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UNIVERSITÀ DI ROMA



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E-ISSN 2531-7288
ISSN 0394/9001



From Empirical Observations to Learned Curiosities: Alcmaeon's Theory of Goat Respiration

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MEDICINA NEI SECOLI

Journal of History of Medicine
and Medical Humanities

37/3 (2025) 119-142

Received: 07.02.2025

Accepted: 09.08.2025

DOI: 10.13133/2531-7288/3188

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ABSTRACT

This paper examines the transmission and transformation of a zoological theory attributed to Alcmaeon of Croton, who, according to Aristotle, claimed that goats breathe through their ears. Although Aristotle refuted this theory, it persisted for centuries, appearing in the works of Varro, Pliny the Elder, Hippolytus of Rome, and Aelian. Varro and Pliny identified the Hellenistic paradoxographer Archelaus of Chersonesus as their immediate source, while Pliny and Aelian also attributed the theory to herdsmen – and, in Aelian's case, to shepherds. Taking as a starting point Aristotle's account, which identifies Alcmaeon as the ultimate source of this theory, the paper analyses these later testimonies and their contexts, in order to illuminate the dynamic processes of knowledge transmission in antiquity. It argues that the survival of Alcmaeon's theory, despite its refutation, reflects both the resilience of peculiar ideas and the adaptability of ancient scholarly traditions, which integrated physiological theories into diverse epistemological frameworks.

Keywords: Aelian - Alcmaeon of Croton - Anatomy - Aristotle - Hippolytus of Rome - Pliny the Elder - Reception - Varro - Zoology

1. Introduction

If the information Aristotle gives us is accurate, Alcmaeon flourished in Croton at a time when Pythagoras was already advanced in age – that is, around the early 5th century BCE¹. His work *On Nature*, which was later mentioned by Galen and other authors, is lost, and everything we know about him relies on second-hand testimony – or more precisely, “testimony texts” – from subsequent writers². This evidence suggests that Alcmaeon focused primarily on physiological inquiries, much like other early thinkers from southern Italy, such as Hippo of Metapontum (or Croton) and Menestor of Sybaris³. However, the primary aim of this study is not to examine Alcmaeon’s contributions to early science and philosophy – at least, not directly. While several aspects of Alcmaeon’s physiological research will be discussed, the central focus of this article lies on unravelling a curious twist in the tradition relating to Alcmaeon – one that may also shed light on the mechanisms of knowledge transmission in antiquity. This approach aligns with my broader interest in early Greek thought, and particularly in tracing its transmission and reception down through the centuries in various philosophical, religious, and scholarly traditions, from antiquity to the early modern period. Turning to the main subject of this article, it appears that, at some point, a zoological claim about goat respiration attributed to Alcmaeon – one likely grounded in empirical observation – became intertwined with different scholarly traditions, which ultimately obscured its original attribution. Having been severed from its source, the claim continued to circulate under various attributions and was disseminated in later scholarly contexts. This case is particularly compelling not only due to the enduring influence of Alcmaeon’s ideas, but also for what it reveals about the dynamic processes through which ancient scholars engaged with Presocratic texts⁴.

The article is divided into two main sections. The first section explores Alcmaeon’s broader zoological and anatomical observations, in order to establish the necessary context for his theory of goat respiration, which is introduced toward the end of the section. This context is crucial for understanding the broader scope of Alcmaeon’s inquiries, as his theory is neither an isolated view nor likely one that is confined solely to animal physiology in the narrower sense. In the second section, the focus shifts to later testimonies about the same theory that are attributed to a different figure, namely a certain Archelaus. This intriguing congruence has so far received little attention in the scholarship. Yet, a thorough analysis reveals that it contains valuable insights into the transmission and reception of Alcmaeon’s teachings during the Hellenistic Period and the High Empire.

2. Alcmaeon’s Zoological Observations and the Theory of Goat Respiration

The primary sources for Alcmaeon’s physiological observations are Aristotle and, to a lesser extent, Theophrastus, supplemented by additional – likely indirect – testimonies

from the broader *Placita* tradition and other authors, such as Censorinus. Alcmaeon's inquiries into procreation provide a natural starting point for this study. There are several texts that attest to this aspect of his work, but let us begin with one that addresses the subject of sexual maturity. Here, Aristotle is our principal source⁵. In a discussion of human reproduction and development in the *History of Animals*, Aristotle notes (7/9.1, 581a 12–17)⁶ the belief that males begin producing sperm around the end of their second heptad (approximately fourteen years of age), which coincides with the onset of pubic hair growth⁷. In support of this claim, Aristotle mentions Alcmaeon's observation that plants flower when they are about to bear seed (καθάπερ καὶ τὰ φυτὰ τὰ μέλλοντα φέρειν τὸ σπέρμα ἀνθεῖ φησὶ πρῶτον Ἀλκμαίων ὁ Κροτωνιάτης)⁸. It is unclear from the Greek text whether Aristotle is attributing the general correlation to Alcmaeon or only the specific observation about plants⁹. Nonetheless, the various testimonies attributing to Alcmaeon theories of both animal and human procreation¹⁰ – many of which will be discussed in the following pages – coupled with the use of analogical reasoning in this passage (a method evident in other doctrines attributed to him, as will be shown below)¹¹, suggest that he may indeed have applied this framework not only to plants, but to other living beings as well¹².

While Aristotle's account does not make this evident, numerous other testimonies about Alcmaeon's interest in procreation reflect what appear to be precise – if not always accurately interpreted – observations of animal anatomy. On this point, it is not Aristotle but the *Placita* tradition and Censorinus that provide key evidence. For instance, the *Placita* tradition¹³ attributes to Alcmaeon theories on infertility in mules, linking male infertility to thin and cold semen (τὴν λεπτότητα τῆς ἄθρονης [...] καὶ ψυχρότητα)¹⁴ and female infertility to a womb that does not “gape” (ἀναχάσκειν). Today we know that mules are infertile due to differences in the number of chromosomes possessed by the parent species. However, the theories attributed to Alcmaeon in the *Placita* tradition align with his broader ideas about disease resulting from imbalances between heat and cold, as attested elsewhere in the tradition¹⁵, while offering hints that their origin lies in detailed physiological and anatomical observation¹⁶, apparently based on some form of examination of male semen and female reproductive anatomy. A similar situation arises in testimony given by Censorinus¹⁷. He attributes to Alcmaeon a counterargument to Hippo of Metapontum's claim that sperm originates from marrow¹⁸. According to this counterargument¹⁹, mating depletes marrow, fat, and flesh. Given the type of evidence that likely underlies such a claim, it is reasonable to assume that these conclusions were drawn from observations of animals killed or dissected immediately after mating²⁰. Of course, the available evidence does not allow us to determine whether Alcmaeon himself performed the dissections, or whether he relied on the empirical knowledge of shepherds or butchers to formulate the inference²¹. That said, and notwithstanding chronological discrepancies – possibly stemming from a confusion originating in Censorinus' sources²² – which make it un-

likely that Alcmaeon directly refuted Hippo²³, the argument itself nonetheless reflects detailed anatomical knowledge, whether gained first-hand or second-hand.

Other physiological theories attributed to Alcmaeon manifest a combination of empirical²⁴ observation and analogical reasoning, akin to the approach evident in the testimony concerning his views on sexual maturity. In his examination of the development of birds from eggs in the *Generation of Animals* (3.2, 752b 15–27)²⁵, Aristotle cites Alcmaeon’s belief – which accords with popular opinion (οἱ τε ἄνθρωποι οἴονται καὶ Ἀλκμαίων φησὶν ὁ Κροτωνιάτης)²⁶ – that the white of an egg nourishes the embryo, based on its resemblance to milk²⁷. This analogical reasoning, later noted by Michael of Ephesus in his commentary on the passage²⁸, reflects Alcmaeon’s comparative investigations into nourishment across species, specifically birds and mammals. With regard to sensory perception, another area of physiology he was interested in, Alcmaeon located its seat in the brain, as detailed by Theophrastus in *On Sense Perception* (25–26)²⁹. Alcmaeon posited that sensory organs connect to the brain through “passages” (πόροι), with disturbances in the brain disrupting perception. In this context, Chalcidius’s later testimony in his *Commentary on Plato’s Timaeus* (256.22–257.15)³⁰, which credits Alcmaeon with being the first person to have dissected an eyeball, is particularly relevant. According to Chalcidius, Alcmaeon identified “narrow channels” (*angustae semitae*) leading from the brain – the seat of the soul’s highest power – to the eye sockets, which transmit light via “natural breathing” (*spiritus naturalis*). While Chalcidius’s account is complex and lies beyond the scope of this discussion³¹, it highlights two key points: first, that Alcmaeon possessed a meaningful degree of anatomical experience, whether gained first-hand or second-hand, possibly involving animal rather than human dissection, although the latter cannot be entirely ruled out³²; second, that he attempted to develop a unifying theory of sensory function. The “channels” mentioned by Chalcidius, likely corresponding to Theophrastus’s “passages”, further illustrate the nature of Alcmaeon’s analogical reasoning, highlighting functional similarities among sensory organs, even though the exact nature of these similarities remains unclear.

The discussion of Alcmaeon’s views above helps us to contextualize the curious testimony about his theory of goat respiration in Aristotle’s *History of Animals*. In this text, Aristotle uses the parts of the human body as a framework for analyzing animal anatomy, including the head and ears³³. Against this backdrop, he briefly challenges Alcmaeon’s claim that goats breathe through their ears. The relevant passage reads as follows (1.11, 492a 13–15, ed. Balme)³⁴:

ἔστι δὲ κεφαλῆς μόριον, δι’ οὗ ἀκούει ἄπνουν τὸ οὖς· Ἀλκμαίων γὰρ οὐκ ἀληθῆ λέγει, φάμενος ἀναπνεῖν τὰς αἰγὰς κατὰ τὰ ὦτα.

The ear is a part of the head through which one hears, not an organ used for breathing. Alcmaeon is mistaken when he claims that goats breathe through their ears.

In light of our discussion of Alcmaeon’s ideas on sensory perception, this claim can potentially be connected to the “passages” mentioned by Theophrastus, which connect the brain of living beings to their sensory organs. It is possible that not only the channels linking the brain to the eye sockets contain air, as suggested by Chalcidius, who refers to “natural breathing”, but that all such channels, including those connected to the ears, do so as well. According to another passage from the same text by Theophrastus, Alcmaeon proposed that sound is perceived when it resonates within the ear cavity, facilitated by the presence of internal air (τὸν ἀέρα δ’ ἀντιχεῖν)³⁵. Thus, the air in the ears is of critical importance, at least in the process of hearing³⁶. Interestingly, both Hippolytus of Rome and Aelian later mention the same – or nearly the same – claim, though they do not attribute it to Alcmaeon. Writing in a Christian apologetic context, in which he sought to expose the practices of pseudo-diviners involving the unexpected deaths of various animals, Hippolytus (*Ref.* 4.31.1) describes it as a popular notion (cf. φασί), explaining that sealing a goat’s ears with wax prevents it from breathing and leads to its death. Aelian (*Nat. anim.* 1.53), in contrast, attributes the idea to reports from herdsmen and shepherds (ὡς οἱ νομευτικοὶ λόγοι καὶ ποιμενικοὶ φασιν), but offers no further explanation, simply describing it as a natural advantage that allows goats to breathe through their ears. Unlike other animals, which rely solely on their nostrils, Aelian suggests that goats can breathe through both their ears and their nostrils, a claim that is not supported by Hippolytus’ testimony. Aristotle’s position on this point is not made clear in the surviving passage, although the terminology and syntactical structures in Aristotle’s and Aelian’s texts exhibit certain similarities (Arist.: φάμενος ἀναπνεῖν τὰς αἴγας κατὰ τὰ ὄτια vs. Aelian: [ὡς οἱ νομευτικοὶ καὶ ποιμενικοὶ λόγοι] φασιν. ἀναπνεῖ γὰρ καὶ διὰ τῶν ὄτων καὶ διὰ τῶν μυκτῆρων)³⁷. Given the differing attributions and Aelian’s reference to the nostrils, which is not seen in Aristotle, direct dependence seems unlikely, and these parallels may instead point to a common original source. I will return to this point below.

In the early modern period, naturalists such as Gilbert White compared this claim, as recorded by Aristotle, with their own investigations based on the dissections of various animals – deer, in White’s case – in the course of which they observed the lacrimal puncta and interpreted them as potential auxiliary breathing passages³⁸. Similarly, some modern scholars have hypothesized that the belief attributed to Alcmaeon and the herdsmen and shepherds may have arisen from empirical observations, possibly of the Eustachian tubes³⁹. These tubes, which connect the middle ear to the nasopharynx, may have correspondingly been interpreted as alternative or auxiliary nostrils. However, we now understand that their real function is to equalize air pressure on both sides of the eardrum, which indirectly assists with proper hearing but has no relation to breathing. While this identification remains speculative – and despite the fact that Alcmaeon’s claim is incorrect from the standpoint of modern anatomy, as neither goats nor any other mammals can breathe through their Eustachian tubes or, indeed,

any structures in the head besides their nostrils and trachea – it aligns with the approach to zoological observation attributed to him. As previously noted, Alcmaeon’s conclusions seem to have been rooted in practical anatomical experience, gained either first-hand or through reports from individuals with specialized knowledge in animal husbandry or related fields and then combined with analogical reasoning. The fact that the theory concerns goats may increase the likelihood that practical experience played a role, as anatomical information about goats would have been easy to obtain, given their significant role in everyday life. An individual who was observing a cut-open goat’s skull and attempting to explain the function of the various cavities seen there, while simultaneously working toward a unifying theory of sensory perception, might easily have been led to believe that goats could breathe through their ears. If so, the story about the wax may have been a clever invention by Hippolytus, offering an explanation for how a pseudo-diviner could kill an “ear-breathing” goat without being detected by his clients.

3. Transmission and Transformation: From Alcmaeon to Archelaus and Beyond

Approximately 450 years after Alcmaeon and roughly 400 kilometres north-west of Croton, there lived a certain Marcus Terentius Varro, a highly prolific Roman scholar and writer. His work *On Agriculture*, one of the earliest and most comprehensive treatises on the subject to survive from antiquity, includes another reference to the same view on goat respiration, though this time attributed to a different source. The treatise is structured into three books, each written in the form of a dialogue in which Varro is purported to have participated, with each addressing a distinct aspect of farming. The passage in question, drawn from the second book on cattle breeding, reads as follows (*R.* 2.3.5, ed. Goetz):

quod etiam Archelaus scribit: non ut reliqua animalia naribus, sed auribus spiritum ducere solere pastores curiosiores aliquot dicunt.

Archelaus also writes that certain particularly inquisitive shepherds claim goats habitually draw breath not through their nostrils, as other animals do, but through their ears.

This is essentially the same theory that Aristotle attributes to Alcmaeon, and there seems to be no compelling reason to call his testimony into question or to hypothesize that Varro’s version derives independently from a broader cultural tradition that coincidentally ascribed the same view to certain shepherds. While it is certainly possible that such a tradition may have existed in parallel, and may even have provided the empirical background to Alcmaeon’s theory in the first place, the likelihood of a direct dependence on this tradition, aligning so precisely with Alcmaeon’s theory is further diminished by the specificity of the details and the lexical and syntactical parallels – such as those already noted between Aristotle’s and Aelian’s versions, or the shared reference to the nostrils observed in both Varro’s and Aelian’s accounts, even though

one refutes their function as a breathing organ, while the other affirms it. These parallels point to a distinctly Greek intellectual framework, rather than a broader cultural coincidence. How exactly the references to shepherds and herdsmen came to appear in Varro and, later, Aelian will be addressed below, as, to my mind, there exists evidence that points to a viable explanation. As things stand, it therefore appears more economical – and perhaps also more plausible – to conclude that Alcmaeon was the ultimate source not only for the Aristotelian testimony, but also for all the parallel passages discussed so far, including those of Varro, Hippolytus, and Aelian.

That said, the immediate source of Varro's testimony is evidently not Alcmaeon or Aristotle themselves, but rather a certain Archelaus, whom we will discuss in more detail below⁴⁰. Varro mentions Archelaus three more times in the same work, albeit in the third book, which focuses on the breeding of domestic animals: first, attributing to him the claim that partridges conceive upon hearing the voice of the male (*R.* 3.1.4); second, stating that, according to Archelaus, the age of hares can be determined by examining their intestinal structure (*R.* 3.12.1); and, third, quoting two verses from epigrams by Archelaus which assert that bees are produced from the corpses of oxen, while wasps arise from those of horses (*R.* 3.16.4). These views all pertain to animal physiology, with a notable focus on procreation and anatomy. Nevertheless, the specific points in relation to which Varro cites Archelaus as an authority amount to little more than passing remarks. However noteworthy the reports in question might have been, they clearly do not occupy a central place in *On Agriculture*, which primarily bears on the practical management of an estate (cf. *R.* 1.1.2, 1.1.4).

A further witness to the theory of goat respiration appears just over a century later in the form of Pliny the Elder's *Natural History*, one of the largest and most comprehensive encyclopaedic texts to have survived from antiquity. Organized into thematic sections spanning geography, anthropology, zoology, botany, pharmacology, and mineralogy, it provides a thorough account of Roman knowledge in these fields, blending empirical observations with reports from a wide array of sources that reflect, to some extent, imperial Rome's access to resources and ideas from across its vast territories and beyond. In the eighth book, which covers various mammals, both wild and domesticated, as well as some reptiles, Pliny makes the following observation (*Nat. hist.* 8.202, ed. Mayhoff):

auribus eas spirare, non naribus, nec umquam febris carere Archelaus auctor est. ideo fortassis anima iis quam ovibus ardentior calidioresque concubitus.

Archelaus asserts that they breathe through their ears, not their nostrils, and that they are never free from fever. Perhaps this is why their spirit is more fiery and their mating more intense than that of sheep.

The second part of this testimony is clearly Pliny's own conjecture and need not concern us here. The remainder is purportedly derived from Archelaus, and given its

lack of external similarity to Varro's version despite their partial overlap in content, it seems unlikely to have originated with him. The reference to constant fever in the first part does not appear in Aristotle's account, but it does vaguely reflect Alcmaeon's interest in the temperature of living beings, as previously noted⁴¹. However, it need not share the same provenance as the rest of the testimony, since it is quite possible that Archelaus may have incorporated it from another source (or found it already incorporated in an intermediate source)⁴².

Pliny does not specify which Archelaus he is referring to here either, although an obvious candidate presents itself, as I will explain shortly. Later in the same book (*Nat. hist.* 8.218), Pliny mentions Archelaus again, attributing to him the view that the number of folds in a hare's bowel corresponds to its age in years – a notion that is also attributed to Archelaus by Varro – as well as that each hare possesses both reproductive capacities, enabling it to reproduce without a male⁴³. In another, much later book in the same work (*Nat. hist.* 28.34), Pliny attributes to both Archelaus and Orpheus the belief that arrows removed from a body, provided they have not touched the ground, can serve as love charms when placed beneath someone at rest, as well as that epilepsy can be cured by consuming the flesh of a wild animal killed with the same weapon used to take a human life. A few lines later (*Nat. hist.* 28.43), he refers to a report according to which applying a person's own blood, taken from any part of the body, is highly effective for treating quinsy and the mouths of those suffering from epilepsy, as it is said to cause immediate recovery. This claim, too, he attributes to Archelaus and Orpheus.

Before attempting to identify which Archelaus, from among the numerous individuals bearing that name in surviving Greek literature, we are talking about, it is worth briefly considering whether the name might, in fact, represent a corruption of "Alcmaeon" in the common source shared by Varro and Pliny. The answer, however, is no. While the hypothesis as such is not implausible – given that "Alcmaeon" has frequently been misread in both Greek and Latin manuscripts⁴⁴ – it seems unlikely in this case. No documented misspelling or misidentification of "Alcmaeon" would directly result in "Archelaus". Moreover, both Varro and Pliny elsewhere attribute to a certain Archelaus – likely the same individual – views that are not typically, or in some cases not specifically, associated with the tradition of Alcmaeon of Croton. This includes, for instance, Pliny's reference to the observation about constant fever in goats. While it might vaguely echo Alcmaeon's interest in the temperature of living beings, there is no compelling evidence to conclude that it ultimately originates with him. Instead, it points to Archelaus as an intermediate compilatory source. But let us turn back to the question of how goats breathe. Taken together, the considerations presented above suggest that Varro and Pliny encountered the theory of goat respiration in a text attributed to a certain Archelaus. Pliny was certainly familiar with Aristotle's *History of Animals*, as he frequently quotes from it, including elsewhere within the same book.

Nonetheless, he appears to have overlooked the isolated reference to Alcmaeon and relied instead on the text attributed to Archelaus. Varro, for his part, may have been unfamiliar with both Alcmaeon of Croton and the Aristotelian testimony. In both cases, the theory appears to have been attributed to Archelaus, whose work likely served as their immediate source. Several historical figures named Archelaus are known, three of whom are associated with works of philosophical or scientific interest⁴⁵. However, only one is linked to a text thematically relevant to Varro's and Pliny's accounts, namely Archelaus of Chersonesus.

Archelaus of Chersonesus is described as an Egyptian by Antigonus of Carystus, which suggests that Chersonesus was likely a town in Egypt⁴⁶. A work entitled Ἰδιοφῶνῃ (“Strange Animals” or “Peculiar Animals”) is attributed to him by several ancient authors⁴⁷. The exact dating of his life remains a matter of scholarly debate: once again according to Antigonus, Archelaus dedicated his work to a certain Ptolemy, possibly the “current” Ptolemy, as Dennys Page suggests⁴⁸. This interpretation would make Archelaus and Antigonus contemporaries, while the Ptolemy in question would be identified as either Ptolemy Philadelphus (285–246 BCE) or Ptolemy Euergetes (246–221 BCE)⁴⁹. All the information we have about Archelaus derives from secondary sources. In addition to Varro and Pliny, further references appear in various Greek authors, most notably Antigonus of Carystus, Athenaeus, and Aelian. The earliest testimonies, from Antigonus and Varro, include quotations in verse, suggesting that Ἰδιοφῶνῃ was either a poem or a collection of poems⁵⁰. Beyond the topics mentioned by Varro and Pliny⁵¹, the work reportedly included observations about flies having livers with fifteen lobes⁵², scorpions being born from dead crocodiles⁵³, and snakes emerging from the spinal marrow of deceased men⁵⁴. It also described how, in Libya, the Basilisk devours mules left for dead and causes other snakes to flee at the sound of its hissing⁵⁵. Additionally, it contained accounts of the creature Catoblepas⁵⁶, the eggs of sea urchins⁵⁷, and how moray eels reproduce⁵⁸. The fact that Archelaus lived in Egypt may explain the themes of his work. Ptolemaic Egypt, with Alexandria as its capital, served as a hub connecting the Mediterranean to the Nile, the Red Sea, and the Indian Ocean, through which it rapidly accumulated not only wealth, but also exotic goods and information about these regions⁵⁹.

However, it would be a mistake to assume that Archelaus relied solely on personal experience and exotic reports for information. His mention of goat respiration also suggests familiarity with Alcmaeon's theory, raising further questions about his sources. As noted earlier, I do not rule out the possibility that this theory may have originated within – and even coexisted alongside – a broader cultural tradition in which herdsmen and shepherds orally transmitted various beliefs about the animals they tended. However, the lexical and syntactical similarities among the surviving testimonies examined in the present study are such that they point to a shared textual origin, rather than to independent derivations from a broader cultural context. Since there is no rea-

son to doubt Aristotle's attribution of the theory to Alcmaeon, I take him to be the ultimate source of the various surviving versions of this theory. The absence of references to Aristotle and Alcmaeon in Varro and Pliny, along with the differences between their accounts, lends support to the notion of independent traditions that, when traced back, ultimately converge on Alcmaeon's original text, either directly or through Archelaus. Aelian's testimony further corroborates this hypothesis, but in a more differentiated way. His account appears to be independent not only from Aristotle's version, but also from that of Archelaus, as attested by Varro and Pliny. Notably, Aelian is the only witness who allows for the co-existence of both respiratory pathways (ears and nostrils), rejecting the exclusivity implied by Varro, Pliny, and Hippolytus. While Aristotle's testimony does not clarify whether Alcmaeon claimed that goats breathe solely or partly through their ears, it seems unlikely that Aelian derived his account from Aristotle, especially given that Aristotle refers exclusively to Alcmaeon and, unlike Aelian, makes no mention of reports from herdsmen and shepherds. This raises the question of attribution, with regard to which Aelian partially (but significantly) aligns with Varro's testimony. The shared attribution of the theory to shepherds and herdsmen by both Varro and Aelian suggests, once again, an intermediate origin distinct from Aristotle's account. Furthermore, Aelian's acceptance that goats breathe through both their ears and their nostrils strengthens the argument for a source separate from both Aristotle and Archelaus. Hippolytus need not concern us on this point, as his testimony has been so creatively adapted to its immediate argumentative context that its origin is no longer identifiable. In fact, it could derive from any of the Greek texts discussed so far, except Aelian's, of course, as he lived later⁶⁰. In short, a comparative study of these testimonies (cf. also Table 1) indicates – leaving Hippolytus aside – that both Archelaus and Aelian likely drew from a source attributing the theory to shepherds (and herdsmen), distinct from Aristotle.

Aristotle may yet offer a clue – albeit not a decisive one – that this source is none other than Alcmaeon himself. While Aristotle attributes the idea of goat respiration solely to Alcmaeon, he elsewhere notes that Alcmaeon's claim about the white of an egg nourishing the embryo was shared with common opinion (οἱ τε ἄνθρωποι οἴονται καὶ Ἀλκμαίων φησὶν ὁ Κροτωνιάτης). This type of reference, which combines common opinion with attribution to a specific thinker, is unique in Aristotle and thus warrants particular attention⁶¹. One possible interpretation is that Aristotle was aware of a popular belief that aligned with an explanation proposed by Alcmaeon. Alternatively, Aristotle may have encountered in Alcmaeon's writing an explanation that Alcmaeon himself had identified as a common belief. If this second hypothesis is correct, it raises the question of whether Alcmaeon employed a similar approach in other observations, such as in his theory of goat respiration. If this were indeed the case, Aristotle might have credited Alcmaeon as his direct source for the theory without acknowledging Alcmaeon's ultimate informants. This would explain why Varro (citing Archelaus)

and Aelian independently attribute the theory to shepherds, as well as why Aelian refers to reports from herdsmen and shepherds. While this interpretation remains largely speculative, if we nonetheless accept it – while exercising due caution – then we can infer that Archelaus and Aelian, or their intermediaries, likely had access to a copy of Alcmaeon's text that linked the theory to common sources, whereas Aristotle, attributing it solely to Alcmaeon, overlooked the role played by shepherds and herdsmen.

4. Conclusion

Elaborating and proving hypotheses concerning the reconstruction of the textual tradition of a given report is one thing; making use of what has survived is another – although a certain degree of overlap often seems inevitable. The tradition surrounding Alcmaeon's zoological theory of goat respiration offers a fascinating lens through which to examine the dynamics of knowledge transmission in antiquity. As this study has shown, the theory, initially attributed to Alcmaeon by Aristotle, resurfaces later in the works of Varro, Pliny, Hippolytus, and Aelian – each writing within a different scholarly and cultural context. Notably, Varro and Pliny explicitly name Archelaus (of Chersonesus) as their source, while Aelian seems to represent a third independent tradition and Hippolytus provides no clear value in terms of transmission. That said, Hippolytus' testimony is particularly fascinating, as it situates the theory within a Christian apologetic context that opposes animal divination practices and possibly employs it in a distinctive and creative way. Equally intriguing is the role played by Archelaus in disseminating this theory, as he seems to have propagated it in contexts where the focus had shifted from physiology – perhaps broadly understood in Alcmaeon's lost work or Aristotle's surviving treatises – to the collection and organization of knowledge about extraordinary animals. This shift, with its more focused yet cumulative character, made it possible for the theory to be incorporated with relative ease into Varro's didacticism and Pliny's encyclopedism. It was undoubtedly more convenient for those writing about farming and animal husbandry to have access to a compilation of stories and observations about various animals than to have to laboriously consult the voluminous physiological writings of Aristotle, Theophrastus, or Presocratic thinkers who occasionally touched on aspects of physiology⁶². After all, this was the role of the compiler: to bring together information of this kind for ease of reference.

Of course, it remains uncertain to what extent Archelaus may have adapted and enriched Alcmaeon's ideas with additional observations. One case where such an adaptation may have occurred involves the link between goat respiration and fever in Pliny's version, which vaguely recalls certain ideas attributed to Alcmaeon by other witnesses. This detail is absent from Aristotle's account, and no element in Archelaus' version that is missing from Aristotle can be assumed to originate directly from Alcmaeon. It is equally plausible that Archelaus incorporated observations from other sources or drew from his own empirical studies and autopsies, further complicating the transmission

of these ideas. However, in another comparable case, we do find a recurring element that merits attention. The attribution by Varro and Aelian of the same theory to herdsmen and shepherds underscores the significance of practical, empirical observations in the development of early zoological theories. Combined with Aristotle's testimony concerning another of Alcmaeon's theories, these attributions suggest the possibility that Alcmaeon not only relied on, but also explicitly referred to such common sources in his writing. This hypothesis aligns with other theories attributed to Alcmaeon in surviving testimonies, such as the claim that the thin or cold semen of the male and the shape of the female's womb cause mules to be infertile or that mating between animals depletes marrow, fat, and flesh, as well as his observations on how the eyeball of a living being connects to the brain – insights that would have been possible only within the context of the practice of animal husbandry, which Alcmaeon may have already systematically and explicitly identified as a crucial source of information. However that may be, a thorough analysis of Alcmaeon's theory about goat respiration, as discussed above, incidentally allows us to draw broader conclusion about how ideas from early Greek thinkers endured over time and were transmitted in subsequent periods. What is particularly striking about the theory of goat respiration is the contrast between Aristotle's formal refutation of it and its continued circulation in later texts. This discrepancy highlights the resilience of certain ideas, even as their original context and authorship are obscured. But what makes such ideas resilient? The answer does not lie solely in the influence of Alcmaeon or Aristotle. Alcmaeon's theory notably continued to circulate despite Aristotle's refutation. In much later times, inattentive readers even began attributing the idea not to Alcmaeon, Archelaus, or any earlier thinker, but to Aristotle himself – a fact highlighted by Gilbert White, the naturalist previously mentioned in connection with deer anatomy⁶³. As this study has sought to demonstrate, this resilience owes much to the scholarly practices of figures such as Archelaus of Chersonesus, as well as later authors like Varro, Pliny the Elder, Hippolytus of Rome, and Aelian. These writers created new contexts in which such ideas could persist, regardless of whether they were verifiable, falsifiable, or traceable to their original source. Naturally, what makes an idea a good candidate to be taken up in a new context is its ability to capture attention – and peculiar notions, such as ear-breathing goats, are particularly adept at doing so⁶⁴.

Aristotle (384–322 BCE)	Varro (116–27 BCE)	Pliny the Elder (23–79 CE)	Hippolytus (c. 170–235 CE)	Aelian (c. 175–235 CE)
<i>Historia animalium</i> 1.11, 492a 13–15 (ed. Balme)	<i>Res rusticae</i> 2.3.5 (ed. Goetz)	<i>Naturalis historia</i> 8.202 (ed. Mayhoff)	<i>Refutatio omnium haeresium</i> 4.31.1 (ed. Marcovich)	<i>Natura animalium</i> 1.53 (ed. Garcia Valdés, Llera Fueyo & Rodríguez-Noriega Guillén)

<p>ἔστι δὲ κεφαλῆς μόριον, δι' οὗ ἀκούει ἄπνον τὸ οὖς· Ἀλκμαίων γὰρ οὐκ ἄληθῆ λέγει, φάμενος ἀναπνεῖν τὰς αἴγας κατὰ τὰ ὄτα.</p>	<p><i>De quibus admirandum illud, quod etiam Archelaus scribit: non ut reliqua animalia naribus, sed auribus spiritum ducere solere pastores curiosiores aliquot dicunt.</i></p>	<p>auribus eas spirare, non naribus, <i>nec umquam febris carere Archelaus auctor est. ideo fortassis anima iis quam ovibus ardentior calidioresque concubitus.</i></p>	<p>Αἰγῶν δὲ κᾶν ἐπιπλάσῃ τις κηρωτῆ τὰς ἀκοάς, φασὶ θηήσκων μετ' ὀλίγον, ἀναπνεῖν κωλοομένας· ὁδὸν γὰρ αὐταῖς ταύτην εἶναι λέγουσι τοῦ δι' ἀναπνοῆς ἔλκομένου πνεύματος.</p>	<p>Ἔχει τι πλεονέκτημα ἢ αἷξ τὴν τοῦ πνεύματος εἰσροήν, ὡς οἱ νομειτικοὶ λόγοι καὶ ποιμενικοὶ φασιν. ἀναπνεῖ γὰρ καὶ διὰ τῶν ὄτων καὶ διὰ τῶν μυκτήρων, καὶ αἰσθητικώτατον τῶν διχλήλων ἐστὶ. καὶ τὴν μὲν αἰτίαν εἰπεῖν οὐκ οἶδα, ὃ δὲ οἶδα τοῦτο εἶπον.</p>
<p>The ear is a part of the head through which one hears, but it does not breathe. For Alcmaeon is mistaken in claiming that goats breathe through their ears.</p>	<p>Among these goats, there is something remarkable, as Archelaus also writes: some particularly inquisitive shepherds claim that they draw breath not through their nostrils, as other animals do, but through their ears.</p>	<p>Archelaus asserts that they breathe through their ears, not their nostrils, and that they are never free from fever. Perhaps this is why their spirit is more fiery and their mating more intense than that of sheep.</p>	<p>They say that if one seals a goat's ears with wax, it will die shortly thereafter because its breathing is obstructed. For they claim that this is the passage through which the breath is drawn in during respiration.</p>	<p>The goat has a certain advantage in the intake of breath, as reports from herdsmen and shepherds claim. For it breathes both through its ears and its nostrils, and it is the most sensitive of cloven-hoofed animals. As for the reason why, I do not know; I have only stated what I know.</p>

Bibliography, notes and references

1. Arist. *Metaph.* 1.5, 986a 28–30 (cf. 24 A3 DK; P1 Laks & Most; Alk 9). For the claim that this piece of information was added to Aristotle's text at a later stage, see Primavesi O, Aristotle, *Metaphysics A*, A New Critical Edition. In: Steel C (ed.), *Aristotle's Metaphysics Alpha: Symposium Aristotelicum*. Oxford: Oxford University Press; 2012. pp. 385-516, at 447-8. For a contrasting perspective, see Fazzo S, *Aristotle's Metaphysics – Current Research to Reconcile Two Branches of the Tradition*. *Archiv für Geschichte der Philosophie* 2016;98: 431, n. 55; Golitsis P, *Editing Aristotle's Metaphysics: A Response to Silvia Fazzo's Critical Appraisal of Oliver Primavesi's Edition of Metaphysics Alpha*. *Ibid.*: p. 436, n. 14; Kouloumentas S, *Aristotle on Alcmaeon in relation to Pythagoras: An addendum in Metaphysics A?* In: Golitsis P, Ierodiakonou K (eds), *Aristotle and his Commentators: Studies in Memory of Paraskevi Kotzia*. Berlin, Boston: W. de Gruyter; 2019. pp. 58-59. On Alcmaeon's chronology, cf. also Thibodeau P, *The Chronology of the Early Greek Natural Philosophers*. North Haven, CT: Cosmographia.net; 2019. pp. 279-86. Aristoxenus of Tarentum (fr. 16 Wehrli from Porphyry, *Vita Pythagorae* 9) connects Pythagoras' departure from Samos and settling in Southern Italy with the seizure of power in Samos by the tyrant Polycrates, whose reign dates from 538-522 BCE. The literature on Alcmaeon has grown significantly in recent years. The following titles provide an initial overview and include further references to works addressing more specialized aspects: Centrone B, *Alcméon de Croton*. In: Goulet R (ed.), *Dictionnaire des*

- philosophes antiques I. Paris; 1989. pp. 116–117; Perilli L, Alcmeone di Crotona tra filosofia e scienza. *Quaderni Urbinati di Cultura Classica*, 2001;69:55-79; Zhmud LZ, Pythagoras und die Pythagoreer. In: Flashar H, Bremer D, Rechenauer G (eds), *Grundriss der Geschichte der Philosophie. Die Philosophie der Antike I: Frühgriechische Philosophie*. Basel: Schwabe; 2013. pp. 407-412; Kouloumentas S, The Body and the Polis: Alcmaeon on Health and Disease. *British Journal for the History of Philosophy* 2014;22:867-887; Huffman CA, Alcmaeon. In: Zalta EN (ed.), *The Stanford Encyclopedia of Philosophy* (Spring 2017 Edition). URL = <<https://plato.stanford.edu/archives/spr2017/entries/alcmaeon/>> (last retrieved on August 8, 2025); Tsiampokalos T, Wie schreibt man ‘Alkmaeon’ richtig? Zur Namensproblematik in der Überlieferung der Zeugnisse zum Naturphilosophen Alkmaion von Kroton. *Museum Helveticum* 2022;79(2);179-202; Gambetti F, Beyond Disciplinary Boundaries: Alcmaeon of Croton between Physics. *Medicine and Philosophy*. B@belonline 2023;10:95-104.
2. For references to Alcmaeon’s text, see Galen, *De Elementis ex Hippocrate* 1.9.25–28 (24 A2 DK; D2 Laks & Most; Alk 29); id., *In Hippocratis de natura hominis librum commentarii* [proemium] 5.10–14 (Alk 30); Clement of Alexandria, *Stromateis* 1.16.78.3–5 (24 A2 DK; D1b Laks & Most; Alk 33); Diogenes Laertius, *Vitae philosophorum* 8.83 (24 A1 DK; D1a Laks & Most; Alk 42); Theodoretus of Cyrhus, *Graecarum affectionum curatio* 1.23–24 (Alk 52). On the term “testimony texts” (*Zeugnistexte*), see Wöhrle G, *Fragmente im Überfluss: Zur Problematik eines philologischen Begriffs*. *Hermes*, 2022;150:394.
 3. A new edition of the surviving Greek, Latin, and Arabic testimonies to all three of these early Greek thinkers has recently been published: Wöhrle G, *Alkmaion von Kroton, Hippon von Metapont und Menestor von Sybaris*. In collaboration with Tsiampokalos T, with contributions by Lammer A. Berlin, Boston: W. de Gruyter; 2022. The abbreviation “Alk” found above and below accompanying references to ancient and medieval testimonies, corresponds to the numbering of testimonies to Alcmaeon of Croton in this edition. Similarly, the abbreviation “Hipp” corresponds to the numbering of testimonies to Hippon in the same edition. Regarding the testimonies to Alcmaeon, there are two additional standard editions that are frequently cited, whose numbering is also referenced below: 1) Diels H, Kranz W, *Die Fragmente der Vorsokratiker I*. 6th edition. Wiesbaden: Weidmann; 1951. pp. 210-216 (Abbreviation: “DK”); 2) Laks A, Most GW, *Early Greek Philosophy V, Western Greek Thinkers*. In: *Journée G* (collaboration with), and Iribarren L (assisted by). Cambridge, Mass., London: Harvard University Press; 2016. pp 735-771 (Abbreviation: “Laks & Most”). These two editions are also used for references to testimonies of other early thinkers, such as Thales of Miletus. For references to Thales in particular, the following edition is also cited alongside the above: Wöhrle G, McKirahan R, *The Milesians: Thales*. 2nd edition. Berlin, Boston: W. de Gruyter; 2014 (abbreviated as “Th”).
 4. On the concept of “Presocratic”, see Gemelli Marciano L, *Die Vorsokratiker I*. Düsseldorf: W. de Gruyter; 2007. pp. 373-385. A broader theoretical framework that could be brought into dialogue with the present study is Dan Sperber’s theory of the “epidemiology of representations”, which metaphorically conceptualises the transmission of ideas on the model of disease spread, as a decentralised, adaptive process in which mental representations are reproduced and transformed across individuals and communities. While the present article is grounded in the analysis of the mechanisms of knowledge transmission within scholarly textual contexts and does not adopt this framework explicitly,

it nonetheless shares with cultural epidemiology a critical awareness of the limitations inherent in traditional approaches that view the origin of ideas in narrow genealogical terms, without considering the dynamics of reception and other broader cultural parameters. The reason for focusing here on textual transmission, rather than expanding the scope to encompass possible parallel developments in oral tradition, lies in the nature of the surviving material itself: as will be shown in the second part of the article, the testimonies under discussion display such concrete lexical and syntactical similarities that they can only plausibly be explained as witnesses within different branches of literary transmission converging back on the same source. This does not rule out the possibility that the theory of goat respiration may have originated from – or coexisted with – popular beliefs and empirical observations; indeed, some of the ancient sources themselves suggest as much, which, as this article argues, may indicate that the literary tradition in question was already informed by a broader cultural context of knowledge related to animal husbandry. For an accessible introduction to the “epidemiology of representations”, see Sperber D, *La Contagion des idées. Théorie naturaliste de la culture*. Paris: Odile Jacob; 1996. For further discussion of how popular knowledge about animals finds its way into scholarly contexts, see Li Causi P, *Sulle tracce del mantichora. La zoologia dei confini del mondo in Grecia e a Roma*. Palermo: Palumbo; 2003.

5. On Aristotle’s engagement with the transmitted teachings of earlier Greek thinkers, see, e.g., Primavesi O, *Neues zur aristotelischen Vorsokratiker-Doxographie*. *AKAN - Antike Naturwissenschaft und ihre Rezeption* 1998;8:25-41; Althoff J, *Aristoteles als Medizin-doxograph*. In: van der Eijk Ph J (ed.), *Ancient Histories of Medicine. Essays in Medical Doxography and Historiography in Classical Antiquity*. Leiden, Boston, Cologne: E. J. Brill; 1999. pp. 57-94; Föllinger S, *Aristoteles’ Auseinandersetzung mit Empedokles in *De generatione animalium**. In: Hellmann O, Strobel B (eds), *Rezeption der Vorsokratiker von der Antike bis in die Gegenwart*. Berlin, Boston: W. de Gruyter; 2022. pp. 87-102.
6. Cf. 24 A15 DK; D20 Laks & Most; Alk 5. For the book numbering in the Aristotelian work in question, see Kullmann W, *Die Reihenfolge der Bücher in Aristoteles’ *Historia Animalium**. In: Id., *Aristoteles als Naturwissenschaftler*. Boston, Berlin, Munich: W. de Gruyter; 2014. pp. 291-294.
7. See Diels H, Kranz W, Ref. 3. p. 214, which already includes additional references to Solon (fr. 27, 3-4 West) and Heraclitus (22 A18 DK).
8. This testimony is also available in an Arabic translation; see Uṣṭāṭ, *Kitāb al-Ḥayawān* 9.1, 581a12-17 (Alk 80).
9. In this passage, Cherniss C, *Aristotle’s Criticism of Presocratic Philosophy*. New York: Octagon; 1971, p. 344; only attributes to Alcmaeon the claim about plants. Alcmaeon’s interest in plants is further corroborated by the appearance of his name in the preserved Arabic translation of Nicolaus’ *On Plants*, within a discussion on plant nourishment; see Ishāq ibn Ḥunayn, *Kitāb al-Nabāt* 1.2.44, 817a 25-29 (Alk 85). Cf. also Ps.-Aristotle, *De plantis* 1, 817a 27-28. The latter Greek text is a relatively late translation of an earlier (though still late) Latin translation of the above-mentioned Arabic text. However, even the Arabic text does not derive directly from Nicolaus’ lost work, but rather from an intermediate Syriac translation. For a very brief overview of the transmission of Nicolaus’ text, including discussions of its sources and authorship, see Wöhrle G, Ref. 3. pp. 39, 41.
10. These theories pertain to embryology and sperm and are partially related to zoology. Specifically, the teachings on sperm include the notion that females also produce sperm, that embryos are formed from the sperm of both male and female parents (Censorinus, *De die*

- natali* 5.4 [24 A14 DK; D23 Laks & Most; Alk 37]) - and more precisely from the parent whose seed is more abundant (Censorinus, *De die natali* 6.4 [24 A14 DK; D25 Laks & Most; Alk 39]) - and that sperm originates from the brain (Aëtius, *Placita philosophorum* 5.3.3 [24 A13 DK; D21 Laks & Most], reconstructed from Pseudo-Plutarch, *Placita philosophorum* 5.3, 905A [Alk 23], Pseudo-Galen, *Historia philosopha* 107 [Alk 70], and Qusṭā ibn Lūqā, *Kitāb Fulūṭarḥus* 5.3.3, 218.7 [Alk 90]) rather than the marrow (Censorinus, *De die natali* 5.2–3 [= 24 A13 DK; D22 Laks & Most; Alk 36]). Alcmaeon's interests also include the idea that the head forms first in the embryo (Aëtius, *Placita philosophorum* 5.17.3 [24 A13 DK; D27 Laks & Most], reconstructed from Pseudo-Plutarch, *Placita philosophorum* 5.17, 907E [Alk 26], Pseudo-Galen, *Historia philosopha* 121 [Alk 72], and Qusṭā ibn Lūqā, *Kitāb Fulūṭarḥus* 5.17.3, 230.16 [Alk 93]; *contra* Censorinus, *De die natali* 5.5 [24 A13 DK; D26 Laks & Most; Alk 38]), theories on how embryos are nourished in the womb (Rufus of Ephesus from Oribasius, *Collectionum medicarum reliquiae* 38.9 = *Corpus Medicorum Graecorum* 6.2.2, 136.26–32 [24 A17 DK; Alk 18 and Alk 50 respectively]; Aëtius, *Placita philosophorum* 5.16.3 [24 A17 DK; D28 Laks & Most], reconstructed from Pseudo-Plutarch, *Placita philosophorum* 5.16, 907E [Alk 25] and Qusṭā ibn Lūqā, *Kitāb Fulūṭarḥus* 5.16.3, 230.10 [Alk 92]), and explanations for why newborns immediately seek out their mother's breast (Galen, *In Hippocratem de alimento commentarii*, P.Flor. 2.115, fr. 1r.9–1v.13 [Alk 31]).
11. For the relevant passages, see Aristotle, *De anima* 1.2, 405a 29–b1 (24 A12 DK; D9 Laks & Most; Alk 3) and, from the *Placita* tradition, Aëtius, *Placita philosophorum* 5.30.1 (24 B4 DK; D30 Laks & Most), reconstructed from Pseudo-Plutarch, *Placita philosophorum* 5.30, 911A (Alk 28), Stobaeus, *Anthologium* 4.37.2 (Alk 62), and Michael Psellus, *De omnifaria doctrina* 117 (Alk 98) as well as *Solutiones diversarum quaestionum* 66 (Alk 99). In the passage from Aristotle, Alcmaeon is said to have attempted to prove the immortality of the soul by comparing its presumed perpetual motion to the constant movement of the celestial bodies. His reasoning was that perpetual motion, a characteristic shared by both the soul and celestial bodies, implies immortality. Hence, since the celestial bodies are immortal, it follows by analogy that the soul, too, must be immortal. It is worth noting briefly that a little earlier in the same text (*De anima* 1.2, 405a 19–21), Aristotle attributes the idea of the soul's ability to cause motion to Thales of Miletus (11 A22 DK; Th 31; D11a Laks & Most). For O'Grady P, Thales of Miletus. *The Beginnings of Western Science and Philosophy*. Aldershot: Burlington; 2002. p. 17, this potentially suggests that Alcmaeon was Aristotle's source for Thales' teachings. If so, the concept of the ever-moving soul that Alcmaeon appears to accept axiomatically may have roots, either wholly or in part, in earlier teachings. However, regardless of this historical question, what is relevant in the present context is the analogical reasoning in Alcmaeon's argument, which enables a comparison to be made between the soul and the celestial bodies based on their shared characteristic: perpetual motion. For more on Alcmaeon's view, cf. Cherniss C, Ref. 9. p. 299. In the above-mentioned passages from the *Placita* tradition, an analogy is drawn between health and the state of *isonomia*, a term originally used to describe political equality or balance of power. This concept is central to early Greek political thought, but also appears in entirely different contexts, including medicine and philosophy. For Alcmaeon's significance with regard to the conceptual history of this term, see Schubert C, *Isonomia. Entwicklung und Geschichte*. Berlin, Boston: W. de Gruyter; 2021. pp. 151–174, 246–248, 259–274. Similar ideas are also found in the philosophical tradition that interprets *isonomia* or the balance between opposing forces

- on a metaphysical level as a form of cosmic harmony. See also Mansfeld J, *The Body Politic: Aëtius on Alcmaeon on Isonomia and Monarchia*. In: Harte V, Lane M (eds), *Politeia in Greek and Roman Philosophy*. Cambridge, New York: Cambridge University Press; 2013. pp. 78-95. According to Mansfeld, the political terminology in these later passages did not originate in Alcmaeon's time, but instead reflects the influence of the constitutional debate in Herodotus (*Historiae* 3.80-82). Cf. also Mansfeld J, Runia D, Aëtiana. *The Method and Intellectual Context of a Doxographer V: an Edition of the Reconstructed Text of the Placita with a Commentary and d Collection of Related Texts*. 4 Parts. Leiden, Boston: E. J. Brill; 2020. p. 2050. For a contrasting view, see Kouloumentas S, Ref. 1. p. 871 n. 9. Cf. also Schubert C, Ref. 2. pp. 153 n. 578, 155 n. 585, 270.
12. The view that humans reach (sexual) maturity upon completion of the second heptad is also attributed to Alcmaeon in *Scholia in Platonis Alcibiadem priorem* 59 (Alk 96). However, the possibility that the author(s) of these scholia misattributed the idea to Alcmaeon, perhaps due to a misinterpretation of the aforementioned passage in Aristotle, should not be overlooked, particularly since other testimonies ascribe both this theory and the analogy with plants to Heraclitus and the Stoics (Aëtius, *Placita philosophorum* 5.23.1 [22 A18 DK and *Stoicorum veterum fragmenta* 2.764, respectively], reconstructed from Pseudo-Plutarch, *Placita philosophorum* 5.23, 909C–D, and Pseudo-Galen, *Historia philosopha* 127). Elsewhere, the heptad theory is attributed either to the Stoics alone (Iamblichus, *De anima* 15.1–4) or to no one in particular (Alexander of Aphrodisias, *In Aristotelis metaphysica commentaria* 38.16–39.4). For more on this theory, see Boll F, *Die Lebensalter. Ein Beitrag zur antiken Ethnologie und zur Geschichte der Zahlen*. In: Stegemann V (ed.), *Kleine Schriften zur Sternkunde des Altertums*. Leipzig: Koehler and Amelung; 1950. pp. 183-213; and Festugière AJ, *La Révélation d'Hermès Trismégiste III*. Paris: Lacombe; 1953. pp. 13-14. Solon, whose surviving poetry contains a famous mention of this theory (fr. 27, 3-4 West), and Heraclitus, to whom the theory is attributed in the *Placita* tradition (as indicated above), appear to have been a much earlier and a slightly earlier contemporary, respectively. On Heraclitus' chronology, see Thibodeau, Ref. 1. pp. 149-152. When Aristotle, for his part, employs the heptads theory (*Politica* 7.17, 1336b 37 -1337a 1; *Rhetorica* 2.12, 1388b 3- 2.14, 1390b 13), he does not attribute it to any particular thinker, although he at one point acknowledges that the theory was accepted by more than one person (*Politica* 7.17, 1336b 37: οἱ γὰρ ταῖς ἑβδομάσι διαποῦντες τὰς ἡλικίας). Be that as it may, what is pertinent to the present discussion is not whether Alcmaeon was the first to employ the heptad theory he probably was not but rather whether he attempted to draw an analogy between plants and animals on this basis.
 13. Aëtius, *Placita philosophorum* 15.14.1 (24 B3 DK; D24 Laks & Most), reconstructed from Pseudo-Plutarch, *Placita philosophorum* 5.14, 907A-B (Alk 24); Pseudo-Galen, *Historia philosopha* 118 (Alk 71); Qusṭā ibn Lūqā, *Kitāb Fulūṭarḥus* 5.14.1, 228.5-7 (Alk 91).
 14. As Diels H, Kranz W, Ref. 3. p 215, have already noted, Aristotle (*De generatione animalium* 2.7, 747a 2) attributes the same characteristic - namely, having semen that is thin and cold to effeminate men.
 15. For the relevant passages, see n. 11 above.
 16. The term ἀναχάσκειν appears in the Hippocratic corpus in gynaecological contexts; see Hp. *De victu* 1.30, 1-6; *De morbis mulierum* 2.167, 1-8; *op. cit.* 3.217, 49-54; *De natura muliebri* 45, 1-7; *De superfetatione* 29, 49-52; 32.1-8. Cf. also Gal. *Vocum Hippocratis glossarium* 19.154, 9-10 K. However, the term sounds so archaic that it would not be

implausible to trace it back to the original text of Alcmaeon, although nothing can be said with certainty.

17. Censorinus, *De die natali* 5.3 (24 A13 DK; D22 Laks & Most; Alk 36).
18. Cf. Hippo, 38 A12 DK; D9 Laks & Most; Hipp 29.
19. The other thinkers mentioned in Censorinus' text as sharing the same view as Alcmaeon are Anaxagoras (59 A107 DK) and Democritus (68 A141 DK). The *Placita* tradition (Aëtius, *Placita philosophorum* 5.3.6, attested by Pseudo-Plutarch, *Placita philosophorum* 5.3, 905A, and Pseudo-Galen, *Historia philosopha* 107) explicitly attributes to Democritus the theory that semen is derived from all the parts of the body, including its most essential components i.e. bones, flesh, and sinews. Erna Lesky, in her now-classic study on ancient semen theories (Die Zeugungs- und Vererbungslehren der Antike und ihr Nachwirken. Akademie der Wissenschaften und der Literatur, Mainz. Abhandlungen der Geistes- und Sozialwissenschaftlichen Klasse [Jahrgang 1950] 1951;19:1225-1425), referred to this as the "pangensis" theory. This attribution may lead readers of Censorinus to infer that Alcmaeon, too, was an adherent of the same theory. However, this can hardly be the case, as Alcmaeon is traditionally thought to have traced the origin of semen to the brain (see n. 10 above). In a separate article addressing this inconsistency, Lesky argued that Censorinus included Alcmaeon because his view that semen originates in the brain contradicts Hippo's claim that it comes from the marrow, while Anaxagoras and Democritus refuted Hippo based on observations that animals deplete their marrow, fat, and flesh after mating (see Lesky E, Alcmaeon bei Aëtios und Censorin. *Hermes* 1952;80(2):249-255). Although it cannot be confirmed in the absence of further testimony whether Alcmaeon made such an observation, the reference in Censorinus' text to animals depleting these parts does not necessarily imply that these thinkers explicitly argued that semen is derived from them.
20. The same argument can also be made for Hippo's claim regarding the marrow; see, e.g., Lesky E, Ref. 19(b). pp. 251-252. Although it is uncertain whether the observations mentioned in Censorinus' text should be attributed to Alcmaeon, or only to Anaxagoras and Democritus (see the previous footnote), it is not implausible to associate observations of this sort with Alcmaeon as well. Indeed, we possess testimonies connecting him with observations about post-mortem bodily behaviour. For instance, the *Placita* tradition ascribes to Alcmaeon a theory explaining the difference between sleep and death in terms of the movement of blood in the veins; see Aëtius 5.24.1 (cf. 24 A18 DK; D32 Laks & Most) Pseudo-Plutarch, *Placita philosophorum* 5.24, 909D (Alk 27); Pseudo-Galen, *Historia philosopha* 128 (Alk 73); Qusṭā ibn Lūqā, *Kitāb Fulūṭarḥus* 5.24.1, 238.22-24 (Alk 94), and Michael Psellus, *Solutiones diversarum quaestionum* 66 (Alk 99). It is also worth noting that another testimony, preserved in the pseudo-Aristotelian *Problemata physica* 17.3 (24 B2 DK; D31 Laks & Most; Alk 12), further attests to Alcmaeon's interest in matters related to death.
21. Cf. also Bubb C, *Dissection in the Classical Antiquity*. Cambridge: Cambridge University Press; 2022. pp. 11-12, who argues that the anatomical knowledge found in early Greek sources, such as Homer, most likely derives from animal sacrifice, butchery, and familiarity with open wounds and corpses resulting from warfare. Later (p. 13), in discussing testimonies that attribute anatomical observations to Presocratic philosophers, she appears hesitant to accept the practice of dissection for philosophical purposes, although she does note that these testimonies point to a widespread interest in both the structure and the function of bodies among early Greek thinkers.

22. It is widely assumed that later Latin authors, such as Censorinus, derived their knowledge of early Greek philosophy and science from now-lost works of Varro, who, in turn, had access to doxographical sources and likely many other works as well. For a brief overview of this question, see Mansfeld J, Runia D, Ref. 11. p. 1748 (with further references).
23. This point is also made by Lesky E, Ref. 19(b). p. 255. Hippo is dated to the mid-fifth century, making him one to two generations younger than Alcmaeon. On Hippo's chronology, see Thibodeau, ref. 1, pp. 301-304. In the *Placita* tradition (Aëtius, *Placita philosophorum* 5.3.3, reconstructed from Pseudo-Plutarch, *Placita philosophorum* 5.3, 905A, and Pseudo-Galen, *Historia philosopha* 107), a theory attributing sperm to an effluence from the marrow in the backbone is ascribed not to Hippo but to Plato, likely influenced by *Timaeus* 73E-74A. In this Platonic passage, the seed is described as originating from the marrow, which is regarded as the body's fundamental life-generating substance. The most refined and sacred form of marrow is the brain (cf. *Tim.* 73C-D), from which the seed ultimately derives via the spinal cord. According to Lesky E, Ref. 19(a). pp. 1233ff., Plato's account aligns with a broader tradition originating with Alcmaeon, referred to as the "encephalomyelogenic" theory of semen. For further discussion of Lesky's conjecture, as well as the value of Censorinus' testimony, see Mansfeld J, Runia D, Ref. 11. pp. 1789-1790 (with further references).
24. For the empirical character of Alcmaeon's researches, see also Vassallo C, Alcmaeon's Empirical Side: Unpublished Notes from the Vlastos-*Nachlass*. RSF n.s. 2021;76(1):167-179, esp. 173-174, where particular emphasis is rightly placed on the occurrence of τεκμαίρεσθαι in the surviving so-called incipit of Alcmaeon's writings, as quoted in Diogenes Laertius 8.83 (24 B1 DK; D4 Laks & Most; Alk 42).
25. Cf. Alcmaeon, 23 A16 DK; D29 Laks & Most; Alk 7.
26. In his zoological writings, Aristotle not only mentions theories proposed by earlier authorities and reports from individuals with specialized knowledge, such as fishermen, hunters, and the like, but also occasionally lists common beliefs, which are introduced with phrases of the type "people say" or "they say"; on this type of reference, see Manquat M, *Aristote naturaliste*. Paris: J. Vrin; 1932. pp. 75-82. This is not to suggest, however, that Aristotle always treats such evidence with caution. This cannot be assumed even for reports introduced with formulas such as "it is handed down by myth/legend", or "the myth/legend has it", where, as Hellmann O, *Aristotle and Myths about Animals*. In: De Brasi D, Papatthomas A, Tsiampokalos T (eds), *Fake News in Ancient Greece: Forms and Functions of 'False Information' in Ancient Greek Literature*. Berlin, Boston: W. de Gruyter; 2025. pp. 149-168, recently demonstrated, Aristotle sometimes attempts to extract hidden truths from these stories. In the passage in question, we find a mixed type of reference, in which Aristotle identifies a supposed popular belief with a theory proposed by an earlier authority, only to reject both. As far as I can determine, this is the sole occurrence of this type of reference in Aristotle's works. As for the theory itself, there is a parallel passage in the Hippocratic corpus that defends Alcmaeon's view against the idea that the white and yolk of an egg nourish the embryo, as suggested here by Aristotle; see Hippocrates, *De semine, De natura pueri, De morbis* 30, 62-74.
27. The testimony is also available in an Arabic version; see Uṣṭāṭ, *Kitāb al-Ḥayawān* 17.2, 752b 15-27.
28. Michael of Ephesus, *In Aristotelis libros de generatione animalium commentaria* 138.10-14: Ἀλκμαίων δὲ ὁ Κροτωνιάτης διὰ τὸ ὄρᾶν τὸ τοῦ ὄψθ' λευκὸν ὅμοιον τῷ γάλακτι (λευκὸν γὰρ τοῦτο κάκεινο), εἶναι δὲ τὸ γάλα τροφήν, ἐνόμισεν ὡς καὶ ἐν τοῖς ὄψθ' τὸ μὲν

λευκὸν τροφή ἐστι, τὸ δ' ὄχρον τὸ τῶν νεοττῶν σῶμα· οὐκ ἔστι δέ, ὡς οὔτος ὁ Ἀλκμαίων οἶεται, τὸ λευκὸν τροφή, ἀλλὰ μᾶλλον τὸ ὄχρον. The key indicators of Michael's recognition of Alcmaeon's analogical reasoning are the reference to similarity (ὅμοιον) and the transition from this observation to inferred function (ἐνόμισεν ὡς).

29. Cf. Alcmaeon, 24 A5 DK; D12a, D13a, D15a, D16, D18, D19 Laks & Most; Alk 11.
30. Cf. Alcmaeon, 24 A10 DK; R6 Laks & Most; Alk 48.
31. For the dissection, see Hirschberg J, Alcmaeon's Verdienst um die Augenkunde. *Albrecht von Graefes Archiv für Ophthalmologie* 1921;105:131-133; 1968; Koelbing HM, *Zur Sehtheorie im Altertum: Alkmeon und Aristoteles*. Gesnerus 1968;25:8-9; Perilli L, Ref. 1. pp. 58-62; Bakhouché B, Calcidius, Witness to Greek Medical Theories: Eye Anatomy and Pathology. In: Maire B (ed.), "Greek" and "Roman" in Latin Medical Texts Studies in Cultural Change and Exchange in Ancient Medicine. Leiden/Boston: E. J. Brill; 2014. pp. 119-134; Bubb C, Ref. 21. pp. 12, 172. For the results of the dissection presented in the current testimony, cf. Hippocrates, *De locis in homine* 2, 8-13; *De carnibus* 17; Aristotle, *Historia animalium* 4.8, 533a 13-15; *De generatione animalium* 2.6, 744a 5- b 11. Furthermore, see Diels H, Ueber die Excerpte von Menons iatrika in dem Londoner Papyrus 137. *Hermes* 1893;28:421 n. 2; Diels H, Kranz W, Ref. 3. pp. 212-213.
32. Zhmud L, *Wissenschaft, Philosophie und Religion im frühen Pythagoreismus*. Berlin: Akademie Verlag; 1997. pp. 250-251. For the contrary view, see, e.g., Huffman C, Ref. 1.
33. For more on Aristotle's conception of the human body comprising specific parts as a regulatory model for the description and organisation of other living beings, see Carbone AL, *Aristote illustré: Représentations du corps et schématisation dans la biologie aristotélicienne*. Paris: Classiques Garnier; 2011. Cf. also Zucker A, *Le modèle humain en biologie animale. Genèse aristotélicienne de l'anatomie comparée*. Association des Études Grecques (04/01/2016); 2016;HAL-02264715. URL = <<https://hal.science/hal-02264715>> (last retrieved on August 8, 2025).
34. Cf. Alcmaeon 24 A7 DK; D14, R2 Laks & Most; Alk 4.
35. Cf. Aëtius, *Placita philosophorum* 4.16.3 (cf. 24 A6 DK; D12b Laks & Most), reconstructed from Pseudo-Plutarch, *Placita philosophorum* 4.16, 901F (Alk 20), Stobaeus, *Anthologion* 1.53.2 (Alk 59), Pseudo-Galen, *Historia philosopha* 97 (Alk 67), Qusṭā ibn Lūqā, *Kitāb Fulūṭarḥus* 4.16.2, 204.23-206.1 (Alk 87), and Michael Psellus, *De omn. doct.* 108 (Alk 97).
36. There are also Aristotelian parallels to this conceptualization of hearing, although Alcmaeon is not mentioned by name; see Aristotle, *De anima* 2.8, 420a 18-19, and *De partibus animalium* 2.10, 656b 13, as well as Alexander of Aphrodisias. *De anima* 48.21-49.3
37. The choice of κατά versus διά reflects varying degrees of focus on the question of how goats breathe. Aristotle's κατά emphasizes the region or association with the ears, while Aelian's διά offers a functional description, highlighting the respiratory process through specific pathways on a more general level. These subtle differences underscore the contrast between the scientific tone of Aristotle's testimony, which inclines toward anatomical precision, and Aelian's anecdotal storytelling. In Aristotle's text, the functional focus implied by διά appears earlier in the same passage, where he refers not to a specific organ, such as the ear or nostril, but more abstractly to a part of the head (ἔστι δὲ κεφαλῆς μόριον, δι' οὗ ἀκούει ἄρνουν τὸ οὔς).
38. See White G, *The natural history and antiquities of Selborne, in the county of Southampton*. London: Published by Orr & Smith; 1789. pp. 41-2.

39. Beare JJ, Greek Theories of Elementary Cognition from Alcmaeon to Aristotle. Oxford: Clarendon Press; 1906. pp. 93-94; Singer C, A Short History of Anatomy from the Greeks to Harvey. New York: Dover Publications; 1957. p. 9; Singer C, Underwood EA, A Short History of Medicine. 2nd edition. Oxford: Clarendon Press; 1962. p. 244; Lloyd GER, Alcmaeon and the Early History of Dissection. *Sudhoffs Archiv* 1975;59:122-123; Zhmud L, Ref. 32. pp. 251-252. For a discussion that suggests that Alcmaeon may have observed the post-auditory sinuses of the chamois, whose openings are located behind the base of the ears, and interpreted them as alternative nostrils, see Cherniss C, Ref. 9. p. 333 n. 20 (citing J E Harting).
40. No Archelaus is mentioned in the list of literature in *R.* 1.1.8-11. That said, this list should not be directly equated with the sources Varro made use of in this work, as the texts mentioned there are simply those that address topics related to estate management – texts that any interested party, such as Fundania, the addressee of Varro’s treatise, would be expected to have at hand. It functions as a kind of canon on matters related to farming. As the reference to Archelaus above also suggests, Varro occasionally made use of additional sources that he did not bother to include in the list, likely because they were not directly and unequivocally relevant to farming. On Varro’s sources for *On Agriculture*, see Flach D, Marcus Terentius Varro. *Über die Landwirtschaft*. Darmstadt; 2006. pp. 6-9.
41. The same view is mentioned in passing in Plin. *Nat. hist.* 28.153.
42. Interestingly, the view about the temperature of goats is later attested in the Byzantine agricultural compendium *Geoponica*, where it is attributed to Florentinus, possibly a compiler from the imperial period who likely drew from the same source as Pliny; see *Geop.* 18.9.5 (ed. Beckh): (Περὶ αἰγῶν καὶ τράγων. Φλωρεντίνου.) αἱ δὲ τοιαῦτα καὶ πρὸς ἐπιμονὴν κρείττους εἰσὶ· φύσει γὰρ δύσριγόν ἐστι τὸ ζῶον, ἀμέλει φυσικῶς αἰετὸς πυρέττει· καὶ εἴ ποτε ἐπιλείψει ὁ πυρετός, διαφθεῖρονται.
43. The latter view is also attested in *Geoponica*, where it is attributed to Democritus - though in fact to a later compendium circulating under his name; see *Geop.* 19.4.1 (ed. Beckh): (Περὶ λαγῶν. Δημοκρίτου.) Λέγεται ὅτι ὁ αὐτός ποτε μὲν ἄρρην, ποτὲ δὲ θῆλυς γίνεται, καὶ μεταβάλλει τὰς φύσεις, καὶ ποτε μὲν ὡς ἄρρην γονοποιεῖ, ποτὲ δὲ ὡς θῆλυς τίκτει.
44. See Tsiampokalos T, Ref. 1. pp. 190-198; Tsiampokalos T, A Note on Theon *Prog.* 73,14-21 and Io. Sard. *Comm. in Aphth. Prog.* 8,1-8. *Eikasmós* 2024;35;257-259.
45. Fortunately, Diogenes Laertius, *Vitae philosophorum* 4.17, mentions all three figures: 1) Archelaus, the Presocratic philosopher, a student of Anaxagoras and alleged teacher of Socrates; 2) Archelaus of Chersonesus, the paradoxographer and author of a text on extraordinary zoological phenomena (see below); and 3) Archelaus the Chorographer, to whom two lost texts on rivers and stones are attributed. For more on the latter, see *FrGrHist* 123 T 1. Regarding the Chorographer, if the reference in Diogenes is not to an otherwise unknown bematist (cf. Tzifopoulos YZ, Bematists. In: Bagnall R, Brodersen K, Champion C, Erskine A, Hübner S (eds), *Encyclopedia of Ancient History III*. Malden, Mass.: Wiley-Blackwell; 2023. pp. 1079-1080), it may instead point to the client king of Cappadocia, the so-called Archelaus I Philopatris, Ctistes (reigned 36 BCE–17 CE). For this identification, see already Berger EH, Archelaos (15). In: *RE II.1*. Stuttgart: Metzler; 1895. pp. 451-452. For further details on King Archelaus (*PIR*² A 1023), see Sullivan RD, The Dynasty of Cappadocia. In: *ANRW II.7.2*. Berlin: W. de Gruyter; 1980. pp. 1149-1161.
46. On Archelaus of Chersonesus, see Reitzenstein R, Archelaos (34). In: *RE II.1*. Stuttgart: J.B. Metzler; 1895. pp. 453-454; Maass E, *Commentariorum in Aratum Reliquiae*. Berlin:

- Weidmann; 1898. p. 79 (in the critical apparatus); Kroll W, *Zum Art. Archelaos* Nr. 34. In: *RE Suppl.* VI. Stuttgart: J. B. Metzler; 1935. pp. 11-12; Fraser PM, *Ptolemaic Alexandria II: Notes*. Oxford: Clarendon Press; 1974. p. 1089 n. 451; Page DL, *Further Greek Epigrams: Epigrams before A.D. 50 from the Greek Anthology and other sources*, not included in 'Hellenistic Epigrams' or 'The Garland of Philip'. Revised and prepared for publication by Dawe RD, Diggle J. Cambridge: Cambridge University Press; 1981. pp. 20-21, 345-346; Voutiras E, *Le cadavre et le serpent, ou l'héroïsation manquée de Cléomène de Sparte*. In: Pirenne-Delforge V, Suárez de la Torre E (eds), *Héros et héroïnes dans les mythes et les cultes grecs: Actes du colloque organisé à l'Université de Valladolid, du 26 au 29 mai 1999*. Liège: Presses universitaires de Liège; 2000. p. 384 n. 30; Wenskus O, *Paradoxographoi*. In: *DNP IX*. Stuttgart: J.B. Metzler; 2000. p. 311; De Angelis A, *Tra Varrone, De re rustica 3.16.4 ed Archelao di Chersoneso, fr. 2 FGE Page*. *Seminari Romani di Cultura Greca* 2007;10:311-317; Ibáñez Chacón A, *Poesía y paradoxografía*. *Maia* 2008;60:393-404. The testimonies concerning his work were first collected by Westermann A, *Παραδοξογράφοι*. *Scriptores rerum mirabilium Graeci*. Braunschweig, London: Black et Armstrong; 1839. pp. 158-160, and later also by Giannini A, *Paradoxographorum graecorum reliquiae*. Milan: Instituto editorial Italiano; 1964. pp. 24-28. The numbering of the latter edition is used for references here. Some verses attributed to him were edited and commented on by Page D, *op. cit.*, pp. 20-24. Regarding his place of origin, Page D, *op. cit.*, p. 20 n. 2, suggests it is likely to be identified with Χερσόνησος μικρά, a peninsula on the Mediterranean coast of the Mareote nome, west of Alexandria.
47. Athenaeus of Naucratis, *Deipnosophistae* 9, 409c (= T1 Giannini); *Scholia et glossae in Nicandri theriaca* 823 (= T2 Giannini); Diogenes Laertius, *Vitae philosophorum* 4.17 (= T3 Giannini).
 48. Page D, Ref. 46. p. 21.
 49. *Ibid.*
 50. Cf. Page D, Ref. 46. pp. 21-24.
 51. Varro, *Res rusticae* 2.3.5 (= F 1 Giannini); *id.* 3.12.4 and Pliny the Elder, *Naturalis historia* 8.218 (= F 2 Giannini); Varro, *Res rusticae* 3.16.4 (= F 11 Giannini); cf. Antigonus of Carystus, *Historiarum mirabilium collectio* 19.3 [= F 10 Giannini]; Varro, *Res rusticae* 3.11.4 (= F 12 Giannini); Pliny the Elder, *Naturalis historia* 28.43 (= F 13 Giannini); *op. cit.*, 28.34 (= F 14 Giannini).
 52. *Anecdota Graeca*, ed. Boissonade, I p. 417-418 (= F 3 Giannini).
 53. Antigonus of Carystus, *Historiarum mirabilium collectio* 19.3 (= F 4 Giannini).
 54. Antigonus of Carystus, *Historiarum mirabilium collectio* 89.2 (= F 5 Giannini).
 55. Aelian, *Natura animalium* 2.7 (= F 6 Giannini).
 56. Athenaeus of Naucratis, *Deipnosophistae* 9, 409c (= F 7 Giannini).
 57. *Anecdota Graeca*, ed. Boissonade, I p. 418 (= F 8 Giannini).
 58. *Scholia et glossae in Nicandri theriaca* 823 (= F 9 Giannini).
 59. It is worth noting that a work entitled ἰδιοφυῆ is attributed to one of the Ptolemaic kings; on this, see Page D, Ref. 46. p. 84. Furthermore, Page D, Ref. 46. p. 20 n. 1, citing Hecker A, *Commentationis criticae de Anthologia Graeca. Pars prior*. Leiden: E. J. Brill; 1852. pp. 17-18, who in turn mentions Diodorus Siculus, *Bibliotheca historica* 3.36.3, and Athenaeus of Naucratis, *Deipnosophistae* 14, 654c, highlights Philadelphus' interest in strange animals. This evidence, which, at least as far as Diodorus is concerned, depends on Agatharchides of Cnidus, suggests that Philadelphus assembled a kind of zoo, in which extraordinary and powerful animals, such as elephants, were kept.

60. That said, the closest parallel to Hippolytus' version in terms of word choice appears to be Varro, as both testimonies uniquely refer to the capacity of goats not merely to breathe, but "to draw breath" through the nostrils; see Varro: *sed auribus spiritum ducere solere pastores curiosiores aliquot dicunt*, alongside Hipp.: ὁδὸν γὰρ αὐταῖς ταύτην εἶναι λέγουσι τοῦ δι' ἀναπνοῆς ἐλκομένου πνεύματος).
61. Cf. n. 26 above.
62. Varro, for his part, supposedly composed the work on agriculture in a hurry; cf. *R.* 1.1.1.
63. See White, *The natural history and antiquities of Selborne, in the county of Southampton*, 42: "Writers, copying from one another, make Aristotle say that goats breathe at their ears; whereas he asserts just the contrary: 'Alcmaeon does not advance what is true, when he avers that goats breathe through their ears'."
64. I am very grateful to Oliver Hellmann (Trier) for reading an advanced draft of this paper and providing valuable insights and corrections. An earlier version was presented at the workshop organized by Francesca Gambetti and Marco Cilione in Rome. I extend my sincere thanks to the participants for the stimulating discussion. I am also indebted to the editorial board of this journal and the anonymous referees for their insightful comments, which have helped improve the article.

