PROLOGUE
Plutarch and the history of science: the case of *Quaestiones naturales*

Plutarch was a man of many talents as his life and writings show. Between being a political delegate and representative of his small hometown of Chaeronea, a philosophy tutor specialising in the teachings of Plato, and in his final years a priest worshipping Apollo at the oracle of Delphi, he was a full time intellectual and a true paragon of ancient learning, who found a great joy in collecting and critically transmitting many different forms of knowledge that personally caught his attention (history, literature, philosophy, science etc.). Among many other branches of ancient learning – the code word here is πολυμάθεια –, the Chaeronean was very interested in the natural world around him in terms mainly of its underlying material principles, physical processes and its providential ordering. If Plutarch’s so-called natural scientific writings can teach us one thing about his perception of physical reality, it is the fact that they are based on a very different outlook on the world than is generally promoted by scientists today. Plutarch lived in the same physical world as we do, but he saw it in a very different way and from a very different perspective. In line with his Platonic philosophy and the corresponding division between the sensible and intelligible realms in the cosmos, he ascribed a divine providence to the world, which can partly explain his interest in more fanciful beliefs regarding nature and natural phenomena, as this study will show.

In his dual role as a *homo philosophicus* and a *homo religiosus*, Plutarch did not draw a clear distinction between, what people today would call, natural science, on the one hand, and religion and mythology, on the other – that is, the traditionally ill-conceived distinction between ‘reason’ and ‘myth’. In fact, the opposite is true, as is clear, for instance, from his *De facie*. In this work, Plutarch concludes an astrophysical dialogue about the substance and nature of the moon with a mythological account of the moon’s purpose in the universe, explaining its importance for the life-cycle of human souls. This dualistic approach is not at all new to contemporary Plutarch scholars, but the claim that the same approach is also subtly present in Plutarch’s discussions of more particular scientific topics as treated in *Quaestiones naturalles* – a collection of 41 natural

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1 This number (41) includes the additional problems from Glybertus Longolius’ 1542 Latin translation (*Q.N.* 32–39) and from Michael Psellus’ *De omnifaria doctrina* (*Q.N.* 40–41 = §§170 and 188 Westerink). There is some controversy about the authenticity of
problems modelled after the Ps.-Aristotelian *Natural problems* (from here on simply *Problems*) – has not yet been made, or has even been doubted. One of the goals of this study will be to resolve this issue, and to show that Plutarch’s natural problems form an integral part of his wider natural philosophical project, fully consistent with the method and conceptual framework of his other scientific writings, albeit perhaps in a less obvious manner.

Plutarch discusses natural problems throughout his entire oeuvre. In *Quaestiones convivales* he cross-fertilises the natural problem format with the literary genre of the *symposium*, and in the *Vitae* he sporadically incorporates natural scientific digressions (παρεκβάσεις) in his biographical narratives [see 2.1.3.]. Plutarch uses the problem format in its traditional form only in *Quaestiones naturales*, where he treats such problems in an autonomous fashion. By straddling a large variety of questions (and answers) related to ancient Greek zoology, botany, meteorology and their respective subdisciplines, the collection is firmly rooted in ancient Greek physical theory2, especially as conceptualised by the Peripatetics [see 1.1.3.]. A few examples of particular – and at times very peculiar – problems Plutarch tries to solve are: ‘Why does seawater not provide nourishment to trees?’ (*Q.N. 1*), ‘Why do the tears of boars taste sweet, while those of deer taste salty and ordinary?’ (*Q.N. 20*), ‘Why does a vine wilt if it is sprinkled with wine, and especially with wine made from its own grapes?’ (*Q.N. 31*), ‘Why is water that is drawn from wells less nutritious than water that flows from a spring or falls from the sky?’ (*Q.N. 33*), ‘Why are bees quicker to sting people who have just committed adultery?’ (*Q.N. 36*).

Due to Plutarch’s primary focus on the natural causes of such phenomena and not also on their higher, divine motivation, scholars have argued that the place of *Quaestiones naturales* among Plutarch’s other natural philosophical writings is puzzling. However, as we will see, these scholars have often neglected the deeper philosophical-religious motivations and mythological references that discreetly accompany the collection’s scientific discourse [4.1.2.2.]. The few attempts that have been made to evaluate the work’s scientific character – mainly in terms of its physico-aetiological approach and referential and impersonal style – were mostly

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biased by modern hindsight, at the risk of neglecting the broader scientific and socio-cultural context from which the text originates. In other cases that emphasise the collection’s strange and exotic character, scholars have tried to cover up their interpretative misguidance by conveniently, though often silently, siding with that lovely profundity – or scholarly fig leaf rather? – that the past is a ‘foreign country’, that is, a country with natural laws and scientific conventions of its own, impenetrable to modern understanding. As a result, a proper attempt to make the collection more comprehensible for the modern reader was left to others, and rightly so.

Owing to a growing awareness of the particular and, in many cases, very different intellectual-philosophical and socio-cultural background of ancient scientific texts, there are several methodological tools available now for interpreting the scientific set-up of this type of literature in conjunction with its historical context. This endeavour forms one of the basic objectives for the study at hand. Indeed, only since relatively recently scholars have started to take a more positive stance towards Plutarch’s natural science, but even so Quaestiones naturales has continued to lag behind. This general reappraisal can be linked with the wider scholarly tendency in the contemporary history of science to draw a realistic and detailed picture of ancient scientific literature without in any way idealising it. Thus, it is expected that an attempt to set the game straight for Quaestiones naturales will certainly be of interest both to Plutarchists and to historians of (ancient) science. The principal aim of this prologue, therefore, is to establish a broad conceptual and methodological framework within which we can approach Plutarch’s natural problems in a suitable fashion, that is, in light both of contemporary Plutarch scholarship and of the history of (ancient) science. Historians of science will be familiar with many of the points raised here, but this may not be the case for scholars working in the field of Plutarch studies. In either case, examining Plutarch’s role in the history of science may offer something new to both types of readers.

The prologue at hand aims to explore how the scientific value of Quaestiones naturales can properly be assessed and what is its place in its contemporary scientific context. Through outlining a status quaestionis of the research that has already been conducted on this text, I will try to show that it is only fair to study Plutarch’s scientific endeavours at face value, that is from an ancient rather than from a modern perspective. As such, the goal of this study will be of a mainly historical-antiquarian kind. It should be noted, though, that the principle of charity, which this assessment will be established on – by holding that an author’s tenets and convictions be valued on the basis of his own intellectual standards and that of his time –, should not, of course, exclude a diachronic evaluation3 (see further).

3 See J. Opsomer, 2014, p. 91: “The principle of charity, as I understand it, […]”
A first important terminological question will, then, be whether the concept of ‘ancient science’ is actually legitimate, and, if so, why one would want to apply it here. The overarching question is whether Plutarch’s scientific programme is really as ‘immature’, if not straightway unscientific, as it may seem to some (modern readers). This question may sound naïve, but its apologetic significance will soon become clear. In other words, what grounds do we have to take the more marginal(ised) aspects of ancient science – including Plutarch’s natural problems – seriously, and why would we even care to do so? In order to provide a convincing answer to these questions, we should first take a look at the scientific programme of Plutarch’s philosophical hero, Plato.

1. Plato, Plutarch and scientific infancy

As the attentive reader may have noticed, the quotation from Plato’s Phaedo in the epigraph to this study is a rather misleading excerpt from the original Platonic dialogue. That is, it stands somewhat bare and decontextualised from the original Platonic text. This is deliberate, and it will become clear why, once we have considered the passage in greater depth.

In Phd. 95e–99d, Plato incorporates an important intermezzo, where Socrates is conversing with Cebes in an autobiographical mode about his own intellectual Werdegang. As a younger (νέος), Socrates was very enthusiastic about natural science (περὶ φύσεως ἱστορία), because it seemed to acknowledge for the existence, coming to be and perishing of everything in the world by means of a suitable causal approach. Unfortunately, we can only guess at the real, historical extent of Socrates’ interests in natural scientific matters⁴. From this passage in the Phaedo, however, we learn

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⁴ It remains to be seen, after all, how much truth and how much slandering there is precisely in Meletus’ attribution of Anaxagoras’ physical theories to Socrates at his trial (viz. that the sun is a stone and the moon, earth), or to what precise historical extent Aristophanes’ portrayal of him as a mad scientist is a caricature or not. Pl., Apo. 26d (= Anaxag., DK59A35): τὸν μὲν ἥλιον λίθον φησὶν εἶναι, τὴν δὲ σελήνην γῆν. Cf. also Apo. 19b for the accusation of Socrates’ excessive interest in the study of ‘what is beneath the earth and in the heavens’ (Σωκράτης ἀδικεῖ καὶ περιεργάζεται ζητῶν τὰ τε ὑπὸ γῆς καὶ οὐράνια). The slandering is very clear in Aristophanes, (e.g., Nub. 174: ἤσθην γαλεώτη καταχέσαντι Σωκράτους). But Plutarch is also very clear on the matter in Nic. 23, 3: Σωκράτης, οὐδὲν αὐτῷ τῶν γε τοιούτων προσήκον, ὡς απολέστο διὰ φιλοσοφίαν. Cf. also Pl., Phdr. 230d: φιλομαθής γάρ εἶμι· τὰ μὲν οὖν χωρία καὶ τὰ δένδρα οὐδὲν μ’ ἐθέλει διδάσκειν, οἱ δ’ ἐν τῷ ἀστεί ἄνθρωποι.
that Socrates became interested in Anaxagoras’ theory of an all-embracing νοῦς when he heard someone – perhaps Archelaus, Socrates’ supposed teacher – reading from Anaxagoras’ book. Socrates expected that this νοῦς would arrange everything ‘in such a way as it is best for it to be’ (ταύτῃ ὅπῃ ἂν βέλτιστα ἔχῃ). Anaxagoras’ theory seemed very promising at first in this regard, but eventually – and quite ironically so, considering the kind words Socrates first had for Anaxagoras – it failed to meet Socrates’ initial expectations. This disappointment is due to ‘Mr. Mind’s’ (cf. Per. 4, 6) main focus on natural causes, a rather narrow approach in Socrates’ opinion. Socrates gives the following absurd example to disprove Anaxagoras: one could say that it is due to certain positions and movements of his muscles that he sits there (in prison) with his legs bent, but when it comes to those muscles, he could just as easily have set course for Megara or Boeotia to escape the impending death penalty (the allusion is to the Crito). Therefore, the main cause for Socrates’ stay in prison is his personal choice to accept the judges’ verdict and not go into exile. In this sense, his muscles are only the means by which he can sit or run away, but to call them the real cause of his action is, for Socrates, most absurd (ἄλλ’ αἴτια μὲν τὰ τουαύτα καλεῖν λίαν ἀτόπων).

It is interesting – at least for the sake of the argument – that natural science and a person’s interest in natural causality is depicted in the Phaedo passage as a puerile practice for immature intellects. Socrates is young, so his interest in natural phenomena could be pardoned as a youthful sin. Even as a youth, however, Socrates frowned at the flaws in natural science, mainly because he did not see it as shedding light on the real causes (τὰς ὡς ἀληθῶς αἰτίας). For Socrates, explaining natural phenomena, such as the working of the muscles, in a purely physical-aetiological way is a ‘childish’ and truly ‘infantile’ procedure. It is an oversimplified manner of speaking (πολλῆ ἐν καὶ μακρὰ ἡρθημα εἰθ τοῦ λόγου) and shows an inability to make proper distinctions (τὸ γὰρ μὴ διελέσθαι οἶδον τ’ εἶναι). People who equate the natural cause with the real cause are only groping in the dark and use the wrong word (δὴ μοι φαίνονται ψηλαφώντες οἱ πολλοὶ ἔστη ἐν σκότει, ἁλλοτρίῳ ὄνοματι προσχρώμενοι).

Scholars have argued that Plato is most likely projecting his own philosophicalWerdegang on that of Socrates in this passage. Thus, one may wonder why Plato himself, in spite of his well-known disdain for experimental science (cf., e.g., Th. 162e), still had an interest in biology and physical theory, as is clear from the Timaeus. In this late work, Plato

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5 For more detail on the ancient belief that philosophical education can commence only after infantia, when reason sets in and logical thought starts to develop, see C. Laes, 2011, p. 84 (cf. Aēt., Plac. 4, 11 = Ps.-Plut. 900BD and Sen, Ep. 118, 14).

6 See H. Görgemanns, 1999 (with p. 75 for the theory of Plato’s autobiographical writing in the Phaedo passage).
clearly demonstrates that the contemplation of natural causes does hold great interest for a true and mature philosopher, but at the same time he makes it very clear that the study of natural phenomena should remain completely subjugated to the contemplation of a higher, intelligible cause (i.e. the idea of the beautiful and the good, the divine demiurge etc.). This intelligible and divine principle is the corner-stone of Plato’s philosophical doctrine.

The point I am trying to make is different, though. To stay with Plato’s *Timaeus* for a moment, it would be an understatement that historians of science have not always been very cheerful about its contents. Clagett, for instance, notes that “[e]ven the most apologetic Platonist will not stand behind Plato’s *Timaeus* as a work of high scientific caliber, although it is true that some of the ideas suggested therein were not without their influence on Aristotle and later authors”7. It remains to be seen, of course, whether the significance of the *Timaeus* for the history of science is, as Clagett here suggests, only extrinsic (viz. to be valued by its influence on later authors) and not also intrinsic (viz. to be valued in the text itself qua ancient scientific product). Plutarch, for one, can certainly be counted among these later authors: he is, indeed, an intellectual heir of Plato’s science, for whom the *Timaeus* served as some kind of a scientific manifesto and a methodological guide to be followed when contemplating the natural world [see 4.3.2.]. From Clagett’s perspective, though, this is not exactly a cause for celebration.

In fact, the problem remains, if it does not become even worse in the case of Plutarch, whose scientific project not only stems from that of Plato, but also shows a peculiar inclination to accept popular beliefs regarding nature without great concern for their reliability [see 4.1.1.]. It is not my goal in this preface to concentrate on Plutarch’s own Platonically inspired focus on higher causes (this will be fleshed out later, when dealing with his dualistic view on causality [see 4.1.2.]) but to take a step downwards on the causal ladder and shed a few preliminary thoughts on the scientific value of his natural problems and their attempt to formulate plausible physical explanations for often rather peculiar natural phenomena. This question is particularly relevant in light of the physical aetiologies Plutarch provides in *Quaestiones naturales*, or in Greek: Αἰτίαι φυσικαί [see 1.1.6.].

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Indeed, one may wonder how scientific the answer can be to a question as ‘Why are bees quicker to sting people who have just committed adultery?’, which is *Q.N.* 36 in the collection. Two basic reactions to such questions can be distinguished in modern scholarship: either eager justification of the actual occurrence of such a phenomenon in nature or outright dismissal of the problem as a bizarre, if not completely fictitious, invention. As it turns out, however, both reactions are often equally prejudiced in principle. To take the example of the bee-problem just quoted, Sandbach tried to save the phenomenon by noting that “[t]he belief that bees readily attack those who carry the odour of sexual intercourse may be true, since they appear to be provoked by other body odours.”

Flashar, by contrast, is less enthusiastic about this problem, which he claims to be “ausgesprochen gesucht und naturwissenschaftlich unbegründet”. Arguably, however, Sandbach is asking the wrong question while Flashar is using the wrong standard. When it comes to the scientific appeal of natural *mirabilia*, and of those recorded in Plutarch’s natural problems more specifically, it seems only fair – and certainly much more pertinent – to evaluate these problems according to contemporary (i.e. ancient) natural philosophical standards, as opposed to Flashar’s modern standards. Seeing that Plutarch makes a considerable attempt to explain these and similar phenomena in a plausible, physical way, it is only reasonable to ask why he takes such curiosas seriously. The main point of interest for us, however, should not be to find out whether Plutarch got it right or wrong (which is Sandbach’s main concern): there is no use to testing the bee-problem – by any means! – in order to assess Plutarch’s natural scientific inquisitiveness. What will mainly concern us in this study, then, is Plutarch’s actual intention and underlying motive to account for such problems in a serious way, and what constitutes proper scientific conduct for him.

There is no denying to the fact that some of these natural questions appear to be quite playful, but the modern reader may consider Plutarch’s answers to these questions even more perplexing. One might find that the physical explanations Plutarch provides contain several argumentative flaws. These can occasionally be attributed to the author’s intended and careless writing, but it would certainly be too easy to ascribe each aetiological flaw solely to Plutarch’s sloppy authorship. What is probably most alarming for the modern reader is Plutarch’s mainly theoretical approach to natural phenomena [see 4.3.2.]. The physical aetiologies are not infrequently based on what, for many modern readers, would seem to

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10 Cf., e.g., P. Donini, 2011, p. 20 (with n. 25) for the point that some errors in *De facie* could, in fact, already have been avoided in Plutarch’s time.
be unsound assumptions, if not absurd sophisms, about nature, many of which provoke the author’s argumentative ingenuity and rhetorical talent for vindicating the untenable. This rhetorical ingenuity and aetiological sophistication on Plutarch’s behalf has often been cast in a bad light by modern critics, but it should be noted that it is, in fact, an essential feature of many scientific writings from the Greco-Roman era and also of Plutarch’s scientific programme in particular (think, for instance, of Galen’s rhetorical debunking of rivals and predecessors). Especially the natural problems of Plutarch’s *Quaestiones convivales* have been severely criticised in this way\(^\text{11}\), but the same criticism applies to the problems collected in *Quaestiones naturales* just as well\(^\text{12}\).

The physical explanations Plutarch provides often seem to end up in idiosyncratic associations (e.g., *Q.N*. 16, 915F: the attribution of hot and cold properties to wheat and barley, respectively), absurd value patterns (e.g., *Q.N*. 17, 915F: the strength of hair is gender-related), tentative speculations (e.g., *Q.N*. 3, 912E: salt literally contains sharpness, δριμύτης, because of its taste), and plain contradictions (e.g., *Q.N*. 2, 912BC: rainwater is suggested to be flavourless, but a little further Plutarch

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\(^{12}\) The same is true, moreover, for the Ps.-Aristotelian *Problems*, after which Plutarch’s natural problems are modelled. In Antiquity, however, Aristotle’s *Problems* were praised as being ‘most delightful and filled with choice knowledge of all kinds’ (Gell., *NA* 19, 4: *lepidissimi et elegantiarum omnigenus referiti*). Of course, times have changed considerably since; as is well known, Aristotle’s causal model of scientific research did not survive the Middle Ages. It will not come as a surprise, therefore, that modern readers have not always been positive about the scientific value of Ps.-Aristotle’s *Problems*. For a compilation of modern disapproval (but sometimes also appreciation), see H. Flashar, 1962, pp. 377–378. A. Schopenhauer, 1976 (1851), pp. 478–479, for instance, was very pessimistic – how could he not be? – in his evaluation: “Wer wissen will, wie unglaublich weit die Unwissenheit der Alten in der Physik und Physiologie ging, lese die ‘Problematas’ Aristotelis: sie sind ein wahres specimen ignorantiae veterum. Zwar sind die Probleme meistens richtig und zum Teil fein aufgefaßt: aber die Lösungen sind größtenteils erbärmlich, weil er keine anderen Elemente der Erklärung kennt als nur immer τὸ θερμὸν καὶ ψυχρόν, τὸ ξηρὸν καὶ ὑγρὸν.” R. Mayhew, 2011a has recently produced a new English translation of Ps.-Aristotle’s *Problems*, and the papers collected in B. Centrone, 2011 and R. Mayhew 2015a also mark a renewed scholarly interest in this peculiar branch of scientific literature. For its reception in the Middle Ages, see esp. P. De Leemans and M. Goyens, 2006.
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asserts that it nevertheless contains a sweet constituent; Q.N. 3, 912DE: salt can cause both an increase and a reduction in bulk). Furthermore, the aetiologies are at some points infested with non sequitur inferences, because Plutarch seems to too easily accept what he hypothesises to be true (e.g., Q.N. 18, 916B: the fact that the cephalopod has no body armature and is composed entirely out of soft flesh is not necessarily a cogent reason for it also being more sensitive to cold and disturbance in the sea). One may wonder, however, how fair such an evaluation of Plutarch’s science really is, since many of these theories were commonly accepted by ancient natural philosophers.

Bearing in mind the passage from Plato’s Phaedo, a first – somewhat introductory – point of interest for us will be whether Plutarch’s Quaestiones naturales is perhaps the work of a young author, that is a youthful lapse, representative of Plutarch’s juvenile enthusiasm for things natural. This is not a futile question, let alone an easy one to settle. In order to illustrate this, a link can be drawn with Plutarch’s works on animal psychology (De sollertia animalium, Bruta animalia ratione uti, De esu carnium [see 1.1.1.]). Many scholars have assumed the hand of a young author in these writings, mainly for reasons of their ostensibly playful and juvenile contents and rhetorical style. Such a biographical reading, traditionally based on a text’s style and contents, is generally considered somewhat trite today, though13. Indeed, one may object that the link between zoology and ethics, as is present in these writings (on animal psychology), was not without precedent in ancient literature, and that the philosophical (esp. anti-Stoic and Pythagorean) overtones present therein can just as well point at a more mature authorship14. Of course, Quaestiones naturales

13 Pace, e.g., F. Krauss, 1912, pp. 80–83 and H. Cherniss and W.C. Helmbold, 1957, pp. 314, 490, 537. K. Ziegler, 1951, col. 732 remains hesitant when he says that Plutarch’s works on animal psychology are “der rhetorischen Jugendperiode entweder noch zugehörig oder ihr doch nicht fernstehend”. The belief that a highly rhetorical and literary discourse can only be ascribed to an author’s youthful character, whereas a simple, unadorned style is indicative of a more settled and mature authorship is generally rejected today. Cf. C. Pelling, 2011, p. 211, n. 14 (with further references), who objects to “the crude interference that declamatory style is a mark of immaturity”. The same point was made regarding the date of De sollertia animalium by J. Bouffartigue, 2012, p. xxi. Cf. De soll. an. 959C: καὶ γὰρ ἐκεῖνος [sc. Plutarch?] ἐδοξέ μοι τὸ ῥητορικὸν ἐγεῖραι διὰ χρόνου, χαριζόμενος καὶ συνεαρίζων τοῖς μειρακίοις. Cf. also T. Schmitz, 2014, pp. 32–33.

14 For the anti-Stoic tendencies in these works, see D. Babut, 1969, pp. 61ff., who assigns them “[à] l’époque de sa pleine maturité”. Cf. also J. Bouffartigue, 2012, pp. xx–xxi. For their Pythagorean (and Orphic) tendencies, see D. Tsekourakis, 1986 (who, however, adheres to the youth theory on p. 127, n. 3). For the natural philosophical value of Plutarch’s writings on animal psychology more generally, see R. French, 1994, pp. 178–184 (esp. p. 182 for their Academic leanings) and S.T. Newmyer, 2006 and 2014. Moreover, for the anti-Epicurean tendencies in De amore prolis, see G. Roskam, 2011a, pp. 200–201.
does not belong to the category of Plutarch’s writings on animal psychology, but if one considers the rhetorical dynamics and often peculiar contents of the problems collected there, the situation is worth considering more closely.

2. Date and chronology of Quaestiones naturales: a ‘life’s work’?

As stated, a first hurdle that cannot simply be avoided in this study – and that should best be cleared early on – is that of the date and chronology of *Quaestiones naturales*. Most scholars agree that this collection does not belong among Plutarch’s early works but should be dated to a much later period of his literary career. There are no points of reference in the text to conclusively date the collection, though. The precise *floruit* of Laetus (presumably the Platonic philosopher Ofellius Laetus, quoted in *Q.N*. 2, 911F and 6, 913E), remains uncertain, and the same is true for Dionysius (ὁ ὑδραγωγός, quoted in *Q.N*. 9, 914B) [see 4.2.1.1., nn. 114–115]. It is generally accepted that the collection was composed more or less contemporaneously with *Quaestiones convivales*, around 100–110 AD\(^\text{15}\) (a theory that was first formulated by Sandbach)\(^\text{16}\), but this date is, in my opinion, uncertain for *Quaestiones naturales*\(^\text{17}\). Scholars have

\(^\text{15}\) For the late date of *Quaestiones convivales*, see K. Ziegler, 1951, cols. 713 and 888: “mindestens ins 1. Jahrhundert, und zwar eher an sein Ende als an seinen Anfang”. C.P. Jones, 1966a, pp. 72–73 dates *Quaestiones convivales* after 99 and before 116 AD. Cf. also F. Fuhrmann, 1972, p. xxvi (“les Propos de Table ont été écrits probablement au cours de la 2\textsuperscript{e} décennie du II\textsuperscript{e} siècle, et […] ils représentent une des dernières œuvres de Plutarque”) and J. Sirinelli, 2000, p. 370 (“entre 107 et 115 et plus vraisemblablement entre 107 et 110”) and p. 380 (“Il [sc. Plutarque] touche ou vient de toucher à la soixantaine.”).

\(^\text{16}\) F.H. Sandbach, 1965, p. 138. According to G.W.M. Harrison, 2000b, pp. 242–243 (cf. also 2000a, p. 197) both collections were composed more or less simultaneously, and, indeed, “[t]he *Quaestiones* in general are written in the second half of Plutarck’s career”. L. Senzasono, 2006, pp. 46–48 situates *Quaestiones naturales* at the end of the first decennium of the second century, a little earlier than *Quaestiones convivales* and probably after the *Vitae* (p. 25, n. 36; on the contemporaneous composition of *Quaestiones convivales* and the *Vitae*, see, however, C. Pelling, 2011, pp. 207–208). Problematic in Senzasono’s argument is the idea that the unadorned style of *Quaestiones naturales* [see 1.2.3.] would imply a late date, while the same late date is also presupposed for the literary vivacity of *Quaestiones convivales* and the *Vitae*, i.e. writings that are highly embellished from a stylistic perspective. According to F. Fuhrmann, 1964, pp. 19, 22 and 77, *Quaestiones naturales* was composed after 100 AD, because it contains only one literary image (viz. in *Q.N*. 29, 919B: “Les météores éclatent comme des bulles”), but this is not the only case of imagery, as we will see later [1.2.3.], and, even so, this stylistic argument is not really convincing (see n. 13; it is certainly outmoded, see already F. Krauss, 1912 and J. Kowalski, 1918).

\(^\text{17}\) In fact, only a small number of Plutarch’s works allow for determining an absolute date. A study that cannot remain unmentioned here is C.P. Jones, 1966a (but for a critical
made great efforts in dating some of the sympotic discussions recorded in *Quaestiones convivales* by basing their argument on the historical contexts and the prosopography of the attending symposiasts.\(^\text{18}\) It remains to be seen, though, whether in those cases where a precise date can be deduced (assuming that we can at least accept a certain aspect of historicity for *Quaestiones convivales* [see 2.3.1.]) the same date should necessarily be accepted for the parallel passages in our collection. For example, the specification ἐν γε τῷ παρόντι κτλ. (‘at least in the present discussion’) in *Quaest. conv.* 664D is probably an implicit allusion to the parallel account about the generative property of ‘lightning water’ in *Q.N.* 4, 912F–913A (I will discuss this parallel later [see 3.1.4.]), but the sympotic discussion at issue cannot be precisely dated, since it is set at a random dinner in Elis and is hosted by the otherwise unknown Agemachus. My point is, however, that even if we had been able to date this sympotic discussion precisely, this would not necessarily have implied that the passage from *Quaestiones naturales* is contemporaneous with the one from *Quaestiones convivales*, since an earlier or later composition is at least equally plausible. This is actually true for each and every parallel between the two works (and these are numerous: cf., e.g., *Q.N.* 1, 911CF and *Quaest. conv.* 627AD; *Q.N.* 3, 912F and *Quaest. conv.* 685D etc. [see 2.2.3.]). Therefore, the contemporaneous composition of *Quaestiones naturales* and *Quaestiones convivales* is not a given fact. I am, in any case, inclined to be open-minded in this matter.\(^\text{19}\)

It is important to draw a clear distinction between the date of a text’s publication and its period of composition. This is not irrelevant, especially if one considers that some scholars argue in favour of a posthumous publication of *Quaestiones naturales*\(^\text{20}\) (I will come back to the issue of


\(^\text{19}\) Only in a few exceptional cases one can attempt to reconstruct the approximate chronological order of the text based on specific clusters of parallel passages in the *corpus Plutarcheiun*. However, this attempt will still remain conjectural. This is the case, most notably, with *Q.N.* 19 (on the octopus’ metachrosis): see F.H. Sandbach, 1965, p. 137 and M. Meeusen, 2012a, pp. 250–252. It is perhaps best in such cases not to claim that Plutarch worked on several works at the same time, since this is at the risk of coming to the absurd conclusion that Plutarch wrote his entire oeuvre all at once. Indeed, Plutarch’s use and reuse of personal notes (ὑπομνήματα) at different occasions offers a plausible way out [see 2.1.2.].

\(^\text{20}\) See F. Fuhrmann, 1964, p. 19: “Il est évident que ces ébauches [dont il est malaisé de déterminer le but exact aux yeux de leur auteur] n’ont pas été publiées par Plutarque, mais après sa mort par les membres de sa famille, ses amis ou familiers.
Whereas nothing is known about the date of publication of *Quaestiones naturales*, we do have some indications of its period of composition. I am inclined to accept that Plutarch may very well have worked on his natural problems over several periods throughout his life, perhaps from his years as an Athenian student onwards, adding something new or omitting (or at least reorganising) older material from time to time. These editorial interventions in the text probably involved the addition of new (sets of) problems and new answers to older problems. This is more or less the idea behind Harrison’s theory of a long and intermittent composition of *Quaestiones naturales*. The central point of Harrison’s...
theory is that the collection was probably not put together in one and the same breath but at several distinct moments:

“like someone who solves cross word or jigsaw puzzles over a number of days, Plutarch picked up and put down and came back to a series of questions that had begun to excite his curiosity [...]. While engaged on other projects, as he had further thoughts, Plutarch made additions to each of the quaestiones just as trains may add on cars at various stops but always in a determined sequence.”

The possibility of smaller or larger chronological intervals, during which Plutarch let the material sink in for a while in order to revisit it afterwards, is very difficult, if not impossible, to determine within the text. It is not unlikely that the thematic clusters of problems that are found throughout the collection hint at such an intermittent composition (see the scheme in the introduction to the commentary), but, even then, it is a hopeless task to prove exactly where and when Plutarch put his pen down or picked it up again. On the assumption that such thematic clustering implies

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22 G.W.M. Harrison, 2000b, p. 240. A similar notion of intermittent composition was entertained for Quaestiones Platonicae by H. Cherniss, 1976, pp. 4–5 (cf. J. Opsomer, 1994a, pp. 4–5): “The ten ζητήματα may not all have been written at one time and for a single work. It is at least as likely that at some time Plutarch put together ten separate notes on Platonic passages that he had written at different times and had found no suitable occasion to incorporate into his other compositions. If this is so, any indication of the relative chronology of one of the ten would not necessarily be pertinent to that of the others.” Similarly, for the intermittent composition of Plutarch’s Apophthegmata Laconica, see F. Fuhrmann, 1988, p. 135.

23 See, e.g., the transition between Q.N. 23–24, and more specifically the ghost-reference in the opening phrase in Q.N. 24, 917F: Ἡ διὰ τὴν εἰρημένην αἰτίαν; (see the commentary ad loc. for further detail). Cf. also G.W.M. Harrison, 2000b, p. 241.

24 According to G.W.M. Harrison, 2000b, p. 242 (with a synopsis in 2000a, pp. 197–198) there is a substantial chronological rupture between the composition of Q.N. 1–18 and 19–31, but the stylistic arguments he adduces (viz. the use of the present tense and the incorporation of literary quotations) are not very convincing, in my opinion. Harrison bases his theory on the chronology put forward by F.H. Sandbach, 1965, pp. 136–137. Sandbach does not, however, postulate a chronological rupture between Q.N. 1–18 and 19–31 as such, but focuses only on the chronology of Q.N. 19 and its parallel passages [see the scheme in 2.1.2.]. Considering the thematic clustering of problems on fishing and sea animals in Q.N. 13, 17–19 and the parallel passages – presumably based on the same or similar hypomnematic material – in a relatively small section of De sollertia animalium (viz. 976E–977A, 978EF, 979B), it seems rather unlikely that there is a major chronological rupture in composition between Q.N. 18 and 19. The inclusion of the cluster of problems
synchronous composition, it is not impossible that the problems in each of these clusters were composed more or less contemporaneously. After all, the solution to one problem may trigger the formulation of a new one that is closely related to it. But it is just as likely that some problems were added later on to these clusters, or that the clustering itself is perhaps the result of an editorial intervention. There is no need to go into the details of this theory; it is simply the general idea behind the unspecifiable chronology of Quaestiones naturales that matters here.

The idea that Plutarch perhaps worked on his natural problems from his early years as an Athenian student onwards can be corroborated by the fact that, at several points in the discussions described in Quaestiones convivales, Plutarch stages his own literary alter ego as a young symposiast and interlocutor. The narrated time (erzählte Zeit, temps de l’histoire) of Quaestiones convivales goes back to the time when Plutarch was an Athenian student under the tutorship of Ammonius, with whom he joins in discussion on several occasions. This is the case in the first two talks of Book three (Quaest. conv. 645D–649F), wherein two natural problems are discussed (concerning the natural properties of flower garlands and ivy) and also in Book nine, which is set at the festival of the Muses that probably took place at Ammonius’ private Academy in Athens. Ammonius there (in Book nine) appears on the scene several times, and as the titles of the lost talks indicate (especially talks ten through twelve), some of the discussions originally dealt with particular natural problems (concerning solar and lunar eclipses, the body’s permanent state of flux and the number of the stars respectively). Notably, Ammonius is also an interlocutor in the discussion held in De E, where Plutarch again appears as his young student (the topic of the body being in flux is treated in De E 392AE). Jones has dated these talks in Quaestiones convivales and in De E to around 66–67 AD (when Nero was visiting Greece: De E 385B), pointing out that Plutarch counts himself among the νέοι (Quaest. conv. 649A, 646A, cf. also De E 391E) and that his brother Lamprias (who is also present in De E) is still a παῖς (Quaest. conv. 747B). If there is any historicity to


26 C.P. Jones, 1966b, pp. 206–207 (in my opinion, S.-T. Teodorsson, 1989, pp. 289–290 has no convincing argument against Jones’ early date; and for Book nine he argues that “[t] is quite possible that considerable parts of the contents are student reminiscences of Plutarch”: id., 1996, p. 299). Talk three of Book eight (Quaest. conv. 720C–722F: ‘Why
these passages [see 2.3.1.], this would imply that Plutarch was engaged in solving natural problems – and other kinds of problems just as well – from a relatively early age up until his more settled years as a mature philosopher. Thus, he had a strong grasp of the genre of (natural) problems by the time he started writing *Quaestiones convivales* (which he did at the behest of Sossius Senecio, cf. *Quaest. conv. 612E*: ἤθης τε δεῖν ἡμᾶς κτλ.). So he probably already had some material on hand, and had probably already composed some or most parts of *Quaestiones naturales* by that time.

In conclusion, if it is true that Plutarch worked on his collection of *Quaestiones naturales* during several stadia of his life, there may very well have been an increase and overlap in productivity in the period that he composed *Quaestiones convivales*, hence their mutual influence. This is no reason, however, to restrict the chronology to that period only (nor to take *Quaestiones naturales* as a set of preparatory drafts for the composition of *Quaestiones convivales* [see 2.3.2.]). If we bear in mind Harrison’s theory of intermittent composition, it is not unlikely that Plutarch’s *Quaestiones naturales* (and his other collections of *quaestiones* just as well) were perhaps a ‘life’s work’ in a chronological sense, that is, a lifelong project, representative of his relentless interest in the natural world around him. In that case, it is only likely that Plutarch sporadically made additions and adjustments to the collection after reading something noteworthy or after a discussion with his colleagues. The bottom line is that there are no certainties about the exact date and chronology of *Quaestiones naturales*, but everything seems to indicate that Plutarch started discussing, and presumably also composing, natural problems from a relatively early age onwards up to his more settled years as a mature philosopher.

What we learn from this, is that we cannot effectively vindicate the value of Plutarch’s *Quaestiones naturales* as an ancient scientific product on the mere and most uncertain basis of the text’s chronology. After all, it may still seem to serve a juvenile, pseudo-scientific, if not unscientific purpose. Let us, therefore, return to our initial problem.

\[\text{is the night more sonorous than the day?}\] should probably be dated later, supposedly in 81 AD, because at that occasion Ammonius participates in the discussion with his (presumably) adult son (cf. S.-T. Teodorsson, 1996, p. 181). The difference in date is not necessarily complicated by the fact that Plutarch notes that Ammonius is in office as Athenian στρατηγός both in *Quaest. conv. 720C* (Book eight, talk three) and in *Quaest. conv. 736D* (Book nine), because Ammonius held this office three times throughout his life. To complete the list: Ammonius is also an interlocutor in *De defectu oraculorum* (which Jones dates “in the 70’s or early 80’s”), and he is also mentioned in *De ad. et am. 70E* and *Them. 32, 6*. For further reading on Ammonius, see K. Ziegler, 1951, cols. 651–653, P. Donini, 1986b and J. Opsomer, 2009 (esp. his conclusion at p. 177 for Ammonius’ interest in Peripatetic science).
3. The value of Plutarch’s natural problems

If introductory companions to Plutarch’s life and work or to ancient Greek literature and science more generally do not simply gloss over the Chaeronean’s natural scientific achievements, they are not always very constructive in their value judgements. The general approach of such studies is often underpinned by a certain feeling of astonishment that an author who is mainly known as a biographer and a moralist ventured to take a few humble steps in the field of natural science. Especially the humble character of Plutarch’s science is underlined, in such cases, by depicting it as an often absurd, if not completely insignificant specimen of ancient thinking, or at least as the work of an amateur: that is, a trivial pursuit of inferior knowledge.

If a cursory light is shed on Quaestiones naturales (the work is mostly ignored, though), this often results in discrediting its scientific appeal. The collection’s content is depicted as obscure, trivial, and only marginally scientific at best. This view is typical especially of 19th and early 20th century scholarship (but traces can still be found in more recent literature).

27 R.H. Barrow, 1967, p. 117, for instance, notes in passing that “[t]here are scientific works like the Natural Questions, or On the face on the moon. […] But after making acquaintance with some of the better dialogues or essays a reader must not expect too much from some of those that remain unnoticed here. […] They all contain much of interest, but Plutarch should not be judged by them.” Neither Quaestiones naturales nor Quaestiones convivales are mentioned among Plutarch’s natural philosophical writings by G.E. Karamanolis, 2010. Moreover, A. and M. Croiset, 1899, p. 511 (with n. 1) seem to underestimate the general literary value of several of Plutarch’s scientific writings: “Mais ces traités [sc. écrits relatifs aux sciences naturelles] n’ont pas un rapport assez direct à l’histoire littéraire, pour qu’il soit à propos de les étudier ici.”

28 Similarly, regarding the scientific value of the natural problems in Quaestiones convivales, see, e.g., R. Flacelière, J. Irigoïn, J. Sirinelli and A. Philippson, 1987, p. lxxxiii: “Il faut reconnaître que beaucoup de ces questions nous paraissent aujourd’hui futilites, quelquefois absurdes, et que les explications proposées sont souvent peu convaincantes. […] La curiosité de Plutarque, extraordinairement vaste, avait un goût marqué pour l’insolite et le paradoxal, et les arguments d’Aristote, qu’il cite si fréquemment, peuvent aujourd’hui faire sourire. Quandoque bonus dormitat … Plutarchus.” Regarding De facie and Quaestiones naturales, G. Guidorizzi, 2000, p. 559 speaks (without further specification) of Plutarch’s “interesse […] in un certo senso ‘amatoriale’ […] per la scienza” (for Plutarch’s ostensible dilettantism in Quaestiones naturales, see also V. Ramón Palerm, 2005, p. 398). According to P. Levi, 1985, p. 477, “[i]t would be a mistake to value Plutarch only for his Questions and Table Talks and his infinite fund of gossip.” Cf. also p. 479: “Among the stranger themes that attracted Plutarch now and then – relics, I suppose, of sophistic playfulness about science – the Man in the moon [sic] (De Facie in Orbe Lunae) gives the most pleasure.” A.M. Battegazzore, 1992, p. 32 even connects the lack of specialisation in Plutarch’s science with his ‘humanism’ (cf. also M. Vamvouri Ruffy, 2012, p. 75).
Croiset, for instance, resentfully considered the collection “un ouvrage sans valeur”\textsuperscript{29}, which aggravates Doehner’s label of “quisquilias”\textsuperscript{30}, trifles, unworthy of Plutarch’s authorship [see 1.2.1.]. Typical in this regard is also Huit’s remark:

“On éprouve quelque surprise à voir nommer dans une étude sur la philosophie de la nature le célèbre historien de Chéronée, plus connu évidemment comme biographe que comme physicien. Mais ouvrons celui de ses ouvrages qui porte le titre de Causes naturelles. Il contient la réponse (en général, il faut l’avouer, aussi peu scientifique que possible) à trente-neuf questions, les unes assez curieuses […] les autres singulières […] d’autres enfin absurdes […]”\textsuperscript{31}

To claim that it really was Plutarch’s goal to be as unscientific as possible in this “compilation des plus médiocres” and that its bizarre content is necessarily an indication of its lack of proper science is not the most unbiased position to take. To give another example, Emerson also underlines the curious character, rather than scientific merit, of Plutarch’s natural problems:

“Except as historical curiosities, little can be said in behalf of the scientific value of the Opinions of the Philosophers, the Questions and the Symposiacs. They are, for the most part, very crude opinions; many of them so puerile that one would believe that Plutarch in his haste adopted the notes of his younger auditors, some of them jocosely misreporting the dogma of the professor, who laid them aside as memoranda for future revision, which he never gave, and they were posthumously published.”\textsuperscript{32}

In what follows, Emerson adds – on the positive side – that there are some occasional “hints of superior science”\textemdash these are “statements that are predictions of facts established in modern science” that can be culled (to use his wording) from Plutarch’s texts (he mentions “[t]he explanation of the rainbow, of the floods of the Nile, and of the remora”), but in general, Plutarch’s “Natural History is that of a lover and poet, and not

\textsuperscript{29} A. and M. Croiset, 1899, p. 511, n. 1.

\textsuperscript{30} T. Doehner, 1858, p. 14.

\textsuperscript{31} C. Huit, 1901, pp. 479–480 (my italics). One may find it odd, moreover, that Huit considers De E 386E (regarding the Delian problem) an actual introduction to Quaestiones naturales.

\textsuperscript{32} R.W. Emerson, 1891, pp. 309–310 (part of the account also quoted by F. Klotz and K. Oikonomopoulou, 2011, p. 31). For a more recent evaluation of Quaestiones convivales as treating “questioni minime e marginali”, see A.M. Scarcella, 1998, p. 133.
of a physicist”. The message is clear: Plutarch’s natural problems are strange and not all that valuable in themselves, even if they contain some exceptional glints of scientific ingenuity. These exceptional glints are valuable in light of certain achievements in modern science, which they are even believed to predict, but the rest remains obscure and should be bracketed, if only to save the author’s reputation. There are good reasons to discard the underlying logic of this ambiguous compliment.

Most glaringly, it goes without saying, that modern scientists are no longer concerned with the problems raised in *Quaestiones naturales*, or that they would at least frown at Plutarch’s solutions. Take, for example, Q.N. 10, where Plutarch deals with the usefulness of adding salt (seawater) or baked gypsum to wine. He gives two alternative explanations: 1) the heat of these substances is an aid against the chilling of the wine, and 2) their earthy constituents help against unpleasant odours, putrefaction, or turbidity in the wine. A modern explanation of the chemical reactions that occur in this process is provided by Sandbach in his commentary to the passage:

“Sea-water is perhaps no longer used in Greek wine-making. It would slightly increase acidity, since chlorine ions, produced by hydrolysis of sodium chloride, decrease the pH value. This increased acidity might improve the wine by inhibiting the growth of micro-organisms that cause cloudiness and instability. The use of gypsum, baked or unbaked, which is still practiced in some places, has the same good effect by a different means: added to the unfermented juice, the gypsum (calcium sulphate, hydrated when unbaked) reacts with potassium hydrogen tartrate contained in the juice and stalks to produce calcium tartrate, potassium sulphate, and tartaric acid: the last, being soluble in alcohol, is not precipitated (unlike the insoluble tartrate), but remains in the wine and increases its acidity. Calcium sulphate also has clarifying properties, since it causes colloidal suspended matter to settle out. Plutarch therefore correctly states the effects of adding sea-water and gypsum in wine-making, although he had no means of knowing how they are produced.”

Presumably, Sandbach had the best of intentions by providing such information, but the conclusion he draws is rather partial. Of course, Plutarch did not know, or more precisely, “had no means of knowing” these effects the way modern scientists do. Today sulphites are added to the wine, because we know, so to say, that they eliminate unwanted bacteria and yeasts in the wine, and that they slow down the oxidation process, thus extending the wine’s shelf life and increasing its tolerance

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for changing temperatures. But the very existence of bacteria was
unknown in Antiquity, and Plutarch did not have Mendeleev’s periodic
table at his disposal to explain such chemical reactions in, what for
Sandbach would probably be, a more accurate way. Nor was he privy
to an outlook of the physical world as a man like Lavoisier or, for
that matter, any radical atomist was – Plato’s geometric atomism not
included.

The same conclusion can be drawn for Q.N. 4, where Plutarch examines
why rainwater that is accompanied by thunder and lightning is said
to be more fertilising for the growth of seeds. This is considered a
proved fact today, but, for obvious reasons, no explanation in Plutarch’s
tripartite aetiology comes close to a modern chemical explanation of
this phenomenon. I am told that lightning electrifies moist air in the
atmosphere so that nitric acid (HNO₃) is formed, which stimulates
the growth of plants (it is used today primarily to manufacture fertilisers). The
electric currents of lightning flashes trigger a reaction between atmospheric
nitrogen dioxide (NO₂) in the presence of water vapour (H₂O). Perhaps
the following chemical equation can make things clearer: 3 NO₂ + H₂O →
2 HNO₃ + NO. This is what Sandbach (and probably also many modern
scientists with him) would consider to be the “true reason”⁴. Plutarch,
however, explains this phenomenon by referring to 1) the admixture of
air and breath to the rain, 2) the rainwater’s concocted nature and 3) the
chilling effect of spring rains. Strictly speaking, these explanations must
be false, then.

Several other such examples could be added, but this is not the right
place to deal with each and every one of them. After all, one may probably
doubt about the scientific character of many other natural phenomena
that Plutarch tries to explain, but which are less likely to be considered
proven fact today. What are we to make, for instance, of the natural
phenomenon at issue in Q.N. 32, where Plutarch wonders why the palm
tree alone among all trees rises against a weight imposed upon it? In what
sense exactly does the palm rise against an imposed weight? Is it even
plausible that this phenomenon really occurs in nature? Apparently, this
last question – relating to matters of empirical verification – did not really
matter for Plutarch to address the phenomenon in the same aetiological
way as he has been doing all along. As we will see later on, he had good
epistemological motives for doing so [see 4.1.1. and 4.3.2.]. Laying bare
these methodological dynamics will make Plutarch’s scientific project
more comprehensible to the modern reader.

contains nitric acid, formed by the passage of electric currents through the air in the
presence of water: the nitrogen is a rapid stimulant of plant growth.” Cf. also S.-T.
Teodorsson, 1990a, p. 50.
It still remains to be seen what we actually mean by ‘science’, then, and how the present study aims to contribute to its history. The fact that the majority of Plutarch’s natural problems are, in many ways, obsolete, worn-out, and truly ancient, explains why they are generally abandoned by modern physicists today. This does not imply, though, that they are un-scientific in principle. After all, if these ancient beliefs are to be deemed unscientific myths, they are subject to scientific inquiry for much the same reasons as those which lead to scientific knowledge today. If they are to be considered representative of genuine science, on the other hand, we see that ancient science contains a large amount of convictions that are, in many ways, incommensurable with today’s perception of it. How to resolve this tension?

35 One of the exceptions would be “die auch heute noch ungelöste Aporie von dem Verschwinden des Salzes beim Durchgang des Meerwassers durch die Pflanzen”, as reported in Q.N. 5, 913C (H. Diels, 1905, p. 312). Plutarch explains that the pores, on account of their narrowness, filter the earthy and large particles of the salt, but “diese Tatsache ist, wie die moderne Forschung festgestellt hat, in dieser allgemeinen Fassung irrig” (p. 314). Cf. also C.F. Schnitzer, 1860, p. 2709, n. 1: “Daß zum Theil die Stellung der Fragen, noch mehr aber ihre Lösung dem jetzigen Stande der Wissenschaft nicht entspricht, wird der Leser begreiflich finden; indes ist es, abgesehen von dem historischen Interesse das diese Mittheilungen aus der Physik der Alten haben, doch bemerkenswerth wie nahe manche der gegebenen oder versuchten Erklärungen an die richtige hinstreifen.”

36 More universal scientific features would include the fact that Plutarch’s natural science originates from a genuine wonder for the ‘natural spectacle’ and pursues a serious and detailed physical explanation for specific natural phenomena. To this end, Plutarch employs a scientific procedure that takes into account the intellectual tradition but, at the same time, aims to advance traditional theories by looking for innovative viewpoints [see 4.2.]. He also employs a standardised set of scientific terminologies to describe the physical processes that occur in nature in a more or less uniform way, and provides explanations that receive the necessary circumspection and prudence from a logical and epistemological perspective [see 4.3.].

37 In comparison to modern scientific practice, Plutarch’s approach might seem to be too theoretical (there is no interest for personal observation or experimentation) and inexact (it estimates relative qualities rather than measuring absolute quantities). Modern science, by contrast, formulates its claims in terms of universal laws and preferably in a mathematical fashion. It underpins its claims with repeatable experimentation, has a strong link with technological application and often involves an ‘unnatural’ manipulation of nature itself (e.g., in laboratories). It also claims to hold to ‘objectivity’, and – most notably – it is generally considered the counterpart of any religiously inspired discourse that is based on any ‘subjective’ acceptance of dogma or certain belief systems. Plutarch, however, also incorporates mythological and poetical material into his physical aetiologies, and his general outlook on the world is based on a dualistic view on causality, according to which natural phenomena are subjugated to a higher, intelligible cause and divine principle [see 4.1.]. These features are clearly incommensurable with modern science. Cf. also D.C. Lindberg, 1992, pp. 1–2 and T. Barton, 1994b, p. xii.
Lack of appreciation of the scientific appeal of Plutarch’s natural problems mainly arose – and, in many cases, continues to arise – from a basic unfamiliarity not only with the ancient scientific paradigm to which they adhere (viz. as furnished by Ps.-Aristotle’s Problems and its causal model of scientific inquiry) and from an inferior understanding of Plutarch’s more general natural philosophical project (viz. as inspired by Plato’s Timaeus), but also, and often primarily so, from an unfounded belief in the teleological nature of the history of scientific thought. Such a bias, which is representative of more traditional studies in the history of science, is characterised by the acceptance of a progressive and evolutionary development of scientific knowledge, where it is assumed that scientific truth becomes gradually more unveiled over time. This model draws a linear, but inherently distorted, picture of the development of science that is principally unhistorical from the very outset. Only those ancient theories that were considered relevant for contemporary scientific research or were proven to be valid by modern scientists were included in the historical framework under the label of genuine science (as is the case in Emerson’s notion of Plutarch’s “predictions” above)\(^38\). This approach is obviously biased by modern prejudice, which sees the results attained by contemporary science as the culmination of ages of continuous research and scientific progress. In this approach, the category of preconceived scientific ‘correctness’ serves as a historical measure in the evaluation of any scientific theory, without acknowledging that the category in itself is not necessarily a universal or transcultural given (see further). The great ancient Greeks were, thus, presented as having made breath-taking and even ‘miraculous’ advances in the field of science, for which they should be held in honour, but in the long run their discoveries remain rather immature\(^39\).

In this regard, Barton speaks of a ‘genetic history’ of science, according to which the teleological approach entails some kind of a historical eugenics of scientific ideas, where their individuality in the succession of

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\(^{38}\) Exemplary is the remark in R. Flacelière, J. Irigoin, J. Sirinelli and A. Philippon, 1987, p. lxxxi: “[I]l faut bien avouer que les ouvrages ou les passages isolés où Plutarque traite de physique sont généralement décevants, sans doute parce que cette science a fait […] de tels progrès que beaucoup de théories antiques […] nous paraissent aujourd’hui irrémédiablement périmées.”

\(^{39}\) Cf., e.g., W.H.S. Jones, 1931, p. xxii: “The hypotheses of early Greek thought are mere guesses, brilliant guesses no doubt, but related to the facts of experience only in the most casual way.” Cf. also, e.g., P. Raingeard, 1935, p. viii: “Ensuite le De facie nous est un témoin précieux de l’état de la Science vers la fin du premier siècle. Si certaines ignorances nous font sourire […], nous éprouvons par contre quelque stupeur à découvrir l’antiquité de théories relativement modernes à qui il ne manqua pour figurer plus tôt parmi les acquisitions de l’esprit humain que de triompher des opinions régnantes.”
particular world systems is neglected. It goes without saying that such
an approach was bound to remain restrictive, resulting in a fragmentation,
decontextualisation and, eventually, isolation of specific scientific theories
by stripping them from the underlying world view that gave birth to them
in the first place (think of Emerson’s *culling* of the “hints of superior sci-
ence” from Plutarch’s text). As an alternative to this historical model (that
is commonly referred to as ‘whiggish’ history), contemporary history of
science takes a more relativistic and contextual stance. Notably, in Anti-
quity there was no term for denoting what we today call ‘natural science’
(perhaps the notion of ‘natural history’, *φυσικὴ ἱστορία*, understood as the
universal study of things natural, comes closest). The concept of *ἐπιστήμη*,
that is, the Latin *scientia*, primarily refers to ‘scientific knowledge’ (as
opposed to *δόξα*, *τέχνη*, *ἄνοια* etc.), and it does not refer to the actual prag-
amics behind scientific thinking as such (which is not per se an infallible
practice, of course, science being a human enterprise). In accordance
with Plutarch’s Platonism, for instance, no natural science could amount
to the level of genuine ‘science’ in the philosophical-epistemic sense

40 T. Barton, 1994b, pp. xiv–xvi. Barton’s introduction in 1994b, pp. x–xxiii is relevant
for the points made in this prologue. See also her more extensive (and at some points more

41 For further objections to the methods of ‘whig’ history, see A. Cunningham, 1988,
p. 387 and T. Barton, 1994b, pp. xiv–xvi. The term was coined by H. Butterfield, 1931.

42 E.g., for a description of Plutarch’s natural science, as what stands in relation to
ancient theories that explain natural phenomena, cf. J. Boulogne, 2008, p. 734 (who uses
this description in demarcating the scientific digressions in the *Vitae* [see 2.1.3.]). Compare
also, for instance, the definition of ancient science by P.J. van der Eijk, 1997, p. 77, n. 1:
“As for ‘scientific’, this is used […] in a non-sophisticated, non-evaluative manner to refer
to any serious attempt at studying and understanding the nature of things (or part thereof),
and – as far as texts are concerned – to any verbal expression intended to communicate
about this with an audience […]”. Of course I do not wish to claim that the texts in question
meet the criteria of what would count as ‘scientific’ in any modern sense of the word; and I
am aware that there is no clear distinction between ‘science’ and ‘philosophy’ in Antiquity
[…].” Similarly, regarding early Greek and Chinese scientific practices G.E.R. Lloyd, 1999,
p. 314 (also partly in 1996, p. 227) states that: “the history of early investigations in ancient
civilizations is the history of the acquisition of a potential for cognitive development, not
just with respect to what was believed, but also with regard to the ways of getting to believe
it. Where Greece and China are concerned, to go no further afield, history shows both that
the ways of acquiring that potential differed and indeed that the potential acquired did. Not
that, in either case, the new potential corresponded closely to the expectations that might
be generated by naive retrospection from the eventual emergence of modern science.”
In this sense, Plutarch’s natural scientific programme (including his natural problems)
certainly testifies to a certain scientific potential, how essentially different (or not) it may
be from that of modern science.

43 Cf. LSJ, s.v. ii, 2.
of the word\textsuperscript{44}, as it always involves a basic uncertainty towards sensible objects and the kind of knowledge that they yield [see 4.3.2.]. In this sense, \textit{scientia} was not practiced but rather strived after in Antiquity.

As is well known, moreover, in Antiquity the study of natural phenomena was generally integrated in a wider philosophical programme, so that it was not considered an independent branch of research that was conducted for its own sake (as is the case rather with modern science). Also the ancient concept of ‘physiology’ (\textit{φύσιολογία}), which is often used interchangeably with ‘natural history’, cannot be separated from a wider natural philosophical framework, so that it is not an independent science. There is no denying to the fact that there is a certain convenience in speaking about ‘physiology’, ‘natural history’ or ‘natural philosophy’, for the simple fact that the ancient thinkers themselves would have given it that name, and this is basically what it \textit{is} from an ancient perspective. This does not necessarily imply, however, that the term ‘science’ is wrong, or that ancient natural philosophy cannot be considered ‘scientific’. In any case, the fact that ancient Greek and Roman thinkers did not, or could not, call their natural philosophy to be ‘scientific’ does not imply that it is, therefore, fundamentally unscientific.

For many centuries ‘a science’ in English denoted anything that was taught in the schools (such as grammar, logic, theology etc.). The word ‘scientist’ came into use not long before the middle of the nineteenth century, when the concept of ‘science’ began to take on its modern meaning. In this period, the ‘science of natural philosophy’ began to predominate the other ‘sciences’ and eventually acquired the monopoly of the term ‘science’. The practitioners of that ‘science’ were called ‘scientists’ (and it is in this sense that ‘science’ existed before ‘scientists’), but by that time, the ‘science’ itself had become very different from that of the ancients\textsuperscript{45}. So, to reformulate the problem: why do we even care about ‘science’ in Plutarch’s natural philosophical writings in the first place or in his \textit{Quaestiones naturales} more specifically? Why not simply use his own terminology, thus avoiding the risk of any terminological ambiguity or of an anachronistic misconception of what Plutarch himself believed he was doing?

I believe that the connotations connected with such a reticence are undesirable. Not calling Plutarch’s natural philosophy ‘scientific’ might raise the false impression 1) that it is only of pseudo-scientific or para-scientific significance\textsuperscript{46}, or 2) that it has no scientific value at all, or

\textsuperscript{44} Cf. G.E.R. Lloyd, 1968, p. 92.


\textsuperscript{46} According to G. Nuzzo, 1991, p. 410 (repeated in G. D’Ippolito and G. Nuzzo, 2012, p. 58), \textit{Quaestiones naturales} is nothing more than “un singolare ‘zibaldone’ di curiosità
in any case less so in comparison to superior (viz. modern) scientific achievements. This is exactly what I intend to avoid. 1) As regards the first point, Barton has correctly pointed out that “[p]seudoscience is a label that implies a deliberate falsehood on the part of its practitioners”\(^47\), but this does not apply to Plutarch, who himself took his natural philosophical programme seriously. In any case, there is no reason to assume that he did not (see n. 3 above). Even in the ‘spoudogelasic’ context of Plutarch’s symposia we see that serious efforts are made to provide plausible explanations for natural problems. This is at least true within the conceptual scope of ancient physical theory. 2) Therefore, in light of the second point, it is only reasonable to evaluate Plutarch’s natural problems according to the parameters of ancient rather than modern scientific thinking, even if there are certain points of convergence\(^48\). In the end, there are also obvious divergences between the two, meaning that it is best not to assess them in comparative terms (see nn. 36–37 above). It goes without saying, therefore, that when reference is made to ancient ‘science’ in the present study, this must be understood in light of Plutarch’s theories and concepts about the natural world and those of his philosophical role models (unless otherwise suggested). As such, we accept that the distinction in terminology between actor’s terms (‘natural philosophy’) and analytical terms (‘natural science’) is a matter of formality rather than semantics\(^49\).

 pseudo- o parascientifiche, che non un’ opera di impianto organico ed unitario, tanto che qualche studioso fu da ciò indotto a negarne la paternità plutarchea” (I will come back later to Plutarch’s authorship of Quaestiones naturales [see 1.2.1.]). The same label of pseudo-science was used by R. Flacelière, J. Irigoin, J. Sirinelli and A. Philippon, 1987, p. lxiii and by R. Caballero Sanchez, 1992, p. 91. Z. Abramowiczówna, 1962, p. 82 speaks of the “halbwissenschaftliche Atmosphäre” in Quaestiones convivales.

\(^{47}\) T. Barton, 1994a, p. 15 (see also pp. 16–17 on the inappropriate normativity of the concept of ‘pseudo-science’).

\(^{48}\) E.g., according to A.M. Battegazzore, 1992, p. 48, Plutarch’s attitude in scientific matters presupposes “un modello di ricerca vicino a quello di un ‘sapiente rinascimentale’ dilettante di tutto e di tutto curioso”. However, linking Plutarch with a Renaissance model of science probably produces more contextual problems than it solves. See also L. Inglese, 1996, p. 151 (regarding Battegazzore’s remark): “Questo non può comportare, nel giudizio su Plutarco, l’adozione di parametri ‘moderni’ di scientificità della ricerca.”

\(^{49}\) There is much scholarly debate on this topic. A. Cunningham, 1988 prefers using the actor’s terms (such as ‘natural philosophy’) over analytic terms and categories (such as ‘science’) in order to avoid the anti-historical fallacy of imposing present thinking upon the past (pp. 378–385). W.H. Stahl, 1962, pp. 3–14 also doubts the appropriateness of calling Roman science ‘scientific’ (or even ‘Roman’, for that matter). Some scholars would, indeed, prefer the actor’s terminology (see also, e.g., T. Barton, 1994b, pp. xiv, xx, xxiii, n. 13), whereas others do not (see, e.g., G.E.R. Lloyd, 1983, pp. 210–217, who vindicates the appellation of ‘science’ for ancient Greek medicine and biology). Most
Indeed, Plutarch’s subordination of physics to prime philosophy is not an adequate reason to reject it as unscientific. This is significant if for no other reason than that there is a discussion among Plutarchists about the scientificity of the Chaeronean’s natural philosophical works, although it is not very widespread, let alone profound. The ill-considered 19th and early 20th century claims quoted above are clear examples of this. A more recent account is found in Donini’s 1994 contribution on Plutarch and the Platonic renaissance in Lo spazio letterario della Grecia antica, where the author – in a footnote – tends to adhere to this traditional view. Donini concludes: “A mio giudizio, non c’è nessuna opera di Plutarco che meriti di essere definita semplicemente ‘scientifica’.” This is intended as a frontal attack on Ziegler’s designation of the category of Plutarch’s “scritti di fisica e di scienza naturale” (“naturwissenschaftliche Schriften” [see 1.1.1.]), but Donini in his protest employs the concept of ‘science’ mainly – and problematically so – from a modern perspective (in this regard, his approach does not seem to be all that different from Ziegler’s). Donini demarcates Plutarch’s ‘science’ as the attempt to explain natural phenomena solely in terms of natural causes. In my opinion, he thus too strictly divorces the Chaeronean’s physical theory from its philosophical implications. It is absolutely true that Plutarch distinguishes between the physical causes of natural phenomena and their higher, divine motivation, but the distinction is not strict, since he subordinates the former category to the latter [see 4.1.2.]. As such, both categories are not, and should not be, disconnected. As Donini himself has shown in his pioneering work on Plutarch’s view on causality, both modes of explanation actually go hand in hand (viz. physical and meta-physical). In the account at hand, then, Donini’s restriction of “scienza” to natural causality alone might be problematic – in opposition to other, more nuanced accounts of his on the topic (see n. 54 below). In what follows, Donini successively sheds his

notably, according to E. Grant, 2007, p. 319, the difference between actor’s terms and analytic terms is superficial, because actor’s terms are “mere names, or labels”. However, the application of “mere” is perhaps somewhat too dismissive (as E. Lao argues in her 2010 BMCR review of Grant’s work). It should be noted, moreover, that a broadening of the semantic field of ‘science’ may risk the concept becoming meaningless, because it enables the modern historian to identify the category of ‘science’, or whatever it was called in the past, as always having existed. The correct procedure is probably somewhere in between, viz. in applying the concept of ‘science’ in historical contexts only with the necessary conceptual circumspection and qualifications (which is my aim in this study).

50 P. Donini, 1994a, p. 48, n. 32 (the quotations that follow are drawn from this passage).

51 Compare the use of inverted comma’s by I. Gallo, 1998, p. 3527 (= 1999, p. 64) in his description of Quaestiones naturales as “una raccolta di quesiti ‘scientifici’ con le relative risposte”.
light on Plutarch’s *De facie*, *De primo frigido* and *Quaestiones naturales*. As to the *De facie*, first of all, he seems to overdo things when he writes that the work:

“contiene certamente molta buona scienza astronomica e d’altro genere, ma non è affatto un trattato scientifico: discute un importante problema filosofico, al quale è totalmente subordinato il contenuto che i moderni [!] chiamano scientifico.”

Further on, however, Donini is more at ease to underline the conceptual unity of *De facie*, pointing out that the closing myth:

“vuolo ridurre, non distruggere il credito delle scienze; è lí precisamente ad dire che il discorso delle scienze fisiche e matematiche, se non è teologicamente fondato, sarà sempre inadeguato.”

When Donini, in what follows, claims that Plutarch in *De primo frigido* – which he interprets “a rovescio dalla maggior parte dei moderni” – actually discusses an epistemological problem, he restricts the entire treatise to the ἐποχή statement in the very last paragraph (in combination with the eighth [see 4.3.2.1.]). This seems to entirely overlook Plutarch’s introductory discussion about whether heat and cold are principles of their own and also the lengthy doxography that follows on the principle of cold. However, I see no reason to assume that both types of discourse (viz. physical and epistemological) were seen as completely distinct by Plutarch himself.

With respect to *Quaestiones naturales*, lastly, Donini remains pensive in making his judgements:

“A conti fatti, ho l’impressione che resti disponibile per questa classe [sc. scritti di fisica e di scienza naturale] forse (forse) la sola raccolta delle *Cause naturali*, che potrebbe essere soltanto un insieme di appunti da elaborare in altre opere di tutt’altro genere.”

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53 Other scholars have interpreted the ancient scientific character of *De primo frigido* in terms of its allegedly playful and theoretical approach. See O. Longo, 1992, p. 229: “*Lusus* di letterato? Vera e propria discussione scientifica? Un po’ dell’uno e un po’ dell’altro, e in ogni caso una fisica fatta a tavolino e sui libri, assai più che mettendo il naso fuori dalla finestra.”
Donini’s hesitation is based on a conviction that the preceding objections (regarding the dualistic and epistemological aspects of Plutarch’s science) do not, at first, seem to apply to this collection. However, as already noted at the beginning of the prologue, one of the goals of this study will be to show that the reverse is in fact true, by demonstrating that *Quaestiones naturales* is fundamentally in line, despite its main focus on physical causality, with Plutarch’s general scientific project, including its dualistic and epistemological backdrop [see 4.1.–3.].

Another point that needs to be stressed in evaluating the scientificity of Plutarch natural philosophical writings is the contingent nature of Plutarch’s truth claims. For instance, regarding the claim in *Quaest. conv.* 641C that there is empirical proof of the fact that a magnet rubbed with garlic loses its attractive powers, Lehoux rightly points out that:

“Any given way of framing questions of truth and falsity about the natural world is bound up in networks of relations and requires a background of standards, concepts, methods, tools, and objects against which truth and falsity can be judged.”

As such, the ultimate scientific truth – whatever this may be – will only be a circumstantial aspect for properly evaluating the scientific character of Plutarch’s theories about the natural world. This boils down to the idea that science is – at least in a historical sense – not all that concerned with ‘truth’ per se.
In order to clarify this, an analogy can be drawn with the revolutionary finds physicists working at CERN near Geneva, home of the Large Hadron Collider, have done in the last years. Besides from further specifying our knowledge about the basic structure of our universe (think of the discovery of the Higgs-boson or ‘God particle’), these scientists have recently found clues that there may be a deeper kind of physics, a dark sector that we have not been able to reach yet, and that may even be unreachable to us. It is this deeper kind of physics that, so it is often metaphorically described, shines through the cracks of the Standard Model, which up to now served – and continues to serve – as the basic fundament of particle physics. It is not so much that the Standard Model would be wrong, of course, but one may still wonder how scientific it really is, considering the fundamental and thus far unanswered problems these discoveries raise about the existence of the universe (not to mention the potential existence of other universes). What is relevant for the history of science, then, is not so much whether any truth comes out of smashing atoms together, but what kind of truth people make of it, how it is reached, and why such research is conducted to begin with. What the study at hand aims to do, then, is to put the kind of natural problems Plutarch sought to explain in a contextual perspective, to find out what ultimate goals he had in mind in doing so, and which conceptual limits he faced. To this end, we can learn a great deal from the kind of answers he provides and from the general methodology and theoretical-conceptual framework that he employs.

Apart from revealing these intellectual mechanisms that underlie a person’s or a society’s world view, contemporary studies of ancient scientific literature often also bring into consideration how specific socio-cultural factors play along in the authorisation, validation and dissemination of scientific knowledge in particular societal contexts.

A study of these features is relevant to us, as it provides a valuable perspective on how the natural world was perceived of in Antiquity and how this view became entrenched in a real-life community and

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57 For the concept of ‘world view’ as a discursive category in ancient scientific texts, cf. H. Flashar, 1962 (e.g., pp. 318 and 331), who uses its German equivalent (Weltbild) to designate the general explanatory scheme that can be deduced from the problems and explanations recorded in Ps.-Aristotle’s Problems. Cf. also, e.g., the title in D. Lehoux, 2012.

58 This socio-cultural contextualisation is, in fact, very central to contemporary studies in the field of the history of science: cf., e.g., T.E. Rihll, 1999, p. iv. Cf. also J.T. Vallance, 1990, pp. 716–717: “First, it is now generally agreed that we should not – indeed, cannot – separate ancient science from its philosophical background. Ethical, metaphysical, and scientific motivations must be understood side by side. Second, some idea of the social and cultural context in which scientific ideas developed is now widely seen as essential to any generally useful appreciation.”
civilisation – the Greco-Roman civilisation, which had a seminal influence on our own. This has reflective value for our contemporary outlook on the natural world and for the place that is allotted to it in our own modern society, where science has become omnipresent.

Of course, world views can shift over time, and can be different from person to person or from society to society. Therefore, it seems useful to study scientific concepts and theories on their own terms and in view of the social and intellectual contexts from which they originate. This is especially to be understood as a caveat to the teleological approach as described above (i.e. the ‘genetic history’). It does not imply that a diachronic approach should be avoided at all costs. This approach has its use, for instance, when examining the scientific or philosophical importance of a person’s outlook on the world in view of a scientific or philosophical historiography\(^{59}\). From this perspective, the value of Plutarch’s *Quaestiones naturales* for the history of science is reflected in the work’s reception and transmission by later authors and can be examined by studying how they picked it up and adopted it to suit their specific authorial needs. In what follows, I will not discuss this in full detail but will only highlight a number of cases that were of importance for the text’s later history.

The 11\(^{th}\) century Byzantine polymath and ‘Chief of Philosophers’ Michael Psellus is especially worth mentioning here, as he incorporated and adapted several of Plutarch’s natural problems – both from *Quaestiones naturales* and *convivales* – in his encyclopaedic *De omnifaria doctrina* (two additional chapters, viz. *Q.N.* 40–41, derive from this work: see the commentary *ad loc.*). In global, Psellus’ work nicely illustrates how Pagan knowledge, thus including Plutarch’s natural problems, was hesitantly accepted by the author and which intellectual restrictions were imposed on it by the religious (c.q. Christian-Orthodox) establishment of his time. Notably, Psellus did not label his excerpts as being drawn from Plutarch (thus, perhaps, implicitly rejecting the Chaeronean’s scientific authority?). On the contrary, it seems that Psellus, through Plutarch’s lens, looked at, and approved of, Aristotle’s scientific authority by quoting the *Problems* via Plutarch. The merit of Psellus’ *De omnifaria doctrina* (or at least the work’s first redaction) lies in its attempt to create a genuine Christian cosmology, which is firmly based on ancient authority. Importantly, Psellus addressed his work to the Byzantine emperor, God’s regent on earth. The relationship between such encyclopaedic knowledge and

\(^{59}\) E.g., for the influence of Plutarch’s *De facie* on Kepler, see H. Görgemanns, 1970, pp. 157–161. Kepler found the text so important that he edited it with his own Latin translation and astronomical commentary. In what follows, I repeat some of the insights gained in previous publications on the reception of Plutarch’s natural problems (for a short overview, see M. Meeusen, forthcoming b).
imperial power is not of disinterest, as it provides a better understanding of what highly placed Byzantine figures were expected to know, or, at the very least, to have read\textsuperscript{60}.

A similar case of religious adoption of Plutarch’s natural problems is found in the *Diálogos Familiares de la Agricultura Cristiana* (1589) by the Spanish humanist and Jesuit Juan de Pineda. In this work, the author relies heavily on Plutarch’s authority (amongst that of other Pagan authors) and, at points, incorporates several passages from *Quaestiones naturales* in his Christian discourse. As Ramón Palerm has shown, the author of this work “through an ongoing confrontation of the Christian and Pagan worlds, struggles to win for the Christian cause the content of the ancient traditions, to which he gives an obvious moral sense in a didactic-doctrinal tone”\textsuperscript{61}. As such, the cases of Psellus and de Pineda show how later, Christian authors – both in the Orthodox East and in the Reforming West (de Pineda speaks with little respect of the Spanish Inquisition) – used Plutarch’s natural problems as a basis for their own inquiries, not so much by addressing them anew, but by exploiting them as a *Fundgrube* of exotic materials to be assimilated into the context of a new (c.q. Christian) world system.

The situation is different in other cases, though. The scholarly interest in Plutarch’s *Quaestiones naturales* in the Humanist era is reflected mainly in the production of new editions and Latin translations (mostly in collective volumes with other works from the *corpus Plutarchei*). The 1542 Latin translation by the Dutch Protestant scholar, professor and doctor Gybertus Longolius deserves specific mention here. In this Latin version, the Aldine problems (*Q.N.* 1–31) are followed by eight additional problems (*Q.N.* 32–39) that were extracted, so Longolius indicates in a marginal note, from a Milanese manuscript. Unfortunately, this manuscript has been lost ever since, and the Greek text is still missing today. Considering the numerous parallels in Plutarch’s other works and the same general style and method of explanation, it is beyond doubt that these additional problems are authentic (see the commentary *ad loc.*\textsuperscript{62}).

Another Latin translation of the Aldine problems was produced by Pedro Juan Núñez in 1554. Interestingly, this translation served as an appendix to Theodor Gaza’s version of Ps.-Aristotle’s and Ps.-Alexander’s

\begin{footnotes}
\item[60] For further discussion of the reception of Plutarch’s natural problems in Psellus’ *De omnifaria doctrina*, see M. Meeusen, 2012b (*Quaestiones naturales*) and forthcoming c (*Quaestiones convivales*).
\item[61] V. Ramón Palerm, 2011, p. 621 (see pp. 629–632 for an analysis of the *Quaestiones naturales* material).
\end{footnotes}
Problems. This is important, as it seems to imply that Plutarch was seen as continuous with a unified and long-lasting scientific tradition that was initiated by Aristotle and his Peripatetic successors (see also Psellus’ case above). The practice of solving Aristotelian natural problems lasted well until the Middle Ages and the Renaissance, when new collections of problems made their appearance and older ones were constantly copied, translated and commented upon [see 1.1.3., n. 78]. As such, Plutarch’s *Quaestiones naturales* were seen as a genuine contribution to the Aristotelian study and understanding of natural phenomena and to the development of a scientific method for approaching them. One of the goals of this study will be to nuance this view, and to show that Plutarch’s natural problems are not the product of the author’s Aristotelian aspirations – despite the fact that history clearly suggests otherwise [see 1.1.2. and 4.3.4.3.].

In conclusion, the study at hand takes inspiration from the plea often heard in recent scholarship to study ancient scientific texts impartial to considerations of quality or centrality. Rihll, for instance, has argued:

“The primary sources for any period consist not just of the well-known and well-ploughed texts: there are a lot of grossly underutilized ‘scientific’ texts too, which cast a different and sometimes brilliant light on ancient society. This incidental information is also important to the historian of science, for the society in which the science was created shapes the science itself, and neither can be properly understood in isolation from the other.”

By taking these contextual facets into consideration, the study at hand can be seen as a contribution to broadening the traditional image of ancient science and, by implication, of the history of science in general. Even though we are dealing with a rather obscure, non-canonical source in the case of *Quaestiones naturales*, this should not complicate our efforts to

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63 The work was printed in 1554 in Valencia by Joan Mei from Flanders as *Problematum Aristotelis sectiones duae de quadraginta. Problematum Alexandri Aphrodisiei libri duo Theodoro Gaza interprete ad haec Eruditissima problema Plutarchi. Extant apud Borbonium bibliopolam. Valencie, Typis Ioannis Mey, Flandri. (Raya) 1554*. See A. Morales Ortiz, 1998 and 2000, p. 90. For further detail on the Latin translations of Plutarch’s *Moralia* more generally dating from the 13th to the 16th century, see F. Becchi, 2009.


65 I, thus, accept Rihll’s challenge (1999, p. xii): “there is a role and a need for ‘ordinary’ historians in the study of the history of Greek science, which is a land of opportunity for adventurous scholars.”
pull it from the margins of the *corpus Plutarcheum*\(^{66}\). In this light, Van der Stockt has recently claimed that “it are precisely the more ‘irrational’ and ‘absurd’ beliefs and practices that are most fascinating”\(^{67}\). His plea for a profound study of Plutarch’s *Quaestiones naturales* more in specific is worth quoting in full:

“[I]t may have become clear that Plutarch’s *Causes of natural phenomena* is in dire need of an interpretation that does justice to its peculiar nature. Provided that this research is conducted with philological tact as well as through a contextualising approach, the results are likely to shed light on the worldview of Plutarch as well as on the practice of authentic ancient ‘science’.”\(^{68}\)

The phrase “philological tact”, especially in conjunction with “a contextualising approach”, is well-put from a methodological perspective but may require some further specification, which the following section will provide.

4. Classical philology and the petrification of science

Historians of ancient science generally hold that there was a rapid decline of scientific creativity after its ‘Golden Age’\(^{69}\) in the Hellenistic era, an era when several scientific disciplines, such as medicine, biology, alchemy, mathematics, geography, astronomy and mechanics, flourished more than ever before or ever after (esp. the 3\(^{rd}\) and 2\(^{nd}\) centuries BC). The Imperial Era, by contrast, is presented as a period of consolidation and transmission of received knowledge. The *Zeitgeist* of this era finds its incarnation in the figure of Pliny the Elder, author of the encyclopaedic *Naturalis historia*. Traditional Plutarchists have not resisted this view of a scientific decline in Plutarch’s days, yet some nuancing is in place, at least in Plutarch’s case.

In light of the period in which Plutarch lived, someone like Sambursky favoured the idea of a “petrification of science” by arguing that:

“the first century A.D. marks the beginning of the work of compilers and interpreters which went on for more than four hundred years and

\(^{66}\) This idea is inspired by the new historicist perspective that ascribes historical value to each historical product. For problems of quality and canon in Greek literature, see T. Whitmarsh, 2004, pp. 8–10.


\(^{68}\) L. Van der Stockt, 2011, p. 450.

\(^{69}\) For this designation, see, e.g., G. Sarton, 1970 and S. Sambursky, 1963, p. 204.
which is the mirror wherein we see a large part of ancient Greek science.”

Regarding the natural problems discussed in Plutarch’s *Quaestiones convivales*, Fuhrmann bade the reader, in a rather condescending fashion, to not be too hard on Plutarch, given that his time was afflicted with “un affaiblissement général de l’esprit scientifique”. Similar conclusions have been
reached for Pliny the Elder’s *Naturalis historia*. Yet, as Stahl rightly nuances, “Plutarch demonstrates greater aptitude for assimilating and reporting scientific information than Pliny, but he is no less credulous and uncritical of quaint and incongruous data.” In light of Plutarch’s allegedly derivative and compilatory authorship, Jeanneret even claimed that the Chaeronean (again in his *Quaestiones convivales*) could be categorised as an author who, just like Athenaeus or Macrobius, aimed for a variegated, though bloodless accumulation of knowledge, without any sense of critical evaluation. The lack of scientific creativity and ingenuity thus becomes connected with a faceless authorship that is characterised by the absence of any serious intellectual talent and ambition for personal creativity:

“What is often said of Plutarch is also true of the others: they are basically eclectic. They neither judge nor criticize, but rather put things on show […] The author melts into an anonymous collector and mediator; he lets the books, of which he is a mere interpreter, speak for themselves.”

The idea that Plutarch should be ranked among other late compilers and interpreters risks grossly oversimplifying the real accomplishments of his work. Throughout his scientific writings, to go no further afield, Plutarch unambiguously aims to formulate inventive and innovative explanations for the phenomena he studies [see 4.2.2.2.]. In fact, he often explicitly marks his own, personal views (e.g., via his literary alter ego in *Quaestiones convivales*), thus emphasising that he does not blindly rely on received knowledge. Of course, the aspect of Plutarch’s scientific innovativeness should be placed within the ancient scientific paradigm of his time: Plutarch was no scientific revolutionary. He did not leave the confines of the ‘normal science’ of his day. But even so, this did not stop him from contriving explanations that were certainly original within the scientific paradigm at that time.

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72 See V. Naas, 2011, pp. 61, and esp. 66–67.


Only since relatively recently, scholars have started to recognise that Plutarch’s scientific project, and his science of natural problems more in specific, is not just an impersonal echolalia of past authorities. But even so, most of the existing scholarship remains restricted to matters of source criticism. Of course, traditional *Quellenforschung* has great value for properly understanding the composition of a text on the basis of its specific sources and, more broadly, of the tradition in which it is anchored (this will prove a particularly useful approach in the commentary), but it also has a number of interpretive deficits. By largely restricting its scope to the analysis of the sources of a text, such an approach tends to downplay, isolate, and eventually even exclude the author from his own text. The author is, in fact, reduced – often in a highly speculative fashion – to the sources that he is claimed to rely on, while his personal adaptations of the tradition are generally ignored. If there is any place left for the author’s personal contributions, these are pushed to the margin of the text, if for no other reason than that scholars are embarrassed not to have found any matching *Quellen* for them.

On the other hand, even if Plutarch clearly pursues argumentative creativity and originality in his scientific writings, traditional authorities still play an important role in his arguments. As such, his innovativeness is perhaps not as ‘adventurous’ as modern critics may have expected.

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77 E.g., regarding the *Quellenforschung* tradition on Plutarch’s writings on animal psychology, see S.T. Newmyer, 1992, p. 41: “Scholars eager to detect the sources of Plutarch’s arguments have paid relatively little attention to the points which he makes or to how he defends his positions.” On Plutarch’s adaptation of his source-material in the *Vitae*, cf. also C. Pelling, 1980.

78 See, e.g., K. Giesen, 1901, p. 448 (with the quote from F. Leo, 1864). Such an approach would be sound if the text were simply a derivate of traditional sources, but things are obviously not always so simple.

79 See, e.g., R.H. Barrow, 1967, p. 74: “It is not too much to say that Plutarch had at his command Hellenic and Hellenistic thought and literature. His mind was not adventurous; it did not use its accumulated knowledge as a springboard to make a leap; it may have lacked imagination.” See also Barrow’s strong words on p. 77: “Plutarch was a teacher, not a constructive thinker; he created no new system. Few teachers do; they may have
Even still, to claim that his scientific programme is representative of, what Sambursky called, the “petrification of science in the period of commentators and scholastics” \(^{80}\) is a one-dimensional presentation of the facts, as this study will show [see 4.2.2.2.].

An alternative way to examine how Plutarch deals with received knowledge and how he constructs his own scientific authority is by studying his ‘authorial voice’ – understood as an analytical concept that has recently been introduced by scholars of ancient scientific and technical writing \(^{81}\). This ‘authorial voice’ serves as an important discursive category in the text that resonates, for instance, in the explicit evaluation of the theories of predecessors but is also situated at a structural level, viz. in the development and ranking of the different arguments, and can also be seen in his method of quoting and adapting the available source material \(^{82}\). The concept of the author’s voice proves to be a worthy analytical tool in examining the discursive construction (and deconstruction) of scientific authority and, more particularly, in detecting the author’s scientific creativity that manifests itself in this process. The question of scientific authority is highly relevant in examining Plutarch’s ________

at the back of their minds guiding principles, but they do not readily build theoretical constructions but rather make practical application. They are bound to be opportunists, availing themselves of the openings furnished by their pupils, responding to questions in answers adapted to the intelligence and experience of the questioner and then abandoned till some later time.” This is in keeping with what he says earlier about *Quaestiones convivales* (p. 27): “table talks are interesting for their incidental matter, seldom for the original question or its answer”. For the question of Plutarch’s originality in the field of ancient science, see also A.M. Battegazzore, 1992, p. 32 and pp. 35–36. Pace J. Sirinelli, 2000, p. 359: “Les explications qu’il nous donne sur la patine des statues des navarques lacédémoniens à Delphes [= De Pyth. or. 395A–396C; see 2.1.1.] sont un peu naïves et ses traits *Sur le froid primitif* et *Sur les causes physiques* sont des recueils d’opinions glanées au gré de ses lectures. Le résultat n’est pas plus brillant que les considérations qui jalonnent les *Propos de table*. Ce sont des ‘curiosités’ dont, avec ses convives, il cherche l’explication, et non des démarches scientifiques. En résumé, on peut difficilement présenter Plutarque comme un savant, même à l’aune de ce temps.” For further criticism of the general scholarly contempt of Plutarch’s originality in the field of philosophy, see J. Opsomer, 1994a, pp. 17–19 (with further references).


\(^{81}\) See the contributions in L. Taub and A. Doody, 2009 and M. Asper, 2013.

\(^{82}\) To employ the alternative terminology of the classical hermeneutical schema set out by W. Babilas, 1961, the ‘authorial will’ (*voluntas auctoris*) has to be taken into consideration at any point in the text. In light of the philological method employed by traditional *Quellenforschung*, Babilas has warned that traditional *materia* is only seldom simply copied by the author. It is not only commented on and criticised, but also often adapted according to the particular needs of the author. The reconciliation of the *materia* to the new context occurs at three distinct levels, viz. of content, arrangement and phrasing (*inventio, dispositio, elocutio*).
position towards the scientific tradition, and more precisely how he tries to inscribe himself within it (or opposes it). Also the use and avoidance of a self-referential ego and alternative personal forms are relevant to us, as they can tell us something about the underlying sociology of the text. In particular, the addresses to the reader can inform us about the envisaged knowledge transfer from author to reader (and, thus, the text’s intended reading). Analysing these discursive features in Plutarch’s Quaestiones naturales will yield a much richer interpretation of the text than has been offered thus far. Let us, therefore, take a closer look at the existing scholarship and how this study aims to contribute to it.

5. Status quaeestionis

Scholars have only relatively recently started to reappraise the actual appeal of Plutarch’s scientific writings. In 1976 Flacelière could still write that “‘Plutarque et la science de son temps’ est un sujet qui a été à peine effleuré jusqu’ici, et qui mériterait, à mon avis, des recherches approfondies”\(^84\). However, there has been considerable progress since that time. Scholarly attention mostly goes to the more literary and essayistic treatises like De facie, De primo frigido, Quaestiones convivales and Plutarch’s writings on animal psychology, whereas Quaestiones naturales often remains undiscussed\(^85\). It may well be the case that these other treatises offer a more efficient introduction into the author’s scientific thought than the one at issue here, but then again Quaestiones naturales originates from the same ‘genius’, and, if we may assume that the much praised unity of Plutarch’s works also applies to this work\(^86\), there are clear

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\(^{83}\) On Plutarch’s self-presentation in Quaestiones convivales, see F. Klotz, 2007 and J. König, 2011.

\(^{84}\) R. Flacelière, 1976, p. 195. Several editions and commentaries of Plutarch’s scientific writings had already appeared by that time, but no further study of these texts had been conducted – with the important exception of H. Görgemanns, 1970. For a general introduction into ‘Plutarcho e le scienze’, see R. Flacelière, J. Irigoin, J. Sirinelli and A. Philippon, 1987, pp. lxix–lxxxvii, J. Sirinelli, 2000, pp. 355–366 and the contributions in I. Gallo, 1992; see also recently M. Meeusen and L. Van der Stockt, 2015. Scholars have devoted much attention to the presence and tenets of several separate scientific disciplines and fields of technical knowledge throughout Plutarch’s works, such as medicine (e.g., J. Boulogne, 1996; M. Vamvouri Ruffy, 2012), astronomy (A. Pérez Jiménez, 1992), mathematics (R. Seide, 1981; M. Isnardi Parente, 1992), music (J.P.H.M. Smits, 1970) and linguistics (O. Göldi, 1920).

\(^{85}\) Characteristic of the general scholarly neglect of Quaestiones naturales is the fact that in the proceedings of the 1991 conference on “Plutarco e le scienze” (organised by the Italian section of the International Plutarch Society), there is only one reference to this work (in a footnote): see O. Longo, 1992, p. 230, n. 4. The same observation was made by L. Van der Stockt, 2011, p. 449.

indications that it is in several respects (including contents, method and composition) fundamentally in line with his other writings. In light of this understanding, Harrison even wrote – in a lyrical vein – that Plutarch’s problems “offer endless delight to the literary critic since they are so well written and so deeply infused with the warmth of Plutarch’s personality”. Regarding Quaestiones naturales, he asserts that they “offer a coherent and manageable collection for an investigation of Plutarch’s style of composition and literary techniques within all of the quaestiones”87. One of the goals of this study will be to prove Harrison right, while also showing that there is even more to the collection than matters of style, composition and literary technique alone.

The situation has improved for Quaestiones naturales over the past few years. We have several thematic studies which examine specific aspects of the collection in more detail, viz. specific textual problems88, its textual history89, the relationship between Plutarch and Aristotelian science90, Plutarch’s use of scientific terminology91, the collection’s literary value92 as well as its ‘encyclopaedic’ appeal93. A programmatic study of Quaestiones naturales with specific attention to the cluster analysis of parallel passages was conducted by Van der Stockt94 [see 2.1.2.]. Until recently, a systematic study of the collection, which includes both an analytical and a descriptive approach, remained a scholarly desideratum. The 2006 edition, with an Italian introduction, translation and commentary by Senzasono was intended to fill in this lacuna (in the Corpus Plutarchi Moralium series). Senzasono’s work offers a useful contribution especially as a scholarly instrument for consultation of the text, its translation and specific lemma’s, but the general approach in the introduction is somewhat disappointing in some regards95. Senzasono’s main focus is on the text and its translation, and this is certainly where the main value of his work rests. In his introduction, he is not, however, concerned with the actual place of the collection in its wider socio-cultural and intellectual-philosophical context, especially its educational goals. Senzasono does not

87 G.W.M. Harrison, 2000b, p. 237.
89 A. Morales Ortiz, 1999, M. Meeusen, 2012b and forthcoming a, b, c.
92 G.W.M. Harrison, 2000a and 2000b.
93 K. Oikonomopoulou, 2013a.
94 L. Van der Stockt, 2011. For a preliminary study of Plutarch’s science of natural problems more generally, see M. Meeusen, 2014 and 2015b.
95 See also the criticism by L. Van der Stockt, 2011, p. 449. The notes in Senzasono’s commentary are often very extensive, but they do not always clarify the actual logic behind Plutarch’s arguments and they are sometimes dizzyingly off track (moreover, for a scholarly instrument the “indici” at the end of the book are rather meagre).
discuss Plutarch’s dualistic view on causality, a remarkable interpretative inadvertence considering the collection’s main aetiological concern. In general, Senzasono fails to provide a coherent and comprehensive account of the text’s place among Plutarch’s other (natural scientific) writings, its social and intellectual *Sitz im Leben* and its scientific methodology.

The more dated, though still recommendable, 1965 Loeb edition by Sandbach is by no means adumbrated by this recently renewed scholarly interest in *Quaestiones naturales*. The relatively circumstantial introduction and clear notes have been a welcome source of inspiration for this study. Sandbach is obliged to Hubert’s 1960 Teubner edition for the collection of parallel passages, from which he admits to “have drawn heavily” in his own clarifying notes. For my part, I owe them both a serious debt of gratitude in this regard.

*Quaestiones naturales* has been translated into several modern languages, but nowhere do we find a comprehensive and monographic study of the collection as a whole, accompanied by a thorough lemmatic commentary. Therefore, the present study will attempt to restore this often marginalised and undervalued Plutarchan work by rehabilitating its significance to contemporary scholarship. This will be done in two ways. The first part of this study contains four chapters, which successively discuss 1) the collection’s relation to the Aristotelian genre and tradition of natural problems and its sub-literary and a-moralistic discourse, 2) its relationship with other works in the *corpus Plutarchei* (esp. *Quaestiones convivales*) and its alleged hypomnematic nature, 3) its educational and intellectual-philosophical value as a propaedeutic school text, and finally, 4) its aetiological design and scientific method. The first part will provide the preliminaries required for an informed reading and proper understanding of the text itself, which is presented in the form of a commentary in part two (see the introduction *ad loc.*).

6. **Note on translations and abbreviations**

Translations are borrowed from the Loeb Classical Library (with sporadic adaptations). Commonly used abbreviations are as follows.

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97 The collection has not yet been edited in the *Collection des Universités de France* (Budé) but will be soon by Filippomaria Pontani and myself.


99 In much the same way as J. Boulogne, 1992, p. 4683 tried to revalue *Quaestiones Romanae* by saving it from a classification among Plutarch’s “écrits secondaires, négligeables ou à jeter aux oubliettes”.
**General abbreviations**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>D.L.</td>
<td>Diogenes Laertius, <em>Vitae philosophorum</em>.</td>
</tr>
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</table>

**Plutarch’s works**

**Moralia**

<table>
<thead>
<tr>
<th>Work</th>
<th>Abbreviation</th>
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<tbody>
<tr>
<td><em>De libris educandis</em></td>
<td><em>De lib. educ.</em></td>
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<tr>
<td><em>De audiendis poetis</em> (Quomodo adolescens poetas audire debeat)</td>
<td><em>De aud. poet.</em></td>
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<tr>
<td><em>De audiendo</em> (De recta ratione audiendi)</td>
<td><em>De aud.</em></td>
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<tr>
<td><em>De adulator et amico</em> (Quomodo adulator ab amico internoscatur)</td>
<td><em>De ad. et am.</em></td>
</tr>
<tr>
<td><em>De profectibus in virtute</em> (Quomodo quis suos in virtute sentiat profectus)</td>
<td><em>De prof. in virt.</em></td>
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<tr>
<td><em>De capienda ex inimicis utilitate</em></td>
<td><em>De cap. ex inim.</em></td>
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<tr>
<td><em>De amicorum multitudo</em></td>
<td><em>De am. mult.</em></td>
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<tr>
<td><em>De fortuna</em></td>
<td><em>De fortuna</em></td>
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<tr>
<td><em>De virtute et vitio</em></td>
<td><em>De virt. et vit.</em></td>
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<tr>
<td><em>Consolatio ad Apollonium</em></td>
<td><em>Cons. ad Apoll.</em></td>
</tr>
<tr>
<td><em>De tuenda sanitate praecepta</em></td>
<td><em>De tuenda</em></td>
</tr>
<tr>
<td><em>Coniugalia praecepta</em></td>
<td><em>Coni. praec.</em></td>
</tr>
<tr>
<td><em>Septem sapientium convivium</em></td>
<td><em>Sept. sap. conv.</em></td>
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<tr>
<td><em>De superstitione</em></td>
<td><em>De sup.</em></td>
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<tr>
<td><em>Regum et imperatorum apophthegmata</em></td>
<td><em>Reg. et imp. apophth.</em></td>
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</tbody>
</table>
Apophthegmata Laconica – Instituta
Laconica – Lacaenarum apophthegmata
Mulierum virtutes
Quaestiones Romanae
Quaestiones Graecae
Parallela Graeca et Romana
De fortuna Romanorum
De Alexandri Magni fortuna aut virtute
Bellone an pace clariores fuerint Athenienses
(De gloria Atheniensium)
De Iside et Osiride
De E apud Delphos
De Pythiae oraculis
De defectu oraculorum
An virtus doceri possit
De virtute moralì
De cohibenda ira
De tranquillitate animi
De fraterno amore
De amore prolis
An vitiositas ad infelicitatem sufficiat
Animine an corporis affectiones sint peiores
De garrulitate
De curiositate
De cupiditate divitialum
De vitioso pudore
De invidia et odio
De se ipsum citra invidiam laudando (De laude ipsius)
De sera numinis vindicta
De fato
De genio Socratis (De Socratis daemonio)
De exilio
Consolatio ad uxorem
Quaestiones convivales
Amatorius
Amatoriae narrationes
Maxime cum principibus philosopho esse
dissererendum (Maxime cum principibus
philosophandum esse)
Ad principem ineruditum
An seni respublica gerenda sit
Praecepta gerendae reipublicae
De unius in republica dominatione, populari statu, et paucorum imperio
De vitando aere alieno
Decem oratorum vitae
Comparationis Aristophanis et Menandri epitome
De Herodoti malignitate
Placita philosophorum
Quaestiones naturales
De facie quae in orbe lunae apparat
De primo frigido
Aqua an ignis sit utilior
De sollertia animalium (Terrestriane an aquatilia animalia sint callidiora)
Gryllus (Bruta animalia ratione uti)
De esu carnium
Quaestiones Platonicae
De animae procreatione in Timaeo
De Stoicorum repugnantis
Stoicos absurdiora poetis dicere
De communibus notitiis adversus Stoicos
Non posse suaviter vivi secundum Epicurum
Adversus Colotem
De latenter vivendo (An recte dicendum sit latenter esse vivendum)
De vita et poesi Homeri
Pars an facultas animi sit vita passiva
De musica
Fragments
Lamprias catalogue

Vitae

Theseus
Romulus
Comparatio Thesei et Romuli
Lycurgus
Numa
Comparatio Lycurgi et Numae
Solon
Publicola
Comparatio Solonis et Publicolae
Themistocles
Camillus
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<th>Shortened Name</th>
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<td>Luc.</td>
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<td>Sull.</td>
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<td>Demetr.</td>
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<tr>
<td>Antonius</td>
<td>Ant.</td>
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<td>Comp. Demetr. et Ant.</td>
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<td>Abbreviation</td>
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<tr>
<td>Caius Gracchus</td>
<td>CG</td>
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<td>Comp. Ag., Cleom. et Gracch.</td>
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<td>Flam.</td>
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