

Kerkenes *eclipse*

MEDES, LYDIANS, THE "BATTLE OF THE ECLIPSE"

AND
THE HISTORICITY OF HERODOTUS

G.D. Summers

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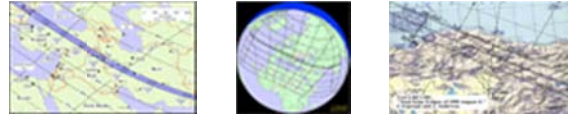
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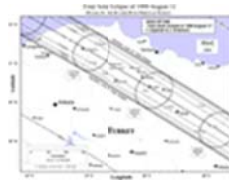
MEDES, LYDIANS, THE "BATTLE OF THE ECLIPSE" AND THE HISTORICITY OF HERODOTUS

G.D. Summers

The last total eclipse of the sun in the Second Millennium AD followed a track across northern Anatolia, visible from the northern edge of the Anatolian Plateau including northern Cappadocia, on August 11, 1999. From a high vantage point, on the Camlik Pass



between Yildizeli and Tokat, we had a magnificent panoramic view of this evocative occasion. Most striking was the suddenness of the totality. Without special glasses it was impossible to view the sun at all until the very moment of totality: Slight darkening of the sky and a surprisingly cool breeze raised our expectations, but would hardly have been noticed were it not for the sense of anticipation



At the instant of totality spontaneous applause broke out amongst our international party. This event took place 2,854 years after the solar eclipse made famous in Herodotus Book I, chapter 74.

The 'historical date', that has long been used by students of history, is May 28, 585 BC. The 'astronomical date', i.e. that used by astronomers, is May 28, -584 (see appendix). Herodotus wrote:



war subsequently broke out between the two countries and lasted for five years, during which both Lydians and Medes won a number of victories. One battle was fought at night. But then, after five years of indecisive warfare, a battle took place in which the armies had already engaged when day suddenly turned into night. This change from daylight into darkness had been foretold to the Ionians by Thales of Miletus, who fixed the date for it for the year in which it did, in fact, take place. Both the Lydians and the Medes broke off the engagement when they saw this darkening of the day: they were more anxious than they had been to conclude peace, and a reconciliation was brought about by Syennesis of Cilicia and Labynetus of Babylon, who were the men responsible both for the pact to keep the peace and for the exchange of marriages between the two kingdoms. They persuaded Alyattes to give his daughter Aryenis to Astyages, son of Cyaxares - knowing that treaties seldom remain intact without powerful sanctions. (Translation: [Grene 1987](#)).

This passage from Herodotus has often been discussed, but the identification of the mountain-top city on the Kerkenes Dag in north-central Anatolia with the Pteria of Herodotus ([Przeworski 1929](#), [Summers 1997](#)), and thus identification of the site as a Median imperial city prompts this reappraisal of some of the problems surrounding the account given by "The Father of History". The Median city of Pteria was conceivably founded following the conclusion of the 5 year war between the Median and Lydian empires or, more probably, as the base from which the Medes organised their side of the Median-Lydian war.

The version of events that most closely follows the account given by Herodotus would have the war ending in its sixth year, on May 28, 585 at the "Battle of the Eclipse", somewhere close to the Halys River (the modern Kizilirmak). The Median side was led by Cyaxares (explicitly in Herod. I.16.2 and I.103.2) who had been succeeded by his son Astyages by the time the peace treaty between the Medes and Lydians had been drawn up. The treaty was brokered by Syennesis, apparently the title rather than the name of the king of Cilicia, and Labynetus of Babylon (usually taken to be the Babylonian king Nabonidas, although there are considerable difficulties, ([Beaulieu 1989](#), 80-83). Why should this account given by Herodotus be doubted and, if it is to be doubted, what might be retained as containing some historical truth? The inclusion of prediction by Thales in the narrative makes clear that Herodotus was referring to a total solar eclipse. The date and time of the eclipse, placed on the afternoon of May 28, 585 BC has long been associated with that referred to by Herodotus, there being no other candidate.



THALES

<http://www-groups.dcs.st-and.ac.uk/>

Thales, considered by Aristotle to have been the founder of the Milesian School, was the only presocratic thinker to be acclaimed a sage. The claim that he predicted the 585 eclipse has therefore exercised the minds of philosophers attempting to unravel the origins and progress of philosophical and scientific thought and method, as well as arousing the interest of historians of astronomy and ancient historians in general. Opinion is divided between those who think that Thales did make a prediction and those who think the whole tale was the result of later association of a great name with a legendary event.

Several authorities have put forward forceful arguments that Thales would not have been capable of predicting this or any other eclipse with such temporal or geographic accuracy. The early idea that Thales somehow had access to Babylonian astronomical data and science that enabled him to predict solar eclipses has failed to stand up because, it is now generally accepted, the Babylonians themselves did not have sufficient

knowledge to predict solar eclipses, making further discussion unnecessary ([O'Connor and Robertson 1999](#)). Neugebauer wrote despairingly:

"Concerning the prediction of a solar eclipse in -584 (May 28) by Thales a few remarks may be made here though I have no doubt that they will remain without effect.

In the early days of classical studies one did not assume that in the sixth century B.C. a Greek philosopher had at his disposal the astronomical and mathematical tools necessary to predict a solar eclipse. But then one could invoke the Astronomy of the "Chaldeans" from whom Thales could have received whatever information was required. This hazy but convenient theory collapsed in view of the present knowledge about the chronology of Babylonian astronomy in general and the lunar theory in particular. It is now evident that even three centuries after Thales no solar eclipse could be predicted to be visible in Asia Minor - in fact not even for Babylon." ([Neugebauer 1975](#), 604)

Herodotus, however, brings the prediction into his account and there is considerable body of other ancient tradition, which strongly suggests that Thales was indeed believed to have made a prediction that turned out to be correct (e.g. Diogenes Laertius, derived from Eudemus, and Apollodorus). The strength of this ancient tradition might be taken to infer that Thales' method, whatever its scientific basis or philosophical value, was indeed a method and not just a lucky guess, a stab in the dark. Presumably Thales predicted one particular eclipse, and only to the year 585 B.C. at that, because the tradition would hardly have been so strong had he made numerous eclipse predictions of which only one happened to be correct. Herodotus says that the eclipse was "foretold", i.e. was somehow announced or proclaimed in advance. Panchenko, arguing that the prediction is too well certified to reject as legend and, reasonably, arguing that Thales gained knowledge of Egyptian (rather than Babylonian) astronomy, has advanced an elaborate theory concerning chance intervals between eclipses that enabled Thales to predict the either the eclipse of 582 or that of 581 ([Panchenko 1993](#); [Panchenko 1994](#)). Panchenko further suggested that it was for this prediction that Thales was acclaimed Sage in the same year. According to this reconstruction, Thales' methodology depended on observed eclipses and the date of the 585 eclipse was crucial to the cycle that Thales computed. This cycle was the result of a coincidental and apparent sequence. Panchenko argued for a series of two intervals between consecutive eclipses thus:

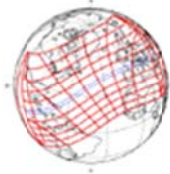
17 lunations to Feb 13, 608, 18 lunations to July 30, 607: = 47 lunations.

17 lunations to Dec. 14, 587, 18 lunations to May 28, 585: = 47 lunations.

He also predicted a further eclipse before end of the 4th year from 585, which was the eclipse that did in fact take place on March 16, 581.

The fact that the cycle has no real basis but was computed from a succession of coincidences does not, of itself, detract from the development of rational thought in the early 6th century B.C., nor therefore from Thales' place in the development of philosophy.

But what is the relationship between modern ingenuity and historical reality? Panchenko's elaborate calculations have been demolished by Stephenson and Fatoohi, who have demonstrated that only the 585 eclipse could have had any impact in Asia Minor ([Stephenson and Fatoohi 1997](#)).



More recently [Espanak](#) has made an enormous amount of data on ancient eclipses easily accessible. For the 585 eclipse click the image.

Panchenko's theory also assumes, with Plutarch, that Thales was declared the first and the only presocratic sage of the seven sages for his rational thinking and more directly suggests that the honour was awarded specifically for his prediction of the eclipse. In the other six cases however, the acclimation of sage was awarded for political brilliance and, as O'Connor and Robertson have pointed out, Thales was also a shrewd politician ([O'Connor and Robertson 1999](#)).

An earlier attempt at finding a solution to the problem of how Thales made the prediction was made by Hartner, but this too contains special pleading and has found little acceptance despite the skill with which it was constructed ([Hartner 1969](#)). Hartner presumes that Thales had discovered the Exeligmos cycle from study of precise records that would have been kept at Miletus. From these putative records, it is assumed, Thales was able to predict an eclipse at Miletus on May 18, 584 BC, an eclipse that was, as it turned out, of insufficient magnitude to have been noticed in Ionia. On the basis of further assumptions concerning irregularities in the calendar Hartner suggests that the 585 eclipse, which would have been a surprise to Thales himself, was fitted into the prediction for the year in which it did in fact take place. To quote the harsh judgement of Mosshammer:

"Hartner's ingenious approach only serves to demonstrate how utterly fictional the story of Thales' prediction is" ([Mosshammer 1981](#), 147).

Detractors have also argued that because Thales' disciple Anaximander clearly did not understand the true nature of solar eclipses, Thales' prediction must be considered spurious. This argument appears, however, to be weak since Thales' prediction may have been correct although based on a false premise.

In summary, the strength of the ancient tradition indicates that Thales did indeed predict an eclipse for the year in which it happened. The basis on which the prediction was made is unknown, and the accuracy appears to have been the result of chance circumstances.

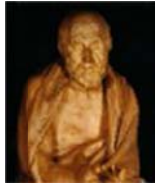


THE ECLIPSE

A second line of inquiry has centred on the path and time of the eclipse itself. That Herodotus' account concerned the eclipse 585 was understood by Pliny (NatHist 2.53) and rediscovered by Airy, the Astronomer Royal ([Airy 1853](#)). Roller, in a somewhat negative paper, ([Roller 1983](#)), suggested that Airy was perhaps influenced by Pliny, but Airy seems to have been more concerned with astronomy than with ancient history and made no reference to Pliny. Modern calculations of the exact time and precise path are not as accurate as might be hoped because of uncertainties caused by minor changes in the speed of the earth's rotation. It is nevertheless certain that a total eclipse of the sun would have been visible from north central Anatolia in the late afternoon of May 28, 585 (most recently [Stephenson and Fatoohi 1997](#)). There is little to be gained by suggesting the eclipse was too close to sundown to have made an impact ([Mosshammer 1981](#), 148), since the eclipse had obviously made a considerable impression, whether or not Herodotus was correct to associate it with the end of the battle. Given that the sky was clear a total eclipse, even shortly before sunset, would have had a profound impact on the observer.

In the course of our own observations of the August 11 eclipse in 1999 we were stunned by the suddenness of the totality and the fact there was no indication that a total eclipse was about to take place until a slight darkening and cool breeze shortly before totality itself. On the Cappadocian Plain even an eclipse late in the day would have been seen as a sudden and awe-inspiring event. The maximum duration of totality during the the 585 eclipse was a fraction over six minutes ([Esenak 1999](#)), almost two and a half times longer than our view of the A.D. 1999 event.

Worthen has suggested that the whole passage is misunderstood. He would combine the battle that took place at night with the eclipse and retranslate Herodotus in such a way as to make the eclipse lunar ([Worthen 1997](#)). This approach requires much rewriting of Herodotus, denies any ancient tradition of Thales prediction of a solar eclipse and is strongly based on calculations concerning the path of totality for the 585 solar eclipse. Further, Worthen postulated a total lunar eclipse at sunset because lunar eclipses are not sudden events but take a considerable time to gradually reach totality. Worthen also rejects the 585 eclipse because his calculations suggest that it would not have been total anywhere near the battle and would not, therefore, have had the impact ascribed to it by Herodotus. But Fatoohi and Stephenson, as well as Esenak, produce maps showing the band of totality passing right across Central Anatolia ([Stephenson and Fatoohi 1997](#), [Esenak 1999](#)).



HERODOTUS

In his account of the Medeo-Lyidian War Herodotus mentions a battle that took place at night (Herod. 1.74.1) as well as the "Battle of the Eclipse". Commentators who maintain that the night battle should in fact be understood as another reference to the "battle of the eclipse" (e.g. [Cobbe 1967](#), 32n.18; [Worthen 1997](#)) may be correct. It is wrong, however, to argue, on the one hand, that the eclipse itself had little or no impact and, on the other, that the eclipse not only ended the battle but gave rise to a tradition that the battle took place at night. The furthest that it seems possible to take the evidence is to suggest that Herodotus had several conflicting or confused sources that he attempted, incorrectly, to weave into a single coherent account. Were that to in fact be the case, it might be argued that there was indeed a war in progress between the Medes and the Lydians during the eclipse that took place in May, 585, because there would be evidence for at least two different traditions of the same event, one of which Herodotus himself misunderstood. Conflation of two separate passages in *The Histories*, those relating to the night battle and the battle that was brought to an end by an eclipse, into a single event may not, however, be methodologically sound. Scholars who suggest that Herodotus himself combined different events, such as battles and eclipses, into a single story, only compound the problems by then suggesting further conflation of events in the narrative.

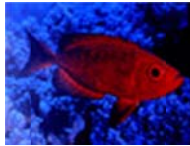
A further curiosity is the point at which Herodotus chooses to refer to the prediction of Thales in his narrative. The very mention of Thales seems to be an aside, for there is no suggestion that the eclipse itself played any role in the battle or its outcome, but rather that the two sides, the Medes and the Lydians, took it as an omen. Note the way in which Herodotus handles it: "the year in which it did in fact take place", a fairly vague time frame. Why was it included at all? Possible motives come to mind: an attempt to fix the chronology, since the reader would have known which eclipse Thales had predicted; the inclusion of Thales to give added credibility or to explain the day turning into night as a solar eclipse; to enhance the reputation of Thales; to demonstrate to the reader that Herodotus himself did not believe that eclipses were divine portents; or simply for dramatic effect. None of these motives needs to have been mutually exclusive. Herodotus surely considered the eclipse and its prediction to be of relevance and importance.

If Thales had not in fact made the prediction (as some would argue), was the story already current in Herodotus' day or did he make it up? And if the story was current, did Herodotus believe it or did he knowingly write a fabrication into his "history"? Those who take the line that Herodotus knowingly included falsehoods, could well take leave to doubt the rest of the passage.

To recap so far: an eclipse took place, visible from Central Anatolia in the late afternoon of May 28, 585 BC which Herodotus, rightly or wrongly, associated with an eclipse predicted to the Ionians by Thales for that same year.

THE BATTLE

An equally intractable problem is the association of the eclipse with the battle. Did the war between the Medes and the Lydians come to an end with the eclipse on May 28, 585 or is Herodotus so unreliable that his "history" has to be discounted?



a red herring ?

Whether or not Thales was a red herring, there are serious and irreconcilable chronological problems in the literal acceptance of the Herodotean account.

One way of approaching these chronological difficulties is to disassociate the culmination of the war and its final battle from the 585 eclipse. It has to be admitted that there is another instance of Herodotus associating a battle with an eclipse which can be shown to have its basis in storytelling rather than historical accuracy ([Mosshammer 1981](#), 151-53 & n. 18). Herodotus relates (7.37) that a total eclipse occurred in 480 B.C. just as Xerxes set out from Sardis to Abydos although it is certain that no eclipse occurred in or around 480 B.C. It has been argued, however, that in this instance there was a clear motive ascribable to the subterfuge ([Panchenko 1994](#), 276). It is legitimate, then, to suggest that in dealing with earlier and more shadowy events the temptation to telescope two events into one, either by Herodotus himself or by an earlier, lost, source, might explain away inconsistencies. In this case, one possibility would be to contemplate the continuation of the war between the Medes and the Lydians for some years after the "battle of the eclipse" thereby lowering the date of the peace treaty that was eventually drawn up between Astyages and Alyattes. A later tradition had it that there was another, later, war between these same protagonists ([Cobbe 1967](#), [Huxley 1965](#)).

To sum up thus far: there was an eclipse on May 28, 585, traditionally and perhaps actually predicted by Thales, when it seems possible and perhaps probable that a war was in progress between the Medes and the Lydians.

Now to consider the role of the eclipse. From here on I take it that the battle and the eclipse did coincide; doubters need read no further. The Herodotean account would have readers understand that the eclipse was taken by the protagonists on both sides as a sign from the heavens that they should make peace. The internationally brokered peace treaty would have taken time to arrange, much discussion, and very considerable diplomacy. The Cilicians and Babylonians saw it as being in their own interests to foster peace. One would dearly like to have the text of the treaty itself. It may be imagined, then, that the eclipse brought about a cessation of hostilities, but that the ensuing treaty was not finalised until some considerable time afterwards. Cobbe proposed an interval of three years ([Cobbe 1967](#)). We have no idea either where the negotiations were held nor where the treaty was signed. Some of its important terms were reported by Herodotus: a fixing of the border between the Median and Lydian empires at the Kizilirmak (which had earlier been the eastern border of Phrygia and thence of imperial Lydia) and a royal marriage between the Median king Astyages and Aryenis, a daughter of Alyattes and by the same token a sister of Croesus.

Huxley has very recently revived the attractive idea that Herodotus intended his audience to understand that a double marriage was involved. Although Herodotus does not provide names, Huxley tentatively suggests that in a reciprocal arrangement a Median princess might have been given in marriage to a member of the Lydian royal family, perhaps even to Alyattes himself ([Huxley 1997/8](#)).

CHRONOLOGY

Chronology impinges on this scenario. Firstly, if Cyaxares led the Median forces in the "Battle of the Eclipse" sufficient time had to have elapsed for his death and funeral and for the elevation of his son Astyages to the throne. Other possibilities exist, including the possibility that Herodotus was in error in relating that Cyaxares himself took part in the battle.

Then there is the thorny problem of Labynetus of Babylon. Labynetus is usually taken to be a Greek rendition of the name of Nabonidas, King of Babylon. The difficulty here has long been realised (e.g. [Drews 1969](#), [Cargil 1977](#), [Beaulieu 1989](#)). Nabonidas does not accede to the throne until c 556. This raises several possibilities: 1. Nabonidas was acting as the representative of the Babylonian King; 2. Herodotus named the wrong king; 3. the peace treaty was not in fact signed until after the accession of Nabonidas; 4. the whole account is fiction, or at least so hopelessly muddled that nothing of worth can be wrung from it. There is no escaping the conclusion that Herodotus probably conflated events. Cobbe has shown that there was a later ancient tradition of second Medio-Lydian war ([Cobbe 1967](#)). It may also be possible that the idea of a second war arose because of the internal difficulties of the Herodotean account and perhaps the irreconcilability of other ancient traditions that are now lost to us. What may and may not have been conflated it is not possible to disentangle: two wars, two peace treaties, numerous traditions and sources?

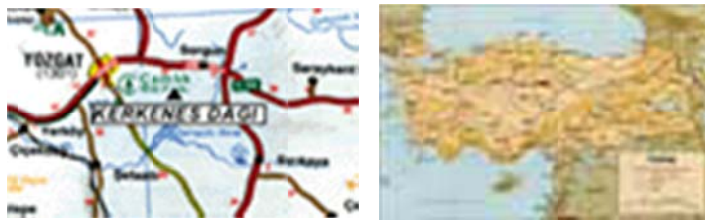
What then survives from this critical but not unsympathetic examination of Herodotus' account of the "Battle of the Eclipse"? There was a war in progress in May 585, perhaps already in its sixth year. Some time after 585 there was a peace treaty that fixed the border at the Halys and there were one royal marriages. An unknown period of time and an unknown number of events took place between the eclipse and the treaty, events that may have included a second war.

There has been a long season of taking Herodotus to task, with the result that much of his reputation is in tatters. Some of the critical deconstruction has been warranted; some has been very negative. Much of the best, and some of the not so best, criticism has come from attempts to study Near Eastern Ancient History in its own right and not as an adjunct of the Classical World seen from the perspective of Greek civilisation. Such revisionist history is to be applauded, but the baby should not be thrown out with the bath water. There are passages in Herodotus where he is imparting information that is demonstrably correct and remarkably accurate, as French has admirably demonstrated for the course of the Achaemenid Royal Road ([French 1997](#)). One casualty of over-zealous reassessment has been the Median Empire. If Thales was a red herring and the rest of the account given by Herodotus was based on fable rather than on factual history, the Medes and their Empire could be consigned to the dustbin not of history but of historiography. That there was a Median Empire, just as

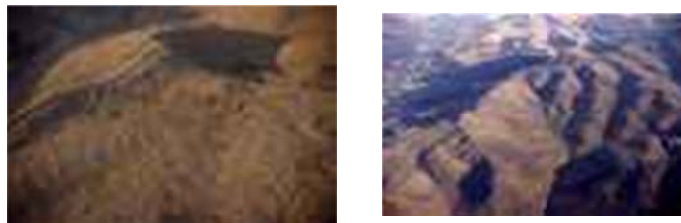
there was a Lydian Empire, can hardly be doubted, nor is the testimony of Herodotus to be lightly discarded ([Huxley 1997/98](#), 11; [Muscarella 1994](#); [Pritchett 1993](#), 231-35). One powerful argument against the reality of a Median Empire as portrayed by Herodotus has been the failure of archaeology to provide material evidence that could in any way be associated with a Median presence in Anatolia. Emphatic archaeological evidence is, however, there. It was recognised as such by Przeworski as early as 1929, but attracted only scant attention ([Summers and Summers 1998](#)).

The EVIDENCE of ARCHAEOLOGY

In central Turkey, north and east of the Halys on the northern edge of the Cappadocian plain a huge and grandiose city was constructed on the Kerkenes Dag in the early sixth century B.C



This city has been identified with the city of Pteria, to use the name given by Herodotus ([Przeworski 1929](#), [Summers 1997](#)). Pteria is also referred to by Stephanos of Byzantium who knew it to have been "a city of the Medes". The source of Stephanos' information is unknown, although he does not seem to have relied solely on Herodotus ([Summers 1997](#)).



Pteria on the Kerkenes Dag was conceivably founded by the Medes as the base from which they campaigned against Lydia and from which they administered their western lands, it was also a city that was set [ablaze](#) by Croesus in the autumn before the fall of Sardis.

CONCLUSION

One school of thought is so suspicious of Herodotus that those who do subscribe to it accuse him of distorting history in order to embellish it. Others, to whom I incline, tend towards accepting Herodotus as is and until there is proof positive to reject him. The position is, of course, more complex. Herodotus was dependent on sources of varying reliability. The further removed in time from the events described the more likely it is that errors crept in (not, in my opinion deliberate lies; in this case, no motivation presents itself beyond perhaps dramatic embellishment). Herodotus was also attempting to write a coherent account, for whatever reasons, and thus wished to pull together various bits of information without, perhaps, the rigour that we might demand, but which we do not always get, from modern scholarship.

The material evidence for Median power in Anatolia exists indeed. The political geography fits very well with the account of Herodotus. Confrontation between Media and Lydia, two of the most aggressive and expansive powers of the ancient world, was perhaps inevitable. The conflict between Media and Lydia and the rise of Cyrus should not be discounted because Herodotus was sometimes mistaken, had occasional lapses of judgement, and was not beyond a certain indulgence in distortion or embellishment, either for dramatic effect, or to make a particular point. After all, Herodotus was writing his histories for a reason, not just for the sake of writing history. At Kerkenes, Herodotus' Pteria, we are beginning to provide a background against which Herodotus' account of the Median-Lyidian war and the conquest of Cyrus can be set.

ACKNOWLEDGMENTS

I would like to express my thanks to all those who have stimulated my thoughts and contributed to the development of my ideas. In particular I express my gratitude to H. Crawford Greenwelt JR. who suggested to me that Thales' eclipse warranted further consideration; he and David Stronach have kindly commented on an earlier version of this paper which has led to considerable improvement. Nicholas Postgate, J. J. Coulton, E. C. Krupp, Mark Nesbitt and Jennifer Stewart have kindly provided me with copies of literature not available in Ankara. All faults and errors, of both fact and interpretation, remain my own.

I am most grateful to F. Espenak and NASA for permission to reproduce data and images from their eclipse web pages. Renger Sobbiah took the photograph of the 11. August eclipse from the Çamlık pass.

This paper is an experiment in electronic publication. The advantages lie in the ability to add links to other sections of the Kerkenes Project web page and to other electronic publications. A further advantage is the inclusion of colour illustrations both within the body of the paper, as zoomable thumb nails, and through links. Publication on the web also enables readers to communicate directly with the author via e-mail and will permit future updates and additions to be made, should such be desired.

APPENDIX

There has been much debate about the exact beginning of the Third Millennium AD that has resulted from the astronomical use of year zero. I am grateful to the scholars quoted below for permission to quote from recent e-mail discussion touching on this subject, and to Fred Espanak of NASA for permission to quote from his "Eclipse Predictions" web page.

J.M.Steele. Thu May 23 10:01:24 1996

To: Ancient Near East list <ane@mithra-orinst.uchicago.edu>

"To further add confusion to the dating problem, it is the common use of historians of astronomy to use a system known as Julian Years to give a continuous dating system. In this system, there is a year 0 - it is the year before 1 AD. Hence year 0 = 1 BC, -1 = 2 BC, and so on. For comparing astronomical events in the past, such as the solar eclipse that was total in Babylon on 15 April 136 BC, it is much easier to call this year -135 April 15. For examples of dates of this kind, see the translation of the Babylonian astronomical diaries by Sachs and Hunger, or Sachs' Late Babylonian Astronomical Texts (LBAT).

This may seem a strange system of dating to many Ancient Near East scholars, but believe me it is by far the best when dealing with ancient astronomy."

From t.sagrillo@utoronto.ca Thu May 23 10:02:24 1996

To: ANE List <ANE@oi.uchicago.edu>

"- astronomers START *counting* AT 0 (and thus the FIRST whole year is called "year 0", which would be *historical* year 1 CE), unlike historians who for some reason START at 1 (i.e., the "zero" point for historians is *not* 0, but 1 BCE/1 CE).

The 28 May 585 BCE date is the *historical* date of the eclipse; the astronomical date would be 28 May -584 (astronomers avoid the confusion of the BCE/CE label all together).

Just make sure, I confirmed this with my astronomy software (Voyager II 2.02). (I used Athens as a viewing point.) The results are:

Athens 23 deg. 43' E; 37 deg. 58' N

Processional epoch -583

Date: 28 May -584 (historical 585 BCE); Julian Date 1507900.089

Time: 16:08 (04:08 pm) local time, 14:08 Universal Time (GMT)

Altitude: +37 deg. 08'

Angle of separation between sun and moon: 20 deg. (i.e., not total)

Using Voyager II 2.02:

Athens

Date: 23 Oct. -527 (528 BCE); Julian Date 1528866.767

Time: 08:24 (08:24 am) local time, 06:24 Universal Time

Altitude: +18 deg. 40' (low to horizon)

Angle of sep.: 27 deg. (more than 28 May -584)

Also came up with:

Athens

Date: 30 June -530 (531 BCE); Julian Date 1527656.000

Time: 14:00 (2:00 pm) local time, 12:00 Universal Time

Altitude: +64 deg. 22'

Angle of sep.: 06 deg. (total eclipse)"

From J.M.Steele. Thu May 23 10:03:15 1996

To: ane@mithra-orinst.uchicago.edu

"In order to calculate the circumstances of eclipses in the past, it is necessary to take full account of variations in the rotation of the Earth (for a discussion see Stephenson and Morrison, Phil. Trans. Royal Society of London, A, (1995) 351, 165-202). Many eclipse programs, and Oppolzer's canon, fail to do this."

From t.sagrillo@utoronto.ca Thu May 23 10:03:21 1996

To: [geoffrey summers <summers@metu.edu.tr>](mailto:geoffrey.summers@metu.edu.tr)

I ran the numbers in Voyager II for Ankara instead:

Date: 28 May -584 (historical 585 BCE); Julian Date 1507900.094

Time: 17:16 (05:16 pm) local time, 14:16 Universal Time (GMT)

Altitude: +28 deg. 30'

Angular separation between sun and moon: 14 deg. (not total but darker than Athens!)"

As John Steele notes, this programme is admittedly not 100% accurate. The manufacturer states that the programme uses resolutions of 1 min. of time and 1 min. of angle and is intended for a broad audiences -- including specifically archaeo-astronomers and scientists. While the *precise* numbers listed above are therefore somewhat suspect, it cannot be doubted that an eclipse did in fact occur on 28 May 585 BCE at about 5:15 pm

and was visible in central Turkey."

From J.M.Steele. Thu May 23 10:04:26 1996

To: geoffrey summers < summers@metu.edu.tr >

"There was an eclipse of the sun on 28 May 585 BC visible in the area you gave me. Here are the details assuming 35 deg east and 39 deg north :

Magnitude = 0.9627

UT at Max phase = 16.08 hours

Alt at Max phase = 6.4 degrees

This eclipse was not total, however given the uncertainties in position and Delta T (the clock error introduced by variations in the Earth's rate of rotation), it is possible that totality was observed somewhere in this area."

-0584 May 28 14:13 T 57 0.316 1.080 37.9N 42.4W 71 271 06m05s

<http://sunearth.gsfc.nasa.gov/eclipse>

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