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Meton of Athens: An Astronomer in the Democratic Landscape of the Polis

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Abstract. The Athenian democracy of the fifth century BC saw a blossoming of knowledge. Some was closely associated with the institutions, with locations that were defined in the urban topography, while the new knowledge is more difficult to pinpoint. However, two testimonies situate the astronomer Meton in the Pnyx (Philoch. *FGH* 328 F 122) and in the theatre of Dionysius (Ar. *Nu*. 992-1020) meaning that he appeared before large audiences. This situation allows us to explore the social perception of new knowledge in Athens, and to understanding the unique mixture of realism and humour expressed by Aristophanes.
Key words: Astronomy; Assembly; Pnyx; Theatre; Aristophanes.

[esp] Metón de Atenas: un astrónomo en el paisaje democrático de la polis

Resumen. La democracia ateniense del siglo V a.C. registró un florecimiento del saber. Algunas formas estaban estrechamente asociadas con instituciones y se desarrollaban en localizaciones bien definidas en la topografía urbana, al mismo tiempo, expresiones de nuevas formas de saber son más difíciles de situar. Con todo, dos testimonios sitúan al astrónomo Metón en la Pnyx (Philoch. *FGH* 328 F 122) y en el teatro de Dionisio (Ar. *Nu*. 992-1020) indicando que aparecía ante amplias audiencias. Esta situación permite explorar la percepción social del nuevo saber en Atenas y entender la singular mezcla de realismo y humor que expresa Aristófanes.
Palabras clave: Astronomía; asamblea; Pnyx; teatro; Aristófanes.

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1. Introduction[2]

One peculiar aspect of society in democratic Athens was the diversity of the types of knowledge that became integrated into the city's life in different ways. Some of these types of knowledge were deeply connected to the political, institutional, and religious development of the polis, occupying specifically defined locations in the urban topography. Everything began in the Agora, where political meetings were held, together with theatrical presentations and other events.[3] From there, the political rhetoric travelled to the northern slopes of the Pnyx,[4] while the dramatic representations travelled towards the southern slope of the Acropolis, to the sanctuary and theatre of Dionysius where the building and the physical aspects of performances in the fifth century conditioned the audience's perceptions.[5] However, several important activities remained at the Agora, mainly around the Bouleterion[6] and the different legal procedures and court activity and the rhetoric associated with them.[7] Athenian mythology was mainly reshaped around Theseus immediately after the Persian invasion under the leadership of Kimon,[8] but the most important effort in this regard was developed on the Acropolis and the myth of autochthony closely related to its topography during the rule of Pericles.[9]

This political knowledge, in the hands of citizens, was complemented by the specialized knowledge of public slaves, who ensured the correct daily functioning of the city's central institutions such as the archive, the mint, the police, and justice.[10] Together with this knowledge, other types appeared in other less obvious locations. Some years ago, A. Momigliano[11] discussed the evidence about the public presentations that Herodotus made of his investigations. On the other hand, the Hippocratic doctors coexisted reasonably well with the healing sanctuaries built in Attica in the second half of the fifth century,[12] and they also used tools elaborated by the contemporary rhetoric, including public debates,[13] although it is difficult to determine if this practice also had a real institutional basis.[14] Plato

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2 Research project "Los Lugares del Saber en la Atenas Democrática" (AEI PID2019-106782GB-100); Programa Logos (Fundación BBVA y Sociedad Española de Estudios Clásicos). All dates are BC unless otherwise stated.

3 On the celebration of political assemblies there, see Thompson – Wycherley 1972 (particularly 126-129, on the presentation of plays and other events in the Agora). Also, McDonald 1943; Martin 1951.

4 Kourouniotes – Thompson 1932; Thompson 1982; Forsén – Stanton 1996. Johnstone (1996) refers in detail to the physical difficulties of using the Pnyx as a location for deliberative oratory during the fifth century; also, Bers 2013. Several papers by H. M. Hansen (1983, 1989) have dealt with different aspects of the subject. For a recent general survey, see Moretti 2019.

5 On the physical aspects of performances in the fifth century and how these conditioned perceptions, see Wiles 1997; Rehm 2002; Wilson (ed.) 2007, 87-182.

6 Thompson – Wycherley 1972, 29-35; Shear Jr. 1994, 418-27; Sickinger 1999, 81-3.

7 Thompson – Wycherley 1972, 52-72, for a general overview. More detailed, Boegehold 1995; Lanni 2006.

8 Di Cesare 2015, 77-118.

9 The Acropolis was always important in Athens (Hurwith 1995), although the significant role of Pericles and his followers during the fourth century is beyond debate: Hurwit 2004; Shear Jr. 2016. On the myths associated with the Acropolis, see Loraux 1984.

10 Ismard 2015.

11 Momigliano 1978, 64-6.

12 Gorrini 2005, 141-147.

13 Agarwalla 2010; Jouanna 2012, 39-53.

14 In Pl. *Grg*. 455b, Socrates refers to meetings to choose technicians, although they do not speak (see also Pl. *Prt*. 322d); and Gorgias speaks (456b) of doctors acting before the assembly or other meetings. Pl. *Prt*. 259a, on

presents Socrates debating with his interlocutors in locations set some distance apart from the places of public activity in Athens, except for those concerned with the trial and death of Socrates.[15] The teachings of the Sophists, in parallel with their frequent official duties as ambassadors of their respective cities, took place in the private homes of the aristocrats who hired them.[16] Pericles was responsible for the construction or restoration of the Odeon, probably in the 440s, chiefly for musical representations,[17] although some testimonies refer to other uses.[18] It is interesting to consider that Aristophanes needed to invent the *phrontistérion* in his *Clouds*, released the year 423, to locate Socrates.[19] The assembly also met in the theatre of Dionysius from the second half of the fourth century onwards, although it seems that this was only to deal with matters associated with theatre festivals, but there are also some exceptional assemblies at the theatre at the end of the Peloponnesian War.[20]

And so, how does astronomy fit into this panorama? To answer this question, we need to understand what was considered as astronomic knowledge in the fifth century. On the one hand, general knowledge included the movement of the stars and the year periods of their appearance and disappearance over the horizon. This empirical knowledge existed from the times of Homer and Hesiod, mainly in connection with the agricultural year[21] and has calendrical implications that reached a particularly high level of development in democratic Athens.[22] There are also folkloric observations of an astro-meteorological nature contained in the treatise of Theophrastus (born in 372/1 or 371/0), *On Weather Signs* mixed with information gathered from multiple sources.[23] We also have testimonies of the use of instruments to observe the positions of the stars from specific locations, such as *parapégmata*, *heliotrópoi*, *póloi*.[24] These practices lacked any predictive ability in scientific terms, capable of providing these observations with a theoretical explanatory model, which did not appear until the times of Eudoxus of Cnidus (c.

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public doctors, and X. *Mem*. 4.2.5, on how to choose them. But we do not know enough about the public physicians before the Hellenistic period (on Democedes, Hdt. 3.131); see Cohn-Haft 1956, 56-61.

15 Pl. *Prt*. 311a-317e, on the Callias house, and Pl. *Hp.Ma*. 282a-d on the complementarity of the public and private activity of the sophists. Vidal-Naquet 1990; Nails 2002, 307-330.

16 García Quintela 2009.

17 Plu. *Per.* 13. Mosconi 2000; Shear Jr. 2016, 197-228.

18 The building was used as premises for court sessions (Ar. *V.* 1109; D. 34.37, 59.52) and as a venue for public conferences (Alex. *PCG* 2 fr. 25 = Ath. 8.15.336e; D.L. 7.184; Plu. *Mor*. 13.1033e). Did Damon of Oa, Pericles' political councillor and musical theorist have any influence on the construction of the Odeon? On Damon, Wallace 2015.

19 Ar. *Nu.* 94, 128, 142, 181, 1144, 1487. See Konstan 2010; Bromberg 2012, 83-84; Heiden 2015; Morosi 2018.

20 Lambert 2012, 337-341; but there are some exceptional assemblies at the theatre at the end of the Peloponnesian War: Tozzi 2016, 84-100.

21 Dicks 1970, 27-38; Hannah 2001, 139-142.

22 Dicks (1970, 84-85) notes that in the last decades of the fifth century in Athens, there was a conjunction of empirical observations on the movement of the stars, accumulated by the knowledge of farmers and sailors, with a test aimed at mathematically systematizing the duration of the seasons and consequently establishing the calendar. See Hannah 2001, 143-147; Dunn 2007.

23 Sider – Brunschön 2007.

24 The invention of the heliotrope was attributed to Pherecydes of Syros (D.L. 1.119 = DK 7 A 1) and to Anaximander of Miletus (D.L. 2.1 = DK 12 A 1; see also A2, A4). Herodotus (2.109.3) states that the Greeks had made use of *póloi* and *gnómones* from the Babylonians implying the knowledge of these devices among his readers. See Lehoux 2007.

390-337), and further developments that occurred during the Hellenistic period.[25] However, we do not know where these practices took place, although the *póloi* or *heliotrópoi* needed to be properly positioned in order to function correctly.

The testimonies about Meton of Athens, sometimes mingled with references to Euctemon,[26] stand out against this backdrop, as they specifically describe him as being on the Pnyx, making his observations and building his *heliotrope*,[27] the remains of which have probably been identified by archaeologists, and as a secondary character in the theatre of Dionysius.[28] The first piece of evidence has been examined by historians of science or ancient astronomy, while the second has been taken up by scholars and commentators of the works of Aristophanes. Both pieces of information are of interest, inasmuch as that they present the astronomer, real or as a literary construct, in contexts of maximum publicity, acting in places that guaranteed the greatest amount of attention from the Athenians towards his person and his actions, the opposite to his fellow astronomer, the metic Phaeinos, who made his observations in isolation on the summit of the Lycabettos, outside of the city walls.[29] In the following discussion, we will attempt to demonstrate that both testimonies should be read together in order to understand the perception that Athenians had of this new type of knowledge, created before their very eyes in the public spaces of the city. Therefore, we do not propose a discussion of the astronomical knowledge and suggestions of Meton, more befitting of the history of science, or a commentary on the verses of Aristophanes, more befitting of a linguistic or literary study:[30] instead, what we will attempt to do is to explore the social and cultural perception of the new astronomical knowledge in Athens.

2. Meton on the Pnyx

Within the context of how observations of the sky and celestial phenomena are observed from the Earth, Theophrastus refers to the locations from where different astronomers made their observations. He states that Phaeinos made his observations from Mount Lycabettos, and states that Meton was one of his disciples, an Athenian citizen whose work consisted of establishing the 19-year cycle.[31] Also, Theophrastus describes (§ 1 and 2) how observations were made of the stars during the sunrises (*anatéllo*) and sunsets (*dýo*), implying the horizon.[32] However, it was Philochorus who stated that Meton used the Pnyx of Athens as observatory, and that he built a heliotrope there in 433-432[33] in close correlation with the

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25 Dicks 1970, 151-189; Bowen – Goldstein 1988, 79-80. See also, Goldstein – Bowen 1983; Bowen 2002a; 2002b.

26 Ptolemaeus (*Alm*. 3.1.205 Heiberg) refers to his connection with the prediction of the summer solstice of the year 432 at early morning (*próios*), and his relation to the setting of a *parápegma* in Athens. See van der Waerden 1984; Hannah 2001, 148-159; Lehoux 2007, 77-78, 95-96.

27 Schol. Ar. *Au*. 997 = Philoch. *FGH* 328 F 122.

28 Ar. *Au*. 992-1020.

29 Thphr. *Sign*. 4.

30 Dunbar 1998, 371-380.

31 Thphr. *Sign*. 4. See Sider – Brunschön 2007, 40-43, on the authorship of the treaty and its complex history.

32 Already present in Hom. *Od*. 10.190-192, and in two fragments attributed to Hesiod's *Astronomy*, fr. 290 MW (= fr. 226 Most) and fr. 292 MW (= fr. 228 Most).

33 Schol. Ar. *Au*. 997 = Philoch. *FGH* 328 F 122; Ael. *VH* 10.7. Kourouniotes – Thompson 1932, 207-211. To my knowledge, the best presentation of Meton is Bowen – Goldstein 1988.

attribution that Ptolemy makes to the same Meton together with Euctemon for having identified the summer solstice of the year 431.[34] It should be noted that the observations pointed out by Theophrastus and the construction of the heliotrope, or the raising of any instrument used for observing the heavens, such as those that have already been mentioned,[35] involved making continuous observations of the relationship between the stars and stable terrestrial reference points. These observations may have been carried out for utilitarian purposes, and often depended on visiting public spaces, from where it was possible to make note of celestial phenomena of interest, and their frequency (see below). This knowledge was not scientific, but it did mark the dawn of scientific observation, and conditioned the social personality of Meton.

I will now return to the description of the device and its component elements at the Pnyx referred to by Kourouniotis and Thompson (**Fig. 1**).

Figure 1. Fisheye lens caption from the south of Meton's heliotrope looking north, where ancient Athens was, and north-east (picture Sole Felloza).

Firstly, they consider what an instrument with these characteristics would have been like[36] and then describe one of the archaeological remains situated some 22 metres to the south of the position of the *béma* from the final period of the Pnyx:

> It consists simply of a core of limestone left in the process of cutting down the surrounding rock to a plane surface (…) The top is now rough and irregular and was probably always left in its natural state. This core is surrounded by a shallow channel, 0,80 m wide on the north, west and south sides, 0,70 m on the east; its bottom lying ca. 0,10 m below the surface of the surrounding floor.[37]

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34 Ptol. *Alm*. 3.1.205 Heiberg.

35 See n. 24.

36 Kourouniotes – Thompson 1932, 207-208, they cite Plu. *Dio*. 29.2; for the mention of the sundial at 29.3, see below.

37 Kourouniotes – Thompson 1932, 208.

The authors rule out that this would have been an altar for making sacrifices prior to the meeting and would not have served as a point from where to address the audience.[38] They suggest then that it is the base of the podium on which Meton's heliotropium stood. Its position fits with the texts that describe it, and its "situation was excellent for the purpose since here the instrument would catch the earliest beams of the rising und the latest beams of the setting sun summer and winter alike".[39] The authors finally turn to conjecture in reconstructing the shape of the heliotrope, mounted on a brick podium over this base. At a later stage, H. A. Thompson cast doubts on this identification, considering that it would have been built in the fourth century.[40]

Despite these doubts, some basic facts remain true: the high part of the Pnyx is an ideal location from where to observe the movements of the stars in relation to the horizon over Athens; from there, the Athenians would have watched the sun rise at the summer solstice over Mount Lycabettus (see below); according to Philochorus, this is where Meton built the heliotrope, possibly a lighter (wooden?) structure, which left no remains.

Diodorus of Sicily provides us with another passage about Meton that is helpful for our argument, in which he states that Meton's achievement consisted of identifying the 19-year cycle, indicating that it started "on the thirteenth day of the Athenian month Skirophorion" and that after these nineteen years, "the stars return to the positions from which they started".[41] R. Hannah highlights the importance of the thirteenth day of Skirophorion, corresponding to the lunar (and religious) month of Athens, which nearly always included the moment of the summer solstice.[42] Also, the fact that this day was fixed in the lunar calendar suggests that Meton identified the correspondence between the lunar and solar cycles, although Diodorus did not say so expressly when he wrote that: "the stars return to positions from they started". Aelianus describes the device consisting of *stélai* that would have precisely captured the solstice.[43] Also, W. M. Leake, and more recently R. Hannah point out that from the Pnyx, the sun rose over Mount Lycabettos at the summer solstice.[44]

In this context can be interesting to have in mind the mythical and symbolic background of Mount Lycabettus. Its origins are associated with the myth of autochthony,

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38 Kourouniotes – Thompson 1932, 210.

39 Kourouniotes – Thompson 1932, 211.

40 Communication addressed to Bowen – Goldstein 1988, 73.

41 D.S. 12.36.2, translation by Green 2006, 233-234. Green highlights that Diodorus was not an astronomer, as he uses "stars" in an inappropriate way. However, Diodorus seems consistent using ἄστρον to refer at sun and moon. Some lines below (D.S. 12.36.3), he writes again *ástra* to refer to sun and moon. At 2.47.6, Diodorus also uses *ástra* meaning the sun and the moon to describe an unnamed Metonic cycle among the hyperboreans.

42 Hannah 2005, 58; 2009, 32-33, 37; Lehoux 2007, 90-93.

43 Ael. *VH* 10.7: "Meton of Leuconoe, astronomer, built *stélai* and marked on them the turns of the sun (τὰς τοῦ ἡλίου τροπὰς κατεγράψατο = solstice)". The *stélai* suggests the heliotropion. Lehoux (2007, 88-90) examines whether the Greeks knew how to accurately fix the solstice in the year 432. An argument against this is that the closest parallel is the observation of Aristarchus in the year 280, but since this testimony also lacks close parallels, there is the risk of a circular reflection.

44 Leake (1841, 209) wrote: "Undoubtedly some point in Athens may be found (and it would not be far from the Pnyx) from whence the sun may have been observed to rise on the solstitial day, in coincidence with the highest point of the hill of St. George [= Lycabettos]", the description by Kourouniotes – Thompson 1932 cited above also alludes to this; Hannah 2009, 8.

without there being any relevant details regarding its topography.[45] The etymology of its name is controversial: according to Hesychius[46] there were large numbers of wolves (λύκοις) in the area, bearing in mind that the Lykeion, which took its name from a nearby temple dedicated to Apollo, was on the road between Athens and Mount Lycabettos. Two other terms may have influenced the perception of the Athenians.

On the one hand, λυκάβας, is the "year", although it can also refer to other periods of time. Its etymology is uncertain,[47] although according to the folk etymology of Macrobius[48] the name is derived from λύκη and βαίνω, "the path of light", "the sun's course". On the other hand, the River Eridanus (Ἠριδανός) rose on the slopes of Mount Lycabettos and crossed through Athens. Herodotus[49] mentions that the term is Greek, suggesting that it was formed from the adverb ἦρι, "dawn". These temporal references could play in the popular perception of the names of these topographic elements.

This said, the construction of the heliotrope makes sense in relation to a series of observations of the stars made over a long period. During this period, the citizens who came to the meeting of the *Ekklesía* at dawn[50] saw Meton making his observations from the Pnyx. Next, the members of the assembly would turn their back on him, according to the layout of the Pnyx in the fifth century, looking towards the north where the speaker was located, in the centre, and with views over much of the city.[51]

It should also be noted that this type of observation was not exclusive of scientists. It is attested in the discourse of the *phýlax*, the sky watcher, at the start of the *Agamemnon*, although the accuracy of the references to the rising and setting of the stars has been questioned.[52] Continuing with Aeschylus, he attributes Prometheus with having taught mankind to recognise the seasons from the rising and setting of the stars.[53] Aristophanes also includes references and allusions in *Clouds* to a knowledge of weather phenomena based on traditional observations.[54] In other words, the pertinence of observing the skies and its importance in different areas of social action was closely connected to Greek and Athenian thinking.

Our aim is not to discuss the precise knowledge of the sky that existed in Athens in the fifth century, involving a combination of accumulated observations and the first steps towards mathematical systematisation, associated with establishing the calendar or making medical diagnoses,[55] but instead the circumstances of its social use, in order to understand how an ordinary Athenian may have perceived the figure and action of Meton by attending the Pnyx as an assembly member, or the theatre as a spectator. In this sense, a passage from Plutarch's life of Dion of Syracuse is highly illustrative. The scene takes place when Dion leads the fight against the tyranny of

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45 Amelasagoras *FGH* 330 F 1 = Antig. *Mir*. 12.

46 Hsch s.v. *Lukabettós* p. 997 Schmidt.

47 *LSJ* s.v.; also Chantraine 1999, 649.

48 Macr. *Sat*. 1.17.39-40.

49 Hdt. 3.115.2.

50 Ar. *Ec*. 20-21, 84-85, 283-284, 291, 390-391, 740-741. Hansen 1991, 5, 136.

51 Kourouniotes – Thompson 1932, 96-113; Thompson 1982, 134-138.

52 A. *A*. 4-7; with the commentary by Fraenkel 1962, 4-9.

53 A. *Pr*. 454-458.

54 Bowie 1993, 125-127.

55 Dicks 1970, 55-61, 77-91; Langholf 1990, 164-179; Hannah 2001, 143-147. On the difficulty of adapting the basic astronomical calendar with the political and religious Athenian calendars, see van der Waerden 1960; a situation that was reflected very well by Thucydides, see Pritchett 1964, 26-29.

his nephew Dionysus the younger from Syracuse in the year 357.[56] Plutarch situates Dion on a great heliotrope, built by the tyrant Dionysius I, from where he exhorts his fellow citizens to regain their freedom. Plutarch then describes how the soothsayers offer two opposing interpretations. According to some, it was positive that Dion "put under his feet the ambitious monument of the tyrant". However, for others, a bad omen emanates from a play on words: since the monument was a heliotrope, the choice as strategist could be subject to a change (*tropé*) of fortune.[57]

Beyond its plausibility, this episode helps us understand how the heliotrope could operate on different levels. Firstly, it highlights its materiality and visibility raised to the greater glory of the tyrant's ambition (*philothymía*). This results in a social visibility that determines its use as a podium for an occasional democratic speaker. Finally, the dual interpretation of this action highlights two aspects of this materiality. The first interpretation, supported by its monumental nature, indicates how the recovered democracy imposes itself on the main works of the tyrant, while the second interpretation, supported by the function of the solar marker, underlines the changing nature of the new political situation.

The visibility of the heliotrope of Syracuse probably also characterized its Athenian predecessor. We have seen how Kourouniotis and Thompson, in their description, stressed that the heliotropion must have been in a place from where it would be easy to observe the eastern and western skyline of Athens and its construction in this location had to be approved by the assembly.[58] In addition to this is the likely definition of the solstice,[59] fixing the cycle of calendric conjunctions between the sun and the moon (the Metonic cycle) to a period of 19 years, and its widespread use in other cities.[60] All of this did not escape the attention of the assembly in Athens: can we imagine Meton explaining the characteristics of the heliotrope from the *béma* to request funds for its construction? Or imagine either Meton or Euctemon explaining the utility of precisely defining the solstice, or using the *parápegma* for the social life of the Athenians?[61]

These are questions that are impossible to answer, although we can briefly turn to the epigraphs known as the "Coinage Decree" or "Standards Decree"[62] whose

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56 Westlake 1994, 698-702.

57 Plu. *Dio*. 29.3 (trans. Perrin 1954, 63).

58 Marginesu 2010, 18, 37, 39, 44, 90, 113-117, etc. At p. 21 the author writes: "Premessa indispensabile alla creazione delle opere nell'Atene del V secolo era l'approvazione dell'Assemblea e del Consiglio. Dopo aver guidato il dibattito assembleare, Pericle avrebbe comunque avuto di fronte le commissioni di sovrintendenti che vigilavano e guidavano il corso dei lavori".

59 See nn. 26 and 32. Lehoux (2007, 88-90) examines whether the Greeks knew how to accurately fix the solstice in the year 432. An argument against this is that the closest parallel is the observation of Aristarchus in the year 280, but since this testimony also lacks close parallels, there is the risk of a circular reflection.

60 The scholium to Aratus *Phaen*. 752, (p. 478, 8 Martin) tells that "the astronomers after Meton, set up tablets in the cities with regard to the nineteen-year revolutions of the sun, how in each year the winter would be of such a sort and the summer and the autumn and winds and many things of practical use for men", cited by van der Waerden (1984, 103). Diodorus (12.36.3), after writing about the achievement by Meton, signals that "from that day to this, most Greeks go by the nineteen-year cycle, and are not cheated of the truth in so doing" (trans. Green 2006, 234). This situation coexisted with the chaos of the political and religious regulations of the calendar in Athens, see n. 55.

61 See n. 56.

62 *IG* I^3 1453 consists in a collection of inscriptions from a variety of sources published as a composite text. A brief presentation of the main problems in Low (ed.) 2008, 114-115; on the technical aspects of these texts see,

purpose was to impose a uniform system of coinage, weights, and measurements in the Athenian Empire. Without entering too much detail, it seems that in the 440s, the likely date of the first testimony, and until the Peloponnesian war was in full swing, the Athenians considered it appropriate to deal with matters of standardization at the assembly. Another aspect of this standardization process was the testing the imposition of the Attic dialect in relations with the cities subject to Athenian control.[63]

It is interesting to note that one of the literary mentions made of the "Standards Decree" comes from Aristophanes' *Birds*, shortly after the verses dedicated to Meton. The seller of imperialist decrees offers Nephelokokkygia several laws[64] which include[65] those that imposed the same measurements, weights, and decrees (*métron*, *stathmón*, *pséphisma*) in Nephelokokkygia than for the Olofixios, imitating the words and the style of the "Standards Decree".[66] Is the similarity between Meton and the seller of decrees in *Birds* a coincidence, or does the metrological similarity we have identified between the actions of Meton and Euctemon and the "Standards Decree" play some role here? It is worth stressing that both the so-called Metonic cycle of adjustment between the solar and lunar cycles and the unification of weights and measures had a difficult and disputed process of implementation?[67] Once again, these are questions that lead to speculation, but which lead us to examine the way in which Aristophanes presents Meton.

Before doing so, it is recommendable to understand as clearly as possible and perhaps reconstruct how Meton operated on the Pnyx. To reproduce Meton's actions, we must stand on the supposed remains of Meton's heliotrope and look eastwards and observe the irregular profile of the eastern horizon of Athens, with its unique combination of landmarks and sanctuaries, such as the Acropolis or the peak of Hymettus with its sanctuary dedicated to Zeus Ombrios.[68] Under these conditions, Meton could not have ignored the fact that the sun, the moon, and certain stars or constellations rose over these points at regular intervals, acting as a guide for his observations (**Fig. 2**).

3. Meton on the Theatre

And so, we know Meton as an observer of the Athenian horizon from the Pnyx, as a possible speaker at the assembly, and as a member of a political community that considered it important to reflect on accounting standards. Under these conditions, it seems reasonable to consider that he would have been a familiar figure to

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Figueira 1998, 431-463; Lewis 2008. Recently Kallet – Kroll (2020, 111-119) advocate for a date of this decree near to the first representation of *Birds* in March 414.

63 Crespo 2006; 2010.

64 Ar. *Au*. 1035-1057.

65 Ar. *Au*. 1040-1041.

66 Dunbar 1998, 386-387; against a direct allusion to the Standards Decree by Aristophanes, see Figueira 1998, 203-216.

67 On the decree, see n. 62; on the Metonic cycle, see Hannah 2005, 57; 2009, 37. The testimonies cited in n. 58 suggest the dissemination of the *parapégmata* and the Metonic cycle, probably over several centuries, which coexisted with the disorder that affected the calendar in democratic Athens (see n. 55).

68 Langdon 1976. See in Dinsmoor (1939, 146, fig. 6, 154, fig. 8) a forerunner of this type of observation on the Acropolis.

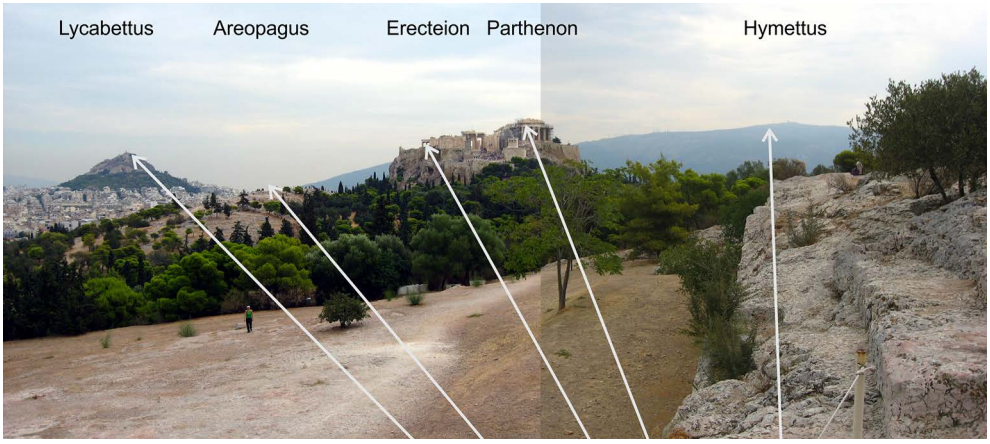

Figure 2. The eastern horizon of Athens as seen from Meton's heliotrope. The white arrows show the landmarks or temples that could have served to divide up the space (Author's picture).

Athenians. This could be reason enough for Aristophanes to choose him as a character for *Birds*.

The play was first performed in 414, at which time some of the audience in the theatre of Dionysus would have certainly seen the real Meton observing the sky from the Pnyx and could compare the actions of the real Meton with those of the theatrical character. Meton appears on the scene as the third of a series of five undesirable intruders,[69] representative of democratic Athens, who interrupt the celebration of the founding sacrifice for Nephelokokkygia: a poet seeking a patron, who is the only one who is treated properly;[70] the oracle-monger;[71] Meton;[72] the overseer;[73] and the decree-seller.[74] The verses Aristophanes wrote for Meton describe his intentions towards the urban layout of the new city:

> Γεωμετρῆσαι βούλομαι τὸν ἀέρα
> ὑμῖν διελεῖν τε κατὰ γύας.
> I want to land-survey the air
> and to parcel them into lots.[75]

To understand these verses, it is necessary to image how the scene would have been represented. As indicated by A. Pickard-Cambridge,[76] "in the fifth century the

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69 Ar. *Au*. 983, 1016.

70 Ar. *Au*. 903-957.

71 *Chresmológos*, Ar. *Au*. 958-991. Thucydides (8.1.1) refers to the negative perception of the *chresmológoi* in the context of the news about the disaster of Sicily, a situation that occurred at the same time as *Birds* was released in 415.

72 Ar. *Au*. 992-1020. See Dunbar 1998, 371-372, n. 52.

73 Ar. *Au*. 1021-1034.

74 Ar. *Au*. 1035-1057.

75 Ar. *Au*. 995-996. Γεωμετρέω means "measure" and "measure land" (*LSJ*). Dunbar (1998, 374) suggests "to practice geometry" and "to land-survey", that fits better with our argument.

76 Pickard-Cambridge 1968, 171.

texts of the plays seem to imply (…) a high degree of mobility, even of rapid movement, kneeling, prostration, and a free play of gesture". On the other hand, some studies underline the spatiality of the stage to correctly understand how the theatrical plays were represented incorporating "the audience in in the spatial field of the performance".[77]

Following this line of thought, R. E. Wycherley[78] explains that the actor playing Meton would have used some type of stage prop and would have drawn his plan for the city on the floor of the *orchéstra*, but N. Dunbar[79] prefers to see the actor drawing in the air using gestures. There can be no doubt about the paradox implied in the action to "land-survey the air" and the humorous intentions of Aristophanes. Nevertheless, this is not contradictory to two other circumstances.

Firstly, citizens attending the assembly would have been accustomed to Meton's presence during the 430s, as they came to the Pnyx before dawn to celebrate assemblies,[80] as this is also the best time for making astronomical observations.[81] Furthermore, if any of them asked Meton what he was doing, his reply would have involved pointing towards directions in the sky over the city of Athens. What Meton did was to literally divide the urban layout of Athens into plots (*dieleîn katà gýas*,[82] in the words of Aristophanes), using the highest section of the Pnyx as his observatory, and the landmarks on the horizon as reference points. He could also explain his measurements in the sky by making sketches on the ground (*geometrêsai… tòn aéra*) (**Fig. 2**). Therefore, these same citizens, in the role of an audience for *Birds*, would have easily recognized the actor's gestures.

Secondly, this implies that these verses can correctly describe how Meton behaved, and therefore constitute an accurate description of how an astronomer would have made his observations and, more importantly for our present argument, explained them to the public as he operated on a prominent point of the fifth century city topography. They can also allow us to explore how those who practised this new science operated against the backdrop of a democratic Athens, where the production of ideas was submitted to public scrutiny.[83] The fact that this way of working was public explains the humour behind making Meton one of the annoying visitors to Nephelokokkygia.

It is important to note that there is a connection between the observations of Meton on the Pnyx, and the gestures that were probably associated with the words of the actor who played Meton on the stage. To help describe these situations, the concept of "horizon calendars" was created. This idea is based on the fact that the sun (and other stars), when seen from a given observation point, are positioned at precise moments over points on the horizon that serve as calendar regulators and/or

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77 Wiles (1997, 212) writes: "The gestures and gaze of the performers necessarily embraced the theatron, and by this means incorporated the audience in the spatial field of the performance".

78 Wycherley 1937, 25.

79 Dunbar 1998, 555-556; Amati 2010, 218.

80 Ar. *Ec*. 20-21, 84-85, 283-284, 291, 390-391, 740-741.

81 See examples gathered from different cultures by Nilsson 1920; and a modern presentation in Ruggles 2015.

82 The fact that *gýas* (a piece of land) is the correction to the text proposed by Dawes of *aguias* (a street) and supported by most scholars (cf. Sommerstein 1991, 264) does not affect our argument. See the discussion by Dunbar 1998, 374.

83 Villacèque 2013.

to control the ritual cycle of the community in question.[84] The most essential aspect is that the observation is made looking towards the line of the horizon, where, obviously, the earth and sky come into contact.[85] A precise account of the results of these observations requires another kind of research, and some scholars have already provided reliable accounts that suffice for our present comprehension of how Meton acted on the Pnyx.[86]

This is what Meton could have done from the Pnyx: measure the earth to understand the sky, with the aim of proposing the organisation of the calendar. I do not know if there are other ways of expressing this in Greek, but the formula used by Aristophanes seems suitable, including a paradoxical and comic touch: *geometrêsai tòn aéra*. We must recognize that there is also some paradox in the very idea of the "horizon calendar", since it connects time (the calendar) with space (the horizon).[87]

4. A spatial joke on Athenian urban landscape

We will continue with this argument, supported by Figure 3, to identify the humour in using the character of Meton, as the way in which Aristophanes made him appear on stage was the opposite of how the Athenians knew the real Meton. To better explain the argument, I propose differentiating three moments in time.

First (**Fig. 3.1**), on one side, at the Pnyx, Meton (red dot) is making observations before the sun rises,[88] located on the southwest side of the Pnyx in the fifth century, near the place where the heliotrope was built the year 432, and before the changes to the layout of the Pnyx were made at the start of the fourth century. From that point the Lycabettos was the marker for the summer solstice over the horizon.[89] On the other side, in the theatre, Aristophanes presented *Birds* the year 414: the play is underway, and the audience are in their seats.

Second (**Fig. 3.2**), on one side, at the Pnyx, the persons attending the assembly (blue arrow) climb from the city towards the Pnyx. As they arrive, they can see Meton as the *phylax* (surveyor) of the sky, and they can eventually ask him what is he doing. On the other side, in the theatre, when the play reaches verse 991, a new

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84 Ruggles (2015, 23-25) warns against the excessive use of the "horizon calendar" formula; but Hannah (2009, 8-12) points to its possible use in Athens. We must correctly understand the terms of the problem. Ruggles argues about the exclusive consideration of orientations as a calendar reference in a given culture, a possibility that has only been witnessed in a few cases. There is, in this sense, no horizon calendar in Athens, and it would be even less a result of Meton's observations. The existence of previous temporal computations completely rules out this possibility. What may have happened in Athens, and Hannah stresses, is that precise space-time references (such as the rising of the sun and the summer solstice on the Lycabettos seen from the Pnyx) would help to fix the cycle of the relationship between the sun and the moon as the basis for establishing an operative "Metonic cycle" in practical terms. As we also know that at the same time *parapégmata* were being calculated and constructed, we suggest that other chrono-spatial references could have been used locally from a particularly suitable horizon.

85 See n. 32.

86 Dunn 2007, 24; Hannah 2009, 5-12; and the precedent of Dinsmoor 1939.

87 See n. 84.

88 Ptolemaeus (*Alm*. 3.1.205 Heiberg) writes *próios*, "early morning", as the moment of observation, in accordance with the usual way of sky watching.

89 See n. 44.

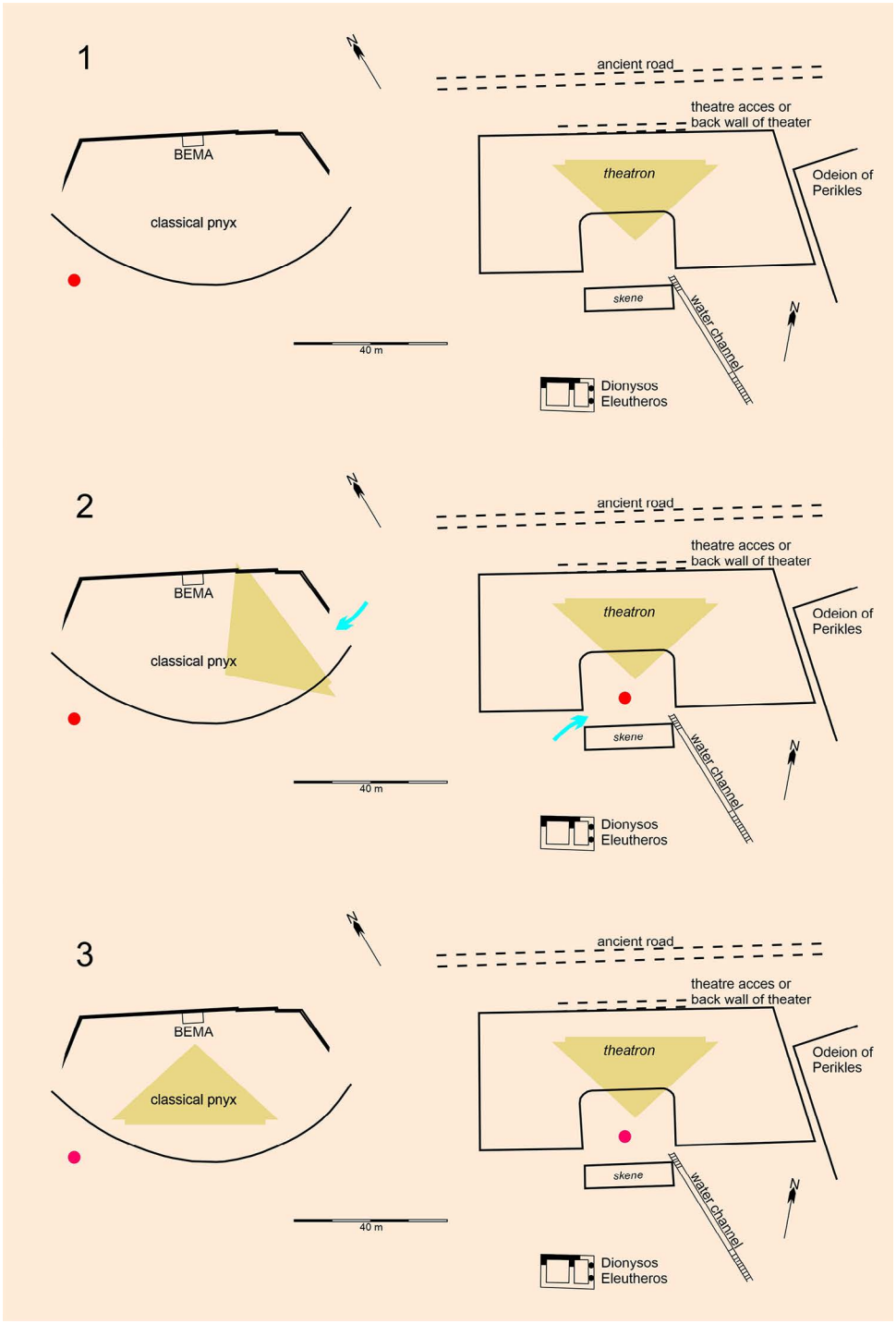

Figure 3. Meton (red dot), from the Pnyx to the theatre. Left, the Pnyx in the fifth century (base illustration adapted from Kourouniotes – Thompson 1932, 106). Right, the theatre of Dionysius in the same period (base illustration adapted from Goette 2007, 117).

character –Meton (red dot)– climbs[90] on the stage (blue arrow) and stands before the audience to play his role.

Third (**Fig. 3.3**), on one side, at the Pnyx, the attendants turn their backs on Meton, to face towards the *béma* from where the orator spoke, and with a large swathe of Athens at their feet, in a similar position to that of Meton who was looking towards the eastern horizon, and we can suspect that the sun rising of summer solstice from the Lycabettos observed from the Pnyx was part of traditional Athenian lore systematized by Meton and Euctemon. On the other side, in the theatre, the playwright inverts the spatial relationships of the Pnyx: Meton the actor faces towards the audience in a position equivalent to that of the orator on the Pnyx. As a result, the mutual positions of the participants in the assembly or the audience at the theatre and of Meton the astronomer and Meton the actor are inverted by Aristophanes.[91]

Finally, we have speculated on the possibility that at some stage Meton may have spoken at the assembly to propose the construction of the heliotrope; what Aristophanes does is to realize this possibility as he presents Meton uttering political propositions to the spectators.[92] More precisely, when Meton the actor divides up the air, he divides up the audience, imitating Meton the astronomer when he divides up the space of Athens (**Fig. 4**). In doing so, Aristophanes encourages the audience to play in their imagination with the similarity between the Pnyx, the theatre stage, and the Agora of the ideal city proposed by Meton the actor.[93]

This topographic interpretation of the verses of Aristophanes also stems from a complex process of understanding the local topography of Athens, guided by the evidence of Theophrastus when he presents Meton as a disciple of Phaeinos. Theophrastus introduces these characters in a discussion about the indicative weather signs, which relate to a popular astro-meteorology that was independent from scientific astronomy, or magical astrology.[94] This is the only reference we have about Phaeinos, although it is of great interest as Lycabettos, from where he made his observations, is a major landmark in the topography of Athens "derived not from the magnitude of the mountain, but from its conspicuous abruptness and proximity to the city".[95] Also, the image of Athens from the summit of Lycabettos blurs the outline of the city in relation to other topographic configurations, with the notable exception of the Acropolis (numerous images are available on the Internet).

It is also interesting to note that Plato[96] precisely chose the Pnyx and Lycabettos as reference points in his description of the hypothetical topography of Athens prior to the deluge. Plato's presentation is limited to specifying the extent of a piece of land, but it also possibly evokes the reality of observations accumulated over the

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90 In the same way as the citizens climb up to the Pnyx from Athens. Slater (2002, 136) points out that *káto* and *áno* (in Ar. *Au*. 175-176) are technical terms used to indicate walking on and off the stage, and the aim is to construct the city of the birds on the stage, viewed by the audience and the gods in the *theologéion* (Ar. *Au*. 146-147).

91 There are other arguments that support including Meton amongst the other annoying characters for the new city of the birds: Dunbar 1998, 372.

92 See above, p. 560.

93 Ar. *Au*. 999-1003. Villacèque 2013 offers an overview of the relationships between political life and theatrical presentations in democratic Athens.

94 Lehoux 2007.

95 Leake 1841, 210; Sider – Brunschön 2007, 109-110.

96 Pl. *Criti*. 112a.

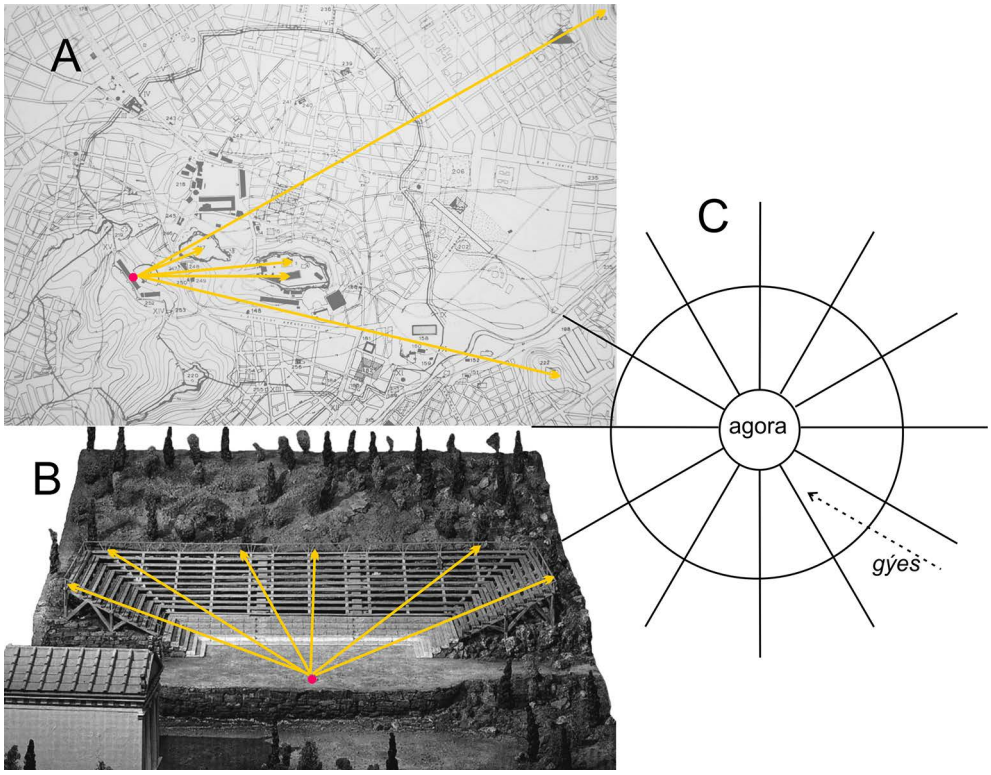

Figure 4. A. Representation of the observation of Meton the astronomer from the Pynx (base map adapted from Travlos 1980, 169). B. The actions of Meton the actor in the theatre of Dionysius, in the fifth century (base image adapted from Goette 2007, 117). C. The layout of Meton's city (adapted from Amati 2010, 222).

years by citizens who repeatedly climbed the Pnyx to attend the celebration of assemblies and who, on the days of the summer solstice, would observe how the sun reached its northernmost position on the horizon. We can therefore suggest that the two points of the Athenian topography we have examined formed a part of the Athenians' empirical knowledge of the urban landscape in which they lived. This can be seen in unsystematized forms of popular perception, probably materialized in the observations and systematization proposed by Meton and Euctemon as a type of elementary predictive astronomy and appears in the text where Plato imagines the city of Athens that may have existed in the remote past.

Returning to Meton, it is interesting to observe what alters each of the elements that characterized Phaeinos. On the one hand, by locating his observatory on the Pnyx, he gave priority to a view over the urban layout of the city, shared with the people who had assembled there (**Fig. 4. A**). On the other hand, this topographic opposition is further developed in the legal differences between Phaeinos, a metic, and Meton, an Athenian citizen.[97] Theophrastus' descriptions of these characters

[97] Sider and Brunschön (2007, 111) consider this detail as "an intrusive gloss", but like scholia and other commentaries, it adds information that could be relevant.

reveal that in the process of changing hands from the master to the disciple, the observation of the skies became politicized. It leads to the appearance of a type of knowledge associated with the practises of the city, and specifically with the calendric adjustment of the cycles of the sun and the moon.[98] Therefore, this also served to set Meton apart from the unconventional, foreign and perhaps more astro-meteorological perception of Phaeinos.

And so, the astronomy that had passed from Lycabettos to the Pnyx in the hands of Meton now passed on to the theatre, in the hands of Aristophanes. While the representative of this science was originally a metic and then a citizen, perhaps exotic or marginal in nature, he was now the protagonist of a theatrical scene. This invites us to consider that the humour may lie in the spatial decontextualization, a supporting role at the Pnyx playing as lead actor for a while at the theatre, offering a discourse for all the citizens, and equivalent to the other intruders.

The situation we seek to understand throughout our argument concerns the complex and probably ambiguous social perception of knowledge that is presented as new, and of the individuals who elaborated and disseminated it, against the historical background of democratic Athens. To understand it a little better, we will resort to an ambiguity that is present in today's scientific world. This ambiguity, or even contradiction, can be detected in the general praise for interdisciplinary studies,[99] and the no lesser certainty that this type of study is discriminated against or penalized in the publications with the greatest impact.[100] It seems that the figure of the Homeric hero, able to unite saying and doing, able to offer good advice and putting it into practice,[101] does not function efficiently in modern science.

Mutatis mutandis, looking at Meton in two social contexts that were the most publicized in Athens, it seems that we detect something similar. On the one hand, Meton is the bearer of new knowledge, constructed in full view of his fellow citizens, in order to provide a service aimed at standardizing the calendar that would come into general use. However, the Athenians did not equally appreciate this example of science constructed directly before the public. In the assembly, the majority that voted for the allocation of funds for the construction of the heliotrope would appreciate the interest in Meton's proposal. However, others would despise it and subject it to ridicule, while others would detect hidden intentions based precisely on his public character. Aristophanes probably summarizes these critical positions in his presentation of the comic astronomer.

In closing, when we think of an astronomer today, we think of a night owl surrounded by sophisticated devices. However, the lesser-known field of archaeoastronomy allows us to more clearly understand how the ancient astronomers operated, as the work of present-day scholars consists of replicating the observations of their predecessors. This allows us to focus on the preciseness of the vocabulary

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98 This is the aspect that stands out in all presentations of Meton's work, in which case we refer to the studies by Bowen – Goldstein (1988) and Hannah (2005, 52-58; 2009, 31-42).

99 Keshen – Perrier 2005; Hirsch Hadorn *et alii* 2008; Frodeman (ed.) 2010; Barry – Born (eds.) 2013; Frodeman 2014.

100 Porter – Rossini 1985; Lamont *et alii* 2006; Rafols *et alii* 2012.

101 Hom. *Il*. 1.258, 2.202, 9.443. In the *Odyssey* the expression defines Ulysses three times in the words of Athenea-Mentor (2.272), of Ulysses himself in disguise (14.491), and of Telemachus (16.241-242). See also Pi. *O*. 6.17; *N*. 8.7-8. The idea survives to define the teachings of the Sophist: Pl. *Prt*. 318e-319a.

and the expressions that Aristophanes attributes to Meton. Therefore, the humour lies in the words, but also in presenting the audience with what was a unique profession in democratic Athens.

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