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THE ECLIPSE OF XERXES IN HERODOTUS 7.37: *LUX A NON OBSCURANDO**

Reports of lunar and solar eclipses are of interest to students of both history and the history of science. Used with care, they can anchor significant historical events in time.[1] Greek literature, like that of other civilizations, has its fair share of such reports. Often they motivate the actions of characters or expose aspects of belief. Sometimes they shed light on the assumptions of the writer. There are three places in the *Histories* of Herodotus where the author mentions darkenings of the sky (generally taken to be solar eclipses), which have narrative significance and which assist in dating the wars between the Lydians and the Medes (1.74) and between the Greeks and the Persians (7.37 and 9.10).[2]

The Eclipse of Xerxes (7.37), so called because it occurs as the eponymous Persian king sets out to invade Greece in 480 B.C.E., is puzzling for two main reasons. First, there appears to be confusion over its interpretation: in particular, it is not clear why Xerxes' religious advisers, the Magi, tell him that it is a favourable omen. Second, unlike the other two reported eclipses, it did not actually occur.

The puzzle is not new and hardly admits of a definitive solution, but throws up questions at every turn.[3] Yet, in presenting and weighing the arguments, we can build up a better picture of contemporary religious and scientific understanding, both in the minds of the historian and his audience, and in the wider cultural region too. My own solution to the puzzle, though not without weaknesses, takes fuller account of the evidence than appears in the standard commentaries and makes better use of what is known of ancient

* My thanks are due to Elizabeth Glover for her insightful remarks, to *CQ*'s anonymous reader for assisting with focus, and to Professor Brian Everitt for encouragement and advice.

[1] An important *caveat* arises for distant epochs, owing to the risk of circular reasoning. Dated observations of astronomical phenomena are the basis for estimation of the critical parameter ΔT, which is the accumulated deviation from a uniform time scale caused by the Earth's variable rate of rotation. These observations become sparser the further back in time one goes. Yet, ΔT in turn may be used to fix the dates of astronomical phenomena and thus the contexts in which they are described: see F.R. Stephenson, 'How reliable are archaic records of large solar eclipses?', *JHA* 39 (2008), 229–50; L.V. Morrison and F.R. Stephenson, 'Historical values of the Earth's clock error ΔT and the calculation of eclipses', *JHA* 35 (2004), 327–36. However, by comparing two sets of independent data, the authors show that the values for ΔT can be quite accurately interpolated with cubic spline functions down to about 700 B.C.E. (a parabolic estimator being used for earlier times) and are thought to be reliable to this date.

[2] The first of these, the Eclipse of Thales, has been controversial with some historians of science: see O. Neugebauer, *The Exact Sciences in Antiquity* (Princeton, NJ, 1951), 142–3, a view I do not share.

[3] It was already debated over a century ago: see W.T. Lynn, 'The eclipse of Xerxes', *The Observatory* 13 (1890), 327–8; J.N. Stockwell, 'On the rectification of chronology by means of ancient eclipses', *Astronomical Journal* 10 (1891), 185–9.

astronomy.[4] However, it is first necessary to examine the background to the study of eclipses in antiquity in order that the problems and attempted solutions can be understood.

I. ECLIPSES IN ANTIQUITY

Eclipses, both lunar and solar, were phenomena of fear and wonder in the ancient world.[5] The cause of eclipses was first understood in Greece during the sixth and fifth centuries B.C.E., possibly with the speculations of Thales or, failing that, certainly by the time of Anaxagoras.[6] Interestingly, however, the art of eclipse prediction in Antiquity developed sooner than physical understanding, and it took place not in Greece but in Mesopotamia. The Babylonian astronomer-priests, who, outside China, were the most assiduous observers of eclipses during the first millennium B.C.E., never seem to have developed any spatial astronomical theory and relied on manipulating numerical relationships to carry out their work.[7] We do not know how, or even if, they thought of eclipses in physical terms, whether in respect of solar eclipses (in which the Moon lies between the Earth and the Sun) or the conceptually more difficult and less obvious case of lunar eclipses (in which the Earth lies between the Sun and the Moon).[8] In cuneiform texts, now known as *Astronomical Diaries*, various celestial phenomena including eclipses were recorded. These go back to 652 B.C.E., although the earliest survive only in later copies from the Seleucid era.[9] Ptolemy states that eclipses were recorded from at least the start of the reign of the Assyrian king Nabonassar in 747 B.C.E.[10]

[4] Commentaries repeatedly cited are H&W = W.W. How and J. Wells, *A Commentary on Herodotus* (Oxford, 1928), and Macan = R.W. Macan, *Herodotus: The Seventh, Eighth, & Ninth Books: With Introduction, Text, Apparatus, Commentary, Appendices, Indices, Maps* (London, 1908).

[5] Plin. *HN* 2.15 charts the transition from ignorance to knowledge.

[6] An anonymous commentary on Hom. *Od.* 20 (*P. Oxy* 3710, col ii, fr. c, 36–43) attributes to Aristarchus the view that Thales understood the geometry of solar eclipses. Stronger is the evidence for Anaxagoras, as stated in Pl. *Cra.* 409a7–b8. It has been suggested that Anaxagoras witnessed the annular solar eclipse of 17 February 478 B.C.E. in Athens and derived estimates for the size of the Sun and Moon; see D.W. Graham and E. Hintz, 'Anaxagoras and the solar eclipse of 478 BC', *Apeiron* 40 (2007), 319–44. For detailed analysis (though prior to the Oxyrhynchus evidence for Thales), see D. O'Brien, 'Derived light and eclipses in the fifth century', *JHS* 88 (1968), 114–27.

[7] O. Neugebauer, *A History of Ancient Mathematical Astronomy* (Berlin, 1975), 1.2, Introduction. The Babylonians were not dispassionate observers, however, and concentrated on phenomena which they deemed to be ominous: see F. Rochberg-Halton, 'Between observation and theory in Babylonian astronomical texts', *JNES* 50 (1991), 107–20. They also invented astronomical phenomena which could never occur, such as constellations approaching each other: see D. Brown, *Mesopotamian Planetary Astronomy–Astrology* (Groningen, 2000), §3.2.1.

[8] Neugebauer (n. 7) 1.2, 550, points out that understanding the true nature of a lunar eclipse is tantamount to knowing the Earth to be spherical, whereas understanding a solar eclipse does not entail knowing more than what is already apparent to the eye, namely that the Sun and Moon present themselves as discs. Anaxagoras, who espoused the notion of a flat Earth and was mindful of the geometrical problem that this would cause, postulated celestial bodies, in addition to the Earth, as causes of lunar eclipses. It seems likely that Herodotus' own astronomical understanding was rudimentary, judging from his analysis of the annual Nile flood (2.24). However, he may have understood the basic cause of eclipses to be the blockage of the Sun's light by the Moon or the Earth.

[9] Established by A.J. Sachs, 'Babylonian observational astronomy', *Philosophical Transactions of the Royal Society A* 276 (1974), 43–50. The standard edition is A.J. Sachs (completed by H. Hunger), *Astronomical Diaries Vols I–VI* (Vienna, 1988–2006).

[10] *Alm.* 3.6 (*Syntaxis Mathematica* Teubner 254, 3–13). The date is generally accepted: see Neugebauer (n. 7), 1.2, 549.

From these diaries and related astronomical texts, including reports sent to Assyrian kings, almanacs, ephemerides (documents giving positional information on celestial objects), and eclipse tables, the progress of Babylonian astronomy as a predictive science during the Greek Archaic, Classical, and Hellenistic periods can be roughly gauged.[11] It is my contention that aspects of Babylonian astronomy help us to resolve the puzzle of the Eclipse of Xerxes.

It has been shown that, by about 550 B.C.E., through arithmetical tabulation and extraction of difference sequences, the Babylonians were able to predict lunar eclipses (visible everywhere on Earth) with an accuracy of 90% to within a timing error of around an hour.[12] For the much more difficult case of predicting solar eclipses (only visible in a restricted area), the Babylonians had achieved accuracy to within about two hours from around 350 B.C.E., *provided that the geographical locus of the eclipse was ignored*. In practice, their predictions for the latter appeared to fail about 55% of the time, since these missing eclipses – those which were said to have 'passed by' – were only visible in locations far removed from the Middle East.[13] Without some kind of geometrical theory, determination of not only *when* but *where* a solar eclipse would be visible could make no further progress.

In Greece, following the explanations first put forward by philosophers such as Anaxagoras, eclipses were clearly understood in broad spatial terms in the later fifth century by an educated elite, but probably not by the bulk of the population. Thucydides, for example, writes of the partial solar eclipse of 3 August 431 B.C.E. as if the phenomenon were quite well understood, at least by him (see below). The later accounts by Cicero and Plutarch of the same eclipse contrast the matter-of-fact explanation given at the time by Pericles (derived, possibly, from Anaxagoras in person) with the fearful ignorance of the general populace.[14] During the following century, when Aristotle presented his arguments in favour of the sphericity of the Earth, the geometrical explanation of eclipses was clearly taken for granted and was, presumably, seen as a consequence of the models of the heavens then being put forward.

However, while the Greeks of the Classical era understood eclipses in qualitative spatial terms, they had no tradition of data tabulation and arithmetical analysis to rival that of the Babylonians. Consequently, without adequate empirical support, they had no means of predicting even lunar eclipses, and it was not until the time of Hipparchus in the second century B.C.E. that data and theory combined sufficiently to enable geographically relevant solar eclipse predictions to be made.[15]

Improvement in the qualitative understanding of eclipses went hand in hand with specialization in the vocabulary. The earliest use of the word ἔκλειψις to mean 'eclipse' in its full astronomical sense occurs in Thucydides (1.23.3), where he remarks:

[11] For the haphazard provenance, relative sparsity, and complexity of the Babylonian 'mathematical' sources, see Neugebauer (n. 7), 1.2, 351–3. A recent account can be found in Brown (n. 7), Introduction.

[12] J.M. Steele and F.R. Stephenson, 'Lunar eclipse times predicted by the Babylonians', *JHA* 28 (1997), 119–31.

[13] J.M. Steele, 'Solar eclipse times predicted by the Babylonians', *JHA* 28 (1997), 133–9.

[14] Plut. *Vit. Per.* 35.1–2 ; Cic. *Rep.* 1.16.

[15] This was possible owing to the incorporation of Babylonian numerical data into Greek geometrical analysis: see Neugebauer (n. 7), 1.1, 308–9. Note also that Plin. *HN* 2.10 credits Hipparchus as the originator of contemporary eclipse theory.

… ἡλίου τε ἐκλείψεις, αἳ πυκνότεραι παρὰ τὰ ἐκ τοῦ πρὶν χρόνου μνημονευόμενα ξυνέβησαν …

… and eclipses of the Sun, which occurred more frequently than those recorded in prior times …[16]

a statement which was not true in fact, but perhaps reflected popular opinion among a citizenry abnormally attuned to portents in time of war. In 2.28 we find the description of the aforementioned solar eclipse of 3 August 431 B.C.E.:

τοῦ δ᾽ αὐτοῦ θέρους νουμηνίᾳ κατὰ σελήνην, ὥσπερ καὶ μόνον δοκεῖ εἶναι γίγνεσθαι δυνατόν, ὁ ἥλιος ἐξέλιπε μετὰ μεσημβρίαν καὶ πάλιν ἀνεπληρώθη, γενόμενος μηνοειδὴς καὶ ἀστέρων τινῶν ἐκφανέντων.

The same summer, at the beginning of a new lunar month (the only time indeed when it appears possible), the Sun was eclipsed in the afternoon and then returned to its full size, having assumed a crescent shape and allowed the stars to shine out.

The descriptive accuracy of this passage suggests that the author understood the basic astronomical configuration and had probably witnessed the event. The 'stars' referred to were probably the planets Venus, Mercury, and Saturn and some of the brighter stars. This eclipse was partial in Athens in the late afternoon, achieving a magnitude of 88% at 15:58 UT.[17]

Similarly, in 4.52.1 we have the report of the partial solar eclipse of 21 March 424 B.C.E., again with mention of the necessary lunar phase:

τοῦ δ᾽ ἐπιγιγνομένου θέρους εὐθὺς τοῦ τε ἡλίου ἐκλιπές τι ἐγένετο περὶ νουμηνίαν …

And at the very beginning of the next summer there was an eclipse of the Sun at the time of the new Moon …

Finally, in 7.50.4 he records the total lunar eclipse of 28 August 413 B.C.E., which took place during the infamous Sicilian expedition (note, again, the reporting of the lunar phase):

καὶ μελλόντων αὐτῶν, ἐπειδὴ ἑτοῖμα ἦν, ἀποπλεῖν ἡ σελήνη ἐκλείπει· ἐτύγχανε γὰρ πασσέληνος οὖσα. καὶ οἱ Ἀθηναῖοι οἵ τε πλείους ἐπισχεῖν ἐκέλευον τοὺς στρατηγοὺς ἐνθύμιον ποιούμενοι, καὶ ὁ Νικίας (ἦν γάρ τι καὶ ἄγαν θειασμῷ τε καὶ τῷ τοιούτῳ προσκείμενος) οὐδ᾽ ἂν διαβουλεύσασθαι ἔτι ἔφη πρίν, ὡς οἱ μάντεις ἐξηγοῦντο, τρὶς ἐννέα ἡμέρας μεῖναι, ὅπως ἂν πρότερον κινηθείη.

And as they were about to sail away, since they were ready, the Moon was eclipsed. For it happened then to be full and most of the Athenians, taking this to heart, urged the generals to stay put; and Nicias (a man too much inclined to such superstition) said he would not consider how he should move until, as the seers directed, they had waited thrice nine days.

[16] All translations from Greek are mine unless otherwise stated. Unless indicated otherwise, Greek text is taken from the appropriate OCT.

[17] The term *magnitude* refers to that proportion of the diameter of the eclipsed body which is obscured. A total eclipse has a magnitude of 100% or greater, a partial eclipse has a magnitude of less than 100%. The abbreviation *UT* refers to Universal Time, essentially the modern form of Greenwich Mean Time. Locations in ancient Greece and western Anatolia can be thought of (anachronistically) as being between 1.5 and 2 hours ahead.

These passages show that, by the end of the fifth century B.C.E., eclipses were quite well understood as natural phenomena by at least a few of the educated Greeks. They could also describe them using appropriate vocabulary, even if many still regarded them as ominous (the two interpretations are not necessarily mutually exclusive, of course).

Before Thucydides, though, ἔκλειψις and related words occur only in the general sense of 'abandonment' and are not necessarily used in descriptions of phenomena that clearly are eclipses. However, a transitional use may occur in Aristophanes, *Clouds* 582–6, where the leader of the eponymous chorus says:

… τὰς ὀφρῦς ξυνήγομεν
κἀποοῦμεν δεινά, βροντὴ δ᾽ ἐρράγη δι᾽ ἀστραπῆς.
ἡ σελήνη δ᾽ ἐξέλειπεν τὰς ὁδούς, ὁ δ᾽ ἥλιος
τὴν θρυαλλίδ᾽ εἰς ἑαυτὸν εὐθέως ξυνελκύσας …

… we knitted our brows
And made terrors, and thunder was split by lightning.
The Moon abandoned [or, was eclipsed in] her paths and the Sun
Immediately drew in his wick to himself …

This, of course, is not intended as a historical report but it does illustrate, more or less, the 'correct' use of the term.[18] From these considerations, therefore, it seems that the use of this word in its specialized sense must have developed during the second half of the fifth century B.C.E. and, if not initiated by a philosopher such as Anaxagoras, then perhaps by the astronomer Meton or one of his circle.[19] Such terminological specialization fits in well with the emergence of 'academic disciplines' during these decades.[20]

II. ANALYSIS OF HISTORICAL ECLIPSES

The accuracy of Babylonian eclipse prediction was not high by modern standards, being essentially a matter of determining the Saros cycle of 223 lunar months and sub-periods of 6 months (33 occurrences) and 5 months (5 occurrences) within it.[21] Knowledge of these period relations, especially the two shorter ones, goes back at least to the seventh century B.C.E.[22] Modern eclipse theory, of course, is far more accurate, but only in the last two centuries has it become sufficiently comprehensive in terms of date, time, and place for the analysis of historical eclipses to be viable.

Two early attempts to analyse the first Herodotean eclipse (1.74), the Eclipse of Thales (now widely, but not universally, accepted as that of 28 May 585 B.C.E.), were made by Baily in 1811 and Oltmanns in 1812, though neither in fact succeeded in its correct identification. In a paper delivered to the Royal Society in 1852, George Airy,

[18] I have given the text according to K.J. Dover (ed.), *Aristophanes: Clouds* (Oxford, 1968). He notes (ad loc.) that this part of the play was composed in late 424 B.C.E. As he observes, there was a total lunar eclipse on 9 October 425 B.C.E. and a partial solar eclipse in Athens on 21 March 424 B.C.E. but, while topical, these can hardly be used to 'date' the action of the play.

[19] Meton appears in Ar. *Av.* 993–1018 and is mentioned in Ptol. *Alm.* 3.2 (Teubner 205, 15–21) as having observed the June solstice of 432 B.C.E. in Athens, during the archonship of Apseudes.

[20] For emergent subject specialisms, see J.A. Bromberg, 'Academic disciplines in Aristophanes' *Clouds* (200–3)', *CQ* 62 (2012), 81–91.

[21] For analysis and nomenclature, see Neugebauer (n. 7), 1.2, 497–9 (also Neugebauer [n. 2]), 502–4, 525.

[22] Neugebauer (n. 7), 1.2, 542.

the Astronomer Royal, summarized and criticized past attempts to analyse historical eclipses.[23] Airy, who had studied Classics as well as mathematics at Cambridge, turned his attention to two of the three Herodotean eclipses (1.74 and 7.37).[24] Since then, ephemerides have become more accurate, the orbital dynamics of the Moon better understood, and computational techniques vastly improved. These factors, together with better estimates for the Earth's rotational clock error (ΔT), mean that nowadays it is possible for any researcher to make use of accurate and comprehensive datasets.[25]

Given that eclipses were general objects of wonder, even alarm, in the ancient world, it is no surprise that they are mentioned in early Greek literature. The language is not precise, but there are characteristic references to the disappearance of the Sun or an unexplained darkening of the sky, together with suggestions of coolness or humidity. If the day grows dark, there are only three possible explanations: atmospheric obscuration (such as clouds or dust storms), nightfall, or an eclipse; and it is inconceivable that ancient people were unable to recognize the first two. The language used before the later Classical period is vague but is appropriate to the genre in which it occurs and fairly consistent.

The earliest eclipse description in Greek may be in the *Odyssey* (20.356–7), reflecting in some way perhaps the solar eclipse of 16 April 1178 B.C.E., which was total over Corfu around noon.[26] Another early poetic description occurs in a fragment of Archilochus (*IE*^{2}, vol. 1, fr. 122 + *P. Oxy*. 22.2313 fr. 1a).[27] If this is an allusion to a recent solar eclipse it may be that of 6 April 648 B.C.E. or (perhaps more likely, in view of the time of day) that of 27 June 661 B.C.E.[28] With Archilochus we are still in the realm of the prescientific, of course; moving into the Classical era, however, we have Pindar's description of a solar eclipse in *Paean* 9.1–5, which suggests, at a time of great intellectual advance, the still primitive sense of bafflement and powerlessness occasioned by such events.[29]

[23] G.B. Airy, 'On the eclipses of Agathocles, Thales, and Xerxes', *Philosophical Transactions of the Royal Society of London* 143 (1853), 179–200.

[24] The disparagement of Airy's analysis in J. North, *Cosmos* (Chicago, IL, 2008), 95, seems overdone and to be based on the scepticism of scholars such as Neugebauer towards the Eclipse of Thales. It arises, perhaps, from unfamiliarity with the typical formulaic vagueness of early Greek eclipse descriptions.

[25] I have used two: F. Espenak and J. Meeus, *Five Millennium Catalog of Solar Eclipses: –1999 to +3000 (2000 BCE to 3000 CE), Revised* (NASA Technical Publication NASA/TP-2009-214174, 2009), cited as *FMCSE* and available online at http://eclipse.gsfc.nasa.gov/SEcat5/SEcatalog.html, and F. Espenak and J. Meeus, *Five Millennium Catalog of Lunar Eclipses: –1999 to +3000 (2000 BCE to 3000 CE)* (NASA Technical Publication NASA/TP-2009-214173, 2009), cited as *FMCLE* and available online at http://eclipse.gsfc.nasa.gov/LEcat5/LEcatalog.html (both last retrieved 17 February 2013). Espenak and Meeus use the estimates for ΔT as derived by Morrison and Stephenson (n. 1). For the time period we are concerned with (*c.* 480 B.C.E.), the interpolated value of ΔT is approximately 16,800 seconds (4 hours and 40 minutes) and the standard error estimate for ΔT (given by $\sigma = 0.8\, t^2$, where $t = [\text{year} - 1820] / 100$) is 416 seconds or nearly 7 minutes, which corresponds to 1° 44′ in longitude. At the latitude of Sardis this gives a longitudinal error of approximately ±150 kilometres.

[26] This is the eclipse of the Oxyrhynchus commentator (n. 6). It is not unanimously accepted. For recent support, see C. Baikouzis and M.O. Magnasco, 'Is an eclipse described in the Odyssey?', *Proceedings of the National Academy of Sciences* 105 (2008), 8823–28, which is challenged in P. Gainsford, 'Odyssey 20.356–7 and the eclipse of 1178 B.C.E.: a response to Baikouzis and Magnasco', *TAPhA* 142 (2012), 1–22.

[27] For context, see Arist. *Rh.* 3.17.16.

[28] The eclipse of 648 B.C.E. was total over the central Aegean (though not quite total over either Paros or Thasos), reaching a maximum in the mid-morning at 08:06 UT. The eclipse of 661 B.C.E. was annular, reaching a maximum around 13:30 UT.

[29] Probably the eclipse of 30 April 463 B.C.E., which was partial at Thebes (not total, as reported in many commentaries), reaching a magnitude of 98% at 13:01 UT. See I. Rutherford, *Pindar's Paeans: A Reading of the Fragments with a Survey of the Genre* (Oxford, 2001), 189–200, for analysis.

Obviously, poetic references to eclipses need not refer to actual historical events; they are speculative conjunctions of real (and possibly contemporary) astronomical phenomena with imagined circumstances. However, the situation with historiographical texts is wholly different and it is clearly appropriate to enquire whether eclipse reports help us to understand the chronology of events or to identify the motivations of the actors in the narrative.

III. CURRENT INTERPRETATIONS OF THE ECLIPSE OF XERXES

The Eclipse of Xerxes in Herodotus 7.37 takes place during the first phase of the final Persian advance on Greece. As previously mentioned, it involves difficulties of timing and interpretation. In contrast, the Eclipse of Cleombrotus (9.10), which occurs while the Spartans are making defensive preparations, seems unproblematic. In order to fix the chronology, I shall recapitulate the accepted sequence of events.

In the summer of 480 B.C.E. Xerxes advanced southwards through Greece, reaching Athens via Thermopylae in the middle of September (8.51.1).[30] This timing is secured by references to the Carneia festival and to the Olympic Games (7.206.1–2, 8.26.2) which pin the battle of Thermopylae to late August or early September of that year.[31] Around this time, owing to the threat of invasion of the Peloponnese, the Spartans under the command of Cleombrotus began to construct a defensive wall across the Isthmus of Corinth (8.40.2, 8.71.1–2, 9.7.1).[32]

However, after Xerxes had captured and burnt Athens, but had lost the subsequent battle of Salamis towards the end of September, he decided to withdraw for the winter to Thessaly (8.113.1), from where a new assault would begin in the following spring, led by his general, Mardonius (8.107.1). At this point, Cleombrotus considered whether to attack the retreating Persians. In the event, this plan was not executed and we learn instead that he returned to Sparta (9.10.3):

ἀπῆγε δὲ τὴν στρατιὴν ὁ Κλεόμβροτος ἐκ τοῦ Ἰσθμοῦ διὰ τόδε· θυομένῳ οἱ ἐπὶ τῷ Πέρσῃ ὁ ἥλιος ἀμαυρώθη ἐν τῷ οὐρανῷ.

Cleombrotus led the army away from the Isthmus for this reason: while he was offering sacrifice for victory over the Persian, the Sun was darkened in the sky.

There seems no reason not to accept this as a description of a solar eclipse.[33] It coincides perfectly with the partial eclipse of 2 October 480 B.C.E. which reached a maximum of 61% at 12:02 UT in the vicinity of the Isthmus. Moreover, it fits well with the chronology of the war as established from other textual references.

This was not a prominent eclipse and, ordinarily, few people would have noticed it. However, the circumstances were special. Cleombrotus was performing a 'border ritual'

[30] For a chronology of events see K.S. Sacks, 'Herodotus and the dating of the battle of Thermopylae', *CQ* 26 (1976), 232–48.

[31] So H&W (n. 4) and Macan (n. 4), ad loc. For the date of the Carneia, see W. Burkert, *Greek Religion*, tr. J. Raffan (Oxford, 1985), 234. If the festival ended on the full Moon, this was on 20 August.

[32] See M.A. Flower and J. Marincola, *Herodotus: Histories: Book IX* (Cambridge, 2002), ad loc.

[33] P. Vannicelli, *Erodoto: Le Storie: libro IX* (Milan, 2006) ad loc., rightly dismisses the suggestion of a cloudy sky as being the cause of the darkness, although, of course, clouds often assist in witnessing a solar eclipse.

and would have taken care to ensure that there were no unfavourable omens in the sky.[34] The narrative leaves it open for us to interpret his reaction. Did he consider the eclipse a bad omen or did he use it as an excuse to return home at the end of the military season? Notwithstanding Spartan piety and courage, it is difficult to decide from the information given, but the Spartan interpretation of this eclipse remains a relevant issue.[35]

We might ask whether there were any other eclipses that could serve to mark the ritual of Cleombrotus should it be necessary to reconsider the date. The answer to this is emphatically negative. It is clear from the narrative that the eclipse must have occurred in the autumn, but for several years on either side of 480 B.C.E. there were no autumnal solar eclipses visible in Greece. Therefore, the text effectively nails this eclipse onto the timeline of the war and reinforces the accepted chronology.

It follows that the Eclipse of Xerxes must have occurred in the preceding spring, when Xerxes had set out from Sardis in western Anatolia in order to march into Greece via Thrace.[36] The invasion had been four years in the planning (7.20). A canal had been dug through the Athos peninsula for the accompanying fleet, provision dumps had been established *en route*, and, most famously, the Hellespont bridges constructed from Abydos to Sestos in order to permit the crossing of the army from Asia into Europe. At 7.37 we learn that:

[1] ὡς δὲ τά τε τῶν γεφυρέων κατεσκεύαστο καὶ τὰ περὶ τὸν Ἄθων, οἵ τε χυτοὶ περὶ τὰ στόματα τῆς διώρυχος, οἳ τῆς ῥηχίης εἵνεκεν ἐποιήθησαν, ἵνα μὴ ἐμπίμπληται τὰ στόματα τοῦ ὀρύγματος, καὶ αὐτὴ ἡ διῶρυξ παντελέως πεποιημένη ἀγγέλλετο, ἐνθαῦτα χειμερίσας ἅμα τῷ ἔαρι παρεσκευασμένος ὁ στρατὸς ἐκ τῶν Σαρδίων ὁρμᾶτο ἐλῶν ἐς Ἄβυδον.

When work on the bridges and at Athos was complete, and the groynes at the canal's entrances (which were built to prevent the tide from silting up the entrances of the dug passage) and the canal itself were reported to be completely finished, the army then wintered, and at the beginning of spring made ready and set forth from Sardis for Abydos.

[2] ὁρμημένῳ δέ οἱ ὁ ἥλιος ἐκλιπὼν τὴν ἐκ τοῦ οὐρανοῦ ἕδρην ἀφανὴς ἦν οὔτ᾽ ἐπινεφέλων ἐόντων αἰθρίης τε τὰ μάλιστα, ἀντὶ ἡμέρης τε νὺξ ἐγένετο. ἰδόντι δὲ καὶ μαθόντι τοῦτο τῷ Ξέρξῃ ἐπιμελὲς ἐγένετο, καὶ εἴρετο τοὺς Μάγους τὸ θέλει προφαίνειν τὸ φάσμα.

As it set out, the Sun abandoned its place in the sky and did not shine, although the sky was without clouds and very clear, and night replaced day. To Xerxes this was a cause for concern when he learned of it and saw it, and he asked the Magi what the phenomenon would foreshadow.

[3] οἱ δὲ ἔφασαν ὡς Ἕλλησι προδεικνύει ὁ θεὸς ἔκλειψιν τῶν πολίων, λέγοντες ἥλιον εἶναι Ἑλλήνων προδέκτορα, σελήνην δὲ σφέων. ταῦτα πυθόμενος ὁ Ξέρξης περιχαρὴς ἐὼν ἐποιέετο τὴν ἔλασιν.

They said that God was predicting to the Greeks the abandonment of their cities, saying that the Sun was a predictor for the Greeks, but the Moon for themselves. Xerxes, having learned this, was greatly pleased and embarked upon his expedition.

[34] Such 'border crossing' sacrifices are mentioned elsewhere at Hdt. 6.76.2 and 9.19.2 and also in Thuc. 5.54.1, 5.55.3, and 5.116.1. Their importance is discussed in Xen. *Lac.* 13.2–5.

[35] Flower and Marincola (n. 32), ad loc., assume that the very fact of the eclipse was sufficient to halt the intended attack. Cf. the Eclipse of Nicias mentioned earlier (Thuc. 7.50.4).

[36] H&W (n. 4) at 7.37.1, following Hdt. 8.51.1, allow a month for the march from Sardis to Abydos, a month for the sojourn and crossing at the Hellespont, and three months from Sestos to Athens. This suggests that Xerxes left Sardis in early April.

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The passage is problematic, despite the relatively full description and the interesting use of the word 'eclipse' twice (ἐκλιπών/ἔκλειψιν), though not with its later astronomical meaning. The foremost difficulty is that the otherwise ideally timed solar eclipse of 9 April 480 B.C.E. was only visible in the South Pacific. This makes it impossible to accept the text at face value. Xerxes cannot have seen a solar eclipse at that time.[37]

Airy was perhaps the first to establish definitively the non-occurrence of the alleged solar eclipse. He noted that the text asserts that the Magi had said the Sun was viewed as a 'prognosticator' for the Greeks and the Moon for the Persians, but that this was contrary to what was known about Persian religion (worship of Ahuramazda, 'Lord of Wisdom') and its veneration for the Sun.[38] Citing the example of the aforementioned lunar eclipse in Thucydides (7.50.4), where the Greeks seem terrified, he argued that the Eclipse of Xerxes was not solar but lunar. Herodotus, Airy implies, had misunderstood the eclipse report and the justification for it had become scrambled. According to the Magi, he suggested, it was really the Moon that was the predictor for the Greeks and the Sun for the Persians.

Unfortunately for Airy, there appears to have been no convenient lunar eclipse either in the spring of 480 B.C.E. However, one in the following year fitted perfectly: the total eclipse of 14 March 479 B.C.E. which peaked at 02:17 UT with an umbral magnitude of 150% and whose totality lasted for 95 minutes. Of course, to accept this meant violating the accepted chronology of the Persian Wars. Airy acknowledged the difficulty but left it unanswered.

However, Airy omitted the Eclipse of Cleombrotus, which we have already examined and which is securely anchored to 2 October 480 B.C.E. If we accept Airy's lunar eclipse for the Eclipse of Xerxes we need to bring forward the Eclipse of Cleombrotus by a year also. Yet, as has been stated, there is no other solar eclipse with which it can be identified. It seems, therefore, that we cannot extend the Persian War by a year for astronomical reasons, even if we could square the historical chronology, which itself seems unlikely. All major commentaries agree on this point. An alternative solution would be to take the annular solar eclipse of 17 February 478 B.C.E. as the Eclipse of Xerxes.[39] This reached a magnitude of 95% at 10:17 UT at Sardis and must on that account have been quite striking. But by extending the war for two years it violates the chronology even more strongly than does Airy's lunar eclipse and must, therefore, be dismissed.[40]

There is, however, a conventional way out of the problem. In the previous year, Xerxes was at Susa, the western imperial capital, and had begun the preparation for the campaign against Greece. Now, in the fifth year of his plan (7.20.1) in the spring of 481 B.C.E., he set out with his army for Critalla in Cappadocia (7.26.1), the designated mustering point for the many national forces which comprised the army. The location of Critalla has not been determined, but it was probably near the first crossing of the river

[37] This, of course, is acknowledged in all the major commentaries and a variety of solutions proposed which I discuss below.

[38] That Ahuramazda was the guiding principle of Darius and Xerxes is confirmed by the Old Persian inscriptions at Behistun, Persepolis, and elsewhere, but the details and rituals of the accompanying belief system have been the subject of controversy. It now seems established, however, that the Achaemenian dynasty from Cyrus the Great onwards were Zoroastrians: see M. Boyce, *History of Zoroastrianism*, vol. 2 (Leiden, 1982), Foreword.

[39] Proposed by J.R. Hind, *Astronomical Register* 10 (1872), 207–14 (apparently, first stated in a letter to *The Times*), and supported by A.F. Butler, *Herodotus VII* (London, 1891), ad loc.

[40] For discussion, see H&W (n. 4), ad loc.

Halys (modern Kızılırmak) in eastern Anatolia, perhaps at Caesarea Mazaca (modern Kayseri).[41] On the Anatolian plateau, conditions are harsh in winter, so the march must have been planned to have been complete by the autumn in order that the army could overwinter in Sardis, where it would be joined by contingents from western Anatolia and thus be ready for the second leg of the operation in the following spring.

The decision to leave Susa represented an irrevocable step for Xerxes, not only the culmination of four years of planning but a decisive action taken after much vacillation involving the interpretation of dreams (7.8–19). He could not now decide to abandon the invasion, but he still had some leeway in respect of timing and would have wanted to ensure favourable omens for the expedition by employing the Magi to scan for various celestial phenomena.

On 19 April 481 B.C.E. there was a solar eclipse. It was only total over south and east Asia, but it was partial at Susa, though not at Sardis.[42] The maximum occurred at 03:23 UT, just after dawn. With a magnitude of just 19%, the eclipse would have passed unnoticed by most, but to those looking for portents the Sun would have looked distinctly odd, with a flattened side.

The suggestion is, therefore, that original accounts of an eclipse observed by professional skywatchers at Susa in the spring of 481 B.C.E. became transferred in the narrative to the events of spring 480 B.C.E. at Sardis. Whether this was conscious design by Herodotus or confusion in his sources it is difficult to say. Despite being a seasoned traveller to many parts of the Near East, including probably Babylon (1.178–99) and possibly Susa (6.119.2–3), he may have felt more comfortable with locating the story in Sardis, a place well known to him and more relevant to the westerly focus of his narrative.[43]

IV. AIRY REVISITED

The conventional explanation has merit, but it does not account for the confusion over the religious significance of the Sun and Moon. Airy's judgement that Herodotus' description 'is, on the face of it, absurd' has generally been upheld by later commentators.[44] Why, moreover, would Xerxes need to be reminded of the fundamentals of his religion? He would surely know how important the Moon was as a portent, if that were really the case?[45]

Herodotus is clearly trying to justify Xerxes' reaction to a solar eclipse which otherwise would seem perverse. Only a little later, he describes the Persian worship of the Sun (7.54.1–3), when Xerxes begins the crossing of the Hellespont, as he does also (7.223.1) before the battle of Thermopylae. Yet at 1.131.2 he also mentions that the

[41] So H&W (n. 4), ad loc., but Macan (n. 4) thought that it was at Tyana, 120 kilometres south-west.

[42] The limit of partiality was longitude 36° 11′ E, 700 kilometres east of Sardis and thus outside the margin of error for ΔT.

[43] For discussions of his knowledge of Persia, see Boyce (n. 38), 179; M.C. Miller, *Athens and Persia in the Fifth Century BC: A Study in Cultural Receptivity* (Cambridge, 1997), 105–8.

[44] So Macan (n. 4); H&W (n. 4); etc.

[45] The remarks of the Magi may be a marginal comment (cf. προδέκτορα, 'predictor', a *hapax legomenon* formed from the preceding verb), but if so they must be an ancient incorporation. The text as described in C. Hude, *Herodoti Historiae* (Oxford, 1927[3]), Praefatio, seems secure and there is no external evidence to support interpolation.

Persians sacrifice to the Moon, water, and winds as well as to the Sun. In view of this, we might perhaps conclude that Herodotus' knowledge of Persian religious practice was sketchy and liable to adaptation as he saw fit.[46] Equally, however, it might be argued that we are given only glimpses of a religion (whose main features are taken for granted by the author) which viewed all natural phenomena as divine manifestations.

If we can accept that Herodotus may have believed, rightly or wrongly, in the greater importance of the Moon to the Persians than the Sun or, perhaps, have believed that his report would seem credible to his audience, then the way is clear for us to accept that there may be some merit in Airy's hypothesis of a lunar eclipse. The idea that the Sun was the more important celestial indicator for the Greeks was probably acceptable to his Greek audience and few of them, presumably, were knowledgeable enough about Persian religion to gainsay the statement regarding the Moon. So, from a Greek perspective the statement seems fine; but from a Persian religious perspective, it is nonsense.[47]

However, since the Persians considered the Sun more important than the Moon, it might have seemed reasonable to them to think that the Greeks accorded greater importance to the Moon. This is the reversal of the Herodotean statement, but it functions in the same way as a cultural demarcator between the two peoples and as a symbol of otherness. Accordingly, a lunar eclipse might well have been regarded as favourable by Xerxes, since he would have assumed it was unfavourable for the Greeks. On this basis, Airy's instinct was right, but what can be salvaged from the astronomical facts?

It turns out that Airy ignored an earlier lunar eclipse than the one he proposed, namely that of 25 March 480 B.C.E. He must have been aware of it, but probably discounted it because his calculations showed that it was penumbral and, therefore, barely perceptible. In a penumbral eclipse, the Moon's disc still receives some direct light from the Sun, but the reflected light is typically reduced by 80–90%. However, even this reduction causes virtually no apparent diminution in brightness to the human eye.[48] Keen-sighted and experienced observers though they may have been, the Magi could not have observed this eclipse had it been purely penumbral. Airy was right to pass it by, given the data and results that he had.

However, modern calculation shows that this eclipse was not penumbral. Even a small correction to the Greenwich observational data of 1750 to 1830 upon which Airy had relied would have sufficed to show the true state of affairs.[49] The lunar eclipse of 25 March 480 B.C.E. was actually partial. In a partial lunar eclipse, a part of the Moon enters into the Earth's umbra where it receives no direct light from the Sun. Owing to the great differences in light levels between the penumbral and umbral parts of the

[46] Boyce (n. 38), 180–1, states that his presentation of Persian society, though eclectic and superficial, is not fundamentally inaccurate.

[47] Most authorities agree on the significance of the Sun in Persian religion: see M. Boyce, *History of Zoroastrianism*, vol. 1 (Leiden, 1975), 113–14.

[48] *FMCLE* (n. 25), 1.2.11 and 1.7.1.

[49] Airy, of course, supplies no figures for the discounted eclipse of 25 March 480 B.C.E., but he does for the eclipse he himself suggests, that of 14 March 479 B.C.E. That his calculations have been improved upon in recent times is hardly surprising and can be verified by examination of the data which he submits for the later eclipse. For example, he predates it by about twelve hours to 13 March (a ΔT error) and states that totality lasted for 'nearly two hours', whereas in *FMCLE* (n. 25) the duration is given as 95 minutes. With regard to alignment, he says that the Moon's limb was 'at least within 16′ of the inner boundary of the Earth's penumbra'. The modern calculated parameter ($\gamma = -0.1841$) implies that the actual figure should be about 31 minutes of arc (my estimate), indicating that the error bounds for Airy's calculations were sufficiently large to allow the partiality of the eclipse of 25 March 480 B.C.E. to go unnoticed by him.

Earth's shadow (about 500 times) and the fact that the latter forms a convex curve upon the Moon's surface (Aristotle's observation: *Cael.* 297b 24–31), partial lunar eclipses are unmistakeable.[50]

In the case of this lunar eclipse, the extent of umbral shading was comparatively small (magnitude 7.4%), with the maximum occurring around 23:13 UT. Yet even this small amount would have caused a pronounced distortion to the circular form of the full Moon, with the Earth's umbra biting fuzzily into the Moon's disc.[51] The event lasted for 66 minutes and all observers could have seen that there was something amiss. A preliminary suggested sequence of events is thus as follows:

1) a partial lunar eclipse occurs on 25 March 480 B.C.E.;
2) the Magi at Sardis deem it to be a bad omen for the Greeks, explaining (whether in good faith or bad) to an ignorant Xerxes that the Greeks set great store by the Moon;
3) the story of an eclipse witnessed by Xerxes at Sardis enters the popular narrative of the war, together with the remarks of the Magi;
4) Herodotus picks up a garbled account some decades later and, in attempting to make sense of it, writes it up as a solar eclipse, the only type he records;
5) in order to make it credible to his Greek audience that a solar eclipse could be interpreted as a good omen for Xerxes, Herodotus assumes that the actual advice of the Magi ('the Moon is a predictor for the Greeks, but the Sun for us') has been misinterpreted and flips it around.

Yet there is a further twist to the story which needs examination. This is the tale of Pythius, the Lydian, who first appears as a potential financial contributor to the Persian campaign (7.27–9) and then reappears in the narrative, just as Xerxes is setting out, in order to ask if his eldest son can be released from military service (7.38). Hitherto, he has not only wanted to support Xerxes, but has been, we may assume, confident of Persian success. Now, however, he has been frightened by the eclipse and is less sanguine about the success of the invasion.

We first meet Pythius at Celaenae (modern Dinar) in Phrygia, whither he has, presumably, travelled in order to meet Xerxes and, as a member of the defunct Lydian royal family, to welcome him to Lydia with money for his campaign. He then, one assumes, travels back to Sardis with Xerxes as part of his wider retinue. It is difficult to see how he could have become attached to the story of the Eclipse of Xerxes had it originated in Susa, since he had no official role in the Persian hierarchy.

Since Pythius is a Lydian and the Lydians largely share the customs and outlook of the Greeks (1.94.1), we must think this through from the point of view of a Hellenized Lydian who has perforce thrown in his lot with the Persians.[52] By the time of Xerxes'

[50] *FMCLE* (n. 25), 1.7.1.

[51] For an impression of a partial lunar eclipse of small magnitude (5.9%, that of 4 June 2012), see Espenak's personal website: http://mreclipse.com/LEphoto/PLE2012Jun/PLE2012galleryA.html (last retrieved 17 February 2013). It can be seen that the umbra diffuses over more of the disc (an effect of the Earth's atmosphere) than may be supposed from calculation.

[52] Although Herodotus remains our most important source for the customs of the Lydians and the Hellenizing tendencies of their kings, there is a certain amount of external evidence to back up the general assertion of a common Greek–Lydian culture during the sixth and seventh centuries, which persisted into later times: first, early Lydian inscriptions are written in Greek characters (though sometimes featuring different sound values): see H.C. Melchert, 'Lydian', in R.D. Woodard (ed.), *The Cambridge Encyclopedia of the World's Ancient Languages* (Cambridge, 2004), 602; second, Xanthus, the Lydian historian, wrote in Greek: see J. Marincola, *Greek Historians* (Oxford, 2001),

invasion, the Lydians had been under Persian rule for over sixty years, but Pythius was of an age to have been brought up during the last years of Lydian independence and was on that account perhaps more likely to retain the intellectual outlook of his youth.[53] His desire above all else is to ensure that not all of his sons are killed or enslaved, in view of which his commitment to the Persian cause would seem to be paramount. Why, then, does he not share Xerxes' view of the eclipse? It unlikely that he would take a solar eclipse as a personal prognosticator, since astrology, being mainly an invention of Hellenistic Egypt (though founded upon Babylonian techniques), was yet to get under way.[54] If there had been a solar eclipse he would have assumed that this was bad news for the Greeks and, therefore, good news for him and the Persians. Nor can we have him disbelieving the authoritative pronouncement of the Magi regarding Persian beliefs. There seems to be no reason, on the assumption of a solar eclipse, why Pythius should think that it was a bad portent.

If, on the contrary, there had been a lunar eclipse, he would presumably not have been so easily persuaded by the Magi telling Xerxes that this was a bad omen for the Greeks, since he would be aware that the Greeks esteemed the Sun as much as the Persians.[55] In other words, the story of Pythius' reaction seems better motivated by assuming a lunar eclipse than a solar eclipse. It also circumvents the difficulty of relocating the eclipse from Susa to Sardis, since it can hardly be supposed that the aged Pythius was at the Persian capital, although this in itself is perhaps not a serious objection.

Of course, as it turns out, Pythius is not lucky. Xerxes becomes enraged when he hears his request, pointing out the total commitment of his own family to the invasion, and orders that the eldest son be cut in half and the two parts of the corpse arranged so that the Persian army marches between them (7.39.3). Although this is presented as the barbaric act of a cruel and irrational tyrant, which undeniably it was, it may perhaps be viewed also as a punishment for challenging the official interpretation of the eclipse and as an attempt by Xerxes to garner further good fortune by offering a sacrifice along traditional lines.[56]

16–17; third, coinage was (somehow) a joint Greek and Lydian invention: see G.K. Jenkins, *Ancient Greek Coins* (London, 1990[2]), 13–14, and D.M. Schaps, *The Invention of Coinage and the Monetization of Ancient Greece* (Ann Arbor, MI, 2004), 93–101; finally, Lydian religious and vernacular architecture shows Greek influence, as does Lydian pottery and funerary sculpture: see, for example, C. Ratté, 'Anthemion stelae from Sardis', *AJA* 98 (1994), 593–607, who emphasizes the persistence of Greek influence even after the fall of Sardis. The reciprocal cultural influences of Ionia and Lydia during this period, when the two peoples were in frequent and often hostile contact, are discussed generally in J. Boardman, *The Greeks Overseas: Their Early Colonies and Trade* (London, 1999[4]), 94–102, and C.H. Roosevelt, *The Archaeology of Lydia: From Gyges to Alexander* (Cambridge, 2009), ch. 4.

[53] H&W (n. 4) and Macan (n. 4) on 7.27 report an older suggestion that Pythius was a grandson of Croesus (through his son Atys), and point out that his name itself bears witness to the Delphic interests of his grandfather. For the role and resonances of the Pythius story within the overall text, see S. Lewis, 'Who is Pythius the Lydian?', *Histos* 2 (1998), 185–91.

[54] See Neugebauer (n. 7), 1.2, 5. The first known horoscope dates from 410 B.C.E., according to A. Sachs, 'Babylonian horoscopes', *Journal of Cuneiform Studies* 6 (1952), 49–75, at 52. For the relationship between Babylonian and Greek astrology see F. Rochberg-Halton, 'New evidence for the history of astrology', *JNES* 43 (1984), 115–40; F. Rochberg-Halton, 'Elements of the Babylonian contribution to Hellenistic astrology', *JAOS* 108 (1988), 51–62.

[55] We need not suppose, on this interpretation, that Pythius was as superstitious as the unfortunate Nicias in the face of a lunar eclipse during the Peloponnesian War (Thuc. 7.50.4.). His may be taken as a normal 'Greek' reaction.

[56] The Old Testament offers parallels to the practice of divided sacrifice in Genesis 15:9–10 and Jeremiah 34:18–19.

In fact, as Myres pointed out, the story of Pythius is essentially one which has been arranged around the fulcrum of the sojourn at Sardis (7.30–7).[57] He offers Xerxes money for the campaign (7.27–9) and the *quid pro quo* is to be the release of his son from military service (7.38.43). In order to propel his narrative, Herodotus has bisected the story of Pythius as neatly as Xerxes bisected the eldest son so as to propel his passage into Greece. It is clear, therefore, that Herodotus has manipulated his sources to provide, as he sees it, a coherent narrative. For the author, the moral of the story is of great importance and the Eclipse of Xerxes is merely the first of three omens of increasing improbability which the great king chooses to ignore or misinterpret.[58] We may suppose that this crescendo of arrogance and bad judgement would have appealed to Herodotus' listeners and readers. It seems that he knew that there was an eclipse which was ignored but, in default of sufficient source detail, devised a story that made sense.

V. THE PERSIAN PERSPECTIVE

So far, I have offered an alternative explanation, based on a lunar eclipse, for the problems surrounding the Eclipse of Xerxes. Its advantages are first, that it uses an eclipse which actually occurred at the right time (25 March 480 B.C.E.), as suggested by historical events; second, that it makes better sense of the remarks of the Magi; and third, that it better explains the story of Pythius. However, it is not wholly satisfactory. Against it is the text itself, which plainly states that

> … the Sun abandoned its place in the sky and did not shine, although the sky was without clouds and very clear, and night replaced day.

This clearly describes a solar eclipse. On the lunar hypothesis, therefore, we must accuse Herodotus of factual error. For this reason, it might seem preferable that, for the Eclipse of Xerxes, one should retain the idea of a solar eclipse transferred from either the one at Susa in April 481 B.C.E. or the one at Sardis in February 478 B.C.E. or a confusion of both. However, not only is the text unambiguously a description of a solar eclipse, but it also strongly suggests a *total* solar eclipse. Neither of the transferred solar eclipses were total: the preferred eclipse at Susa was barely perceptible and the unlikely one at Sardis, though of dramatic appearance at 95% magnitude, could not, with the Sun being quite high (38°) above the horizon, have literally turned day into night, if by that it is meant that stars became visible.[59] Therefore, whatever the underlying astronomical event, Herodotus cannot escape the charge of distortion.

Since the facts, as they stand in the narrative, cannot be true, we must accept that either the story of a solar eclipse (or eclipses) has been detached from historical context, exaggerated, and reattached to the departure from Sardis in 480 B.C.E. or the nature of the eclipse itself has been misrepresented. A lunar eclipse has been considered, but is not compelling *per se*. However, another possibility exists.

[57] J.L. Myres, *Herodotus: Father of History* (Oxford, 1953), 109.

[58] The other two being the mule giving birth to a horse at 7.57.2 and a horse giving birth to a hare at 7.57.1.

[59] For reports on stellar visibility during partial eclipses towards sunset, see J.K. Fotheringham, 'Visibility of stars in Great Britain during the solar eclipse of 1925 January 24', *Monthly Notices of the Royal Astronomical Society* 85 (March 1925), 509.

Let us reconsider the incongruous words of the Magi (leaving aside the question of why they were inserted into the text and by whom). Was the Moon a predictor for the Persians and the Sun a predictor for the Greeks, as reported, or was it the other way round? This apparent binary choice may be fallacious: perhaps neither the Greeks nor the Persians thought of eclipses in that clear-cut way. All eclipses may have had ominous significance depending upon circumstances. After all, we only have Herodotus' word for the interpretation given and it has been established in this case that he is not necessarily reliable. Moreover, given the source, the viewpoint hitherto taken has been unavoidably Hellenic. However, it takes two to make a war, and it behoves us to consider what we can make of a possible Persian perspective.

Arguably, the text as we have it misunderstands the Persian attitude in a rather more fundamental way than previously considered, a suspicion bolstered by an almost contemporary passage in Aristophanes, *Peace*, 406–13, where Trygaeus remarks that, whereas Greeks worship gods, foreigners worship the Sun and Moon. This is a pronouncement put into the mouth of a simple farmer and perhaps not to be taken as authoritative but indicative of a mismatch between Greek and foreign belief systems, in so far as those in the Near East generally placed much greater emphasis on celestial phenomena. More specifically, we may cite Herodotus' own observation (1.131.1) that the Persians deny anthropomorphism in gods and do not set up statues to them as Greeks do, but (1.131.2):

οἱ δὲ νομίζουσι Διὶ μὲν ἐπὶ τὰ ὑψηλότατα τῶν ὀρέων ἀναβαίνοντες θυσίας ἔρδειν, τὸν κύκλον πάντα τοῦ οὐρανοῦ Δία καλέοντες.

… they have a custom of going up to mountain peaks to make sacrifices to Zeus, calling the whole circuit of the sky Zeus.

Further to this, we may recall, as did Airy, the Greek fear of the lunar eclipse described in Thucydides 7.50.4 and then again the attitude of the Spartans to the solar eclipse in 9.10.3. All in all, we should conclude, perhaps, that neither Greek nor Persian attitudes to eclipses were resolvable along a simple Sun/Moon line of demarcation and that the reality was more complex. If we step back from the text and focus on what we really do know about the origins of ancient astronomy, we may be able to find a better approach.

Notwithstanding the famous eclipse 'prediction' of Thales, the Greeks in the fifth century had no innate tradition of predictive skywatching other than to forecast the seasons via the annual cycle of the stars.[60] Nor, however, did the Persians, nor the Medes, nor, probably, the Magi (originally, for Herodotus, a Median tribe).[61] Whatever anyone knew about astronomy was derived ultimately from the Babylonian astronomer-priests,

[60] For a recent interpretation of the Eclipse of Thales, suggesting home-grown ingenuity and luck rather than reliance on Babylonian expertise, see D.L. Couprie, 'How Thales was able to "predict" a solar eclipse without the help of alleged Mesopotamian wisdom', *Early Science and Medicine* 9 (2004), 321–37. Despite a recent attempt to champion the idea that Thales used Babylonian data by P.F. O'Grady, *Thales of Miletus: The Beginnings of Western Science and Philosophy* (Aldershot, 2002), ch. 8, the warning issued in Neugebauer (n. 7), 2.4, 603, remains valid.

[61] The description of the Magi in 1.101.1 is somewhat confused but not without a grain of truth. Darius himself refers several times in the Behistun inscription (DB1 36–73) to the usurper Gaumata as being a Magian in much the same ethnic manner as the other rebellious kings whom he eliminates: see R.G. Kent, *Old Persian: Grammar, Texts, Lexicon* (New Haven, CT, 1953^{2}) 117–20. For a general discussion, emphasizing the priestly role, see Boyce (n. 38), 19–20.

especially those working in the Neo-Assyrian (747–612 B.C.E.) and Neo-Babylonian (612–539 B.C.E.) periods, when the *Astronomical Diaries* were first compiled. Their skills and knowledge were disseminated widely into the surrounding cultures, who were keen to augment their own divinatory practices.[62] The domination of Babylon by the Assyrians in the early first millennium and then its subsequent capture by the Persians under Cyrus the Great in 539 B.C.E. witnessed a flowering of astronomical practice which continued into Seleucid times.[63] By the start of the Persian era, however, Babylonian astronomy was already very ancient, having developed over the course of the previous 1,500 years its signature characteristics of planned observation, systematic recording, and omen interpretation. Its chief concern was the safety of the king and state.

The collection of 70 tablets known as the *Enuma Anu Enlil* (*EAE*) series, which dates from the eighth century, contains over 6,000 omen formulae used in astronomical reports sent to the Assyrian kings. Some of the descriptions refer back more than a thousand years.[64] Celestial observations were part of a wider set of natural phenomena that were incorporated into divinatory schemata which consisted of explanatory rules of the form 'If P then Q'.[65] Typical examples read as follows:

If the Moon makes an eclipse and the north wind blows: the gods [will have mercy] on the land.

[If] (the Moon) makes an eclipse [in T]ishri (VII) on the 21st day and sets eclipsed: [they will take] the crowned king from [his palace] in fetters.[66]

Huge numbers of celestial phenomena were incorporated into such schemata and those that featured the Moon were arguably the most important, followed by the Sun.[67] The general importance of celestial phenomena for the Babylonian astronomers in the Neo-Assyrian period derives from the fact that:

The signs in the sky just as those on earth give us signals.[68]

This precept underlies the divinatory approach to astronomy in the ancient Middle East, to the extent that areas and directions in the sky were often seen as corresponding to parts of the Earth, and events that occurred in the former presaged in some way events

[62] The influence extended beyond Iran to India: see Brown (n. 7), 108.

[63] The Assyrians were great consumers of Babylonian skylore: see Brown (n. 7), ch. 1. For published texts, see H. Hunger (ed.), *Astrological Reports to Assyrian Kings* (Helsinki, 1992); S. Parpola (ed.), *Letters from Assyrian Scholars to the Kings Esarhaddon and Assurbanipal* (Kevelaer, 1970).

[64] Systematic observation in Mesopotamia seems to have started at least as early as the time of the Ur III period with omens in *EAE* tablets 20 and 21 referring to lunar eclipses, most probably, of 27 June 1954 B.C.E. and 17 March 1912 B.C.E. respectively. See V.G. Gurzadyan, 'On the astronomical records and Babylonian chronology', *Akkadica* 119 (2000), 175–84.

[65] F. Rochberg, '"If P, then Q": form and reasoning in Babylonian divination', in A. Annus (ed.), *Divination and Interpretation of Signs in the Ancient World* (Chicago, IL, 2010), 19–28. On the complex relationship between the *EAE* omen literature and later astronomical reports, see N. Veldhuis, 'The theory of knowledge and the practice of celestial divination', in ibid., 77–91.

[66] Hunger (n. 63), letter 103 (parts 6 and 12), from the scholar Akkullanu, dated 15 October 667 B.C.E. Most eclipses, however, indicated royal demise: see Brown (n. 7), 145. Note the impossible eclipse on the 21st of the month.

[67] See F. Rochberg, *The Heavenly Writing* (Cambridge, 2004), 68. The first 22 *EAE* tablets concern the Moon and the next 17 the Sun, while the remaining tablets deal with the weather and planets.

[68] Taken from A.L. Oppenheim, 'A Babylonian diviner's manual', *JNES* 33 (1974), 197–220, at 203.

on the latter.[69] There was no necessary causal connection; rather, the sky was viewed as a kind of text, written by the gods, indicating what might happen.[70]

The main aim of Babylonian astronomers was not to predict celestial events in the pursuit of objective science but to extract ominous meaning and not to be caught unawares by those events which did occur.[71] Almost all unusual events, if they were not predicted, were bad omens, especially eclipses, whereas predicted events, whether or not they occurred, were potentially benign. An eclipse that occurred 'on schedule' could have its deleterious power reduced or nullified by the performance of an apotropaic rite.[72] Curiously, the Babylonian/Persian king-substitution rite finds its way into Herodotus (7.15–18), although not in a celestial context.[73] If, on the other hand, an eclipse failed to occur, then, apart from perhaps the wounded pride of the astronomers, no real harm could ensue. In fact, if the rite were performed before the failed event was due to occur (a strong impetus to prediction in itself) then the rite could be viewed as having been successful.[74] Of course, the Babylonian astronomers did not want to be seen to be foolish or tempting fate and so they strove to improve the accuracy of their observations and predictions for all sorts of astronomical phenomena.[75] However, there was a strong intrinsic bias towards making predictive claims on the shared understanding that they were declaring when events *might* occur, not when they *would* occur.[76]

It seems to be the case that solar eclipses were not included as predicted events in the extant texts until the fifth century B.C.E.[77] This may be a sampling effect, owing to the relative paucity of recovered and published texts, but it may genuinely reflect the fact that Babylonian astronomers were more concerned, for calendrical purposes, with understanding the motion of the Moon (for which they reserved their most advanced

[69] See Hunger (n. 63), letter 316, from the scholar Munnabitu, dated 22 May 678 B.C.E. The correspondences are analysed in detail in Brown (n. 7), §3.2.2.

[70] Brown (n. 7), 112.

[71] F. Rochberg-Halton (n. 7), 107–20. For the methodological aspect, see Brown (n. 7), 166–8.

[72] Rochberg (n. 67), 50–1; Oppenheim (n. 68), 209. For the general point, see J.M. Steele, 'Eclipse prediction in Mesopotamia', *AHES* 54 (2000), 421–54, and Rochberg (n. 67), 77–8. The fact of prediction did not of itself annul the omen, but afforded an opportunity to do something about it. The most common rituals were those of king-substitution (Rochberg [n. 67], 78 and 222) or making a noise (Brown [n. 7], 161 n. 376). For the latter, see P.-A. Beaulieu and J.P. Britton, 'Rituals for an eclipse possibility in the 8 year of Cyrus', *Journal of Cuneiform Studies* 46 (1994), 73–86, where the banging of a copper kettledrum on 15 June 531 B.C.E. is reported (this eclipse was penumbral and therefore not visible). An apotropaic ritual featuring king-substitution at the time of a predicted lunar eclipse is described in a letter to the Assyrian king Esarhaddon (681–669 B.C.E.) in J. Pritchard (ed.), *The Ancient Near East*, (Princeton, NJ, 2011), 443–4.

[73] Modified by the author, one assumes, for his narrative purposes. Xerxes makes Artabanus take his place in order to forestall the visitation of a dream.

[74] See Hunger (n. 63), Introduction, xix; Brown (n. 7), 168.

[75] This was the transition, in Brown's terminology, from the *EAE* paradigm to the *PCP* (*P*redicting *C*elestial Phenomena) paradigm of the *Astronomical Diaries*: see Brown (n. 7), ch. 4. In fact, the accuracy of Babylonian eclipse prediction did not improve very much once the basic periodic techniques were discovered. In the case of lunar eclipses, typical accuracy improved from 1.12 hours before 550 B.C.E. to 0.95 hours after that date: see Steele and Stephenson (n. 12), 130. For solar eclipses there was no improvement over the four hundred years of available records from 357 B.C.E. onwards, a consequence of the lack of Babylonian geometrical theory and geographical understanding: see Steele (n. 13), 138–9.

[76] See A. Aaboe, 'Remarks on the theoretical treatment of eclipses in Antiquity', *JHA* 3 (1972), 105–18.

[77] Steele, (n. 72), 442 and n. 48. According to Neugebauer (n. 7), 1.2, 525, solar eclipses were tabulated at least as far back as 475 B.C.E.

techniques of tabulation and calculation) and the relatively tractable nature of lunar eclipses, owing to the five- and six-month cycles and the larger Saros cycle.[78] Solar eclipses were simply too difficult to predict in the early fifth century B.C.E. and generally occurred too infrequently, although they were always regarded as significant and featured in the omen literature.[79]

Given the pervasive nature of Babylonian astronomical practice throughout the Middle East during the first millennium B.C.E., particularly as absorbed and promulgated by the Assyrians from the eighth century onwards, it seems likely that the Magi, whatever their own local traditions of skywatching and divination from the pre-Zoroastrian period (which we can scarcely guess at), would have assimilated this aspect of Babylonian culture when the opportunity occurred.[80] Support for this comes from the fact that, although the names differ, the Old Persian months (like the Elamite and unlike the Avestan) correspond largely to the Babylonian scheme in respect of intercalations.[81] Regrettably, we know little about the Magi at this date and our primary source of information is again Herodotus. That they were regarded in later times as expert astrologers is underscored by their appearance in the New Testament (Matthew 2:1) but, as already suggested, this cannot have been their function in the early fifth century B.C.E. since astrology in the personal sense had yet to be invented.

However, the path from divination to astrology, from the public realm to the private, is not a difficult one provided that the necessary data and techniques have become widely available, as they had done during the Seleucid period. Since the Magi are credited by Herodotus with the art of divination in several places (1.107.1, 1.120.1, 1.128.2, 7.19.1), it seems likely that they fulfilled a similar role in fifth-century Persian society to the astronomer-priests in Assyria/Babylon during the preceding centuries. Of course, we do not have any documents to prove this. There is no royal library of Darius, for example, to match that of Assurbanipal in which many source texts of Babylonian astronomy were found.[82] Let us suppose, however, that such documents once existed and that the Magi learned astronomical techniques from their Babylonian peers. In this context, we can see another way of looking at the Eclipse of Xerxes.

[78] Neugebauer (n. 7), 1.2, 474; Steele (n. 72), *passim*. The fact that eclipses were often associated with the death of a king must also have encouraged royal patronage of astronomy.

[79] Parpola (n. 63), letters 41 and 42.

[80] This is a supposition but, I contend, a reasonable one. See Boyce (n. 38), ch. 4 and esp. 66–7, for discussion of the influence of the Babylonian astronomer-priests upon the Zoroastrian Magi around the time of the fall of Babylon in 539 B.C.E., where the latter gathered and the former continued to function well into the Achaemenian era and beyond.

[81] A. Poebel, 'The names and the order of the Old Persian and Elamite months during the Achaemenian period', *American Journal of Semitic Languages and Literatures* 55 (1938), 130–41. See also S. Stern, *Calendars in Antiquity: Empires, States, and Societies* (Oxford, 2012), 170–4.

[82] An apparent difficulty arises with respect to writing. If the Magi were astronomer-priests in the Babylonian sense, they must have been literate and numerate (see Brown [n. 7], 109) in order to carry out their calculations. Old Persian texts are notoriously limited to the formulaic stone and metal inscriptions of the Achaemenian royal dynasty. However, the recent find of an administrative clay tablet in Old Persian cuneiform (along with texts in Aramaic, Elamite, and Greek) at the Persepolis Fortification Archive, which dates from around 500 B.C.E., suggests that writing was more widespread than previously thought. See M.W. Stolper and J. Tavernier, 'An old Persian administrative tablet from the Persepolis Fortification', *Arta* (2007.001), available at http://www.achemenet.com/document/2007.001-Stolper-Tavernier.pdf (last retrieved 17 February 2013). In any case, it is quite possible that, by the fifth century B.C.E., facilitated by the conquest of Egypt under Cambyses, the data tabulated, calculations performed, and advice proffered would have been set down on papyrus rather than clay. Furthermore, the Magi may well have used Babylonian for astronomical purposes.

The chief message that Xerxes took from his consultation with the Magi is that the eclipse was a good omen. This much seems guaranteed, almost literally, by the march of events. We may surmise that it was viewed as benign, not because it was a bad predictor for the Greeks (whether lunar or solar), but simply because it had been successfully predicted by the astronomers and that, consequently, there had been time to put in place an appropriate ritual. We do not know, of course, whether this was actually the case for the Eclipse of Xerxes, but we do know that, for lunar eclipses (but not for solar eclipses), the technology to predict them with sufficient reliability was already well established by the early fifth century B.C.E.

As far as I know, the lunar eclipse of 25 March 480 B.C.E. does not occur in the extant Babylonian records, but both earlier and later eclipses are tabulated. They show that the 90% success rate in predicting lunar eclipses can be broken down into 55% umbral (total and partial) and 35% penumbral, some 10% being outright failures.[83] Since penumbral eclipses cannot usually be observed by the naked eye, the astronomers working in the Babylonian tradition must have considered (erroneously) their own failure rate to be relatively high, but within the context of celestial divination the apparent fact of non-occurrence was, as has been argued, not a poor result.

If we shift our focus to consider eclipses to be a matter of predictive success or failure for the Persians then we can understand why the Magi would have been pleased, perhaps even jubilant, to have caught, by a whisker, the partial lunar eclipse of 25 March 480 B.C.E., which they may have predicted using traditional Babylonian techniques – a feeling, we may surmise, that was communicated to Xerxes in the form of an omen. Of course, we do not know how the eclipse may have been interpreted in detail nor what apotropaic ritual may have been put in place. It is not necessarily the case that the Magi would have followed original Babylonian omina or rituals. They may well have devised their own, or at least modified Babylonian originals, since many of the latter referred to political situations which were no longer extant.

By contrast, most Greeks of the fifth century B.C.E., notwithstanding the Ionian philosophical tradition, probably had little interest in, or knowledge of, the predictive schemes emanating from the Middle East. The brief success of Thales a century earlier was not and (if the analysis by Couprie is correct[84]) could not be repeated. They knew that the barbarians studied the sky, but not to what end. What mattered to the Greeks was the fact of the eclipse itself, not whether it had been successfully foretold.[85] When it occurred, therefore, it was likely to be interpreted as a bad omen, just as those observed by Cleombrotus and Nicias had been. On this basis, we can ascribe the alarm of Pythius at seeing the eclipse to his general Hellenic outlook and the fact that he was not part of Xerxes' inner circle, rather than trying to work out whether he would have been more or less concerned depending upon whether it was lunar or solar.

In addition, by attributing to the Magi general Babylonian techniques, we can rescue their reported remarks ('the Sun is a predictor for the Greeks, but the Moon for the Persians') since, although the Sun was arguably of greater significance within Persian

[83] Steele and Stephenson (n. 12), 130.

[84] Couprie (n. 60).

[85] As far as I am aware all the reactions to eclipses in pre-Hellenistic Greek literature are reactions to the event itself and not based on considerations as to whether the eclipse was expected, even if, as in Hdt. 1.74, it was. Cf. Pind. *Paean* 9, as previously mentioned, where possible disasters are foreseen and the song itself acts as an apotropaic ritual.

religion, the Moon was far more important for the Babylonian astronomical tradition within which, I contend, they themselves were working.[86] Moreover, we need not suppose that Xerxes himself, while necessarily familiar with the tenets of Zoroastrianism, would have known much about Babylonian astronomy. In this context, his initial misgivings are well motivated. On this interpretation, therefore, Herodotus has somehow misreported the facts of the eclipse, but he has correctly, albeit imperfectly and too briefly, characterized the attitude of the Magi.

VI. CONCLUSION

The idea that the Eclipse of Xerxes was a lunar eclipse has certain attractions at the cost of undermining the main presented fact of the narrative. Taking a Greek perspective and ignoring the preoccupations of the Magi, it fits in better with the general historical facts and makes better sense, *prima facie*, of the reported Persian interpretation of events, but it does not address fully the question of possible Persian astronomical knowledge and practices which Herodotus may have unintentionally obscured.

Airy was working before the rediscovery of Babylonian astronomy, which began at the end of the nineteenth century, and based his conjecture on what he knew of Persian religious practices. However, it may be that Xerxes' religion was not so important in the rather technical context of an eclipse and that the key to interpreting the role and remarks of the Magi is dependent upon their behaviour as astronomer-priests working in the Babylonian tradition. Because we know little about the beliefs and practices of the Magi and the influence of Babylonian learning on Persian thought, this hypothesis is hardly susceptible to proof and is offered here as a suggestion.[87]

On the nature of the eclipse itself, the hypothesis that the Eclipse of Xerxes was one predicted by the Magi does not favour it being lunar or solar. They would, presumably, have been rather pleased to have successfully predicted the latter as well as the former. However, given the astronomical facts and the concerns and expertise of the Babylonian tradition at the time, the lunar hypothesis seems the more likely *if we continue to insist only that an eclipse, of whatever kind, did in fact occur*.

However, besides this new interpretation of the eclipse as a lunar eclipse, another must now appear. As a final twist in the story (though perhaps, by now, not surprising), we should reconsider the case for the solar eclipse of 9 April 480 B.C.E. This was the one, it will be recalled, that was visible only in the South Pacific but at exactly the right time and, occurring just fifteen days after the lunar eclipse of 25 March, part of the same lunation. Although the extant astronomical diaries do not feature solar eclipses this early, the techniques for predicting them are necessarily shared with those for lunar eclipses.[88] We know that it was common practice to watch for solar eclipses at the times of a new Moon which both immediately preceded and followed the time of a predicted lunar eclipse.[89] Accordingly, it seems likely that the Magi would have watched for this eclipse. It would, of course, have been one of the 55% that failed to appear,

[86] F. Rochberg-Halton (n. 7), 111.

[87] On this topic, we may note that Achaemenian inscriptions are often trilingual in Old Persian, Elamite, and Babylonian, reflecting the high cultural status of the latter two civilizations within the Persian Empire and suggesting the polyglot character of the Iranian 'intelligentsia'.

[88] See Neugebauer (n. 7), 1.2.B, esp. 521–4.

[89] See Hunger (n. 63), letter 320 (from the scholar Munnabitu); Brown (n. 7), 203–6.

since Babylonian theory could not reliably predict solar eclipses. Could it be that the Magi were watching for this eclipse and, professional pride notwithstanding, reported to Xerxes that it had 'passed by' and, therefore, held no adverse consequences? We know that some Babylonian scholars took a dim view of solar eclipses and their possible amelioration:

> This Akkullanu wrote me: 'A solar eclipse of two fingers magnitude took place during sunrise. There is no apotropaic ritual against it, it is not like a lunar one.'[90]

although others prescribed the usual prophylactic:

> As regards the substitute king about whom the king, my lord, wrote me: 'How many days should he sit?', we waited for a solar eclipse, (but) the eclipse did not take place. Now, if the gods are seen in opposition on the 15th day, he could go to his fate on the 16th.[91]

This indicates an inherent variability within the Babylonian divinatory tradition. Either way, the fact that an anticipated solar eclipse did not happen was good news (though not, presumably, for any substitute king). Such an interpretation makes sense within the context both of the Babylonian tradition and of the historical narrative, but once again makes it necessary for us to challenge Herodotus in his reporting of the astronomical facts.

On this reading, the Eclipse of Xerxes becomes a kind of *lucus a non lucendo* of celestial phenomena, the eclipse that became famous precisely because it did not happen or was of the wrong sort. This raises a question as to what Herodotus thought he was reporting and whether, in relation to his description of the Eclipse of Thales, he could have countenanced the idea that the Persians were capable of relatively advanced, predictive astronomy.[92] It seems unlikely that he, or any contemporary Greek, knew much about the rich Babylonian astronomical tradition.[93]

Putting this all together, then, I suggest that the following sequence of events lay behind the Eclipse of Xerxes:

1) using Babylonian techniques, the Magi predict a lunar eclipse for 25 March 480 B.C.E. and, as usual, watch for a solar eclipse on 9 April;
2) a suitable apotropaic rite is performed in anticipation, perhaps a source for Herodotus' own king-substitution story (7.15–18);
3) the lunar eclipse occurs, thus worrying Pythius (who is excluded from the Achaemenian inner circle and the Magian worldview) and, initially, Xerxes himself, but its small magnitude (now reckoned as 7.4%) is attributed to the efficacy of the ritual;
4) the anticipated solar eclipse 'passes by', that is, fails to occur in Sardis (another positive effect of the ritual, perhaps), and Xerxes is now fully reassured by the Magi;
5) the double eclipse, apparently greatly ameliorated, is taken by the Persians as a beneficent sign and an endorsement of Xerxes' campaign;

[90] Parpola (n. 63), letter 104.
[91] Ibid., letter 135. The 'gods in opposition' are the full Moon and the Sun.
[92] Especially pertinent, given his preference for locating the sources of scientific knowledge and expertise in Egypt, rather than in Anatolia or Mesopotamia.
[93] Neugebauer (n. 7) 1.2, Introduction, 348, points out that Hellenistic Greeks, although they had access to the data, knew little of the underlying motivation for Babylonian astronomy.

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6) the occurrence of the lunar eclipse is conflated in Graeco-Lydian accounts with the non-occurrence of the solar eclipse and the ominous rationale for both is lost, but the ‘predictor’ justification remains largely intact, if somewhat misunderstood.

I believe this that explanation, though not fully supported by evidence at all the points we would desire, accounts for the difficulties of the text better than those found in the standard commentaries.

The chief assumption is that there were two distinct cultural areas during the early fifth century B.C.E. which did not at this date intermix (at least in relation to skylore and its religious significance), namely Greece/Lydia and Babylon/Persia, and that Herodotus has scant knowledge of the latter.[94] It does not wholly vindicate the text of the *Histories*, but at least it does give prominence to the reported solar eclipse (albeit in a negative manner) and makes some sense of the alleged justification and what is known of contemporary astronomy. Moreover, it motivates the reactions of both Pythius and Xerxes.

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[94] Notwithstanding possible Iranian (Zoroastrian) influences on Ionian philosophy for the period 550–480 B.C.E. as outlined in M.L. West, *Early Greek Philosophy and the Orient* (Oxford, 1971), particularly ch. 7 (a thesis which is not incompatible with the specific Babylonian influence suggested here) and the more general cultural influence described in Boardman (n. 52), 102–9, which, however, seems to be mainly *from* Greece *to* Persia (cf. Hdt. 1.135.1, 3.129.3, 6.119.1–2). All this fits in well with the suggestion of Boyce (n. 38), 67, that the Magi were split into two groups along a conservative (pre-Zoroastrian) to progressive (Zoroastrian) axis. She envisages members of the Zoroastrian group travelling to Lydia and Ionia prior to the accession of Cyrus in 550 B.C.E. to escape persecution under the Median king Astyages and, later, others of the group being sent by Cyrus to Babylon in anticipation of the war against Nabonidus. This latter group would then have become the vector by which Babylonian astronomical learning infiltrated Persia.