Cultural History of the Lunar and Solar Eclipse in the Early Roman Empire

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> The regularity and consistency of human imagination may be first displayed in the beliefs connected with eclipses. It is well known that these phenomena, to us now crucial instances of the exactness of natural laws, are, throughout the lower stages of civilization, the very embodiment of miraculous disaster.[1]

> Fifteen hundred years have not yet passed since Greece numbered and named the stars and yet many nations today only know the heavens by their appearance, and do not yet understand why the moon fails or how it is overshadowed.[2]

More than fifteen hundred years separates these two remarks. Each reveals a gulf between the learned and unlearned, but for Tylor it is a contrast between today and long ago, or here and far away, while for Seneca it is a contrast between the wise and the vulgar, who live in the same time and place. For the lunar and solar eclipse is a phenomenon where the strongest and clearest divide appears between the educated Roman and the common multitude. In contrast with almost everything else in Roman experience, from earthquakes to disease, eclipses of sun and moon can be understood in their entirety, and explained with mathematical precision, without the aid of advanced technology or modern scientific methods. But to those who lacked the encouragement to employ careful observation and physical explanation, and who lacked the breadth of information available to the literate, the eclipse was the most awesome and dire event in human experience. Nothing was more regular or more vital than the sun's daily illumination. Its disappearance could easily call to mind the end of the world. And while the monthly absence of the new moon was routine, and its disappearance gradual, occurring by degrees with clock-setting regularity, for the moon to suddenly and visibly fold up its light in one fell hour—and during the full moon no less, when this is least expected—it is easy for the ignorant to imagine that all has become confusion and doom.

Beliefs differed regarding eclipses, both between and among the learned and unlearned in the early Roman Empire. We find the eclipse in ancient sources as omen, as astrological portent, and as the outcome of diabolical magic, but also as a natural phenomenon scientifically understood. But though the superstitions can be found on both sides of the literacy divide, a scientific understanding of the eclipse seems never to

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[1] Tylor, p. 328.

[2] Seneca, *Natural Questions,* 7.25.3.

have spread beyond the literate elite, and as they represent a tiny minority of the population even within cities, much less in the countryside, we cannot generalize in our declarations of what the ancients "knew" about the natural world. For if this example can be extended, science does not seem to have penetrated into public lore as it has in modern societies.

I. Science Lessons: the Gulf Between the Learned and the Unleared

Rationality is partly to be found in the belief that nature itself is rational. In other words, there is a natural order which proceeds by repeatable causes that can be discovered and understood by man—a natural order, moreover, which proceeds irrespective of human affairs. Educated Romans and Greeks were aware of such a principle, and it would play a significant role in their response to all kinds of extraordinary phenomena. But this was seen as a dogma that not only aids in getting at the truth, but that calms and civilizes the mind. The uneducated commons not only knew substantially less than their educated leaders, they also lacked enculturation into this dogma of rationality, so that even if presented with the facts, they would be unprepared to fully understand their significance, and may even be suspicious of them.[3] The different cultural perspectives of these two social groups, and the interaction between them, is the first object of our study.

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It was Aristotle who first declared that wisdom was the measure of one's knowledge of the natural causes of things,[4] and this assumption had been assimilated into Roman elite culture by the first century B.C. And so we find Cicero stating unreservedly:

> it is necessary that whatever arises, of whatever kind, has its cause from nature, so that even if it happens contrary to what is usual, it still cannot happen contrary to nature. Therefore, investigate the cause for every new and remarkable event, if you can, and if you discover none, you must still consider it certain that nothing can happen without a cause.[5]

He goes on to add the reason one should adopt this assumption: to do so will free you from fear, for then nothing will terrify you.[6] A century later, the younger Seneca repeats this sentiment: "Since the cause of being afraid is not to know, isn't it very worthwhile to

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[3] The novelty and difficulty of scientific reasoning has recently been argued by Alan Cromer in *Uncommon Sense: The Heretical Nature of Science* (Oxford, 1993) and Donald Calne in *Within Reason: Rationality and Human Behavior* (Vintage, 1999). Both argue that an enculturation period is necessary for scientific explanations to be readily understood.

[4] *Metaphysics,* 982a.

[5] *On Divination*, 2.28 (60).

[6] cf. also Virgil, *Georgics*, 2.4.90-2. Although Cicero attributes this thesis to the Stoic philosopher Chrysippus, it was a view shared also by Epicureans (cf. Lucretius 1.146-8), and of course by the Peripatetics, whose ideas generally descended from Aristotle.

know, so we can be unafraid? How much better it is to inquire into the causes and, in fact, to be intent on this with the whole of our mind,"[7] for, "there is nothing greater than this: to know nature."[8] This is a thoroughly Roman belief during this period, and we will soon see it in the elder Pliny and in Plutarch, among others, and it is with this sentiment in mind that Seneca begins the seventh book of his *Natural Questions*, noting that eclipses were held to be prodigies only because they *seemed* contrary to the natural order by those who were ignorant of the way things really worked.[9]

This 'rational' interpretation of extraordinary phenomena was only truly available to the educated, who had been exposed to the Aristotelian notion that natural causes ought to be sought to explain the things that happen, and who had been given enough instruction to see the principle bear fruit. Under the Empire we generally find the uneducated masses portrayed as ignorant and superstitious precisely because this interpretation of events was not available to them. Aristotle and Cicero, however, are not so arrogant, the former beginning his entire treatise on the subject with the democratic assertion that "all men by nature yearn for knowledge,"[10] while Cicero specifically defends the common man from aristocratic arrogance, implying in the process that the masses were not only capable of understanding science, but would benefit from learning it.[11]

The pretext for this defense is an imaginary conversation between Tubero and Scipio concerning the army's 'science lesson' from Gallus (discussed below), instructing the ignorant army about the real causes of eclipses, to which Tubero indignantly responds, "What are you saying? That he could teach this to men who are virtually farmboys, and that he dared to say these things in the presence of ignoramuses?" Scipio corrects him: "He certainly did," in fact, what mattered most about his doing this was that he "banished fear and false religion from confused men," an important point, considering that he could have instead mentioned the utility of winning the upcoming battle as the most important result, as Valerius Maximus would a century later.[12] Much of Scipio's fictional response is unfortunately missing. In contrast, only a century later, the younger Seneca would say with a hint of disgust that "no one observes the moon until it is eclipsed—then cities raise a din, then everyone on his own behalf makes a racket out of groundless superstition,"[13] although elsewhere he holds out hints of promise for mankind, as we will see. Plutarch is a little more sympathetic when he tells us that a lunar eclipse was "a great terror" to those "who panic at such things because

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[7] *Natural Questions*, 6.3.4.

[8] Ibid., 6.4.2.

[9] Ibid., 7.1, cf. also 6.3.2-3.

[10] *Metaphysics,* 980a.

[11] *On the Republic*, 1.15 (23).

[12] 11.1, where he says that without this science lesson dispelling fear 'the general would not have been able to defeat his enemy'.

[13] *Natural Questions*, 7.1.2. This 'groundless superstition' will be explored in detail later.

of their inexperience or superstition," for the scientific truth "was not easy to apprehend,"[14] recognizing the difficulty of the concepts involved.

An excellent look into the social world of eclipse lore is provided by Quintus Curtius Rufus, Seneca's contemporary, who describes the superstitious reaction to a lunar eclipse by the army of Alexander the Great, though his comments have a ring of contemporary relevance.[15] He records that Alexander's response was to manipulate their superstition by employing 'Egyptian soothsayers' (*Aegyptios vates*) to interpret the omen favorably.[16] Curtius then lavishes a sackfull of loathing on both the soothsayers and the credulous masses. His comments are instructive. He charges that although the soothsayers know very well the natural causes of an eclipse, "they do not teach the masses the knowledge that they themselves have learned,"[17] a charge that Curtius could as easily level at himself, since it is unlikely that any member of the *vulgus* in his day would read his book, and there was certainly no program at Rome to promulgate scientific lore to the people. Instead of proposing a solution in mass education, or even an oral dissemination of natural science, Curtius has little sympathy for the innocent *vulgus*, for "nothing governs the multitude more effectively than superstition," because they are, "generally fickle, wild and lacking in self-control" and because of this, "when seized by a false religion, they are more obedient to soothsayers than their own leaders."[18] It is unlikely that Curtius is thinking only of Alexander's soldiers. This is no doubt his opinion of the *vulgus* of his own day.

However, we get a different spin on a similar story in Livy. Writing on the third Macedonian war, with the Roman legions about to engage the enemy at Pydna, Livy tells an interesting tale. Gaius Sulpicius Gallus, a man noted by Cicero as a geometer and astronomer,[19] was at that time a tribune of the soldiers. Knowing that a lunar eclipse was due to occur, and no doubt wishing to avert a situation like that faced by Alexander, Gallus conferred with the consul and summoned the soldiers for some basic instruction in astronomy, predicting for them the very hour of the event. His speech, and the reaction of the soldiers, as constructed by Livy, is noteworthy. "No one should regard it as a portent," Gallus says, "because it happens according to the natural order at established times and it can be predicted and known in advance."[20] And so, he continues, they should not be amazed when it happens, any more than they are when

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[14] Plutarch, *Nicias*, 23.1-2.

[15] *History of Alexander*, 4.10.1-7. The same eclipse is also reported without much ado in Plutarch, *Alexander,* 31.8 and Arrian, *Anabasis,* 3.8.7.

[16] Arrian, *Anabasis,* 3.7.6, reports that it was Alexander's diviner Aristander who interpreted the omen favorably.

[17] *rationem quidem ipsis perceptam non edocent vulgus*. On the mingling of science and superstition by diviners and mages, see below, p. 34, 39-40, 43-4.

[18] *nulla res multitudinem efficacius regit quam superstitio, alioqui impotens, saeva, mutabilis, ubi vana religione capta est, melius vatibus quam ducibus suis paret.*

[19] *On Old Age*, 14 (49); according to the elder Pliny, he wrote a treatise on lunar and solar eclipses after this event (*Natural History,* 2.9 (53)), which may be the source for what Pliny, Cicero, and other Romans knew about the phenomena -- as well as this event (see below, p. 10).

[20] Livy 44.38.5-9: *ne quis id pro portento acciperet...id quia naturali ordine statis temporibus fiat et sciri ante et praedici posse*.

the sun and moon rise and set. When everything came to pass as he predicted, "the wisdom of Gallus seemed almost divine to the Roman soldiers,"[21] a remark demonstrating the gulf between the world view of Gallus and that of the commons. Of course, on the other side the uninstructed Macedonians were demoralized, taking the same event as a dire omen (*triste prodigium*), and raising a din (*clamor ululatusque*) until the moon returned, even despite the apparent use of *vates* to put a positive spin on the event in the same manner as their ancestor Alexander.[22]

This story, though probably based on reality, has a noteworthy touch of legend in it. For others tell it differently. Plutarch omits the instruction,[23] and indeed any reference to Gallus, noting that although the consul Aemilius knew the truth, he nevertheless made sacrifices out of his personal religiosity, while the soldiers behaved superstitiously but interpreted the omen as foretelling the fall of a Macedonian king. Pompeius Trogus follows Plutarch in a greatly abbreviated version, reporting that it was the Macedonians who interpreted the omen this way.[24] In Plutarch's version, if it is true, one might imagine such a rumor being spread deliberately by Aemilius among his own troops to manipulate the omen to his advantage (see below, p. 17), and his religious behavior would be in tune with such a strategy. However, Livy is closer to the event in time, and he adds the detail that it was the Macedonians who interpreted the omen as dire, even despite apparent attempts to manipulate the omen by the Macedonian leaders (if we assume the same strategy). However, Cicero's account is probably closest to what really happened. He portrays the soldiers as reacting to the eclipse with fear and superstition, and being instructed *afterwards* to calm them down. The words of Gallus in his account are similar to those reported by Livy: "it is no prodigy," he taught, for "it happened then, and would happen at fixed times in the future, because the sun had been so positioned that it was unable to reach the moon with its light."[25] Valerius Maximus follows Cicero, reporting that "the fear of our soldiers was overcome," because Gallus "most skillfully lectured them on the logic of the heavens and the nature of the stellar bodies."[26]

I am inclined to believe that something like Cicero's account is true. The only reservation I have about this is the fact that Gallus wrote a treatise on eclipses after this event, which may very well be the source for this story. If so, the tale could have been fictionalized to any degree for literary or philosophical reasons, and then taken as fact by later writers. This is especially a concern since Livy's order of events is repeated by the elder Pliny, who writes that Gallus was "the first of the Roman race to divulge to the masses the rationale behind both kinds of eclipse," first to the army at Pydna, and "soon

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21 *Romanis militibus Galli sapientia prope divina videri*.

22 *movit nec aliter vates*.

23 *Aemilius Paulus*, 17.7-11; a fragment of Polybius, 29.16, corresponds briefly with this account, simply reporting that the omen was interpreted by the Roman soldiers as foretelling the fall of a king, which could only bode ill for the Macedonians.

24 via the epitome of Justin, 33.6-7; the brevity is no doubt due to Justin, not Trogus.

25 *On the Republic*, 1.15 (23): *nullum esse prodigium, idque et tum factum esse et certis temporibus esse futurum, cum sol ita locatus fuisset, ut lunam suo lumine non posset attingere*.

26 Ibid., 8.11: *metum nostrorum militum vicisset* by *de caeli ratione et siderum natura peritissime disputando*.

thereafter by publishing a treatise."[27] This suggests that the Pydna story could have been colored by what Gallus wrote, or his fame for the latter may have inspired a legend surrounding the earlier event. But whether truth or invention, the story is important, for it represents an example of the legend of the 'science lesson' among the lore of elites, something which replaces for them the mythology of the masses, and becomes a paradigm example of the difference between the educated and the uneducated, and between the enlightened and the superstitious. We hear of an explicit attempt to make this distinction in Plutarch, who writes that women should be educated in astronomy so that they will not be superstitious, and he notes that they should learn the story of Algaonike, a witch who used scientific eclipse predictions to dupe the masses.[28] Stories such as these formed an excellent framework for transmitting the scientific lore of eclipses in the context of relating an act of heroism, though this lore was only transmitted among the literate.

As one might expect, we soon find this heroic tale overtly fictionalized. In his essay *On Benefits*, while concluding his answer to the question of "whether it is shameful to be outdone in acts of kindness,"[29] Seneca has occasion to address the kinds of benefits wise men have to offer kings, which outdo any gift a king can bestow. The last example he uses is the truth about eclipses, which involves him in a marvelous contrafactual, proposing the hypothetical case of Socrates teaching this to king Archelaus, concluding, "How great would the benefit have been, if he had dragged the frightened king from his hiding place and told him to be of good cheer,"[30] and then explained how eclipses really worked. It is noteworthy that Seneca exhausts a good deal of ink spelling out this explanation, showing off his knowledge, and instructing his readers. This penchant for giving lengthy footnotes on the causes of eclipses appears in numerous writers of the period. This may be just another reflection of the Roman fascination with rhetorical topoi, or it could suggest that this was not common knowledge among the literate -- or that many authors thought it was not.[31] Pliny, for instance, laments that "we" do not give any thanks to astronomers, but prefer to compose annals of blood and slaughter, "so that the crimes of men may be well known to those who are ignorant of the very universe."[32] Nevertheless, both Pliny and Seneca

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[27] *Natural History*, 2.9 (53): *et rationem quidem defectus utriusque primus Romani generis in vulgum extulit...sollicitudine exercitus liberato...mox et conposito volumine.*

[28] *Advice to Bride and Groom*, 145C-D.

[29] *On Benefits*, 5.7.1: *an turpe esset beneficiis vinci.*

[30] Ibid., 5.6.4: *quantum fuisset beneficium, si timentem e latebris suis extraxisset et bonum animum habere iussisset*.

[31] e.g. Dio Cassius, 60.26; Valerius Maximus, 9.1; Plutarch, *Aemilius Paulus,* 27.7-10, *Nicias,* 23; in a much later period, Ammianus Marcellinus practically inserts an essay on the subject into his history at 20.3. I cannot imagine any other reason for this, since the point could be made with a casual remark, as it is with most other natural phenomena, trusting in the common knowledge of the reader (as does Frontinus, *Stratagems,* 12.8-9, although he is aiming at brevity; but Plutarch also assumes this knowledge is already possessed by the reader of *Advice to Bride and Groom*, 145C-D). Seneca's 'dissertation' is in fact the longest to be found in a work not devoted to natural phenomena, apart from Marcellinus, and it goes way beyond the bounds of necessity in the given context. One would never see such digressions in modern works. The edict of Claudius (below) also suggests a belief that there were literates lacking this knowledge.

[32] *Natural History,* 2.6 (43): *ut scelera hominum noscantur mundi ipsius ignaris.*

regarded this knowledge, and the ability to impart it, as a benefit greater than wealth and power, for otherwise one can only be ignorant and frightened, and most of their colleagues would agree.

Nevertheless, while men within this limited cultural sphere could praise astronomers as "great men, beyond mortal nature, who have discovered the law of such great divinities and freed the sorry mind of man from fear,"[33] the commons could on occasion look upon the educated and their 'theories' with a certain measure of contempt, and continue abiding by their own superstitious explanations. Plutarch shows an awareness of this when discussing the history of the science of eclipses in *Nicias.* He attributes the discovery to Anaxagoras, whose explanation was transmitted slowly and to only a few, and even they received it

> with caution rather than confidence, for they did not exalt the physicists and star-gazers, as they were called then, because they let god vanish into reasonless causes, improvident forces and deterministic necessity.[34]

Plutarch was speaking of elites, not the commons, but it is easy to imagine the same argument being applicable, for if the educated had a problem with it 'then', the uneducated could have an even harder time with it 'now'.

This contempt we also see reflected in other contexts. Plutarch remarks at another place that the masses do in fact "despise philosophers and statesmen" who try to promulgate philosophical notions of divinity,[35] and, because of their own traditional beliefs, reject the aid of doctors and philosophers.[36] Seneca, too, hints at this in a fragment from his treatise *On Superstition*, where he depicts the common man complaining about the philosopher's religion, "Am I to put up with Plato or Strabo the Peripatetic, of whom the one makes god without a body, the other without a soul!?"[37] This popular contempt is also voiced in early Christian literature, which is as close to being 'popular' as any written text could be in antiquity. "Has not god made foolish the

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[33] Ibid., 2.9 (54): *viri ingentes, supraque mortalium naturam, tantorum numinum lege deprehensa et misera hominum mente metu soluta*.

[34] *Nicias*, 23.2-3: μετ᾽ εὐλαβείας τινὸς ἢ πίστεως βαδίζην, οὐ γὰρ ἠνείχοντο τοὺς φυσικοὺς καὶ μετεωρολέσχας τότε καλουμένους, ὡς εἰς αἰτίας ἀλόγους καὶ δυνάμεις ἀπρονοήτους καὶ κατηναγκασμένα πάθη διατρίβοντας τὸ θεῖον. Plutarch credits Plato with reversing this trend.

[35] *Against Superstition,* 167E: φιλοσόφων δὲ καὶ πολιτικῶν ἀνδρῶν καταφρονοῦσιν, ἀποδεικνύντων τὴν τοῦ θεοῦ σεμνότητα μετὰ χρηστότητος καὶ μεγαλοφροσύνης καὶ εὐμενείας καὶ κηδεμονίας.

[36] Despite the fact that medicine was the third most advanced science in antiquity (mechanics and architecture holding second place, and astronomy first), as any perusal of Celsus and Galen will show. Granted, it was hardly advanced by modern standards, but it was modestly successful. It, too, was built on the cultural assumption of a rational universe functioning according to natural causation, in contrast to popular theories of divine punishment and demonic influence which appear abundantly in the New Testament, as well as Plutarch's *Against Superstition* and Lucian's *Lovers of Lies*.

[37] Preserved in Augustine's *City of God*, 6.10: *ego feram aut Plato aut Peripateticum Stratonem quorum alter fecit deum sine corpore alter sine animo?* This is in the context of what Augustine notes is Seneca's discussion of what Augustine calls the 'natural theology' (*theologian naturalem*) of 'certain philosophers' (*quorundam philosophorum*).

wisdom of the world?"[38] Paul asks rhetorically, for "the Lord knows that the arguments of the wise are useless,"[39] and one should make sure that they are not made a prisoner by "philosophy and hollow deceptions" which follow "the tradition of men and the basic principles of the universe, rather than Christ."[40] Such sentiments reveal a distrust of the learned and their theories and explanations which, if applied generally, would generate resistance to scientific facts about eclipses.[41] This distrust derives no doubt from not having been enculturated in the world of the philosopher and scientist, where, once the basic rational principles were assimilated, all the debates and uncertainties that vex the outsider would be seen by the insider as a natural part of the attempt to explain the universe according to rational principles.[42] To them this is a noble enterprise that dispels fear and cultivates reasonable behavior, but to the unlearned it is sophistry.[43]

Thus, Cicero's optimism that the masses could be educated about such things seems to be misguided, for it is not enough to merely explain things -- one must inculcate the cultural framework in which the facts fit and make sense, including the core belief in a rational natural order independent of human concerns. It is certain, then, that the most ambitious attempt in the Roman Empire to spread the news about the true workings of eclipses would not have much of a noticeable effect on the general populace. I am referring to the decree of Claudius, recorded in Dio Cassius, who gives us the following story:

> Since the sun was about to be eclipsed on his birthday, he feared that some trouble might come out of this, because some other portents had already happened, and he issued a public notice stating not only that there was to be an eclipse and when and how great,[44] but also the reasons why it was going to happen as a matter of necessity.[45]

Dio then gives the reasons, going into a lengthy dissertation on the astronomy of eclipses, which possibly parallels the proclamation he is citing, though perhaps with

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[38] 1 Corinthians 1.20: οὐχὶ ἐμώρανεν ὁ θεὸς τὴν σοφίαν τοῦ κόσμου;

[39] Ibid.: Κύριος γινώσκει τοὺς διαλογισμοὺς τῶν σοφῶν †τι εἰσὶν μάταιοι.

[40] Colossians 2.8: βλέπετε μή τις ὑμᾶς ἔσται ὁ συλαγωγῶν διὰ τῆς φιλοσοφίας καὶ κενῆς ἀπάτης κατὰ τὴν παράδοσιν τῶν ἀνθρώπων, κατὰ τὰ στοιχεῖα τοῦ κόσμου καὶ οὐ κατὰ Χριστόν.

[41] For examples of later Christian opposition to science, cf. Grant, pp. 112-5.

[42] Seneca expresses this admirable scientific sentiment plainly: "A time will come when the very things now hidden, both time and the diligence of a later age will bring to light," *Natural Questions,* 7.25.4: *veniet tempus quo ista quae nunc latent in lucem dies extrahat et longioris aevi diligentia*.

[43] For the similar role of cultural assumptions in driving the perplexing misunderstandings between Christians and pagans, cf. Remus, esp. his chapter "Miracle and the Sociology of Knowledge," pp. 159-82, and his ensuing application of this to Celsus and Justin.

[44] Or possibly 'how long' -- both magnitude and duration could probably be predicted by this time, but neither reliably (see part II below).

[45] Dio Cassius 60.26.1: καὶ ἐπειδὴ ὁ ἥλιος ἐν τοῖς γενεθλίοις αὐτοῦ ἐκλείψειν ἔμελλεν, ἐφοβήθη τε μή τις ἐκ τούτου ταραχὴ γένηται, ἐπεὶ ἄλλα ἄττα τέρατα συνεβεβήκει, καὶ προέγραψεν οὐ μόνον †τι τε ἐκλείψει καὶ ὁπότε καὶ ἐφ' ὁπόσον, ἀλλὰ καὶ τὰς αἰτίας δι' ἃς ἀναγκαίως γενήσεσθαι τοῦτ' ἔμελλεν.

embellishment.[46] The persistence of superstition after this event, indeed the lack of any other mention of this document before the third century, demonstrates the failure of this effort to get the word out. It is not hard to imagine why. Unless decrees were read aloud to attentive crowds, only the literate, and indeed only the curious and those with a need or interest, would have even read this edict, and for many of them this would not be news. For everyone else, it would be little more than imperial sophistry, if it was noticed at all.

Thus, if we take the 'science lesson' of Gallus to be true, and accept Dio's account of the Claudian proclamation, these admirable attempts to spread the gospel of the natural order were not to be repeated in any notable way, and the lore was evidently not transmitted through future ranks and generations -- for the Romans apparently behaved during the mutiny under Tiberius just like their Macedonian enemies centuries earlier. This is recorded by Tacitus, who, like Curtius and Seneca, also expresses little sympathy for the uneducated and panic-stricken, whose "minds once disheartened are excitable to superstition."[47] In this case, just as in Alexander's day, their leaders take advantage of their superstition rather than try to cure their ignorance.

Herein lies another reality, noted by Curtius: it is easier to manipulate superstitious people than to educate them. This was virtually codified by the tactician Frontinus, who includes both stratagems when describing ways to dispell the fear caused by adverse omens.[48] Nevertheless, although seven of the twelve examples given involve manipulating superstition,[49] he also includes the paradigm of the science lesson among his examples, citing Gallus, but also Agathocles of Syracuse, who used the same tactic, and Pericles,[50] who explained the natural causes of lightning with a flashy show worthy of Mr. Wizard.[51] The majority of the tactics suggested, however, fall

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[46] Not necessarily -- Dio may even be summarizing. Claudius had a penchant for showing off his knowledge in lengthy, rambling decrees, if his edict on citizenship is anything to go by (which is largely extant -- cf. *Corpus Inscriptionum Latinarum*, 8.1668.2), of which Tacitus renders an improving summary in *Annals* 11.24. Dio may have done the same here.

[47] Tacitus, *Annals*, 1.28: *sunt mobiles ad superstitionem perculsae semel mentes*.

[48] *Stratagems*, 1.12, with the chapter heading of *De Dissolvendo Metu, Quem Milites ex Adversis Conceperint Ominibus*: 'On Undoing the Fear Which Soldiers Derive from Adverse Omens'.

[49] Ibid. 1, 2, 4, 5, 6, 7, and 12, most found elsewhere in the lore of educated Romans. An eighth may or may not be included: 3, Titus Sempronius Gracchus urges his men to take advantage of the enemy's surprise at a sudden earthquake -- this omits any mention of a science lesson, and being mid-battle it is more likely to have been taken, at the urging of Gracchus, as a favorable portent or god-sent advantage in battle.

[50] Ibid. 8 (following Livy's order of events), 9, and 10, respectively. 11 might also belong to this list: a sneeze is declared unportentious by Timotheus by pointing out the odds of one man sneezing out of so many thousands (*miraris, inquit, ex tot milibus unum perfrixisse?*). It is also worth looking at Polybius 9.19.

[51] Plutarch credits Pericles with a version of the 'science lesson' about eclipses (*Pericles*, 35.2), though in that account Pericles is less detailed and more dramatic than Gallus in his explanation, using his cloak as a visual aid, and he only educates his fearful steersman, and only after the fact. Cicero tells a similar story, but says Pericles eased the fear of all the Athenians (*On the Republic,* 1.16 (25)). But this could be a myth introduced by educators, since Plutarch says this is what "is told in the schools of the philosophers" (taËta m¢n oÛn §n ta›w sxola›w l°getai t«n filosÒfvn). This may be an example of the legend of the 'science lesson' becoming a 'scientific myth' among educated elites, a myth which exemplifies the virtue of the scientist and the value of science (in all versions, the dispelling of fear is central). Like many myths, it may have a kernel of truth. Whether the Pericles story is true at all is difficult to say. Valerius Maximus tells both the Gallus story and that of Pericles (9.2.*Ext.*1), whom he says

on the side of manipulation rather than education, and since the former was much easier, especially in the heat of battle, this is not surprising. Yet Plutarch's portrayal of Aemilius Paulus shows that even without pressing need, manipulation could be seen as a useful tactic, for Paulus knew what was really happening during the eclipse, and Plutarch says he specifically waited until he knew it was about to end and then sacrificed eleven heifers to the Moon.[52] This might have seemed as if, through a formal and official Roman ceremony, he had recalled the goddess. Whether this is the correct account or not,[53] this tactic may still have been preferable. The rational interpretation of the extraordinary requires a larger enculturation in the social sphere of natural science, without which such knowledge simply appears 'almost divine' (*prope divina*) or so much 'empty trickery' (ken∞w épãthw) to the credulous commons. Any other attempts to educate the masses must have been, like the Gallus example, uncommon and *ad hoc*. And so, though the educated saw an eclipse as ordinary, to the *vulgus* it remained extraordinary, and this bred the irrational behavior discussed in part III.

II. Science

In the period being discussed, the knowledge of ancient astronomers concerning eclipse phenomena was considerable.[54] Any of the ancient digressions explaining eclipses so far cited are as correct today as they were then, with only a handful of mistakes, mostly made by non-experts like the elder Pliny. I will supply some of the basic science. Every detail can be found in Ptolemy's *Almagest* (also known as the *Mathematike Syntaxis*), the ultimate source in antiquity, written in the 2nd century A.D. If not there, then it can at least be found in other sources of or before that time, except those few facts that I shall point out.

Nevertheless, the most accomplished predictors of lunar and solar eclipses were the Chinese, with the Babylonians a close second, and the ancient Maya also figure in the top ranks.[55] The Western astronomers were not only the worst at this, but extant eclipse observations from that time and region are the least reliable of all of the four civilizations (Chinese, Mayan, Babylonian, and Graeco-Roman, the latter including Egypt) who have extant records of eclipses.[56] Schove describes the height of the Roman Empire as "a dark age as far as natural phenomena are concerned," i.e. as compared with other ancient civilizations, though he concedes that good records were

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taught the Athenians just what his tutor Anaxagoras had taught him about the path of the sun and moon. This may be true, or the connection between Pericles and the famous astronomer Anaxagoras (also made by Cicero, *loc. cit.*) may have created a plausible pretext sufficient for forming the story.

[52] *Aemilius Paulus*, 17.9-10.

[53] Both *could* be true, if we accept Cicero's order of events -- if manipulation was seen as not working, Gallus may have proposed switching tactics to education instead.

[54] On the controversy as to when these facts were discovered and by whom, cf. Lloyd, pp. 170-1.

[55] Schove, p. xx. Regarding the Maya, it may only be luck that has preserved more records and tables than have survived at Alexandria. The Dresden codex is almost the sole source of evidence for the 5th century A.D., but surviving evidence is more extensive for the 10th century which clearly outclasses the extant Western records. Schove discusses all of these eclipse records and tables, cf. pp. 90, 145, 172, 212-4, 249, and esp. 298-9.

[56] Ibid., p. xxvii.

no doubt kept at Alexandria which would change his opinion if they had survived.[57] Based on the observation data evidently available to the elder Pliny,[58] it is more than possible that Western astronomers could have taken the prize for first place, if there had been any attempt to preserve their records.

A. The Lunar Eclipse

An eclipsed moon is not the same thing as a new moon. The new moon is positioned just so that it blocks the sun's light entirely, and this would always entail a solar eclipse if it were not for the fact that the moon's orbit around the Earth is inclined, a fact known to Cicero and Dio Cassius.[59] For this reason, except for those rare occasions producing an actual eclipse, the moon is never directly between us and the sun. An eclipsed *moon*, however, is positioned just so that it falls under the shadow of the Earth, which means that a lunar eclipse can only occur during a full moon, a fact known to the elder Pliny and to Dio Cassius,[60] since it must be behind the Earth in respect to the sun, before the Earth's shadow can cross it. As was well known to men like the elder Pliny,[61] a new moon is a monthly event, and follows a gradual waxing and waning that is as regular as clock-work -- in fact, most ancient calendars, such as that of the Hebrews and Babylonians, were lunar. An eclipse, however, occurs dramatically fast -- observers can watch the moon fall from full brightness to complete shadow in less than an hour. Plutarch notes the significance of both facts: "the masses" (ofl pollo‹) understand that the new moon every thirtieth day is caused "somehow or other" (èm«w) by nature, but it is when the *full* moon *suddenly* vanishes or dramatically changes color that worries and perplexes them.[62] For example, based on present knowledge, the eclipse of 14 A.D. recorded by Tacitus[63] began around 3:40 AM, achieved totality (in this case, the moon was 1.6 lunar diameters inside the Earth's shadow) near 4:40 AM, and the mid-point of the entire eclipse event was reached at about 5:30, near sunrise. Of course, such exactitude of measurement was not known in antiquity, nor possible.

Contrary to popular belief, an eclipsed moon very rarely vanishes. Unlike a new moon, the eclipsed moon still receives light from the sun, refracted by the atmosphere of the Earth. For Earth's shadow is actually conical, not cyllindrical, even though its termination point happens to fall far past the moon. This was partly understood by the

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[57] Ibid., p.1. Although Schove has a good record of ancient references to all manner of phenomena in the West, showing good attention to the texts, he has the strange notion that the history of Velleius is lost, which lays a shade of doubt on his historical opinions.

[58] *Natural History*, 2.72 (180). Likewise, if the works of Hipparchus had survived, we would no doubt have a great deal more of such information. See below, p. 26.

[59] Cicero: *On the Republic,* 1.16 (25); Dio: 60.26.2-3. It is safe to assume that what Dio reports was also known to the emperor Claudius.

[60] Pliny: *Natural History,* 2.10 (56); Dio: 60.26.5.

[61] *Natural History,* 2.6 (45-6).

[62] *Nicias*, 23.1-2.

[63] *Annals*, 1.28; cf. Schove, p. 4.

elder Pliny, whose explanation is based on basic geometry, correctly assuming the excessive size of the sun, but does not recognize the effects of refraction.[64] As a result of this bending of light, a moon in eclipse can change colors, since, as we see in a prism, light bends differently according to its frequency in the color spectrum, the red bending the most, blue the least. Thus, the most common color of the moon in *full* eclipse is red, which has the longest wavelength of visible light and thus bends the farthest, and many ancient records report the moon turning red.[65] These color changes were observed, noted, and understood to correspond with the depth of the moon's passage into the Earth's shadow, but no one, of course, figured out the real reason for the color changes.[66] On very rare occasions, the moon can fall so far into Earth's shadow that no refracted light reaches it at all. These are calleed 'dark' lunar eclipses, and they are black indeed, though not necessarily 'invisible'. Meteorological factors can also affect both the color and visibility of the moon, such that many 'dark' eclipses identified even in the past two centuries are actually the result of recent volcanic activity affecting the transmission of light through the atmosphere.[67]

Lunar eclipses differ from solar in two important respects: because the Earth is so much larger than the moon, and the sun so distant, a lunar eclipse is visible to everyone in that part of the world experiencing nightfall -- though the time at which it begins and ends will vary from east to west, as was well known to the poet-astrologer Marcus Manilius and others.[68] And since the inclination of the lunar orbit is virtually irrelevant to whether it falls under the Earth's shadow, lunar eclipses are far more common, occurring on average two to three times every year, but not all of these will occur on the same side of the Earth, nor will all be visible even then, since clouds often hide the event. The frequency and pervasiveness of lunar eclipses makes predicting them remarkably easy. In fact, it is not even necessary to understand the astronomical details. A careful observer will discover that lunar eclipses occur in regular cycles with interweaving periods of five and six months.[69] It is possible to draw up tables which will accurately predict lunar eclipses hundreds of years in advance solely by crunching numbers. Solar eclipses also have cycles, though much greater in magnitude. There are 11 year and 1,841-year-and-1-month cycles, among others. Interestingly enough, solar eclipses which had occurred in the 2nd century Roman Empire were repeated in

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64 *Natural History*, 2.7.(47-8), 2.8.(51-2); cf. also Dio Cassius 60.26.5.

65 E.g. Quintus Curtius Rufus, *History of Alexander*, 4.10.2; Dio Cassius, who also mentions its shifting through other colors, 64.11.1, etc., as does Plutarch, *The Face on the Moon,* 934C-D. When we deal with superstition, we will see the red moon appearing again.

66 Cf. Seneca, *Natural Questions*, 7.27.1; Plutarch, *Aemilius Paulus*, 17.7; *Nicias*, 23.2; and *The Face on the Moon*, 19 (934C-E) also comes close to the truth, though only vaguely. In the latter source, Plutarch notes that colors vary according to the time of night the eclipse occurs, which happens to correspond to the fact that this affects the depth of shadow.

67 Cf. Bicknell; Stothers.

68 *Astronomica*, 1.221-227; cf. also Plutarch, *The Face on the Moon*, 19 (932F); Pliny, *Natural History*, 2.72 (180).

69 Schove, p. ix; Thurston, p. 17-19; Ptolemy, *Almagest,* 6.7; Pliny the elder, *Natural History*, 2.10; Plutarch, *The Face on the Moon,* 933D.

just this past decade.[70] Predicting the magnitude of lunar eclipses is harder, but not greatly, provided one has sophisticated mathematical tools available, as Ptolemy did. Magnitude today is measured in lunar diameters, so it is possible to discuss magnitudes greater than one, if the moon enters the Earth's shadow by many times its own diameter. In antiquity, magnitude was only measured by the fraction of the lunar disk that was still visible,[71] which does not allow for calculating different degrees of a total eclipse.

B. The Solar Eclipse

As has already been mentioned, a solar eclipse would be a monthly event, occurring at every new moon, if the lunar orbit were on the same plane as the sun's apparent path around Earth. However, the inclination of the orbit means that there will be an eclipse only when the moon is at that one unique point in its orbit at the very same time the sun happens to be at the right point in the sky. It follows, of course, that solar eclipses can only occur during the new moon, thus wary astronomers will at least know when to look for a solar eclipse long before they are able to predict them, and Seneca describes one of their methods: watching the solar reflection in a thick, opaque liquid.[72] Of course, Babylon and China, using lunar calanders, could expect solar eclipses to occur only on the first day of any given month. This makes their regularity more apparent, and it is thus not surprising that these two civilizations were the first to catch on to that fact. Last but not least, it also follows that a lunar and solar eclipse can never be nearer each other in time than fifteen days, the time it takes for the moon to pass from full to new. Such an event occurred at Rome in 71 A.D., reported by Pliny, who remarks on the fact that this is not unusual.[73]

Naturally, the sun is many times larger than both moon and Earth, and the moon many times smaller than the Earth, which means that the conical shadow of the moon is actually small, only barely reaching Earth before its termination point. Thus, the area covered by a total eclipse is little more than 100 miles in diameter,[74] and will only be partial for those outside this area, in proportion as they are distant. However, due to the relative motion of all three bodies, the eclipse will form a track of darkness moving rapidly eastward for thousands of miles. Ancient astronomers at least since Hipparchus, who flourished in the 2nd century B.C., knew the basic details of this.[75] Nevertheless, solar eclipses in general are somewhat common, but more often than not, especially before the industrial population explosion, they do not occur where anyone

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[70] Cf. Scove, p. xvii. Some argue against the reliability of such cycle systems of prediction in antiquity, cf. Aaboe; Newton, however, argues that modestly reliable cycle charts could plausibly have been available to Thales which would allow an educated guess (pp. 94-5).

[71] Ptolemy, *Almagest*, 6.7.H501.

[72] *Natural Questions*, 1.12.1; Schove, p. xx.

[73] *Natural History*, 2.10 (57). Schove writes that "a lunar eclipse often occurs a fortnight before or after a solar eclipse," p. 16; he also discusses Pliny's eclipse report.

[74] Newton, p. 35.

[75] Cf. Newton, p. 105; Pliny, *Natural History*, 2.9 (53-4).

will see them,[76] and the frequency at which a solar eclipse will be visible in the same location is barely thrice in every thousand years, even though, counting all partial eclipses, the average rate of occurrence for any given location is one every two to three years.[77]

Naturally, predicting solar eclipses requires very sophisticated mathematics -- it is necessary to know to a good approximation the true sizes of sun, moon, and Earth, and their true distances, and Aaboe describes how Ptolemy[78] was the first extant author to have done this with any worthwhile success, but Ptolemy was only repeating and expanding the work of Hipparchus.[79] It is difficult to date Hipparchus, but it is possible that his work was extent in the time of Gallus, and it is certain that it was extant in the time of Cicero.[80] The difficulty of all the necessary calculations, and the paucity of precise data in antiquity, is shown by the eclipse 'predicted' by the edict of Claudius, discussed above: modern calculations show that it was only a 30% magnitude eclipse in Rome, and so was essentially invisible. However, Claudius' astronomers could not have known that with any reliability.[81] Dio's passage mentions the fact that location affects visibility,[82] and it is probable that the Claudian edict did as well. At any rate, Ptolemy was also well aware of the imprecision of prediction,[83] especially his measurements of lattitude and longitude for those wishing to make predictions outside of Alexandria.[84] Likewise, eclipses will start and stop at different times and have a different duration for observers in different locations. This was very well known by the time of Ptolemy,[85] and even Pliny the elder notes the fact,[86] who cites records which show that the times of these events were being recorded in distant places and these records were being compared.[87] Pliny also claims that it was long known how to predict the very hour of solar and lunar eclipses,[88] which was very probably true, since Ptolemy would merely continue the work of Hipparchus. At any rate, such predictions

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[76] There are of course a great many 'eclipses' in which the core lunar shadow misses Earth entirely (Schove, p. xvi); it was possible for an ancient calculation to predict an eclipse without recognizing that, for one or more reasons (location of viewer, clouds, etc.), it would not be visible to anyone, a fact known to Pliny the elder, *Natural History*, 2.10 (57).

[77] Cf. Schove, p. xv.

[78] Cf. *Almagest*, 6.7-8; 6.10.H352-5.

[79] Pliny, for instance, records that Hipparchus accomplished this, making a successful eclipse almanac running the course of the next several centuries, *Natural History*, 2.9 (53-4); cf. Newton, pp. 123-6.

[80] Newton places the last eclipse reputedly observed by Hipparchus on 23 March 126 B.C., p. 105-8.

[81] Schove, p. 7. Incidentally, this event confirms Claudius' birthday as August 1.

[82] Dio Cassius 60.26.3.

[83] *Almagest*, 6.7.H505.

[84] Ibid., 6.10.

[85] *Almagest*, 4.1.H267.

[86] *Natural History*, 2.72 (180).

[87] Ptolemy's report of the same kinds of records collected by Hipparchus shows that the earliest records of this kind in the West date only to around 200 B.C. Hipparchus had to consult Babylonian astronomers to go further back for reliable records, cf. *Almagest*, 3.2, 4.5, 5.11.

[88] *Natural History*, 25.5.10.

were possible, but required complex math and geography comprehensible only to the talented expert.

Overall, a solar eclipse lasts only five to eight minutes, no more nor less[89] (lunar eclipses last for hours). It is also notable that most eclipses cannot be seen. Whereas a partial lunar eclipse is usually visible, a partial solar eclipse will have no appreciable effect on daylight, and will not be noticed unless specifically looked for -- near dawn or dusk is an exception, however, for in these two cases the sun can be looked at directly (and is often likely to be looked at for admiration's sake). Dio Cassius, for example, records a 'partial eclipse' for the year 5 A.D.,[90] which we know had a magnitude of only 40% at Rome, but we know from modern calculations that it occurred very near sunset, which explains why it was noticed.[91] The ancients were aware of partial eclipses,[92] but we have few reported observations. Solar eclipse magnitude is today measured in fractions of totality, and it has been demonstrated that, the noted exceptions aside, a magnitude of less than 80% is invisible to the layman, and unless it is 90% or greater it is still unlikely to be noticed.[93] There is another odd feature of solar eclipses. Due to the fact that the lunar orbit is not equilateral to the Earth, the moon is periodically farther than usual, and solar eclipses which occur when the moon is more distant actually do not completely cover the sun. These are called 'annular' eclipses, because, as the Latin root *anular* suggests, the sun is still visible as a 'ring' of light around the moon. Both Ptolemy[94] and his contemporary Sosigenes were aware of this fact,[95] and Hipparchus very well may have been. This is not the same thing as the corona, which is visible even during a total eclipse. In fact, an annular eclipse can even go unnoticed by those who don't think to look up, for the sun's light is sufficiently strong, even then, for daylight to be nearly unaffected, and there are no confirmed historical observations of an annular eclipse before 1600 A.D.[96]

Two additional details are necessary: first, eclipse reports in antiquity often claim that stars are visible during the eclipse, the sky being described as resembling night.[97] Seneca acts as if this were always the case during a total eclipse.[98] This is suspicious, and suggests literary embellishment, for this very rarely occurs.[99] Even in the most complete eclipses, the sun's corona usually overpowers the light of all but a handful of

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89 Newton, p. 35.

90 Dio Cassius 55.22.

91 Schove, p. 3.

92 E.g. cf. Seneca, *On Benefits*, 5.6.4.

93 Schove, p. xvi; Newton, p. 36, who provides useful anecdotal evidence.

94 *Almagest*, 6.9.H525-7.

95 Cf. Préaux, pp. 224, 252, 284-6.

96 Schove, p. xi.

97 E.g. Pliny the elder, *Natural History*, 2.11.(58); Lucan, who is clearly painting with a literary brush, *Pharsalia*, 1.535-45; and Plutarch, *The Face in the Moon*, 19 (931D), who also knows, however, that this is not always the case (932A-B).

98 *Natural Questions*, 1.12.1.

99 Both Scove (p. iii-vii) and Newton (p. 43-47, 102, 116-7) discuss how ancient sources should be handled, noting the most common causes of error or embellishment.

stars,[100] and Plutarch knew this (*loc. cit.*). Again, experts who train their eyes to look for specific stars might be able to faintly make them out, but this is not the same effect as being 'dark as night'. Usually, Venus is the only other object in the sky visible during an eclipse, and then of course only if it is above the horizon at the time. Second, contrary to popular assumption, predicting solar eclipses has never been a very exact science until quite recently, with the development in the mid-1980's of computer programs and precise data adequate to the task. And calculating eclipses backwards is still not an exact science, due to a little known problem: the moon and the Earth are decelerating,[101] a fact totally unknown in antiquity, and they are decelerating unevenly and unpredictably.[102] Though the deceleration rate is very small, over thousands of years the significance is great enough that calculating solar eclipses in the past is subject to unknown errors. In fact, while historians use eclipses to calibrate chronology,[103] astronomers are doing the reverse, by using ancient eclipse reports to calibrate estimates of the decelerations.[104]

C. Ancient Uses of Eclipse Data

The use of eclipses for historical dating is actually not as recent an idea as commonly thought: the ancient Romans are in fact the first known to attempt this. Plutarch reports[105] that Varro had commissioned the astrologer Tarutius to calculate the year and day of the birth of Romulus, going on the theory that an eclipse of the sun then occurred (as again at the founding of Rome). Though this was a good idea, except for

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[100] Newton, p. 37; Bicknell gives useful modern data on the frequency of 'dark' eclipses of the moon (p. 160-1), and he takes the ancients seriously (though not competently) by positing a series of unusually dark eclipses in need of explanation, a thesis which was soundly refuted by Stothers. Literary embellishment or borrowing is the most likely explanation.

[101] Schove, p. xvii, xxi; the location is the most difficult detail to calculate, more than the time, cf. Newton, p. 113; the deceleration of the moon is due to the tidal forces of gravity, of earth the same thing, as well as, amazingly enough, wind, and water condensation and evaporation. The gravitational effect is somewhat calculable, but weather can't even be predicted a week into the future, much less thousands of years into the past. Coral studies show that the Earth's year was 400 days long in the early Cambrian period. To make matters worse, the moon is slowly retreating, astronomers estimate today that it is over 400 feet farther from the Earth than in 1 A.D., which also affects calculations (Schove, p. xxvii.).

[102] Newton, p. 1-3.

[103] Since they only need an acuracy within one day -- although in Western records, only three eclipse reports in the first four centuries actually include the month and day: 45 A.D., 59 A.D., and 346 A.D.; cf. Schove, p. 2. Pliny the elder (*Natural History,* 2.70.(180)) gives the time and place of the 59 A.D. eclipse and is correct to within half an hour, making this the best extant solar eclipse record in the West (Schove, p. 11-13).

[104] The science behind this is very complicated and will not be discussed here (cf. Schove, Newton, Fotheringham for examples). But in regard to the use of ancient solar eclipse reports for historical reasons, a good deal of caution is in order. As the modern astronomer Robert Newton elegantly puts it, "Most of what the technical literature has to say about ancient solar eclipses is wrong," quoted in Schove, p. ii, who goes on to detail all of the difficulties and necessary sources, as well as catalogue and discuss all the ancient reports of the common era. Modern developments have also made some older work obsolete: e.g. the standard resource, Oppolzer, has some maps sufficiently outdated to be hundreds of miles off the currently calculated marks.

[105] *Romulus*, 12.2-6.

being based in pseudo-history, Plutarch did not take this kind of thing too seriously,[106] but Cicero seems to approve.[107] Christians in the 2nd century tried to use this method to date the crucifixion of Christ, going on the theory that an eclipse occurred at that time,[108] but Origen knowledgeably attacks this idea: Christ was crucified at Passover, which always occurs at the full moon, and a solar eclipse would be impossible then.[109] According to Origen, fellow Christians were following the *Chronicon* of Phlegon, which places a solar eclipse along with an earthquake in Bithynia in 33 A.D. (though modern calculations show he must have meant 29 A.D.), which is the first attempt at using an existing eclipse record to date an event in the past, even though it is surely a mythical eclipse.[110]

But the greatest mileage the ancients got out of lunar eclipse phenomena was to prove that the earth is a sphere.[111] This was amazingly argued first by Aristotle,[112] who recognized that people in different places on the planet have different views of the stars, and that at all these locations the Earth's shadow on the moon was round -- the two facts combined are a potent proof that Earth is spherical. This is an impressively clever argument, proving that we should never underestimate the intelligence of the ancients. Aristotle's argument did not fall into obscurity. It is picked up by the poet-astrologer Marcus Manilius,[113] and Plutarch,[114] and even more smartly the same conclusion is reached by Pliny the elder, observing that the time of observation of *solar* eclipses varries with location on the globe.[115] To all of this should be added Ptolemy's use of the lunar eclipse to calculate the true distance between the Earth and the moon, which can only be calculated when standing on the line connecting the center of both masses, which is exactly where you are standing during a total lunar eclipse, as long as you can calculate the mid-point of the event, which Ptolemy could do.[116]

D. Summary

It is evident from all of the above that the educated were in possession of a great deal of information and understanding, and had at their disposal sophisticated means for using astronomical information to make arguments about the shape of the Earth, the regularity

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[106] Ibid., 12.6.

[107] Who also notes this same use of eclipse data, *On the Republic* 1.16 (25).

[108] Luke 23.44-5, Matthew 27.45.

[109] *In Matthaeum,* 134. He proposes either an interpolation in the text by later copyists or some meteorological event local to Judaea at the time, both rather sophisticated theories. His argument is based also on the fact that no other historian or writer records the event. He also recognizes the possibility of invention.

[110] For discussion of this evidence, including the theory that it is a mistake for a *lunar* eclipse, cf. Schove, pp. 6-7, 328.

[111] Cf. Schove, pp. 34-5.

[112] *On the Heavens*, 297b.

[113] *Astronimica*, 1.221-230.

[114] *The Face on the Moon,* 19.932E-F.

[115] *Natural History*, 2.72.

[116] *Almagest*, 4.1.H268.

and predictability of eclipses, even the distance between Earth and moon, or they at least understood the basic reasoning available to those expert astronomers who could do these things. This was all an ordinary part of their world, however much or little they understood it. And the bulk of their information comes from the one thing that is most available to the educated elite: the ability to compare notes with observers in distant locations. It was easy to be ignorant of the simple fact that solar eclipses are only visible in small tracks on the Earth, and that they appear differently when viewed from different locations. Lacking this information (and how could the commons get hold of it?), when "the sun failed" then surely "darkness came upon the whole Earth."[117] Even Pliny, in a moment of ignorant self-contradiction, could make this mistake.[118]

III. Superstitions

The common man lacked access to coordinated global information, as well as an education in natural history, and enculturation into a rational philosophy directed toward finding regular and natural causes for things. He may have even felt a measure of distrust or contempt for these things. He was thus left to fend for himself in a sea of familiar superstitions. Instead of seeing an eclipse as evidence of an *ordo naturalis* unconcerned with human affairs, it was seen as a *portentum*, a capricious act of gods, demons, or wizards, which usually guaranteed at least someone's doom. But this was not merely the poor man's religion. Educated elites could share similar superstitions. Whether their status as portent was truly believed or not, eclipses were regularly reported as boding ill for someone. But superstitions were not restricted to the magical or divine. Naturalist superstitions abided as well. Aristotle would begin the trend when describing how lunar eclipses coincide with earthquakes, and presage storms.[119] And following this, we find the elder Pliny combining two of these events,[120] as well as Virgil[121] and even the author of the Gospel of Matthew (27.44-8).

In the realm of myth, we see possible syncretism in both directions. The traditional mythology apparently held that Selene (the moon) had monthly love affairs in a cave with her lover Endymion, an obvious folk tale explaining the new moon.[122] But

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117 Luke 23.44-45: σκότος ἐγένετο ἐφ' †λην τὴν γῆν...τοῦ ἡλίου ἐκλιπόντος.

118 *Natural History*, 2.8.(49), "Surely the entire sun could not be removed from the world by the interposition of the moon if the earth were larger than the moon" (*non posset quippe totus sol adimi terris intercedente luna si terra maior esset quam luna*). This is an absurd argument unless one is unaware of the reported magnitudes of eclipses seen in different locations, and the fact that the same eclipse is not even seen at other places, where the sun continues to shine. This information was known in Pliny's day, and must have been known to Hipparchus, and Pliny's ignorance is odd. Dio Cassius knew this simple fact, and the decree of Claudius may have mentioned it as well (60.26.3). But worse for Pliny is that it contradicts his own argument that the Earth's shadow is conical (*Natural History,* 2.7.(47-8)), for if the moon were larger, then the Earth's shadow could never eclipse it.

119 *Meteorology,* 367b2.

120 *Natural History*, 2 (195).

121 *Georgics,* 2.47.478-480.

122 Sappho, fr. 199; Apollonius of Rhodes, *Argonautica,* 4.57-67.

Pliny records[123] that Endymion was the first man to observe the facts about lunar *eclipses*, and this accounts for the myth of their love, and the connection between this love and the moon's phases and eclipses. Here we see the culture of science merging with that of the pre-scientific masses. One can imagine that the traditional myth is here being allegorized into a poetic reference to the first astronomer, their love then becoming symbolic of the astronomer's passion for his art as well as the alluring beauty of the heavens. On the other side of this syncretism, in Arrian's account of Alexander's eclipse, Alexander is said to have sacrificed to the Moon, Sun, and Earth, "who are all said to cause an eclipse."[124] Although Alexander, whose tutor was Aristotle, almost certainly knew the real causes of eclipses, this ceremony, even if an invention of Arrian, is a good example of syncretism between science and superstition, the scientific explanation being transferred to a superstitious solution. This, too, could have served the purpose of manipulation in the manner much earlier suggested in the case of Aemilius Paulus.

Most important, however, is the Moon's connection with magic. Playing on the Endymion myth, Apollonius of Rhodes[125] has the moon speak to a passing sorceress, with whom she associates: both long to wander into the Latmian cave (the residence of Endymion), both burn with love for Endymion. And the Moon, with thoughts of love, is driven away by "deceitful chants" (dol€˙sin éoida›w), so that in the darkness of night, the witch's sorcery could be performed unimpeded or undetected. Thus, we have a syncretic confounding of myth and magic: the Endymion mythology crosses over into magical lore and spellcasting. We know the Moon figured large in real magical practice in the early Empire. Tradition held that one sacrificed to the moon and sun to assure the success of a magical operation, usually with an unblemished rooster.[126] In the magical papyri, Selene is prayed to for magical powers, and equated with the legendary sorceress Hecate,[127] and one papyrus fragment from the 2nd century A.D. carries a sorcerer's own claim to be able to call down the moon,[128] a power to be discussed below.[129]

Thus, the three most prominent places where the eclipse appears in Roman superstition are omens, astrology, and the battle between wizards and masses in the Drawing Down of the Moon, each of which will be discussed in turn.

A. The Omen

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123 *Natural History*, 2.6 (43).

124 *Anabasis*, 3.7.6: †των τὸ ἔργον τοῦτο λόγος εἶναι κατέχει.

125 *Argonautica,* 4.57-67.

126 Préaux, p. 122.

127 *Papyri Graecae Magicae*, 28-32, esp. line 2815.

128 Ibid., 34.

129 An extensive summary of Selene's names and connection with magic can be found in *Ausführliches Lexicon der Griechischen und Römischen Mythologie*, s.v. *Mondgöttin*, sect. vi.

The majority of lunar and solar eclipses mentioned in ancient works are presented as coinciding with wars, battles, or the deaths of prominent persons, and these coincidences are by and large invented without reference to astronomical fact. Préaux counts two hundred and fifty such reports, of which at least two hundred are fictional or assimilated from another time to the nearest historical event.[130] Describing the process of 'assimilation' by which an eclipse is assumed by a later historian to coincide with a nearby historical event, Newton remarks, "This procedure perhaps accounts for the remarkable tendancy of people to fight battles during a solar eclipse" (p. 44). This shows what manner of portent the eclipse could be.

Plutarch sums this up when he writes that "men regard [the eclipse] as monstrous and as a sign sent from god portending some great misfortunes."[131] And such omens could be self-fulfilling. "Because of his terror," writes the elder Pliny, "the Athenian general Nicias, ignorant of the cause [of a lunar eclipse] and afraid to lead his fleet out of the port, ruined the Athenian navy."[132] Thus, the fact that Nicias *believed* it was a dire omen led him to react in just such a way that it *became* one. Likewise, Plutarch tells the story that Pelopidas could not take all his troops to confront Alexander, because of their fear at a solar eclipse.[133] This depletion of his forces, resulting from *regarding* the portent as dire, led to the portent *becoming* dire.

This particular event illustrates the more specific nature of the eclipse as portent. Since apparently the sun and moon were the governing bodies of the skies, their eclipse naturally suggested the 'eclipse' (i.e. the death or downfall) of a ruler or prominent person on Earth. Thus, Plutarch notes that the same eclipse of the sun met by Pelopidas was interpreted by the seers at Thebes as boding ill for a "brilliant man."[134] The prediction was usually one of death, as makes sense considering the semantic connections made between eclipses, closing the eyes, and dying, to be mentioned below. Even fictional solar eclipses were used as retrofitted portents of death, and Dio Cassius records just such an eclipse predicting the death of Augustus.[135] But this was a general principle, as the fifth century antequarian John Lydus records: "if the sun fails, it warns of desolation for men. If the moon during the second watch seems muddy, then men will die."[136] And Seneca tells us in his parable of the 'science lesson' that Archelaus was "a king so ignorant of nature that on a day when there was a failure of the sun, he closed his palace and cut his son's hair, which is the custom when in

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130 Cf. pp. 124ff.; also cf. Boeuffle, pp. 43-52.

131 *Nicias*, 23.2: ἀλλόκοτον ἡγοῦντο καὶ πρὸ συμφορῶν τινων μεγάλων ἐκ θεοῦ γινόμενον σημεῖον.

132 *Natural History*, 2.9 (54): *quo pavore ignarus causae Nicias Atheniensium imperator veritus classem portu educere opes eorum adflixit.*

133 *Pelopidas*, 31.2.

134 Ibid., 31.3: §dÒkei ka‹ prÚw êndra lamprÚn §j oÈranoË gegon°nai shme›on.

135 Dio Cassius 55.29.3.

136 *De Ostentis,* 70A; using the text from *Joannis Laurentii Lydi De Ostentis Quae Supersunt*, Carol Benedict, ed., Paris, 1823: *sol si deficit, vastationem minatur hominibus, luna sub secundam vigiliam si turbida videtur interitus hominum erit*. The Latin and surviving Greek recensions agree without needing comment. Préaux, p. 310, suggests that 'second watch' means April, but it is more probable that it refers to the time of night (Plutarch, *Face on the Moon*, 934C-E).

mourning, and in troubled times,"[137] thus a portent of death and mourning was the immediate assumption here as well.

But there could be variation. Lunar eclipses, according to Philochorus, are propitious for fugitives, since concealment is what they need.[138] And according to Autocleides, apparently from his lost work the *Exegetics*, solar and lunar events of any kind are only portentious for three days.[139] Of course, we have already seen in Quintus Curtius the record of the interpretation made by the Egyptian *vates* that solar eclipses bode ill for Greeks, while lunar ones for Persians. This possibly has a Persian precedent, as suggested by the story told by Herodotus (7.37). This gets even more complicated, however, when we examine the other method of divination in which eclipses figure: astrology.

B. Astrology

Astrology incorporated astronomical science without a hitch, as we have already seen above. Manilius provided correct astronomical information, and Ptolemy himself wrote a treatise defending and expounding astrology (the *Tetrabiblos*). Science was put to good use by astrologers, and this could explain its popularity among the elite. For example, a lunar eclipse, according to Manilius, results in 'turning off' the influence of whatever starsign lies behind the moon at that time, as well as whatever starsign exists on the other side of the heavens (i.e. behind the sun during the same eclipse), and these for various durations "refuse the powers they have lost, and deliver neither such great blessings nor their similar injuries."[140] Thus, an eclipse could be favorable as well as unfavorable in this astrological scheme. This fits with the fact that the solar eclipses reputed to have occurred at the birth of Romulus and at the founding of Rome are generally assumed to bode well by the astrologer Tarutius.[141]

Ptolemy's system was slightly different. His astrological forecasts were derived from the color of a lunar eclipse, which was associated sympathetically with the color of the planets. And so, the color of blood signified the unnatural influence of Mars, which makes men caugh up blood or foretells war or slaughter. A pallid yellow is associated with Saturn, whose influence causes jaundice.[142] This kind of interpretation is found in surviving horoscopes, and appear entirely negative in nature.[143] In surviving horoscopes, eclipses usually advise against undertaking some enterprise.[144] One

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137 *On Benefits*, 5.6.3: *usque eo eius ignarum ut quo die solis defectio fuit, regiam cluderet et filium, quod in luctu ac rebus adversis moris est tonderet*.

138 Quoted by Plutarch (*Nicias*, 23.5-6), this is the flip side of the belief that eclipses portend disaster for great men.

139 Ibid., the text does not make clear what is meant: three days out of the year? Or three out of the week?

140 *Astronomica*, 4.864-5: *amissasque negant vires, nec munera tanta nec similis reddunt noxas. locus omnia vertit.* See also the preceeding thirty lines.

141 Plutarch, *Romulus*, 12.

142 Préaux, p. 295; Ptolemy, *Tetrabiblos,* 3.12.151, and *Apotelesmatica,* 2.10.1-2, 2.14.4-5.

143 Cf. *Catalogus Codicum Astrologorum Graecorum*, Brussels, 1908, vol. 7, pp. 131ff.

144 Sources given by Préaux, p. 310.

astrologer declares that a lunar eclipse foretold anxiety (merimn€a).[145] The inconsistency is typical of astrology, which generally played a Freudian association game with astronomical images, signs and concepts. But it is notable that the *science* of eclipses is used in the 'art' of astrology. The elite have their superstitions, too.

C. Drawing Down the Moon

Oddly enough, the most fascinating and notable response of the masses to the two kinds of eclipse is found to follow not the solar but the lunar, the most common of the two. We have no record of any ritual performed to ward off eclipses of the sun (perhaps because they were over too quickly to get anything started), yet for whatever reason the proper response to a lunar eclipse was to raise a clamor. Every observer who reports why the common people did this approaches the same reason: the clamor is intended to prevent wizards from drawing down the moon, either by interfering in the spell, or providing some kind of magical reinforcement to the Moon's own defenses.

The basic descriptions are all similar. Tacitus records that the moon's light is called back "through the ringing of bronze and the blasting of horns and trumpets."[146] Marcus Manilius throws a related comment into his poem as he describes how a lunar eclipse appears first to Eastern nations, since the moon descends westwardly into Earth's shadow. Since the eclipse has already begun in the East, he notes, "the bronze is struck late in Western nations."[147] Plutarch records that "the Romans, as was their custom, tried to recall her light with the clashing of bronze and by holding up to heaven many burning fire-brands and torches."[148] This detail is unique in Plutarch, but appears again in a medieval account, for this practice persisted long after the dominance of Christianity, attesting to its appeal. The ninth-century Christian observer Rabanus Maurus reports[149] the bellowing of horns, and people grunting like pigs, hurling spears or arrows, raising fires skyward, and even the hacking of hedges and breaking of plates, and all, the locals say, to scare away the monsters who were eating away the moon. This is apparently a world-wide practice, dubbed the 'moon monster' myth, which Tylor catalogues (pp. 328-35).

The elder Pliny gives some details of the history of the practice in his own time. He explains that the commons are "terrified of crimes or someone's death" when stars fail, and are worried about the moon's own death at the hands of evil potion (*veneficia*) and "because of this come to her aid with a discordant rattle."[150] This "evil potion" is given a more detailed explanation by Pliny at another place, where he provides some

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145 Préaux, p. 124.

146 *Annals*, 1.28: *aeris sono, tubarum cornumque concentu strepere.*

147 *Astronomica*, 1.226.

148 *Aemilius Paulus,* 17.8: τῶν δὲ Ῥωμαίων, ὥσπερ ἐστὶ νενομισμένον, χαλκοῦ τε πατάγοις ἀνακαλουμένων τὸ φῶς αὐτῆς καὶ πυρὰ πολλὰ δαλοῖς καὶ δᾳσὶν ἀνεχόντων πρὸς τὸν οὐρανόν.

149 *Homilies,* 42.

150 *Natural History*, 2.9 (54): *in defectibus siderum scelera aut mortem aliquam pavente...aut in lunae veneficia arguente mortalitate et ob id crepitu dissono auxiliante*. To which Pliny reacts with great praise for "philosophy" which, by understanding the *ordo naturalis*, had "saved" mankind from this superstition.

native ethnography: regarding lunar and solar eclipses, “a traditional belief endures among a great part of the masses that they are compelled to happen by potions and herbs and that this particular science has a greater power among women.”[151] In fact, Pliny names Medea and Circe as among those legendary sorceresses around whom such tales have grown.

It was commonplace among magicians to claim power over the stars. Apuleius lists the impossible things magicians claim to do, and the list includes “the sun being stopped, the moon dropping foam, the stars being plucked down,”[152] and later “extinguishing the stars.”[153] And this notion is in fact tied up with the other uses of eclipses in interpreting portents, since the usual Greek phrase for this activity was kayaire›n tØn selÆnhn, where kayaire›n originally signified the “bringing down” of the eyelid, which came to be associated with both the closing of the eyes of a dead man and to the metaphor of “drawing down” the lid over the stellar eye. So it came to be attached to two euphemisms: death and the eclipse. In time, death and the eclipse came to be associated with each other, but also with the magical act of making the moon descend.[154]

Lucan gives the first expression of how the lunar eclipse is linked to the reputed power of mages to draw down the moon, since he mingles the *facts* of eclipses with the *myths* of magic:

> by these women also the stars were first pulled down from the rapid sky, and the bright moon, besieged by none other than awful spells of words, grows pale and burns with black and earthly fires, as if the earth had barred her from her brother’s image and inserted its own shadows into the celestial flames, and she suffers such great labors, weighted down by the spell, until nearer by she befoams the plants set below.[155]

The connection between this and the noisemaking is shown first in Statius, who compares the falling of a discus with the magical drawing down of the moon, for “in this way the dark sister of the sun falls, whenever she is plucked from the astonished stars,”[156] and “far off, the nations providing aid rattle the bronze and are filled with useless fear, but the Thessalian conquerer laughts at the panting team because they listen to her spell.”[157] And Ovid also provides such a description, in the witch’s voice,

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151 Pliny, *Natural History,* 25.5 (10): *durat tamen tradita persuasio in magna parte vulgi veneficiis et herbis id cogi eamque unam feminarum scientiam praevalere.*

152 *Metamorphosis*, 1.3.1: *solem inhiberi, lunam despumari, stellas evelli.*

153 Ibid., 1.8.4: *sidera extinguere.*

154 Cf. Mugler; Préaux, p. 122, 124-8; the story of drawing down the moon goes all the way back to Aristophanes, *Clouds*, 749-52; Plato, *Gorgias*, 513A.

155 *Pharsalia*, 6.499-506: *illis et sidera primum / praecipiti deducta polo Phoebeque serena / non aliter diris verborum obsessa venenis / palluit et nigris terrenisque ignibus arsit / quam si fraterna prohiberet imagine tellus / insereretque suas flammis caelestibus umbras / et patitur tantos cantu depressa labores / donec supposita proprior despumet in herbas.*

156 *Thebaid*, 6.685-6: *sic cadit attonitis quotiens avellitur astris solis opaca soror.*

157 Ibid., 6.686-8: *procul auxiliantia gentes aera crepant frustraque timent, at Thessala victrix ridet anhelantes audito carmine bigas.*

who declares “You, too, Moon, I drag down, however much the Temesaeans’ bronze diminishes your labors, and the chariot of my grandfather, too, by our spell pales! The Sun pales because of our potions!”[158] Seneca also echoes this rationalization, poetically describing how the moon loses control of her “shining chariot” (*currus...candidos*) and “turned red” (*rubuit*) and “we were worried for the troubled divinity and made ringing noises, thinking she was being dragged down by Thessalian spells.”[159] And Plutarch claims to be aware that these witches (he names Algaonike), like the *vates* lambasted by Curtius, do in fact know the truth about eclipses, and use their scientific knowledge to guess the right time to dupe the gullible masses.[160] If so, this shows the ‘manipulation’ strategy, but here used for private profit and prestige.

All of this shows an awareness of a tradition that held lunar eclipses to be the maleficent effects of evil magic -- magic which had to be thwarted by making noise and other commotions. In all of the poetic examples above, the witch is victorious, just as nature is: the noisemaking is always useless, but since the event always does end one could eventually claim success for anything they did beforehand. Whether this rationalization for calling down the moon is an antiquated or invented myth, used only as a literary device by the time of the early Empire, it is difficult to say. We certainly have no first-hand records from believers. We only have observers from the other side of the fence, most of whom already condemn this behavior as superstitious madness. But it is reasonable to assume at the very least that the masses did in fact adhere to some superstition such as this, even if not exactly this one. There is no evidence that they adopted the rational scientific explanation at all.

The one piece of evidence we do have that this was indeed a popular superstition lies in the magical papyri, cited above, where magicians evidently did claim this power, and such a claim would be futile if it didn’t sell tickets. Indeed, we get evidence from another side of the picture: a Christian opponent of quackery, Hippolytus, describes three staged events in which various tricks were used to make audiences believe the sorcerer has ‘drawn down the moon’, and the tricks used vary from using systems of mirrors, to building fake moons illuminated from within, and to using projected images. All of these were evidently carefully staged to create the appearance that the image of the moon is bring drawn down.[161] If Hippolytus is not just making this up, this account shows that there was a popular bewilderment at this power so great and so incredulous that magicians eventually no longer had to wait for a real lunar eclipse for an opportunity to dupe the masses. Their sophistication reached the point where they could, indeed, bring down the moon -- their own version of it, that is.

Conclusion

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158 *Metamorphoses*, 7.207-9: *te quoque, Luna, traho, quamvis Temesaea labores aera tuos minuant, currus quoque carmine nostro pallet avi pallet nostris Aurora venenis.* Other references: Seneca, *Hercules Oetaeus,* 523-7; Ovid, *Amores,* 1.8.12-14 (where the color of blood is associated with the drawing down spell), also *Heroides,* 6.85-6, and *Metamorphoses,* 12.262-4, 14.365-8; also, cf. Lucian, *Lovers of Lies*, 14.

159 *Phaedra,* 788-94: *nos solliciti numine turbido tractam Thessalicis carminibus rati tinnitus dedimus.*

160 *Advice to Bride and Groom*, 145C-D.

161 *Refutation of All Heresies,* 37.

We have examined the interaction between those who understood the science of lunar and solar eclipses and those who were, so to speak, left in the dark. We have surveyed the facts and what those who were educated knew, as well as the superstitions surrounding eclipse phenomena, and what perhaps the uneducated believed. It is evident that there was a large gulf between the belief systems of the literate elite and the illiterate commons, distinguished much in the way the Romans saw it: a line existed between enlightenment (sometimes colored with a dash of superstition) on the one side, and superstition, fear, and gullibility, or distrust of education, on the other. One could sympathize. For if demons really were out to get you, it would be madness to deny their existence by adopting the beliefs of the scientists. And if witches really were killing or stealing the moon, it is true that you had better rattle your bronze pots and ignore the sophistical nonsense of the unbelieving philosophers. If the common people of the early Roman Empire saw their beliefs in such a fashion, it was perhaps to be expected that the scientific lore of the lunar and solar eclipse would not trickle down into the popular mythology. And without any concerted attempt to popularize science among the masses, this was almost certainly the outcome.

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