battle, however, remains uncertain. Hopefully, the discussion and references here will serve to assist future researchers who can approach the subject with an open mind.

Note 1 The retro calculation by [Mitchell](#) of the 1012 BC eclipse, as cited by Egyptologist David Rohl in his book: *A Test of Time* could no longer be found in 2021 to re-assess for this article. However I did reproduce this eclipse as Figure 6.1 of my 2005 book. While I did not and do not accept the revised chronology, the circumstances of the Ugarit sunset eclipse can indeed be reproduced in retro-calculation software and via the NASA website much better than for 1223 BC. It is an interesting aside that close to the eclipsed sun would have been – as Rohl remarked – a first-magnitude red giant star that exploded to form the Crab Nebula in AD 1054.

Note 2 Muddy Waters! In 2006 I did attempt to publish an article on these eclipses in a specialist journal to complete the research of my earlier book, but the mere mention of ‘catastrophism’ led to a dismissive rejection by that journal’s referee who assumed that it was inspired by Velikovsky’s ideas; and another journal that supposedly publishes alternative chronology suppressed a revised version because it would *not* support Velikovsky’s chronology! The revised [article](#) was therefore left in abeyance until I included it in *Prehistory Papers* in 2020. However, it was made available on request as unpublished to a small number of interested researchers who commented on the earlier book.

Relevant Hyperlinks

<https://www.history.com/news/bronze-age-collapse-causes>
https://www.researchgate.net/publication/44963755_Hittite_Chronology
<http://www.touregypt.net/featurestories/letters.htm>
<https://eclipse.gsfc.nasa.gov/SEhelp/deltat2004.html>
<https://eclipse.gsfc.nasa.gov/SEhelp/uncertainty2004.html>
<https://eclipse.gsfc.nasa.gov/SEhelp/deltaT.html>
<https://eclipse.gsfc.nasa.gov/SEcat5/SE-1399--1300.html>
<https://eclipse.gsfc.nasa.gov/5MCSEmap/-1399--1300/-1301-06-05.gif>
<https://eclipse.gsfc.nasa.gov/5MCSEmap/-1399--1300/-1311-06-24.gif>
<https://eclipse.gsfc.nasa.gov/5MCSEmap/-1399--1300/-1331-12-30.gif>
<https://eclipse.gsfc.nasa.gov/5MCSEmap/-1399--1300/-1334-03-13.gif>
<https://eclipse.gsfc.nasa.gov/5MCSEmap/-1399--1300/-1337-05-14.gif>
<https://eclipse.gsfc.nasa.gov/5MCSEmap/-1399--1300/-1351-08-15.gif>
<https://eclipse.gsfc.nasa.gov/SEhistory/SEplot/SE-1374May03T.pdf>
http://www.michaelmandeville.com/earthmonitor/polarmotion/plots/chandler_wobble_plots.htm
<https://earth-planets-space.springeropen.com/articles/10.1186/s40623-018-0971-9>
<https://eos.org/science-updates/earths-wobbly-path-gives-clues-to-its-core>
<https://www.third-millennium.co.uk/under-ancient-skies>
https://f7e94415-3a55-48d9-ba14-ed235f05a65f.filesusr.com/ugd/e5604c_b2b136af2b8f4a05b72ea1c0b6bf9797.pdf?index=true
<http://www.egyptologyforum.org/EMP/DAPE.pdf>
<http://www.touregypt.net/featurestories/amarna.htm>
<https://www.archaeometry.org/helios.htm>
<https://pharaoh.se/dynasty-XVIII>
<https://www.sciencedaily.com/releases/2018/06/180605112057.htm>
<http://www.thehistoryblog.com/archives/29044#:~:text=Since%20Amenhotep%20ruled%20for%20approximately,for%20at%20least%20eight%20years.>
<https://www.smb.museum/en/museums-institutions/aegyptisches-museum-und-papyrussammlung/collection-research/bust-of-nefertiti/the-queen/>
https://www.researchgate.net/figure/The-Akhet-hieroglyph-Cf-Frischers-zone-3-figure-6_fig19_317647684/download
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