

THE METHOD OF MULTIPLE EXPLANATIONS REVISITED

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My aim in this paper is to reconstruct and defend, in so far as this is possible, the Epicurean variant of the method of the *pollachos tropos* or method of multiple explanations. Its core assumption is that certain types of phenomena, notably the so-called *meteôra* (conventionally rendered as celestial phenomena), can be accounted for in several different ways, all of them acceptable in the absence of counter-evidence.¹ As such the *pollachos tropos* invites comparison and contrast with the *monachos tropos*: a standard mode of explanation according to which there is only one correct causal account of the *explananda* – things, processes, events, or states of affairs in the world.

Epicurus does not generally object to the *monachos tropos*. In fact, he argues that the primary function of the science of nature is to discover the real cause and provide the single correct explanation of *kyriôtata* or “most important things”, that is, the fundamental truths of atomic physics.² What Epicurus and his followers reject is the idea that each of the phenomena belonging to the class of *meteôra* can have only one cause and correspondingly can be adequately explained in only one way. Rather, on his view, the method suitable to the study of the *meteôra* is the *pollachos tropos* (*Pyth.* 86), which takes for granted that each of the *meteôra* can be produced by several different causes and therefore allows for several different or even competing explanations to stand, if they are not precluded by empirical evidence.

In what remains extant of his works, Epicurus defends his preference for the *pollachos tropos* on ethical grounds. Famously, he argues that our understanding of the possible causes of the *meteôra* is necessary for attaining tranquillity (*Hrtd.* 80) and essential to our well-being (*Hrtd.* 78). Variations of these claims are interspersed in his own physical writings (e.g., *Pyth.* 97, 104), and they are also found in Lucretius’ poem (*Lucret.* V 1204-40, VI 379, 422) and the monumental inscription of Diogenes of Oinoanda (notably, NF 182). There can be no doubt, I think, that the *pollachos tropos* was part of the canonical doctrine, was highly valued for its contribution to the moral end, and was practised routinely by Epicureans of all periods. Something similar holds, I wish to stress, for the *monachos tropos* as well. But it is largely the former method, not the latter, that has come under attack.

¹ The secondary literature on the Epicurean *pollachos tropos* is of very high quality. Notably, see Bakker 2016, Bénatouïl 2003, Bollack and Laks 1978, Corsi 2017, De Sanctis 2012, Hammerstaedt in this volume, Hankinson 2013, Leone 2017, Masi 2014, Morel 2015, Sedley 1976, Taub 2009, Verde 2013, 2018, 2022a and 2022b, and Wasserstein 1978.

² According to Verde 2013: 129, *Hrtd.* 78 and *Nat.* XI suggest that the *κυριώταται αἰτίαι*, the cardinal causes relevant to the “most important things”, are the fundamental principles of Epicurean materialism (see also Philodemus *De elect.* XIII 17-19).

First, it is alleged that the method of multiple explanations is arbitrary and violates scientific norms. Even within the context of the Epicurean system, it is not *prima facie* clear why this method is uniquely apt to explain the celestial phenomena. Nor is it clear why to endorse the assumption that the *meteôra* have multiple possible causes. More generally, one might add, Epicurus does not determine the criteria according to which some things admit of only one explanation, while others admit of many. Second, critics have noted that earlier and later Epicureans have different views regarding the epistemic standing of multiple explanations. These tensions must be resolved on pain of incoherence. Third, one can easily form the impression that the Epicureans are awfully casual about the quality and consistency of their explanations. For instance, in the *Letter to Pythocles*, Epicurus frequently ends his analysis of a celestial or an atmospheric phenomenon by saying that, in addition to the explanations that he has given, *there are many others*. This sort of remark has been taken to suggest that virtually *any* explanation would do, provided that it is psychologically effective. If so, the value of the *pollachos tropos* is limited and merely instrumental; it cannot be treated as a proper *scientific* method aiming at the discovery of the truth. Further objections concern the ethical contribution of the *pollachos tropos*. Why accept that this method bears on happiness? Why assume that the search for many possible causes contributes to tranquillity rather than anxiety and restlessness? More generally, how does the *pollachos tropos* fit within the framework of Epicurean ethics and the rational pursuit of the supreme good?

To confront these challenges and defend the *scientific* function of the *pollachos tropos* in Epicureanism, I propose to extend the textual basis of the investigation and try to reassess it with an open mind. Part One of the paper traces the historical trajectory of the method from the fifth century to the end of the fourth century BCE. Part Two identifies the principal objects of *pollachos tropos*, reconstructs the dialectical context in which it is originally applied, and highlights its metaphysical basis. Part Three focuses on the epistemic considerations that make the *pollachos tropos* uniquely appropriate for the explanation of the *meteôra*. It shows how the application of the method relies on central aspects of Epicurean epistemology and scientific methodology, and traces the steps by which the method is supposed to work. Part Four entertains a criticism attested in a papyrus and attributed to Zeno of Sidon, and then considers the variations of the method developed by Lucretius and Diogenes in order to assess their consistency with the canonical doctrine. Part Five turns to the ethical importance of the Epicurean study of the *meteôra*. I argue that, even though the *pollachos tropos* does have an overarching ethical intent, it is neither a mere device for averting superstition nor a 'second best' alternative to scepticism.³ Epicurus and his school advance it as a serious *scientific* method whose basic intuition, I submit, is defensible and finds parallels in contemporary philosophical thought.

³ See Vuillemin 1984: 204, and Bénatouil 2003: 25 n. 28.

I

Epicurus is neither the first nor the last ancient philosopher to use the *pollachos tropos* – far from it. The core idea of different possible accounts of the same thing or the same type of thing can be traced back to authors of the Archaic period,⁴ notably Hesiod, while the conception of the *pollachos tropos* as a proper scientific *method* probably has its roots in the atomism of Democritus (Seneca, *QN* V 2.1, VI 20.1; Aristot. *Meteor.* II 7, 365b1-6) and, from a different perspective, in Plato's *Timaeus*.⁵ Aristotle standardly uses the *pollachos tropos* to account for phenomena such as shooting stars, which he explains in multiple ways and by reference to multiple causes (*Meteor.* I 4, 341b36-342a33). Arguably, he justifies the use of that method to explain meteorological and astronomical phenomena by pointing to a distinct evidential standard applicable to these latter, namely that of being *eulogon* (plausible) or *kata logon* (reasonable) or *ouk alogon* (not unreasonable).⁶ Importantly, he thinks that the main reason for treating “plausible” or “reasonable” explanations⁷ as the right explanations in such cases is the *distance* of meteorological and astronomical phenomena from us (*De cael.* II 3, 286a3-7). He suggests that admissible explanations merely need to be *possible* (*Meteor.* I 7, 344a5-7). And he seems to take for granted that one of the principal methodological tools for investigating the aforementioned phenomena is *analogy* – a key feature of both the *Meteorology* and the *De caelo*.

This heritage is appropriated and expanded by Theophrastus, whose use of the *pollachos tropos* is both systematic and exceptionally influential for posterity.⁸ Indeed it is now well known that Theophrastus' *Meteorology* and the view that it implies about God and nature have left a deep impression on later philosophers, from Strato of Lampsacus (Theophrastus' successor in the Lyceum), to the author of the *De mundo*, to the Stoics and especially Posidonius and Seneca, the Epicureans, Arius Didymus, Pliny, Plutarch, and Galen, and the tradition of the commentators (notably Alexander, Proclus, Philoponus, and Olympiodorus).⁹ At the outset, therefore, a few remarks seem in order about Theophrastus and his reception by later authors. They will give a sense of the application of the method of multiple explanations to account for certain phenomena in the atmosphere and beneath

⁴ I am grateful to Stefano Maso for this suggestion.

⁵ I reserve my defence of this claim for another occasion.

⁶ See Bolton 2009, Falcon and Leunissen 2015, and Verde 2022b: 5-14. I am grateful to Thomas Slabon for his comments on Aristotle's use of the *pollachos tropos*.

⁷ On no account should such explanations be viewed as mere *eikota*, i.e., likelihoods that may or may not involve deception. See n. 15.

⁸ On this issue see Daiber 1992, Gottschalk 1998, Kidd 1992, Mansfeld 1994, and Verde 1998b. Verde 2022b: 5-17 offers an informative account of the Peripatetics' approach to multiple explanations, especially focusing on the role of sense-perception in multiple explanations.

⁹ See, e.g., Mansfeld 1992 and Daiber 1992: 282-293.

the ground, and thus will provide some context for the Epicurean conception of multiple explanations.

The surviving parts of Theophrastus' treatise *On Meteorology and Meteorological Phenomena*¹⁰ – whose shortened Syriac version was translated in Arabic by Bar Bahlûl and by Ibn al-Khammar (tenth century) and whose text has now been completed on the basis of extensive excerpts found in the newly discovered *Hexaameron* by the Nestorian Moses Bar Kepha (ninth century) – establishes the centrality of the method of multiple explanations in Theophrastus' natural philosophy. As Daiber convincingly argues,¹¹ the *Meteôrologika* do not belong to Theophrastus' doxographical works but are part of the collection of unpolished treatises summarily called *Peri Physikôn* and containing aspects of his natural philosophy. When he enumerates the causes responsible for each of the *meteôra*, he is not merely citing different opinions without mentioning their authors, but gives all the causes that he himself considers possible. For instance, he draws analogies with phenomena "close to us" in order to show that thunder may have its origin in one of seven causes (*Metarsiology* [1] 1-23 Daiber). In the case of thunder, each of these causes has the *same* result, whereas in the case of winds, for instance, the variety of causes (the place in which a wind arises or the quality of the air of which it is composed) may result in different sorts of winds.¹²

Generally, in his physical works, Theophrastus does not hesitate to mention a plurality of causes where he deems it appropriate. Some of them come from older Presocratic material, others derive from Aristotle, others from contemporary science, yet others from commonplaces also found in Classical literature.¹³ Whatever the provenance of the different causes, they are accepted in so far as they can be integrated in Theophrastus' own physical system, and multiple explanations are articulated accordingly.¹⁴ It is important to stress that the latter are not presented as mere *eikota*, namely likelihoods aiming to produce conviction. They are advanced

¹⁰ The work is entitled *Τῆς μεταρσιολεσχίας καὶ μεταρσιολογικῶν*, and it survives abridged in Syriac and Arabic translation: see Daiber 1992. Its authorship is controversial. Following Daiber 1992, Mansfeld 1994, and Sedley 1998, I assume that the author of the treatise is Theophrastus. A different view is defended by Bakker 2016 (see esp. 70-73, 145-153), who contends that the work in question is a compendium based largely (but not exclusively) on Epicurus' meteorology. Verde 2022b: 29-34 also suggests that the aforementioned text is at least partly influenced by Epicurean meteorology.

¹¹ Daiber 1992: 285.

¹² Theophrastus uses the method of multiple explanations in other scientific writings as well, e.g., botany. On this practice, see Daiber 1992: 285, n. 141.

¹³ For instance, Aristophanes' *Clouds* mention collision and the splitting up of clouds as causes of thunder. See Daiber 1992: 288.

¹⁴ For instance, new elements with regard to Aristotle have been discerned in Theophrastus' accounts of thunder, lightning, thunderbolts, and winds, but also (and more so) in his account of earthquakes and of the halo around the moon. Regarding the latter, Theophrastus leaves aside Aristotle's explanation of the halo as a reflexion of the visual rays; he claims that the moon-rays work an effect on the thick air which surrounds the moon, and he defends this view by means of an analogy with the waves caused by a stone thrown into water.

as *scientific* accounts that can be *true* of a certain token or type of atmospheric or subterranean event.¹⁵

In connection with his use of the *pollachos tropos*, Theophrastus attacks the view that lightning, thunderbolts, earthquakes, and other such phenomena are caused by God (*Metarsiology* [14] 14-29 Daiber). God, he argues, can never be the source of disorder or harm and hence cannot be the cause of the *meteôra*. This source must be sought in nature, which is capable of displaying purposeless activity, disorder, and destruction. In the text of the *Meteorology*, the irregularity of the relevant atmospheric and terrestrial phenomena is tightly linked to multiple causation. It is especially interesting that, according to this picture, the *pollachos tropos* supports rather than undermines Theophrastus' teleological worldview. On the one hand, the distinction between God and nature ensures that there is no diminution to God's divine power and its invariably good effects.¹⁶ On the other, it renders nature solely responsible for irregular phenomena above and below the earth and makes room for the explanation of such incongruities in terms of multiple causes.

Thus, by the time that Epicurus composes his treatise *On Nature*, the *pollachos tropos* is a scientific method that carries a very respectable philosophical pedigree. It has been employed by Aristotle¹⁷ and extensively used by his successor in the

¹⁵ On the notions of *eikasia*, *eikota*, *eikotes logoi*, and other related concepts, see notably Kalligas 2003. As he correctly points out, from the Archaic period onwards, the semantic connotations of these words or expressions include persuasiveness, verisimilitude, convincingness, and also deceptiveness. Forensic orators use *eikota* when direct access to the facts is impossible and, on many occasions, prefer arguing the case on the basis of *eikota* even when hard evidence could be used instead. Naturally, *eikota* are circumstantial and chosen according to the needs of the case. They are often supported by endoxic commonplaces, rely on subjective acceptability as well as objective possibility, and their effectiveness in the argumentation chiefly depends on the structure of the speech and the tree-like logical relations between its parts. Importantly, this sort of argumentation must give the impression that *all* possibilities have been exhaustively considered and all but one have been discarded (e.g.,

π occurred either because of ϵ_1 or because of ϵ_2 ; but neither ϵ_1 nor ϵ_2 ; therefore π did not occur). This kind of pattern aims to create a sense of logical necessity, which, typically, is deceptive and has a practical aim: to convince the jury or the audience that such-and-such must be the case or, alternatively, cannot be the case. If truth enters the picture, it is tailored to the reality internal to the *logos* and woven through it. In my view, none of the above features characterizes the method of multiple explanations. The views put forward are treated as possibly true of the phenomenon under examination; analogies with "things close to us" are used instead of *endoxa*; the enumeration of causes is horizontal, not tree-like; multiple causes may be consistent or inconsistent with one another and are not connected, logically or otherwise; the assumption is that one or more of them are true of corresponding states of affairs; the lists of multiple causes are open-ended; and elimination of causes is effected not on the basis of logic but on the basis of empirical fact.

¹⁶ Daiber 1992: 290.

¹⁷ I wish to mention, without pursuing it here, a suggestion that I deem important and that was addressed to me by David Charles. On the basis of Aristotle, *Posterior Analytics* II 17, 99a1 – II 18, 99b14, one might attribute to Aristotle the view that there would be different types of any phenomenon which turned out to have different types of causes in different conditions, even if, e.g., two types of a phenomenon appeared somewhat similar or were generically the same. If Aristotle held that view and, moreover, if the Epicureans thought that the very same phenomenon could have different types of cause in different conditions (as I argue in this paper), it follows that the Epicureans made a decisive

Lyceum. It is firmly associated with investigations of the world of experience. And it is specifically applied to certain kinds of celestial or atmospheric events summarily called *meteôra*. There is no doubt that Epicurus made use of the lists of explanations already available in Theophrastus in order to compose *On Nature* XI-XIII.¹⁸ Nor can it be contested that Theophrastus has an indirect influence on Lucretius' discussion of the *meteôra* in *DRN* V-VI, which largely draws from the aforementioned books of *On Nature*.¹⁹ I wish to suggest, however, that when it came to the metaphysics and epistemology of the *pollachos tropos*, Epicurus drew inspiration and materials from Democritus more than from anyone else. Not only does the latter defend the infinity of atoms and void and the existence of countless worlds, that is, doctrines that are crucial to the Epicurean version of multiple explanations. He also explained winds in terms of the atomic theory (Seneca *QN* V 2.1) and offered multiple explanations for earthquakes (*QN* VI 20.1, Aristot. *Meteor.* II 7, 365b1-6). Epicurus was more at home in Democritus' mechanistic universe than in the world of Theophrastus. And he proved able to discern the potential of atomism for the purpose of explaining irregularities in nature.

In any case, Epicurus is the first philosopher known to us to situate the *pollachos tropos* in a polemical context, compare and contrast it with the *monachos tropos* or method of a single explanation, and argue in favour of the former and against the use of the latter in astronomy and meteorology. Moreover, he analyses in some detail the elements of the method, indicates how it is supposed to work, and defends it on metaphysical and epistemological as well as ethical grounds. I shall address these topics in turn, beginning with the paradigmatic objects of the *pollachos tropos*, namely, the *meteôra*.

move away from Aristotle's line of explanation. An interesting question to pursue is what might explain that move.

¹⁸ Indeed, close parallels have been drawn between Theophrastus and Epicurus in respect of their conception of the *pollachos tropos*, the sequence of the phenomena that they respectively treat, the specific explanations that they respectively offer and, importantly, the theological dimensions of their approaches. This becomes obvious if we place Lucretius' order of exposition next to the order of exposition found in Aëtius (whose doxography has been traced back to Theophrastus) and compare both of them with the order of exposition in the compendium of *Metarsiologicalica* (which many believe to be authored by Theophrastus). See the table in Sedley 1998: 158, and the discussion in Sedley 1998: 152-185. On Theophrastus in Aëtius's doxography, see Mansfeld 1990, 1992a and 1992b, Runia 1997, and of course Mansfeld and Runia 1997-2020. On Epicurus, Theophrastus, and Aëtius see also Mansfeld 1994 and Runia 2018.

¹⁹ Sedley 1998: chapter 6.

II

Traditionally, the term *meteôra* is rendered by “celestial phenomena”, but in Epicurus it covers much more. Following the sequence of cases in the *Letter to Pythocles*, we encounter multiple explanations of a variety of items. In the first place, there are accounts of the boundary and shape of worlds (88), their place of formation (89), aspects of their creation and constitution (91), the risings and settings of the heavenly bodies (92), their motions and tropics (92-93), the phases, light, and face of the moon (93-96), the eclipses of the sun and the moon (96) as well as the periods of the heavenly bodies (97), the length of nights and days (98), and weather signs (99). Also, multiple explanations are provided for meteorological phenomena: clouds (99), rain (99-100), thunder (100), lightning (101), the reason why the former temporally follows the latter (102-103), and thunderbolts (103-104). Next, Epicurus uses the same method to explain various atmospheric and terrestrial phenomena: cyclones (104), earthquakes (105-106), volcanic explosions (106), hail (106-107), snow (107-108), dew and frost (109-109), ice (109), the generation and shape of the rainbow (109-110), and the halo of the moon (110-111). Then he returns to the region of the heavens to explain comets (111), fixed stars (112), planets (113), differences in the way that stars move and the speed in their orbits (113-114), and falling stars (114-115). He ends with a brief reference to weather signs supposedly coming from animals (116).

As this list reveals, the *meteôra* include not only events and phenomena in the heavens but also in the atmosphere and on the earth, and they range from cosmic events, such as the world’s formation and shape, to trivial occurrences like weather signs.²⁰ Some of these phenomena are spectacular while others are not; some have regularity but others do not; some occur frequently but others very rarely; some are catastrophic for living beings whereas others are harmless, beneficial, or pleasant to behold. Epicurus’ assumption seems to be that, regardless of their family resemblances or differences, all of these phenomena share something in common and admit of multiple explanations by virtue of that fact. Nonetheless, what such commonalities might be is a matter of speculation.

One hypothesis is this: the *meteôra* belong to the genus of *adêla*, non-evident things. They remain hidden from us in their own proper nature but can become known in some ways through signs or proofs (Sextus, *Math.* VIII 316-319).²¹ However, in addition to the fact that some of these phenomena have perceptible by-prod-

²⁰ Epicurus and his followers do not specify whether the *meteôra* constituting the objects of the *pollachos tropos* are types or tokens. However, on the theory of infinite worlds, every token corresponds to a type as well. Within our own world there are token *explananda*, e.g., the stability of the Earth, but the surviving Epicurean texts give no indication that these are differentiated from types, e.g., thunder, earthquakes. I am grateful to David Sedley and Raphael Woolf for their comments on this issue.

²¹ As Verde 2018a: 529 argues, the *meteôra* do not belong to the class of *ta prosmenonta*, i.e., things that await confirmation (Diog. Laert. X 34), for they do not admit of decisive confirmation or disconfirmation regarding their cause.

ucts while others do not, the class of the *meteôra* is by no means coextensive with the class of generically non-evident things. Atoms and void are also non-evident, but they do not belong to the *meteôra*, nor are they objects of multiple explanations. Another hypothesis could be that the common feature of the objects of the *pollachos tropos* is that they occur in the heavens. Yet this is unsatisfactory as well. In the first place, the *meteôra* comprise terrestrial as well as celestial phenomena. Also, even though Epicurus reserves the method of multiple explanations mainly for the *meteôra*, he occasionally employs it in other contexts as well. For example, he offers multiple explanations about the formation of simulacra, all of them operative at the same time: some films of atoms are formed in the air, others derive from bodies, others are generated “in other ways too” (*Hrdt.* 48). The suggestion that what the *meteôra* share in common is that they are physically very distant from us is also inadequate. While distance does play a role in Epicurus’ thinking, it cannot explain on its own the close connection that he draws between the *meteôra* and the *pollachos tropos*. The question, then, remains: why did Epicurus choose to make the *meteora* the objects *par excellence* of the *pollachos tropos*?

It is widely recognised that Epicurus’ ultimate motivation is psychological and ethical. For instance, he says that

we must not suppose that any other object is to be gained from the knowledge of the phenomena in the sky ... than tranquillity and firm belief, just as it happens in all other branches of study (*Pyth.* 85).

Likewise, he remarks that

our mode of life has now no place for irrational thinking and empty belief; rather we should live peacefully and without disturbance. And indeed everything happens without causing any disturbance in so far as it concerns all these events that are explained in accordance with the method of multiple explanations and in agreement with the phenomena, when one accepts what is plausibly said about them as one ought to do (*Pyth.* 87).

I shall return to this topic in the last section of this paper. At present, however, I wish to suggest that these are not the *only* reasons why Epicurus favours the method of multiple explanations; he *also* values the latter as a *scientific* method whose use he justifies on metaphysical and epistemological grounds. If so, then the fact that Epicurean meteorology has an overarching ethical aim does not entail that the latter has no intrinsic value²² from the scientific point of view.²³ I propose therefore

²² A similar remark applies, in my view, to Pyrrhonism: the fact that the proto-Sceptic’s ultimate objective is *ataraxia* (*Pyr.* I 4), freedom from disturbance, does not necessarily imply that his enquiry is insincere or that he has given up the search for truth.

²³ Compare the following passage from Seneca, which suggests a way of reconciling genuine interest in meteorology with its overarching ethical aim. “We marvel at none of these phenomena (sc.

that we look at the evidence regarding Epicurus' polemic against the astronomers of the school of Cyzicus: excerpts from the *Letter to Pythocles* and the *Letter to Herodotus* along with, most importantly, the surviving fragments of Epicurus' *On Nature* XI,²⁴ where he targets a model of mathematical astronomy probably developed by Eudoxus and still predominant in Epicurus' time.²⁵

In the *Letter of Pythocles* (86-88), Epicurus points to two interrelated mistakes that one can make and, as he mentions later on, the astronomers do make in trying to account for phenomena in the heavens. They fail to realise that some things can have only one cause of generation, whereas other things can have many. And correspondingly, they do not distinguish between things that admit of only one explanation and things that admit of many (cf. *Pyth.* 86).²⁶ Both these failures are due to epistemic inadequacy and both can be traced back to the astronomers' fascination with their own theories and their disregard for perception, observation, and empirically grounded reasoning. In connection with his explanations of the phases of the moon, Epicurus comments that the wanings and waxings of the moon "may be accounted for in all the ways in which phenomena on earth invite us to such explanations of these phases, if only one does not fall in love with the method of a single explanation and groundlessly disapproves of others, without having contemplated what it is possible for a human being to observe and what it is not and, for this reason, desiring to observe things that cannot be observed" (*Pyth.* 94).

In Book XI of his treatise *On Nature*, Epicurus has more to say on the astronomers' way of thinking. While the astronomers endeavour to work out the mathe-

the *meteōra*) without fear. And since the cause of fear is ignorance, is it not worth a great deal to have knowledge in order not to fear? It is much better to investigate the causes and, in fact, *to be intent on this study with the entire mind. For nothing can be found worthier than a subject to which the mind not only lends itself but spends itself*" (QN VI 3.4: my emphasis). Here, Seneca suggests that there is no tension between seeking meteorological knowledge for the sake of ethics and pursuing it in its own right. In fact, he appears to think that focusing on the study of the *meteōra* "with the entire mind", i.e., with genuine interest and total concentration, is a constituent of a fear-free life.

²⁴ There is no need to linger on the details of that debate, since there is excellent secondary literature about it. Notably, see the classic study by Sedley 1976, in addition to Taub 2003 and Bakker 2016. I use the text and translation by Sedley 1976 and am greatly indebted to his commentary as well.

²⁵ Pythocles, the addressee of Epicurus' letter, was a prominent member of the Epicurean school of Lampsacus, and there is evidence of interaction and rivalry between the Epicureans of Lampsacus and the mathematical astronomers of the neighbouring town of Cyzicus. See Sedley 1976: 26-30.

²⁶ Epicurus' position can be ramified further. Namely, there is textual support for the suggestion that there are three categories of things: things that have one cause and admit of only one explanation; things that can have many causes and admit of many explanations compatible with each other; and things that have alternative and mutually exclusive causes and, correspondingly, admit of alternative and mutually exclusive explanations. Another distinction cuts across the latter two categories: of things that can have many causes, some admit of a relatively restricted scope of explanations (consider, for instance the explanations of the size of the sun or its distance from the earth), whereas others admit of a vast range of explanations as well as of vastly different explanations, compatible or incompatible with each other. Even though Epicurus does not draw these distinctions explicitly, a plausible case can be made that he makes them implicitly in the course of his argument. I am grateful to David Konstan for his remarks on this topic.

matics of the motions of the celestial bodies and offer a single model for them, it is simply not feasible from the human viewpoint. “Why after all should you declare the measurement from here, or the one from here, or the one from here, or this one a more reliable guide of the risings and settings (of the sun)?” (*Nat. XI PHerc.1042 Ia 11-19* Sedley). Objectively valid calculations, Epicurus contends, cannot be made from any point on the surface of the earth. Eudoxus’ geometrical model of inter-connecting concentric spheres is simply unable to account for the variations and irregularities that we can actually *observe* in the motions of the heavenly bodies.²⁷ On Epicurus’ understanding of the matter, what Eudoxean astronomers do is to construct mental models (*homoiômata*: IIa1) and base their reasoning (*syllogizesthai*: IIa2) on instruments (*organa* IIa17-8) that they construct. But this, Epicurus argues, is wrong. For the indications of the instruments cannot serve as a basis of an analogy with the *meteôra* that we *actually see* in the heavens. The astronomers do not realise that when they talk about the indications of the instrument they are talking about the intrinsic properties of an object, whereas when they talk about a *meteôron* they are talking about a certain appearance or image (*phasma*) arising from certain *symptômata*, accidental properties, and stored in our soul (IIIa 1-21, IIIb 5-12). While the arbitrarily constructed instrument is concrete and its properties determinate, there are indeterminacies (*auristeiai*: IIa 14) in the appearances (*phasmata*: IIa8) of the celestial bodies. This is as it should be, since an astronomical instrument is an object whose properties are observable and known, whereas a *meteôron* is an image whose causes are unobservable and their nature unknowable.²⁸

As things stand, Epicurus continues, the instruments of the astronomers are deceptive. Perhaps the most important way in which they can mislead us is that they represent as regular the motions of the stars (IIa17-19). I shall return to this point in the last section of the paper. For the moment we should retain this: the astronomers’ use of the *monachos tropos*, the method of a single explanation, is motivated by theoretical presuppositions regarding the nature of celestial phenomena and ascribing to them regularity and indeed perfection. And it is part and parcel of a way of doing astronomy traced back to Plato’s Academy and bringing to our mind the higher-level education of the Guardians in *Republic* VII – an education intended to turn the Guardians away from the world of experience and towards the eternal and immaterial Forms.

Epicurus’ critique against the astronomers constitutes an adequate basis for exploring his own alternative proposal further. In the next section, I wish to comment

²⁷ See Sedley 1976: 36-7.

²⁸ On the correct kind of mental image, see the comments by Sedley 1976: 40. In brief, we get the correct mental image only if we realize that to argue about celestial phenomena is to argue about a “seeming” derived from certain chance properties of the appearances. Consider the Epicurean distinctions between, first, the *hypokeimenon* (*Hrtd.* 72, Philodemus *De sign.* IX 38-10.4) and the phenomenon and, second, intrinsic properties (*symbebêkota*) and accidental properties (*symptômata*) (*Hrtd.* 68-71).

on the metaphysical grounding of the *pollachos tropos*, its epistemic virtues, and the intrinsic value that, on my view, is attributed to the knowledge imparted through the method of multiple explanations in so far as it satisfies relevant epistemic norms.

III

In the long programmatic section of the *Letter to Pythocles* (85-88), Epicurus elaborates the two aforementioned modes of explanation and their respective objects: accounting for certain features of the world and of human life *monachos*, in only one way, and explaining other categories of phenomena or types of phenomena *pollachos*, in several different ways.

We must not try to force an impossible explanation, nor must we have with regard to every subject the same theoretical approach (*theōria*), namely, the one concerning the modes of life or the solution of the other physical problems – for instance, that the universe consists of bodies and the intangible, or that the elements are indivisible – and all such claims that we make where there is only one explanation in accordance with the phenomena. This does not hold in the case of the *meteōra*. Rather, these events have both a cause of generation that can be diverse (*pleonachên aitian*) and multiple accounts of their nature (*ousias*) that accord with sensation.²⁹ For we must not conduct our physical enquiries on the basis of groundless assumptions and arbitrary principles, but as the phenomena invite us to do. Our mode of life has now no place for irrational thinking and empty belief; rather, we should live peacefully and without disturbance. And indeed everything happens without causing any disturbance in so far as it concerns all these events that are explained in accordance with the method of multiple explanations and in agreement with the phenomena, when one accepts what is plausibly said about them (*pithanologoumenon*) as one ought to do. But when a person retains one explanation but rejects another, although it is equally in agreement with the phenomena, it is evident that he abandons completely scientific research and recurs to the realm of myth” (*Pyth.* 86-87).³⁰

The first thing to emphasise is that Epicurus does not reject the *monachos tropos* altogether. On the contrary, he posits that the fundamentals of nature and of human life can be explained correctly in one way only. Namely, there is a single theoretical account (*theōria*) which is true of first principles constituting the universe, the indivisibility of atoms, the way to live our lives, and also, as he indicates in other texts (*Pyth.* 116, *Hrtd.* 78, 82), the articles of the Fourfold Medicine, the criteria of truth, the affections of pleasure and pain, and a handful of other issues. These are

²⁹ ταῦτά γε πλεοναχὴν ἔχει καὶ τῆς γενέσεως αἰτίαν καὶ τῆς οὐσίας ταῖς αἰσθήσεσι σύμφωνον κατηγορίαν (*Pyth.* 86).

³⁰ I take it that “myth” here has the sense of epistemological fabrications. I am indebted to André Laks for discussion on this point.

the *kyriôtata* or principal elements of the Epicurean system. And the single explanations accounting for them hold absolutely and universally and are not negotiable. The correlation between the *kyriôtata* and the *monachos tropos* is less arbitrary than it might seem. Every such account is corroborated by empirical observation and argument and by the systematic refutation of competing alternatives. Taken together the *kyriôtata* established through the *monachos tropos* constitute the very framework into which the multiple explanations of celestial and other such phenomena must be integrated (*Hrtd.* 78).³¹ Epicurus does not specify how exactly these latter are related to the aforementioned framework.³² Yet he does stress that the two modes of explanation and their respective objects must remain distinct and separate in our mind (*Hrtd.* 78). On the one hand, the application of *pollachos tropos* to the principal doctrines would undermine the very foundations of Epicurus' system. On the other, it is imperative to avoid the type of confusion that the astronomers suffer from: in studying celestial phenomena, we must free ourselves from the theological assumptions embedded in the *monachos tropos*. Consider Epicurus' remarkably strong claim that anyone following that path "abandons scientific research completely and recurs to the realm of myth" (*Pyth.* 87). I think it suggests not merely that the *pollachos tropos* is acceptable or 'second best' for the study of the *meteôra*, but that it is *necessary* for that purpose.

Why so? What is it about these phenomena that makes the *pollachos tropos* uniquely apt to explain them?

In the first place, this question appears to be answered on ontological and causal grounds. Epicurus has enough of a distinction between explanation and cause³³ to posit a sort of isomorphism between the number of causes that may be responsible for the generation of a phenomenon and the number of explanations that may be offered for that phenomenon. Relatedly, he contends that the number of possible causes should determine one's choice of the mode of explanation. Things that have a single cause and cannot be otherwise require a single explanation (*Pyth.* 86-87), whereas things that can have multiple causes and can be otherwise require multiple explanations (*Hrtd.* 78).³⁴ What determines the appropriate mode of explanation, then, are causal features of the world, not arbitrary theoretical assumptions. The method must accommodate reality, not the other way around.³⁵

³¹ On this point, see Verde 2018: 525.

³² *Hrtd.* 78-80 appears to touch on this matter, but it is notoriously obscure and difficult to interpret.

³³ Whether Epicurus has a sufficiently sharp distinction between explanation and cause is under debate. On this point, see O'Keefe 2005: 105, Verde 2013: 129, and Masi 2014. As Francesca Masi points out, a cause is a fact in the world, whereas an explanation is an account that we, humans, give of a thing or an event by referring to its cause.

³⁴ Hankinson 2013: 78 remarks that each of the multiple explanations of a phenomenon offers a sufficient but not a necessary condition for the occurrence of that phenomenon.

³⁵ Seneca as well as, in all probability, Posidonius and Chrysippus hold a similar view. According to Seneca, there are *physical* reasons on account of which the *meteôra* constitute a special category of

We can now better understand why Epicurus considers the *meteōra* the prime object of *pollachos tropos* or *dynatos tropos*. Since, as he assumes, they have many causes, they must also receive multiple explanations. In every such case, the multiple explanations represent causal possibilities, each of them sufficient to account for the occurrence of the corresponding event. We can only speculate about the reasons why he takes for granted that the phenomena in question have multiple causes. He may be following Theophrastus, or he may share the Stoic assumption that the lower region of the atmosphere is especially unstable and prone to being affected by the same or different factors in various ways. In any case, he probably considers the hypothesis of a multiplicity of causes consistent, or indeed congenial, to certain aspects of the atomic theory and, in particular, the infinity of the basic constituents of the universe and the doctrine of infinite worlds.

A further issue is whether Epicurus would subscribe to the so-called principle of plenitude³⁶ or, as I prefer to call it, the actual multiplicity thesis, that is, the thesis that all possible causes are also actual causes in some world. On the one hand, Epicurus' multiple account of the different phases of the moon precludes that all the explanations that he gives obtain in our world, which after all is finite; we may therefore infer that each of them is true of an event somewhere in the universe. On the other hand, the modalities related to the Actual Multiplicity Thesis are strikingly absent from Epicurus' extant remains. He conspicuously does not refer to infinite worlds in connection to the *pollachos tropos*. Therefore, it seems to me that, as far as we know, his position is under-determined: he does not tell whether the multiple explanations accounting for a celestial event all hold true of that event, synchronously or asynchronously, in this world or in different worlds, now or in the infinity of time or both.³⁷

In his polemic against the astronomers, Epicurus suggests that there is also another ontological reason why the *pollachos tropos* is especially suitable to explain phenomena in the heavens. Namely, he remarks that the risings and settings of the sun have indeterminate elements (*aoristeiai*) and these cannot be captured by a

objects to be explained in a special way. In the first place, the *meteōra* are mainly atmospheric phenomena, and the lowest region of the atmosphere is variable and unstable; it is exposed to many factors and is affected by terrestrial causes in different ways (QN II 11.10). In the second place, the atmosphere is affected by celestial causes as well. The sun, the moon, and other heavenly bodies operate on the atmosphere and are responsible for different sorts of 'disturbances', such as changes in temperature, rainfalls, the alternation of seasons and other *meteōra* (II 1.1-2). Seneca suggests that, given the variety of causal factors, the *pollachos tropos* is the aptest method of explanation of meteoric phenomena. He avows: "I am afraid to either mention or omit a theory established by our Stoic friends ... There are only a few theories without counterargument. The others are pleading in court, even though they eventually may win their case" (IV B 5.1).

³⁶ On the so-called principle of plenitude see A. Lovejoy 1936: 99-182. It can be controverted whether Lucretius' actual multiplicity thesis exactly corresponds to the principle of plenitude in Lovejoy. I am indebted to Paul Kalligas and Doukas Kapantais for discussion on that point.

³⁷ I am grateful to Rupert Sparling for his input on this topic.

single explanation, whereas they are adequately captured by multiple explanations (*Nat. XI PHerc* 1054 IIa 1-21 Sedley). His intuition seems to be that there is a certain indeterminacy inherent in the *pollachos tropos* which makes that method especially suitable to account for the indeterminacies in the *meteôra*. Epicurus does not tell us exactly what he means when he is talking about *aoristeiai* in the *meteôra*. Given his physical theory, he is probably referring to the indeterminacies of atoms and compounds, which allow for multiple possibilities in multiple worlds, or, alternatively, multiple causal possibilities in this world.³⁸

This multiplicity leads us to a number of epistemic considerations that Epicurus advances in support of the *pollachos tropos* as the only suitable method for the study of the *meteôra*. Beginning with the *aoristeiai*, indeterminacies, inherent in these phenomena, our sources mainly focus on three features, all of which bear on the relation between the *meteôra* and the human viewpoint: 1) the *meteôra* are at a great distance from us and thus we do not have the capacity to perceive them fully; 2) what we perceive is not their natures and causes but mere appearances; and 3) these appearances can be misleading. These elements are interrelated and call for brief comment.

1. Epicurus does not explicitly assert that the nature of the *meteôra* is indeterminate *because* things in the heavens and under the earth are at a great distance from us. Even so, he strongly implies that distance makes it impossible for us to have perceptual access to anything other than mere appearances segregated from the factors that brought them about. Consider the following passage.

When we reason about the causes of celestial phenomena and all that is imperceptible to the senses, we must carefully consider in how many ways a similar phenomenon is produced on earth. And we must despise those people who do not recognise *either* what exists and is generated in one way *only* or what may occur in several ways in the case of things which can be seen (only) as appearances coming from a great distance (*ek tôn apostêmatôn: Hrtid.* 80).

The idea that the appearances of the *meteôra* can be misleading and that *therefore* we need to entertain multiple explanations occurs also elsewhere in meteorological writings. Seneca, for instance, compares such appearances to mirrors that distort the object reflected on them. Namely, some mirrors reflect the image of the viewer deformed, others magnify the appearance of one's physique beyond human proportions, others show only one side of the face, yet others twist and invert it (*QN I* 40).³⁹ Epicurus probably defended the deceptiveness of meteoric appearances on the basis of the theory of simulacra. Namely, films of atoms travelling from afar tend to represent inaccurately the properties of the object from which they have been

³⁸ I thank Francesca Masi for her comments on this point.

³⁹ Seneca uses this analogy in the context of his explanation of the rainbow.

emitted. Presumably, this inaccuracy is very much the case regarding the images of the *meteôra* apparent to us. While our perceptions are true of these segregated images (cf. *phas[matôn]*: *Nat.* XI *PHerc* 1054 IVa 21-22 Sedley; *phantasian*: *Hrtd.* 80; *phantasma*: *Hrtd.* 88), they cannot be trusted to reveal the true nature of the event or its cause. Hence the desire to know the latter in the same way that we know, for instance, the facts of experience or the cardinal principles of atomism is an empty desire, for the simple reason that its object is impossible for humans to attain (*adynata theôrein epithymôn*: *Pyth.* 94). In this regard, too, Epicurus' position seems under-determined: we cannot tell for certain whether single explanations of the *meteôra* are precluded because of the nature of things, or because of certain features of our perceptual and cognitive apparatus, or both.⁴⁰

Assuming, then, that we accept the *pollachos tropos*, on what epistemic basis should we proceed? What criteria should we take as our guides? Epicurus' general guideline is that we must determine the multiple causes of the *meteôra* as well as their permanent attributes in accordance with sensation and as the phenomena suggest (*Pyth.* 86).⁴¹ In other words, we should attend to the fundamental criterion of *aisthêsis* and rely on observation and evidence. Moreover, in order to circumvent the difficulties raised in points 2 and 3 – that is, that the perceptible by-products of the *meteôra* are mere appearances and these appearances can be misleading – we need to mobilise the conceptual and methodological apparatus of Epicurean epistemology and science. In particular, we need to rely on signs, follow the standard practice of drawing appropriate analogies between the *meteôra* and things “close to us”,⁴² apply the verificatory procedure of non-contestation, conduct a comparative and simultaneous survey of different explanations of a phenomenon, and attend to the epistemic feature of precision. Let us examine these features in turn, starting with signs:

We can obtain signs (*sêmeia*) of what happens in the *meteôra* from some of the phenomena close to us (*tôn par'hêmin*), for we can observe how they occur, whereas we cannot observe how the phenomena in the *meteôra* occur; for there are several possible ways in which they may have happened. However, we should retain (in our mind) the image (*phantasma*) of each and, moreover, regarding what is associated with it, we must distinguish those things whose generation from many different causes is not contested (*ouk antimartyreitai*) by the phenomena close to us (*Hrtd.* 87-88).⁴³

⁴⁰ According to Morel 2011: 143 and n. 6, multiple explanations in Epicurus do not have to do with the weakness of our senses but with objective processes operating in nature. Even though I believe that Epicurus' position is under-determined, I think that, on balance, the evidence lends support to Pierre-Marie Morel's claim.

⁴¹ ὡς τὰ φαινόμενα ἐκκαλεῖται.

⁴² Such analogies occur in Theophrastus, are likely to have been used by Chrysippus and Posidonius, and are especially striking in Seneca. Notably, the latter draws many analogies between the *meteôra* and processes in the human body (e.g., *QN* III 15.1-6) in order to suggest that the relevant phenomena have multiple causes.

⁴³ This is the sequel to *Pyth.* 86-87 quoted above.

A striking feature of this passage is that, according to Epicurus, the signs that serve as the basis of inferences about the *meteôra* should not come from the *meteôra* themselves, but from objects or events in our own vicinity. Since no details are given, we can only speculate as to how this procedure is supposed to work. That is, since we do not know anything about the nature of the *meteôra*, we need to establish the analogical relation between the *meteôron* and the corresponding nearby event on the basis of the similar content of the appearances accompanying, respectively, the *meteôron* and the nearby event. By observing the appearance of the event near us and by using it as a sign, we can infer its cause. Then, on the basis of the similarity between the appearance of the nearby event and the appearance of the *meteôron*, we can reason analogically: since the appearances are similar and since the appearance of the *par'hymen* signifies a particular type of cause, it is likely that the *meteôron* also has an analogous type of cause.

Why, one might wonder, do we need to follow that tortuous path? Why may we not infer thunder from lightning? Or why may we not rely on weather signs in order to predict an eclipse? Such signs, however, are merely commemorative (Sextus, *Pyr.* II 100-101) and tell us nothing about causes. Epicurus' point is, I think, that we cannot trust the appearances of the *meteôron* to signify that of which they are signs "by virtue of their own nature and constitution" (*Pyr.* II 101). To put it differently, the observable manifestations of a *meteôron* are unreliable as indicative signs of the hidden causes that have brought that *meteôron* about. Why so? Not only because they are very distant from us, but also because they are indeterminate, isolated episodes whose transient and fleeting character bears no necessary relation to their respective causes. While, as we shall see, the *pollachos tropos* must take these images, too, into account (*Pyth.* 88), they cannot do the work that inductive signs are expected to do in respect of generically non-evident things.

Things "close to us" (*par' hymen*), however, can play that role roughly in the way indicated above. Namely, they can give us a tracking device towards possible causes responsible for the generation of each of the *meteôra*. For they are not mere appearances of some unobservable nature far away from us, but earthly realities whose causes we can readily observe and whose generation we can readily explain by reference to those causes (*Pyth.* 87). The choice of such signs is effected on the grounds of relevant similarities with the corresponding celestial phenomena. Their epistemic function is peculiar, however. Unlike straightforward analogical arguments involving inductive signs, analogical inferences from the causes of things "close to us" to the causes of the *meteôra* do not aim to establish the correctness of a single explanation, but to bolster the diversity of several ones⁴⁴ (more on this below).

Is this kind of analogical reasoning respectable? In the context of ancient meteorology, very much so. As indicated, it constitutes standard practice for several

⁴⁴ See Sedley 1976: 41.

authors, including Aristotle, Theophrastus, and the Stoics. As for Epicurus and his later followers, they consider analogy and inference by similarity (*kath'homoiotêta tropos*) fundamental and prior to other modes of reasoning, including deduction. Of course, not every analogy will do. Indeed, Epicurus' criticisms of the astronomers show, precisely, that the analogues for the *meteôra* must be chosen carefully and without being prejudiced by theory. On the one hand, as mentioned, the things "close to us" are causal processes that are relevantly similar to the *meteôra* and that we can observe as they come to pass. On the other hand, the planetaria of the astronomers are artefacts constructed on the basis of arbitrary theoretical assumptions and cannot provide useful analogues for the study of the stars in the heavens.

It is well known that the scientific methodology of the Epicureans employs four basic procedures of verification or falsification: attestation (*epimartyrêsis*), contestation (*antimartyrêsis*), non-attestation (*ouk epimartyrêsis*), and non-contestation (*ouk antimartyrêsis*). A scientific proposition is falsified if it is contested or unattested by experience, whereas it is verified if it is attested or non-contested by empirical data. The latter of these procedures, namely *ouk antimartyrêsis* or non-contestation, is a tried-and-tested method of verification widely applied by the Epicureans in order to draw inferences about non-evident things. Roughly speaking, it is based on the principle that scientific theories and explanations about things that do not fall within our immediate experience are acceptable or even true *if* there is no evidence against them.⁴⁵ We can see why Epicurus considers it *uniquely* suited to the study of the *meteôra*, to the exclusion of every other method: since the *meteôra* are remote from our immediate experience and their causes are hidden, no direct verification or falsification is possible on empirical grounds. Nor are we entitled to reject a proposed explanation for the reason that it is not confirmed by experience, for this is not available to us. On the other hand, from the perspective of Epicurean empiricism, no explanatory hypothesis can be accepted if it is inconsistent with the phenomena. It follows that *ouk antimartyrêsis*, non-contestation, is the only legitimate procedure of evaluating competing explanations of celestial and meteorological phenomena.⁴⁶

The application of the latter makes it very likely that we shall end up with multiple explanations. For while attestation confirms a hypothesis to the exclusion of all others, non-contestation considers valid every explanation so long as there is no counter-evidence against it. Epicurus' explanation of the size of the sun (*Pyth.* 91) illustrates how non-contestation works.⁴⁷ The sun appears to have the same size

⁴⁵ It is debated whether non-contestation amounts merely to the absence of counter-evidence and consistency with the phenomena, or whether it is a matter of entailment. On this point, see the commentary by Long and Sedley 1987: vol. II, 95.

⁴⁶ Non-contestation is not practised only in the context of the method of multiple explanations, but is an independent method of Epicurean science.

⁴⁷ See Sedley 1976: 49-50.

at any distance. Regarding its nature, it can be bigger or the same size or smaller than it appears. Its appearance, therefore, is only an approximate indication of its real size. We cannot measure the diameter of the sun and hence, in Epicurus' own words, "we are limited to saying that its true size is *more or less* what it appears to be". Corroboration comes from a phenomenon close to us: this is how terrestrial fires seen from a distance appear in our perception. As the sun's apparent size does not much change with distance, so the appearance of terrestrial fires does not much change with distance. In neither case is there any counter-evidence against the inference that the object is approximately as big as it appears.

A further feature of Epicurean epistemology and science is put to work in connection with the *pollachos tropos*: following the multiple explanations of eclipses, Epicurus says that "we should consider together (*syntheôrein*) the causes that are akin to one another and realise that it is not impossible that some should coincide at the same time" (*Pyth.* 96). Epicurus' phrasing suggests that multiple causes of the same phenomenon *can* be consistent and operative at the same time. If so, then the phenomenon would have resulted from joint and simultaneous causation; but it need not be always (or frequently) the case. Correspondingly, multiple explanations of a phenomenon may be consistent and mutually supportive or, alternatively, they may not.⁴⁸ There is no suggestion that, other things being equal, consistency of multiple explanations is a *desideratum*. Presumably, if the hypotheses concerning the multiple causes of a phenomenon are inconsistent with one another, we cannot "consider them together" (*syntheôrein*), for their comparative examination is fruitless or impossible. As indicated, inconsistent explanations can be true in this world at different times or places, or they can be true in different worlds either now or in the infinity of time. Epicurus' surviving writings do not reveal his position regarding this point.

A final epistemic feature is worth noting. According to Epicurus, investigations conducted through the *pollachos tropos* have an adequate degree of *akribeia*, precision.

For this reason, even if we discover several causes for turnings and settings and risings and eclipses and the like ... we must not suppose that our enquiry into these things has not reached sufficient accuracy and precision (*akribeia*) to contribute to our tranquillity and happiness (*Hrtd.* 80).

While the content of the above passage is ethical, the virtue of the explanations of the *meteôra* that helps us attain the moral end is epistemic: despite the indeter-

⁴⁸ See also David Konstan's chapter in this volume. He distinguishes between phenomena for which, according to Epicurus, there are alternative but mutually exclusive causes (e.g., the sun is either extinguished at sunset or it is not) and phenomena that "really have multiple causes". For instance, Konstan remarks, thunder may be caused by several different atmospheric conditions, sometimes independently, other times in conjunction with one another.

minacies associated with the possible causes of these phenomena and their corresponding accounts, the latter are sufficiently precise to contribute to our peace of mind. This effect, I maintain, does not mean that any sloppy account will do. Nor does it entail that the enquiry into the *meteôra* has only instrumental value. Epicurus' point is, I think, that we should not have the wrong expectations from the study of the *meteôra*. They are not the kinds of things that could be explained in only one way and with perfect accuracy. This truth is crucial for ethics, and it is also important for science. In fact, one might suggest that a correct preliminary understanding of the scientific limitations of meteorology is a step or aspect of the process towards the moral end. Significantly, Epicurus compares the level of accuracy concerning the celestial phenomena with the accuracy of one's knowledge of the "most important things" (*Hrtd.* 78).

We must believe that to discover the cause of the most important things⁴⁹ is the function of the science of nature, and that blessedness for us in the knowledge of the celestial phenomena lies in this, and in understanding what are the natures that become apparent when we contemplate these phenomena, and in attaining every other knowledge akin to the precise knowledge (*akribeia*) that contributes to happiness (*Hrtd.* 78).

In the case of the *meteôra* the cognitive achievement is gained through the *pollachos tropos*, whereas "the precise knowledge that contributes to happiness" presumably consists in the cardinal principles of Epicureanism defended by means of the *monachos tropos*. In both cases, however, the suggestion seems to be that, notwithstanding the different epistemic constraints set by their respective subject-matter, the precision that can be attained satisfies the demands of reason (more on this below).

Taking stock, I shall attempt to trace the steps by which the *pollachos tropos* is supposed to work. On my interpretation, we are to proceed as follows:

1. We observe the appearance of a given *meteôron* and retain it in memory.⁵⁰ For even though this appearance is only an image and cannot reveal the nature or cause of the *meteôron*, Epicurus suggests, I think, that it can have a corrective function. For instance, obvious irregularities in the heavens can undermine one's misplaced confidence in the results of the planetaria.
2. Then we look for causal processes in our immediate experience which are relevantly analogous to a given (type of) *meteôron* and which will be used as signs in order to infer possible causes of the *meteôron*. Interestingly, this method would seem to imply that we can grasp *something* of the nature

⁴⁹ τὴν ὑπὲρ τῶν κυριωτάτων αἰτίαν.

⁵⁰ See Bénatouil 2003: 32.

of the *meteôron* after all, namely that it can have multiple causes and that none of them derives from supernatural powers.⁵¹

3. The analogies with things close to us will help us circumscribe the terrain in which a number of causal stories can obtain. Our next step is to test these stories in light of counter-evidence and retain only those that are consistent with the phenomena: primarily the phenomena that we observe near us but also, I submit, the images of the *meteôron* that we have retained in mind.
4. We compare side-by-side the explanations that have passed the test in order to discover if they are mutually consistent or incompatible and, presumably, we entertain the implications in each of these cases.⁵²
5. The set of explanations must remain open-ended within the relevant epistemic parameters. While *in abstracto* there are infinite possibilities in the infinite universe, there are not infinite causal possibilities for any given celestial or atmospheric event. There are, however, more than one such possibilities, even though we cannot decisively tell how many. Epicurus underscores this fact: in several cases, after enumerating multiple explanations of a celestial phenomenon, he adds that it can occur also in many other ways (*Pyth.* 99, 102, 104, 106, 108, 112).⁵³

In sum, I hope to have shown that Epicurus' conception of the *pollachos tropos* is rich, nuanced, fairly coherent, and strongly motivated by methodological and scientific considerations and not only ethical ones. Its core remains the same throughout the history of the school. However, Epicurus' later followers also introduce new elements that exercise some strain on the canonical version of the method. The next section of the paper will be devoted to this topic.

⁵¹ My thanks to Rupert Sparling for raising this issue.

⁵² De Sanctis 2012 argues that the incompatibility of multiple explanations can be explained by reference to the ethical aim of the method, while Bakker 2016: 163 is inclined to attribute it to the fragmented nature of events in the cosmos. Verde 2018a suggests that incompatibilities such as, e.g., the incompatibility of different causes intended to account for the risings and settings of the sun can plausibly be explained as a "third path" (see *Pyth.* 92 jointly with *Pyth.* 94-5). If I understand him correctly, his idea is that of two incompatible explanations, one is necessary (hypothetical necessity), the other not. See Verde 2018a: 526: if the cause of the rise of the sun is due to a cause F, then, inevitably, the moon must shine because of its own light; but if the rise of the sun has some other cause, then it is possible that the moon shines owing to the light of the sun and not its own. On the other hand, as mentioned, Epicurus' claim that the causal explanations of a *meteôron* can be examined in relation to each other (*Pyth.* 85) suggests or implies that these explanations can be compatible with each other.

⁵³ Obviously there are restrictions on what might count as additional items to the list of possible explanations. The Epicureans would not accept Zeus as a possible cause of the thunderbolt nor Poseidon as a possible cause of earthquakes. The last section of the paper is relevant to this point.

IV

Zeno of Sidon,⁵⁴ the brilliant and influential scholar of the Garden in the late second century BCE, is the author of the only attested criticism that, arguably, could affect the *pollachos tropos*. In the context of an argument against Dionysius of Cyrene, a Stoic mathematician and pupil of Diogenes of Babylon,⁵⁵ he objects to the fact that the latter defends the view that the sun is much larger than it appears on the basis of analogical comparisons with things in our vicinity (cf. Philodemus *De sign.* X 1-XI 8). Since such analogies are crucial to the application of the *pollachos tropos*, Zeno's objection to Dionysius might be taken to target the method of multiple explanations as well. The relevant passage from Philodemus' *On Signs* runs as follows:

Let it be granted that things in our experience which are slow to reappear either move slowly or occupy large areas. What necessity is there that the sun also, when it reappears slowly, does so for these reasons? Its emanations may be the result of another cause that is peculiar to it and different from things in our experience. Is it not true that all bodies in our experience that have colours bright to the eye have the distinctive property of being able to change to a greater or lesser brilliance, but the sun does not have this distinctive property? Is it not the case also that objects which reappear slowly in our experience will be able to do so by virtue of the two causes, but the sun will be able to have this character not through those causes but through another cause different from those in our experience? (*De sign.* X 26-XI 8).⁵⁶

Zeno's point is that the thesis that the sun must be very much larger than it seems cannot be established on the basis of analogies with things "close to us". For the causes accounting for the size of the sun may be different from the causes accounting for the size of things in our experience. While his argument is dialectical and does not question analogies between the *meteōra* and things "close to us" in any general way, nonetheless it might be interpreted as undermining the *pollachos tropos* in so far as it expresses a degree of scepticism about a central aspect of this latter. However, there is no textual evidence that Zeno occupied himself with the explanation of celestial phenomena or that his pupil Philodemus did. Perhaps, in addition to scoring a dialectical point against Dionysius, Zeno also intended to recommend epistemic caution to fellow-Epicureans who used the *pollachos tropos*, even if Zeno did not do so himself.

Unlike Zeno, Lucretius devotes considerable space to the *meteōra* in Books V and VI of *DRN*. On the one hand, he follows closely Epicurus' exposition in *On Nature* XI-XIII and reflects the Founder's preoccupation to attack literalist and

⁵⁴ See Hankinson 2013: 86.

⁵⁵ De Lacy and De Lacy 1978: 98 n. 28.

⁵⁶ Translation by De Lacy and De Lacy 1978, slightly modified.

creationist interpretations of Plato's *Timaeus*—notably, the thesis that the world is animated, created by a benevolent Demiurge and, therefore, good. Thus, Lucretius interjects the astronomical section of *DRN* V (509-770) between the formation of the cosmos and the development of human civilization.⁵⁷ He patterns the section on atmospheric and terrestrial phenomena in *DRN* VI on Epicurus' *On Nature* XIII (which, as mentioned, probably consisted in a topic-by-topic engagement with Theophrastus' collection and survey of physical doctrines⁵⁸ preserved by Aetius⁵⁹). He examines the *meteôra* roughly in the sequence followed by Epicurus and, before him, by Theophrastus. And, it seems, he uses the lists of multiple explanations cited in Epicurus' treatise.⁶⁰ On the other hand, Lucretius' principal target is different from Epicurus' own. His aim is not so much to refute the theories of the astronomers as to combat popular theology and superstition (e.g. *Lucret.* V 1204-40, VI 50-91). Even though he occasionally concerns himself with astronomical theories (*Lucret.* V 82-9, VI 58-65), this is more a tribute to Epicurus, and perhaps also to contemporary scientific developments, than a genuine interest of his own.

I shall now explain how furious storms of winds arise and how they are calmed so that all is once more what it was, changed and with its fury appeased, and all else that men see happening in earth and sky, when they are often held in suspense with frightened mind – events that abase their spirits through the fear of the gods, keeping them crushed to the earth because their ignorance of causes compels them to attribute events to the power of the gods and yield to them the place of kings ... As for those who have been taught correctly that the gods have a carefree life but still wonder all the while how things can go on, especially the phenomena perceived up above in the ethereal regions, they revert again to the old superstitions and take to themselves cruel masters whom these miserable men believe to be omnipotent ... (*Lucret.* VI 48-64).

As in Epicurus, so in Lucretius the multiple accounts of the *meteôra* are inscribed in an overarching ethical framework. Yet also, I contend, as in the former case, so in the latter the ultimate ethical purpose of the enterprise does not compromise the scientific credentials of the *pollachos tropos* or its adequacy for the task at hand. I shall not dwell on the explanations of specific phenomena, but rather confine my remarks, first, to the rationale underlying Lucretius' use of the method of multiple explanations⁶¹ and, second, to the novel elements of his approach and the tensions that they may cause to the canonical doctrine.

⁵⁷ As Sedley 1998: 152 notes, this closely parallels the place that the motions in the heavens and earth occupy in the *Timaeus*, i.e. after the origin of the world and before the origin of mankind.

⁵⁸ See again Sedley 1998: chapters 5 and 6.

⁵⁹ See previous note as well as nn. 18 and 19.

⁶⁰ While many of the explanations proposed by Epicurus were initially advanced by other thinkers, it is likely that Epicurus also added explanations of his own. On this point see Bakker 2016: 58-62.

⁶¹ See the analysis by Hankinson 2013: 90.

At the outset, it is worth noting that Lucretius offers multiple explanations not only as *accounts* of a given phenomenon but also as *illustrations* of the *pollachos tropos*. For instance, after he gives multiple explanations of clouds (VI 451-494) and rain (VI 495-523) and after a brief account of the rainbow (VI 524-526), he suggests to his Epicurean readers⁶² to figure out for themselves the explanations of snow, winds, hail, frosts, ice, and generally every phenomenon produced in the region above. Multiple explanations, then, are advanced *both* as causal possibilities for the occurrence of an atmospheric or meteorological phenomenon and as exemplifications of a *method* that people familiar with the fundamentals of Epicurean atomism are able to use to good effect. Consider a programmatic passage from *DRN* V:

Which of these causes holds in our world it is difficult to say for certain. But what may be done and is done through the whole universe in the various worlds made in various ways, that is what I teach, proceeding to set forth several causes which may account for the movements of the stars throughout the whole universe; one of which, however, must be that which gives force to the movement of the signs in our world also. For which may be the true one is not his to lay down who proceeds step by step (*Lucret.* V 526-533).

While, on my reading, Epicurus leaves under-determined the question whether one of the multiple causes of a *meteôron* is true or all of them are true and also does not overtly connect multiple explanations with different worlds, Lucretius states explicitly his position on both counts. Namely, he claims that, although there are many possible causes of every *meteôron*, it is necessary (*necessesit*: 531) that *only one of them* be the operative cause of such an event in this world. The other causes listed for that event cannot be true of it, although, according to the actual multiplicity thesis, they are true of corresponding events in other worlds. What is possible, then, is also actual somewhere in the infinite universe and the worlds in it. As for our own world, multiple explanations are causal possibilities that remain alive in so far as they are uncontested by facts.

Another striking element of Lucretius' approach is his reference to the *progreddens*, the Epicurean disciple who is making gradual progress. The progressor simply cannot know the true cause of a celestial phenomenon in our world: neither his perceptual ability nor his epistemic condition entitle him to claim that one of the possible explanations is true to the exception of all others. Generally, throughout his treatment of the *meteôra*, Lucretius does not tire to emphasise that it is extremely difficult to judge which explanation holds true of our world. For this reason it has sometimes been thought that Lucretius presents the *pollachos tropos* merely as an alternative to scepticism.⁶³ However, his explanations of, for instance, the size of

⁶² I.e., "readers who have fully understood what qualities belong to their elements" (*Lucret.* VI 534).

⁶³ See again Vuillemin 1984.

heavenly bodies, the light emitted from the sun, the risings and settings of the stars, the varying length of day and night, the source of the moon's light, and the eclipses (V 564-771), clearly, are not advanced in that spirit, but represent possibilities actualised in different worlds. Specialists in the history of ancient science are in a position to assess whether or to what extent these multiple accounts of the *meteôra* reflect scientific views advanced in Lucretius' time or earlier.

An intriguing and controversial analogy is intended to convey Lucretius' rationale regarding the method of multiple explanations.

There are a number of things for which it is not enough to name one cause but many, one of which is however the true cause – just as, should you yourself see a man's body lying lifeless at a distance, you may perhaps think proper to name all the causes of death in order that the one true cause of the man's death may be named. For you would not be able to establish that he had died by the sword, from cold, from disease, or by poison; but we do know that what happened to him was something of that sort. And likewise in many other matters we are in a position to say the same (*Lucret.* VI 703-11).

According to this passage, *as* we cannot know the true cause of a man's death when we see his lifeless body lying at a distance from us, *so* we cannot know the true cause of a celestial phenomenon when we see the appearance of it in the sky. In neither case are we able to identify the precise factor(s) responsible for the event, mainly because we are at a distance from it but perhaps for other reasons as well. The best thing to do, Lucretius suggests, is to enumerate several causes that can reasonably account for what has happened. Philosophically, the aforementioned analogy leaves open, I think, a range of options: of the causal possibilities listed for a given event, one of them will be true in this world; more than one can be true in this world (in which case the event is overdetermined); or all of them are true of some such event somewhere.

Is Lucretius' approach heretic? On the face of it, it seems unlikely that Epicurus would accept the claim that there must be only one true cause of an event in a given world (V 531: *una causa necessest*) or the idea that, if *per impossibile* we could observe the *meteôra* closely, we would discover what brought them to pass.⁶⁴ Nonetheless, in the first place, we saw that the Founder's position is ambiguous in these regards and, in the second place, there is evidence that it evolved over time at least in respect of the doctrine of infinite worlds. For, according to Diogenes, Epicurus restructured and clarified that doctrine as a result of debates within his own school (fr. 63 II 10-V 1; frs. 64-67 Smith). And together with these revisions, Epicurus may also have modified his view regarding multiple explanations. In any case, Lucretius could argue that his version of the *pollachos tropos* falls within the canon. He could

⁶⁴ On the issue of Lucretius' deviations from the canonical doctrine, see Verde 2018a: 531 and elsewhere.

contend that, since Epicurus posits infinite worlds, he is also committed to the actual multiplicity thesis; if so, he would naturally find attractive the idea that, of all possible explanations of a celestial phenomenon, precisely one holds true of a given world. Even if this sort of argument appears somewhat self-serving, it is not unusual. And it removes some of the grounds on which Lucretius could be accused of being unorthodox. Even so a critic might insist that, while Epicurus considers the *pollachos tropos* the *best* or indeed the *only* method suited to the nature of the *meteôra*, Lucretius recommends it *faute de mieux*.

Turning to Diogenes of Oinoanda we find that, although he draws his material on the *meteôra* from Epicurus and although his approach occasionally resembles that of Lucretius, nonetheless he has different targets and is motivated by partly different philosophical concerns.

First, Diogenes concentrates his attention on philosophers belonging to the Socratic tradition. Near the beginning of the inscription, he mentions that one of the main reasons why he had it engraved was to free people from the fear of death and of the gods, and to restore in them tranquillity and joy by teaching them the truths of physics (fr. 2 III 1-14 Smith). He also says that he intends to refute those who consider natural science useless, notably Socrates and his entourage.⁶⁵

They claim that pursuing natural science and busying oneself with investigation of the *meteôra* is superfluous and unprofitable, and they do [not even] deign to [concern themselves with such matters] (fr. 4 II 1-9 Smith).⁶⁶

However, Diogenes' primary targets are not the Socratics but the Stoics. We are fortunate to have some of its details in the recently discovered NF 182, brilliantly edited and translated by Martin Ferguson Smith and Jurgen Hammerstaedt and discussed in detail by Giuliana Leone.

(Fr. 20 II 11) If therefore the divine nature shall be deemed to have created things for its own sake, (fr. 20 III + NF 182 I)⁶⁷ (there result) all these absurdities; and if for the sake of humans, there are yet other more absurd consequences. Let us divide the discussion into two (the world and humans themselves), and first let us speak about the world (and ask) whether it has all things well arranged for humans and (whether) we have nothing on which to fault them, as they have been prepared by a god. But first let mention be made of the (NF 182 II) occurrences in the *meteôra*. Let anyone say in what ways a thunderbolt benefits life (how does it not even harm?), in what way flashes of lightning do and in what way clasps of thunder, in what way fall of hail, in what way blasts and gusts of violent winds, in what way the irregular

⁶⁵ The expression οἱ περὶ Σωκράτην probably refers to Socrates as well as his immediate associates and their schools. On this point, see Smith 1993: 440, and Leone 2017: 95.

⁶⁶ I use the translation of Smith 1993, with occasional slight modifications.

⁶⁷ As Hammerstaedt and Smith 2010 point out, NF 182 fills part of the gap between fragment 20 and fragment 21.

orbits of the stars and their differing sizes, in what way eclipses of the sun and the moon <and> their spiral-shaped and oblique courses, in what way night, (NF 182 III) when we can [as well rest throughout the] day, in what way the alternating [lengths] of days [and] nights? For of these phenomena some are useless, others even harmful. The *meteôra* do have that character. [But of what kind are matters on earth?] How much of Libya is uninhabitable? How much of the land beyond the Skythians, [how much] of the [region] beyond Asia, how much of India? How many other ...? (tr. Hammerstaedt–Smith).

Here, Diogenes pursues his attack against the Stoic thesis that the world is divinely created, purposeful, and the best possible. In fact, he argues, both the natural world and human beings have so many features that are bad or purposeless that the world cannot have been created by the gods either for their own sake or for the benefit of humans. The *meteôra*⁶⁸ enter the discussion at just that point as prime illustrations of the contention that nature is neither teleologically oriented nor always good to us. The list of these phenomena overlaps with the ones in Epicurus and Lucretius and, judging from Diogenes' enumeration on the causes of hail (fr. 14.1–10 Smith) and his mention of risings and settings in connection to the *pollachos tropos*, we may plausibly attribute to him the view that all the *meteôra* mentioned in fr. 13 constitute objects of that method.

Generally, Diogenes follows Epicurus in placing the study of the *meteôra* squarely within the domain of natural science and in highlighting its ethical dimension.⁶⁹ In addition, however, his analysis of celestial phenomena has distinctive features. Some of them also occur in Epicurus's extant remains but are more fully spelled out in Diogenes, while one idea that he introduces in connection to the *pollachos tropos* is (so far as we know) original and in tension with the canonical doctrine. The emphasis on differences and irregularities in the motions of the heavenly bodies illustrates the category of features also suggested by the canonical writings, whereas the claim that one explanation of a given phenomenon is more *plausible* than the others appears like an innovation or even a breach with Epicurus. Consider fr. 13 of the inscription, which contains, first, the elaboration of Epicurus' assumption that the causes and motions of the *meteôra* are not entirely regular and uniform and, next, the articulation of a criterion for choosing one explanation over others.

This passage is the excerpt concerning the movements of the stars:

[The heavenly bodies, when the whirls of air] cause [such strong motions], are all [violently] tossed about, but some crash into one another while others do not; some pursue a straight course up to a certain point, others, for instance the sun and the

⁶⁸ Diogenes does not use *meteôra* in this context, but elsewhere appears entirely familiar with its use.

⁶⁹ On this point, see Smith 1993: 508, as well as the very informative study on Diogenes and the polemic regarding the *meteôra* by Leone 2017.

moon, an oblique one, and others, like the Bear, revolve in the same place; again, some move in a high orbit, but others in a low one. Also, here is a fact that most people are ignorant about: they suppose the sun to be as low as it appears to be, whereas it is not as low; for if it were so, the earth and everything on it would necessarily be set ablaze. So, it is its image (*apophasin*) which we see low, not the sun itself. But this is a digression (fr. 13 I 1-II 12 Smith).

Here Diogenes' purpose is, I think, to undermine the idea that there is perfect regularity in the motions of the stars in the heavens. I shall say more about this in the next section, but here suffice it to note that the Eudoxean astronomers make a similar assumption, and that the latter is also present in philosophical creationism of all sorts. In sharp contrast, the picture that Diogenes sketches out consists of non-uniform, fragmented events in the celestial sphere: tossings and turnings, violent encounters, irregular trajectories, orbits that are high or low. The whole thing appears quite chaotic and, to the religiously minded, irreverent. As they believe, god is a principle of order, regularity, harmony, and perfection; and nowhere are these features more uniformly present than in the heavenly realm. In the second part of our text, we encounter the by now familiar Epicurean distinction between the nature of the *meteōron* itself, which is unobservable, and its appearance, which can be observed but also can mislead us about its cause. Diogenes refutes the belief that the sun is as low as it appears to be by adducing counter-evidence: if the sun were as low as we take it to be, everything would be on fire; but this is not the case and, therefore, the sun is not as low as it appears. Recall that this method of verification is used to test multiple explanations and reject those of them that disagree with the facts.

In the sequel of the passage, however, Diogenes makes a programmatic statement that has no exact equivalent in other surviving Epicurean writings.

Let us now discuss risings and settings and related matters after making this preliminary point: if one is investigating things that are not directly perceptible, and if one sees that several explanations are possible, it is reckless to make a dogmatic pronouncement concerning any single one; such a procedure is characteristic of a seer rather than a wise man. It is correct, however, to say that, while all explanations are possible, this one is more convincing (*pithanōteron*) than that (fr. 13 II 12-III 13 Smith).

Assuming that fragments 13 and 14 are parts of a longer section on the subject of the *meteōra*,⁷⁰ Diogenes appears to introduce the *pollachos tropos* at the outset, as an essential preliminary feature of his analysis. He takes for granted Epicurus'

⁷⁰ I follow the order defended by Smith. An alternative is entertained by Leone 2017: 96-97. As it seems, Diogenes discussed, first, certain astronomical phenomena and, subsequently, meteorological phenomena. The sequel seems to be roughly the same as in Epicurus' *Letter to Pythocles* and in Lucretius' poem.

distinction between things that are directly perceptible and others that are not, as well as between non-evident things that have a single explanation and others that admit of several possible accounts. Yet while, according to Epicurus, all possible accounts must equally be accepted as true in the absence of counter-evidence, Diogenes allows for a comparative criterion of selection of one explanation over others. Namely, he considers unobjectionable the practice of running a comparative survey of all possible explanations, assessing their respective plausibility, and favouring the one that seems more convincing.

Although Diogenes does not phrase the latter view in a strongly normative manner, he seems to endorse it on his own account. For example, in the case of the formation of hail, he entertains a hypothesis that he deems worthy of acceptance on the grounds that it is “not unreasonable” or “not implausible”. We can accept, he says,

not unreasonably,⁷¹ that hail is produced by a fine, loose conglomeration, which is due to the [self-moving energy] of what surrounds it and [is formed] either by a wind [that is cold] but high in the air or by filmy snow (fr. 14.2-10 Smith).

Admittedly, there is no close precedent for this view in Epicurus. Regardless of Diogenes’ own motivation,⁷² the view in question may appear to constitute not merely a development but a deviation from the canonical doctrine. Nonetheless, a case can be made, I think, that Epicurus does not *preclude* opting for the explanation that seems more *pithanê*, convincing or plausible, than other possible explanations of the same phenomenon. In fact, he seems to have some such thought in mind when he says that multiple explanations in accordance with the phenomena do not disturb us, provided that we accept, as we ought, *to pithanologoumenon*, that is, a plausible or probable account of the phenomena (*Pyth.* 87). And other passages, too, point in that direction.⁷³ Moreover, he frequently appeals to what seems reasonable or plausible in order to draw inferences about non-evident things.⁷⁴ The crucial thing, however, is that we endorse the core assumption of the *pollachos tropos*, namely, that the celestial and the atmospheric phenomena have multiple causes and are accountable in multiple ways. If we accept this principle and the world-view associated with it, our psychological preference for one explanation over others will not make any difference to our tranquillity (cf. *Hrtd.* 79-80).⁷⁵ Viewed in this light,

⁷¹ οὐκ ἀ-/[πει]κότως (fr. 14.2-3 Smith).

⁷² According to Bakker 2016: 74, this is due to the fact that Diogenes is trying to reconcile orthodox doctrine with the astronomical advances of his time. See also Bakker 2016: 36-42.

⁷³ Leone 2017 finds a precedent *in nuce* of Diogenes’ view in *Pyth.* 87, *Hrtd.* 80, and *Nat.* XIV col. XXXV 13-15 and XI [24] [44] Arrighetti.

⁷⁴ See the incisive remarks by Leone 2017: 104.

⁷⁵ The meaning of the closing sentence of *Hrtd.* 80 is obscure. According to Verde 2013: 130, it is this: we can opt for one explanation, provided that we know that there are many possible explanations of a phenomenon; and it is important to make sure that the one explanation that we opt for be *compatible*

Diogenes' addition to the canonical doctrine causes no tension at all. We should now move on to the final section of the paper. It concerns the ethics of the *pollachos tropos* and revisits the issue of its epistemic value.

V

Even though, as I hope to have shown, the *pollachos tropos* is treated by the Epicureans as a valuable tool of scientific research, it serves also and primarily an overarching ethical purpose: to contribute to our tranquillity and happiness. But why is it so important to acquire a correct understanding of the *meteôra* in order to attain peace of mind? And why are multiple explanations especially conducive to that goal?

Consider again the sorts of phenomena that the Epicureans call *meteôra* and their impact on human life. Whether they happen regularly and periodically, like the risings and settings of the sun and the moon,⁷⁶ or randomly and unpredictably, like thunderbolts and earthquakes and falling stars, several of them are spectacular grand-scale events that could arouse strong emotions: delight, marvel, astonishment, perplexity, awe, fear. Some of them are sources of grave danger, capable of destroying crops, cattle, buildings, individuals, and even entire cities. And many of these phenomena are associated with the myths forming the foundation of institutional religion and filling the heart of humans with terror of the gods. Several passages in Lucretius capture these ideas. Examples include the following excerpts from *DRN V*:

For when we look upwards to the celestial regions of the great firmament, to the ether studded with glittering stars, when we think of the ways of sun and moon, into our hearts already crushed with other woes a new anxious care awakening begins to lift up its head, whether by any chance we have to do with some immeasurable power of the gods, able to make the bright stars revolve with their different movements (V 1204-1210)

Besides, whose mind does not shrink up with fear of the gods, whose limbs do not crawl with terror, when the scorched earth quakes with the shivering shock of a thunderbolt and rumblings run through the mighty sky? Do not nations and peoples

with the many other causes that could generate the phenomenon in question. I am inclined to agree with this reading.

⁷⁶ See, e.g., *Lucret. V* 76-90: "I shall explain by what force pilot nature steers the courses of the sun and the goings of the moon; lest by any chance we think that these between heaven and earth traverse their yearly courses free, of their own will, and obliging for the increase of crops and of animals, or deem them to revolve by some plan of the gods. For if those who have been rightly taught that the gods lead a life without care, yet wonder all the while how things can go on, especially those transactions which are perceived overhead in the regions of ether, they revert back again to the old superstitions and take to themselves cruel taskmasters, whom the poor wretches believe to be almighty, not knowing what can be and what cannot, in a word how each thing has limited power and a deep-set boundary mark."

tremble, do not proud kings huddle up their limbs smitten with fear of the gods, lest for some base deed or proud word the solemn time of punishment be now brought near at hand? (V 1218-1225)

Then, when the whole earth trembles beneath our feet, when cities are shaken and fall or threaten to fall, what wonder if the sons of men feel contempt for themselves, and acknowledge the great potency and wondrous might of gods in the world to govern all things? (V 1236-1240).

These verses and many others, including notably the proems of the fifth and the sixth book of the poem, jointly convey a strong theological message: failure to understand the *meteôra* leads to a total misconception of divinity.⁷⁷ And people who misconceive the nature of the gods are incapable of approaching their shrines with peaceful heart and receive divine images. Hence they lack moral exemplars and are bound to live bad lives.

Epicurus' remarks in the *Principal Doctrines* (X-XIII) point in the same direction. He claims that suspicion (*hypopsia*) and fear (*phobos*) about the *meteôra*, as well as the fear of death, are among the chief factors that make us vulnerable to superstition (*KD XII*), shatter our sense of safety, and disturb our peace of mind. Consider, for instance, *KD XIII*:

There would be no advantage in providing security against our fellow-men so long as we were alarmed by occurrences over our heads or beneath the earth or in general by whatever happens in the boundless universe.

As I have argued, however, Epicurus' polemic is chiefly directed at a dominant *scientific* approach to the *meteôra*, which was practised by the mathematicians of Cyzicus and which could be traced back to Plato's Academy. I wish now to underscore what was at stake in that debate.

In the historical and dialectical framework in which this latter takes place, Epicurus views the astronomers' assumption that every celestial phenomenon has a single cause as tightly connected to the belief that the world was created by god for the sake of man, and that its divine origin is especially manifest in the perfect regularity of the motions of the stars in the heavens.⁷⁸ It is terribly important to realise that, in rejecting the methods of the astronomers in favour of the *pollachos tropos*, Epicurus also rejects the theological doctrines that underlie it. Indeed, he appears

⁷⁷ See Sedley 1998: 154.

⁷⁸ However, one could rely on the *monachos tropos* for the explanation of the *meteôra* without necessarily endorsing a creationist theology. Conversely, one could use the *pollachos tropos* to explain the *meteôra* and, nonetheless, subscribe to creationism. This is the case of several Stoics. For instance, Chrysippus accounts for snow in more than one way (Arius Didymus fr. 35 Diels = SVF II 701), Posidonius borrows from the meteorology of Theophrastus, and the *pollachos tropos* is omnipresent in Seneca's *Natural Questions* – a work that heavily relies on Posidonius and is informed by Aristotle's as well as Theophrastus' treatment of the *meteôra*.

to assume that creationism, providentialism, and the method of single explanation stand or fall together. And the same holds, conversely, for the atomic composition of the universe, the mechanistic nature of all its workings, and the method of multiple explanations. In the end, the controversy is not merely about method but about two competing world-views. Moreover, these are not only about physics and astronomy, but about one's way of thinking and of living one's life.

This, I believe, is the real point of Epicurus' preliminary remarks in the *Letter to Pythocles* (85-88), which have commonly been taken to imply that the knowledge of the *meteôra* is solely instrumental and the *pollachos tropos* a mere shortcut to tranquillity. The *Letter to Herodotus* (81) points, precisely, to the major flaw marking the approach of the Eudoxean astronomers of Cyzicus.

We must grasp this truth, that the principal disturbance in the mind of men arises because they believe that these celestial bodies are blessed and immortal, and yet have wills and actions and motives inconsistent with these attributes; and because they are always expecting or imagining some everlasting misery, such as is depicted in legends, or even fear the loss of feeling in death as though it would concern them themselves (*Hrtd.* 81).

On Epicurus' view, the traditional approach to astronomy is scientifically ineffective as well as psychologically frustrating. And its theoretical advocates may be even more vulnerable to disturbance and fear than mere laymen (*Hrtd.* 79). Why so? In the *Letter to Pythocles*, Epicurus addresses that question, highlighting the connection between the epistemic shortcomings of Eudoxean astronomy and the unhappiness that they necessarily cause. To wit, the astronomers under criticism are driven by an empty desire, the desire for something impossible: to know in a certain way – that is, through the discovery of a single explanation – things that are *impossible* to know in that way (*Pyth.* 94) because, by their very nature, they *cannot* admit of a single explanation. Thus they get into a situation that is *adianoêton*, inconceivable or irrational: they are unable to consider together and assess (*synthêôrein*) the relevant phenomena (*Pyth.* 94-95), refuse to entertain evident possible truths,⁷⁹ and find themselves in conflict with *enargêmata*, evident facts. Often they favour the *monachos tropos* just in order to show off. And, typically, they become epistemically arrogant, fanatic, or even insane (*Pyth.* 113).

In sharp contrast, the application of the *pollachos tropos* in the study of the *meteôra* is supposed to avoid or remove these scientific and ethical disadvantages (*Hrtd.* 79-80). It exhibits epistemic modesty, combats fanaticism, and cultivates an open mind. Epicurus makes sufficiently clear, I submit, that the *pollachos tropos* *could not* have such benefits if it did not have the aforementioned epistemic virtues. He seems to believe that these are *necessary* for the proper exercise of the art

⁷⁹ See Hankinson 2013: 85.

of astronomy and for the good ethical consequences that the latter can bring. A stronger claim is defensible as well, namely, that the *pollachos tropos* is an important *constituent* of the Epicurean Gestalt: the frame of mind and the way of thinking tantamount to happiness.

To conclude: I have argued that the *pollachos tropos* does not represent an epistemic compromise that the Epicureans made for the sake of ethics. The Epicureans defend it on independent grounds, both ontological and epistemic, and highlight its scientific appropriateness as well as its ethical contribution. They propose a new astronomy and meteorology, firmly situated in the framework of Epicurean philosophy, conducted through the method of multiple explanations and aiming to satisfy the demands of rationality.⁸⁰ This method, in their view, is the true science of the *meteôra* – a science that is empiricist, pragmatic, intellectually honest, emotionally comfortable, and ethically beneficial.

Historically, Epicurus' conception of the *pollachos tropos* pursues and develops a mainstream approach to the *meteôra* probably initiated by Democritus and operative for approximately a millennium. However, the Epicurean version of that approach is of unique historical value because it is original, coherent, detailed, and defended on theoretical grounds. Philosophically, the Epicurean *pollachos tropos* relies on an intuition that persists under different guises in the philosophy of science to this day. Namely, scientific theories are to be accepted or rejected depending on their empirical adequacy. In principle, there can be multiple empirically adequate theories which may be inconsistent in their unobservable posits but equivalent in their empirical effectiveness, for instance, their predictions or their explanatory power. And each of them is left standing, unless or until decisive counter-evidence is brought against it. This intuition is, I believe, powerful and has significant philosophical vitality and potential. It is worth attending to, both within the Epicurean system and independently, in its own right.⁸¹

⁸⁰ See Hankinson 2013: 94, who argues that multiple explanations are intended to satisfy the claims of reason and also serve as bulwarks against human frailty.

⁸¹ I presented the earliest version of this study at the first conference of the project SPIDER on Epicurean science and meteorology, which was held virtually at *La Sapienza* University in Rome (October 2020). I would like to express my warm thanks to the organizers of the conference (Francesca Masi, P.-M. Morel, and Francesco Verde) as well as the audience for their critical remarks. Since the three organizers of the conference are also the editors of the present volume, it is apposite to express here my gratitude to them for their editorial work and to the anonymous readers for their input. To return to the gradual development of the paper, after the SPIDER conference I presented an improved version at the *Institute of Classical Studies* in London (November 2020), and I wish to thank Raphael Woolf, who organized this virtual event, as well as all the participants for their input. After revising the paper once more, I presented it at the British School of Athens (April 2021). I am grateful to John Bennett (director of the BSA at that time), Alexander Nehamas, and Maria Protopapas for that invitation. I gained much from their comments and from the reactions of the audience. Many thanks to Robert McIntyre for our correspondence on that stage of the process, to Michael Augustin, Caterina Pellò, and Sara Diaco for extensive discussion on the topic of multiple explanations, and to Gabor Betegh, Paul Kalligas, Vasso Kindi, André Laks, Alex Long, and David Sedley for reading and commenting on aspects of earlier drafts. I read the penultimate version of the paper at a conference on *Knowledge*

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