SAPIENZA
UNIVERSITÀ DI ROMA

E-ISSN 2531-7288
ISSN 0394/9001

MEDICINA NEI SECOLI
Journal of History of Medicine and Medical Humanities
37/3 (2025) 57-80

Received: 02.08.2025
Accepted: 12.09.2025
DOI: 10.13133/2531-7288/3183

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New Remarks on the Relationship Between Alcmaeon and the Egyptian Medical Tradition: A Comparative Analysis of Theophrastus' *De Sensibus* Chapters 25-26 and Column 56 of the Shabaka Stone (BM EA 498)

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ABSTRACT

A comparative analysis of column 56 of the Shabaka Stone (BM EA 498), also known as Memphite Theology (747-656 BC), and the testimonium of Theophrastus' *De Sensibus* chap. 25-26 (4th century BC) allows us to gain valuable insights into the knowledge heritage that Alcmaeon probably drew upon—either directly or indirectly—as he conducted his research on sense-perceptions and channels/*poroi* in 5th-century BC Croton. This comparison with Egyptian medical tradition enables us to reassess the *vexata quaestio* regarding the origins of anatomical dissection of the human body in Greece and to place Alcmaeon's theories in a more interconnected historical context.

Key words: Brain - Sense Perceptions - Channels/*Poroi* - Egypt - Heart - Conduits/*Mt.w*

In his *Commentary on Plato's Timaeus*, chap. 237, the philosopher Calcidius (4th century AD) reports that Alcmaeon of Croton, as an expert on questions regarding nature (*in physicis exercitatus*), was the first person to dare to perform a dissection (*primus exsectionem adgredi est ausus*): his engagement focused on revealing the nature of the eye (*oculi natura*)[1]. According to Theophrastus (*De Sens*. 25-26), Alcmaeon identified specific channels (πόρους) capable of conducting sensations from the sense organs—namely, ears, nose, tongue, and eyes—to the brain[2]. These accounts constitute the two primary sources we have about Alcmaeon's research on the human brain. Although the issue is much debated, when it comes to hearing and smell, the most cautious scholars note that the πόροι could identify the nostril conduits and the external auditory canal. However, in the case of vision, attention had to be concentrated not only on the surface structures of the eye, but also on those behind it. The Crotonian physiologist could have practised a limited incision of the eyeball on animals to expose the internal structures that lead towards the brain. This perspective does not alter the fact that dissection in Greece gradually began to establish itself after Aristotle through the work of Alexandrian anatomists Herophilus and Erasistratus during the late 4th and 3rd centuries BC. It became a widespread practice in the Greco-Roman period, particularly due to the contributions of Galen (2nd century AD)[3].

The ideas of Alcmaeon were sometimes associated with the influence of ancient Egyptian medical practices. Only the autopsy investigations, closely related to embalming techniques, could provide an adequate background for understanding the vascular connections between the sense organs and the brain[4]. The channels (πόροι) appear to reflect the doctrine of the *mt.w*-conduits (Fig. 1), which refers to a system of vessels—veins and arteries, as well as muscles and nerves—that extend from the heart throughout the body, including the head[5]. Egyptian physicians (*zwn.w*.PL) were capable of examining deep lesions of the skullcap. In Gloss A of Case 6 by *Smith Papyrus*, it describes the process of palpating a fracture to the point of touching the 'membrane enveloping his brain' and the 'fluid in the interior of his head' with the fingers. Although the pathology was deemed untreatable—no intervention was performed other than the topical application of grease (II 22-23)—the surgeon was able to identify the meningeal membrane and the cerebrospinal *liquor*[6]. In Pharaonic Egypt, there was a remarkable level of knowledge in the field of ophthalmology. The *Ebers Papyrus*, particularly chap. 336-441, details various pharmacological remedies, comprising ointments and eye drops, used to treat a wide range of eye diseases. These treatments addressed conditions affecting the eyelids (e.g., blepharitis, styes, trichiasis, and *ectropion*), the conjunctiva (trachoma, *xanthelasma*, *pterygium*, and inflammation), excessive tearing, the cornea (keratitis), the iris (mydriasis), the crystalline lens (cataracts), and the retina (hemeralopia). The substances used by the eye specialist (*zwn.w jr.tj*) had mostly soothing and antibacterial properties, including ingredients like *ḏ3r.t*-plant, honey, galena, malachite, and terebinth resin. There are no records of surgical interventions[7].

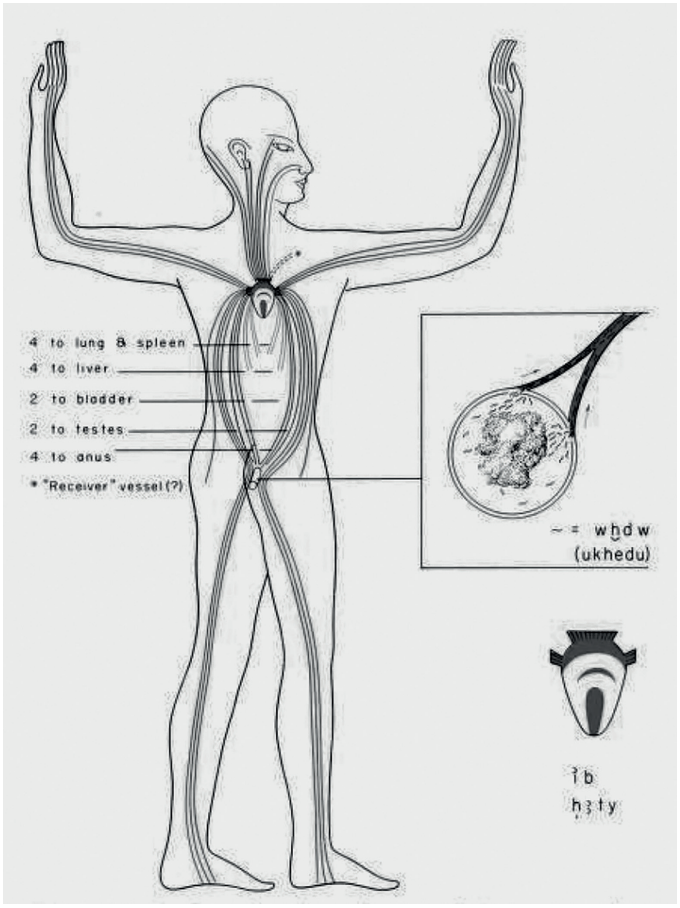


Fig. 1. The *mt.w*-conduits or vessels system is illustrated here. This circle leads to the lungs, spleen, liver, testes, and anus, converging towards the heart (*ḥ3.tj* and *jb*). The pathogenic residue *wḫd.w*, which is expelled from the anus, is shown separately (cf. Nunn JF, Ref. 5. p. 61; David R, Forshaw R, Ref. 5. pp. 7-8). The image is sourced from Majno G, Ref. 5. Plate 3.8.

Chapter 854c of the *p.Ebers* reports the existence of four *mt.w*-conduits inside the temples, specifying that 'the rearmost one is what supplies blood for the eyes'[8]. Since the capillaries that supply blood to the eyes may have been overlooked by Egyptian doctors due to their small size, the conduits mentioned could indicate the optic nerves. The reference to the four conduits or vessels is better understood if we consider the anatomy of the optic chiasm, as illustrated in 1543 by Andreas Vesalius, and so called because it is shaped like an "X". The optic nerves were called πόροι by the ancients, since they were thought to be hollow[9]. Finally, in the medicine of the Pharaonic age, there are numerous references to the effects of wounds or traumas on the cerebral level, as well as on the sense organs and bodily functions. These effects include symptoms such as neck stiffness, an inability to turn one's head, and bleed-

ing from the nostrils and ears (*p.Smith* 3; 4-5; 7-8). Alcmaeon, for his part, according to Theophrastus (*De Sens*. 25-26), believed that sense perceptions are incapacitated when the brain moves or shifts its position (κινουμένου καὶ μεταλλάτοντος τὴν χώραν), because it obstructs the passages through which the sensations take place (ἐπιλαμβάνειν γὰρ τοὺς πόρους). The similarities between Alcmaeon's medical doctrines and the Egyptian tradition do not conceal an important point: according to the available sources, only the Crotonian physiologist assigned a central and dominant role to the brain[10]. In contrast, the Egyptian physicians regarded the heart as the most crucial organ. During the mummification process, the brain was removed in small pieces using a hook inserted through the nasal cavities[11]. A recent study of 33 mummified individuals revealed that the brain is retained in a third of the mummies, and where it is extracted, the cranial cavity is treated with similar care as the trunk of the body[12].

Contacts between Croton and Egypt date back to ancient times, as evidenced by archaeological discoveries[13]. These connections became stronger shortly after the death of Pythagoras, highlighted by the journey of Paapis, a priest-scribe of the Houses of Life, who travelled from Rhegium to Metapontum in Italy[14]. However, in a context of productive cultural exchanges, it is reasonable to consider the physician Democedes of Croton as the most significant *intermediary* during the latter half of the 6th century BC. Before returning to his homeland, he served at the Achaemenid court of Darius I, which was a true crossroads of civilisations between Greece and India, and where doctors traditionally had an Egyptian origin[15]. This situation becomes even more significant when we consider that Democedes and his colleague Udjahorresnet of Saïs, who was the archiater of Darius I, were both active in Persia around the same time (521/520 BC). Additionally, there remains a possibility, still not completely dismissed in studies, that the ophthalmologist mentioned by Herodotus (3, 1, 1-2) as serving Cyrus and advising Cambyses could be identified with the Saitic chief of physicians (*wr-zwn.w*)[16]. The role of the physician Democedes as a *cultural mediator* is supported by probable parallels between Alcmaeon's doctrine regarding the connection between the brain and seed through the spinal canal and similar concepts attested in ancient India (*Kundalini*), which were later included in Plato's *Timaeus* (77c). Furthermore, the notion that the eye, as the organ of vision, contains fire (Theophr. *De Sens*. 25-26) appears to be rooted in the Indian lore of Nyaya-Vaiseshika[17]. Finally, no less important is the contribution that Pythagoras, who was present in Croton between the end of the 6th and the beginning of the 5th century BC, was probably able to provide, especially considering the remarkable cultural similarities between his teachings and those of contemporary Egypt about the belief in the immortality of a virtuous individual's soul[18].

The connection between Alcmaeon's doctrine of channels (πόροι) and the *mt.w*-conduits or vessels found in Pharaonic Egyptian medicine is further supported by a de-

tailed analytical comparison between Theophrastus' testimonium, *De Sensibus* chap. 25-26 (4th century BC)[19], and column 56 of the Shabaka Stone, which dates back to Dynasty XXV, 747-656 BC (Fig. 2; 3)[20]. The latter part of this inscription is also recognised as "Text of Memphite Theology" due to its cosmogonic content (*MT*)[21]. Both passages are presented as follows.

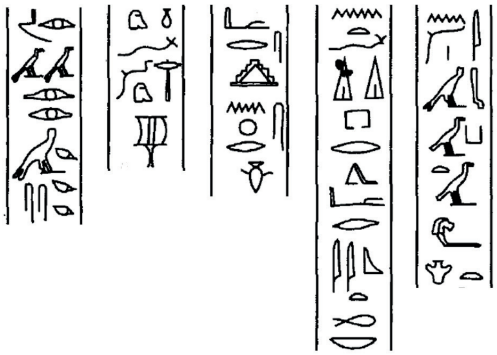
Alcmaeon (Theophr. *De Sens*. chap. 25-26)	Memphite Theology, col. 56
Among those who explain sensation by what it is unlike, Alcmaeon begins by defining the difference between man and the lower animals. Man, he says, differs from the other creatures because he alone *comprehends* (ξυνίησι), whereas they have sensation, but not *comprehend* (αἰσθάνεται μέν, οὐ ξυνίησι); *to be wise* (φρονεῖν) *and to have sensation* (αἰσθάνεσθαι) are different (ἕτερον), not, *in the manner of* (καθάπερ) Empedocles, the same (ταὐτόν). He next speaks of each sense separately. Hearing, he says, takes place through the ears (ἀκούειν μὲν οὖν φησι τοῖς ὠσίν) because they contain a void, which resounds. Sound is produced in the cavity and the air echoes it. Smelling is effected by means of the nostrils (ὀσφραίνεσθαι δὲ ῥισὶν) along with respiration when air is drawn up into the brain (ἅμα τῶι ἀναπνεῖν ἀνάγοντα τὸ πνεῦμα πρὸς τὸν ἐγκέφαλον). Tastes are distinguished by the tongue (γλώττηι δὲ τοὺς χυμοὺς κρίνειν). Since it is warm and soft it dissolves substances by its heat and, owing to its porous and delicate structure, it receives and transmits the flavour. Eyes see (ὀφθαλμοὺς δὲ ὁρᾶν) through the water surrounding them. That the eye contains fire is evident, for the fire flashes forth when it is struck. Vision is due to the gleaming element and the transparent when it gives back a reflection; the purer this element is, the better the eye sees. All the senses are connected in some way to the brain (ἁπάσας δὲ τὰς αἰσθήσεις συνηρτῆσθαί πως πρὸς τὸν ἐγκέφαλον). Consequently they are incapacitated if it is moved or shifts its position (κινουμένου καὶ μεταλλάττοντος τὴν χώραν). For it obstructs the passages through which the sensations take place (ἐπιλαμβάνειν γὰρ τοὺς πόρους, δι' ὧν αἱ αἰσθήσεις). Concerning touch (ἁφῆς) he tells us neither the manner nor the means whereby it is effected. This, then, is the extent of his explanation[22].	 *m33 jr.tj sḏm msḏr.wj* *ssn fnḏ ṯ3w* *sʿrǝsn ḫr ḥ3.tj* *ntf dd prj ʿrqjj.t nb*(*.t*) *jn ns wḫm k33.t ḥ3.tj* The eyes see, the ears hear, the nose breathes: they report to the heart, and it makes every wise decision come forth; and it is the tongue that repeats what the heart has thought[23].

Fig. 2. This image depicts the Shabaka Stone, carved from black granite, with dimensions of 92 x 137 cm (London, British Museum, Egyptian Antiquities 498)—Creative Commons Attribution-Share Alike 4.0 International license.

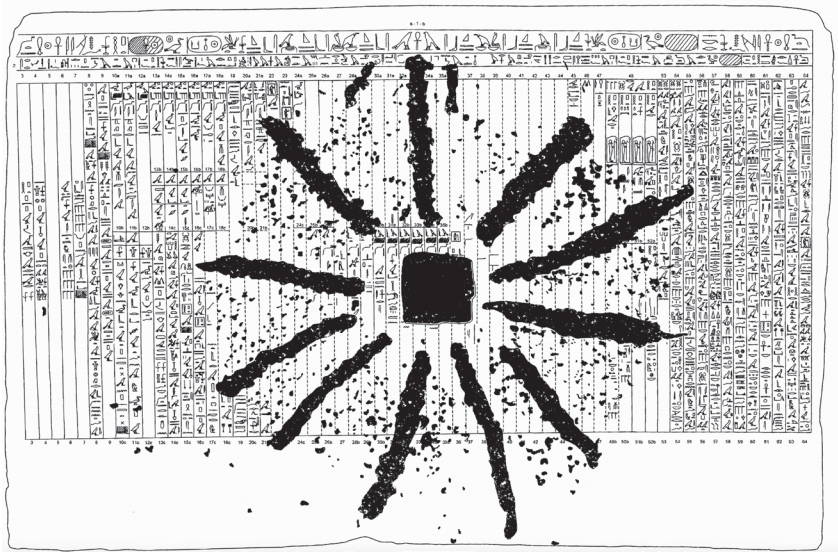


Fig. 3. This image depicts the transcription of the hieroglyphs from the Shabaka Stone, as presented by El Hawary A, Ref. 21. p. X, Bild. 13.

A first significant parallel between Alcmaeon and the Text of Memphite Theology, col. 56, concerns the association of sense organs with the corresponding actions performed.

Alcmaeon, reflecting the *logical* thought prevalent in Greek culture, also explains how each sensation operates (διότι)[24]. He references the tongue (γλώττηι) and its distinct ability to perceive various tastes/humours (τοὺς χυμοὺς κρίνειν), denoting a detail that is absent in the *MT*. In contrast, the *MT* mentions the use of the tongue (*ns*) about the *word* as a manifestation of the thought originating in the heart (*kȝȝ.t ḥȝ.tj*). Neither Alcmaeon, as noted by Theophrastus, nor the *MT* addresses the sense of touch. Table 1 illustrates the overall scheme of the correspondences between these two sources.

Tab. 1. Sense organs and their functions in *MT* col. 56 and Theophr. *De Sens*. 25-26.

MT 56	*jr.tj*	*mȝȝ*
Alcmaeon 24 A 5 DK	ὀφθαλμούς	ὁρᾶν
Translation	eyes	to see/see

MT 56	*msḏr.wj*	*sḏm*
Alcmaeon 24 A 5 DK	ὠσίν	ἀκούειν
Translation	ears	to hear/hear

MT 56	*fnḏ*	*ssn*/*ṯȝw*
Alcmaeon 24 A 5 DK	ῥισίν	ὀσφραίνεσθαι
Translation	nose	to smell/smells to breath/breathes

MT 56	---	---
Alcmaeon 24 A 5 DK	γλώττηι	χυμοὺς κρίνειν
Translation	tongue	to discern tastes/ to discern humours

The lemma *jr.tj* or *jr*.DU derives from the word for 'eye' (*jr.t*) and signifies 'the two eyes'[25]. The Greek term ὀφθαλμοί is used in the plural, and it appears in the dual form only a few times[26]. The corresponding function is expressed by the verb *mȝȝ*, in the 2ae-gem imperfective form, meaning 'to see', 'to look', which in its absolute value corresponds to the Gr. ὁράω[27]. The term *msḏr.wj*, as a dual form of *msḏr* signifying 'ear', identifies the 'ears'[28], and corresponds to the Gr. word ὠσίν, derived from οὖς[29]. The action of 'hearing' is rendered by the verb 3ae-lit *sḏm*[30], which is comparable to the Gr. verb ἀκούειν[31]. The lemma *fnḏ* refers to the 'nose'[32], similar to the Gr. ῥισὶν, derived from ῥίς, which in the plural means 'nostrils', corresponding to the Lat. *nares*[33]. The relative function is expressed by the verb *ssn*, imperfective 3ae-lit, with the double meaning of 'to smell' and 'to breathe', to which is added the lemma *ṯȝw* denoting 'air, wind, breath'[34]. In Greek, there is the verb ὀσφραίνεσθαι, denoting 'to catch scent of' and 'to smell'[35]. Finally, the term *ns* for 'tongue', used in the *MT* regarding the *thought of the heart* (*kȝȝ.t ḥȝ.tj*)[36], corresponds to the Gr. word γλῶσσα (Att. γλῶττα); in Alcmaeon, this lemma is associated with the human ability to discern various tastes/humours (χυμοὺς κρίνειν)[37].

The most significant and original parallelisms between Theophrastus, *De Sens*. 25-26, and column 56 of the *MT* become evident when we consider three key points. First, it is the organs of the body—the eyes, ears, nose, and, for Alcmaeon, also the tongue—that initially produce as a *medium* individual sense perceptions according to their nature. Second, there is a similar concept of convergence (*sʿr≠sn*/συνηρτῆσθαι) of sense perceptions through the conduits/channels (*mt.w*/πόροι) towards a single superior centre, represented by the heart in the Egyptian tradition (*ḥ3.tj*) and by the brain in the doctrine of Alcmaeon (ἐγκέφαλον). Third, the development of human thought can be seen in two equivalent forms: thought-decision, which means 'to be wise' or 'to have a mind' (*prj ʿrqjj.t nb(.t)*/φρονεῖν), and thought-understanding, which denotes an act of intelligence (*k33.t*/ξυνίησι). Table 2 below illustrates the associations outlined above.

Tab. 2. Conduits, heart/brain and mind in *MT* col. 56 and Theophr. *De Sens*. 25-26.

MT 56	*sʿr≠sn*	*ḫr*	*ḥ3.tj*
Alcmaeon 24 A 5 DK	συνηρτῆσθαι	πρός	> ἐγκέφαλον <
Translation	to report/to be connected	on/to	heart//brain

MT 56	*prj ʿrqjj.t nb(.t)*	*k33.t*
Alcmaeon 24 A 5 DK	φρονεῖν	ξυνίησι
Translation	to come forth a wise decision/to be wise/ to have a mind/to be in one's right mind	to comprehend/ to understand/to think

p.Smith 1; 7; 9; 34; *p.Ebers* 854c	*mt.w*
Alcmaeon 24 A 5 DK	πόρους
Translation	conduits/vessels/channels

Analytically, the verb *sʿr≠sn*, derived from *sʿr*, which means 'to make ascend' or 'to present', refers to various sensations, including sight, hearing, and smell. In this context, it employs the determinative O41  , which suggests the convergence of individual sense perceptions into a superior whole unity, with the heart symbolising the seat of intellect[38]. In the Greek text, the verb συνηρτῆσθαι, a medio-passive form of συν, meaning 'together', and ἀρτάομαι, signifying 'to fasten to', conveys the idea of 'to join together' or 'to be connected'[39]. The preposition *ḫr*, indicating 'on' or 'upon', is similar to the Greek word πρός, which means 'towards', as it also denotes a direction. Indeed, it is usually translated as 'to'. In the text handed down by Theophrastus, the concept of superiority is introduced by asserting that thinking and perceiving are two distinct activities (ἕτερον), and that the former is a property unique to humans[40]. The main difference between Alcmaeon and the *MT* lies in the definition of the hegemonic organ. In the Egyptian tradition, it is the heart, which is rendered by the terms *ḥ3.tj* and *jb*, whereas for the Crotonian physiologist, it is the

brain (ἐγκέφαλον)[41]. The activities of φρονεῖν and ξυνιέναι for Alcmaeon constitute the basis for distinguishing humans from animals. The first verb, according to Greek culture, primarily means 'to have a mind', 'to be in one's right mind' or 'to be wise', in the sense of having a good and functioning reason[42]. The second term, on the other hand, refers to the ability to 'understand' or 'to have intelligence'[43]. The Text of Memphite Theology depicts a scenario that is very similar to the one described about Alcmaeon. The phrases used are *prj ʿrqjj.t nb(.t)* and *kȝȝ.t*. The first expression consists of the verb *prj*, which is in the 3ae-inf form and means 'to go forth' or 'to come forth'[44]. This verb is combined with the feminine noun *ʿrqjj.t*, which can be translated as 'wise decision'[45], as it is derived from the verb *ʿrq*, which not only means 'to know' but also 'to be wise'[46]. The sentence is completed by the primary adjective *nb*, which means 'every' or 'all'. Therefore, the comprehensive sense conveys the idea of the 'coming forth of every wise decision'[47]. The second expression is represented by *kȝȝ.t*, a form of the verb 3ae-inf *kȝ*(*j*), which means 'to think about', 'to plan'[48]. From this, the nouns *kȝ.t* and *kȝȝ.t* derive, commonly signifying 'thought' or 'vital principle of intelligence'[49]. Thus, both in Alcmaeon—given the thematic coherence of Theophrastus' testimonium—and in the *MT* col. 56, the sense perceptions, collected together, are conceived as fundamental factors of thought. However, the latter exists on a distinct and superior level if compared to sense perceptions, manifesting in two complementary forms: thought as 'to be wise' or 'to have a mind' (φρονεῖν/*prj ʿrqjj.t nb(.t)*) and thought as intellectual thinking or understanding (ξυνιέναι/*kȝȝ.t*)[50]. This distinction also occurs in some way in Empedocles, perhaps due to the influence of Alcmaeon: 'For know that all things *have a mind* and their share of thought' (πάντα γὰρ ἴσθι φρόνησιν ἔχειν καὶ νώματος αἶσαν)[51]. Plato, in a passage from the *Phaedo* (96b), traditionally associated with Alcmaeon, uses the verb φρονέω to describe the brain's activity, as does Theophrastus in *De Sens*. 25-26[52]. The term πόροι, meaning 'channels' or 'passages', corresponds to the Egyptian lemma *mt.w*, which does not occur in the *MT* but is well-documented in the medical papyri[53]. Theophrastus, in *De Sens*. 25-26, does not further specify the nature of πόροι, which remains uncertain. Nevertheless, Alcmaeon's use of this term regarding the human body is the earliest known instance. In the parallel passage about Diogenes of Apollonia, the terms φλεβία and φλέβες, which were more common in archaic and classical Greece, are employed in the sense of 'vessels'[54]. Alcmaeon's ideas would have influenced Empedocles to develop the doctrine of the ἀπορροαί, which refers to the effluences that detach from objects and are captured by the πόροι spread throughout the human body[55]. The sense organs also have πόροι, but these do not have the function of connecting the sense organ with the seat of intelligence—which for Empedocles is the heart or the blood around the heart—but only of determining whether the sense organ can receive the effluences that are poured forth by external objects[56]. Alcmaeon, on the other hand, as Theophrastus

recalls, had focused on the features of the sense organs and their connection to the brain, without considering the similarities between the act of perception and the nature of the perceived thing[57]. Finally, to complete the framework of the remarkable lemmas analysed, the term ἐγκέφαλος literally denotes 'that which is inside the head'[58]. In Egyptian texts, the word indicating the brain is the masculine noun *ȝjs*, which sometimes also has the meaning of 'viscera'[59].

Although animals, as we commonly observe, possess a brain capable of processing sensory data, Alcmaeon, as referenced by Theophrastus in *De Sens*. 25-26, believed they are unable to engage in thought. We cannot precisely define what he meant by intelligence, beyond the idea of integrating sense perceptions in a single centre. His doctrine, considering the *incipit* of Περὶ Φύσεως transmitted by Diog. Laert. 8, 83, suggests that the ability of τεκμαίρεσθαι arises as a higher-level activity unique to humans. This term, according to post-Homeric Greek lexicon, refers to the capacity to make rational judgments based on the signs provided through sensation. In contrast, clarity of knowledge (σαφήνειαν) is attributed solely to the gods[60]. The specific scope of interest is a matter of debate, primarily depending on the interpretation of fragment 24 B 1 DK. The argument revolves around 'that which is not evident' (περὶ τῶν ἀφανέων), which is introduced at the beginning of the speech. Attention then turns, after the high point, to 'mortal things' (περὶ τῶν θνητῶν), a phrase that critics sometimes expunge[61]. On the other hand, the meaning of the fragment changes if we combine the two expressions placed after the high point, in the sense of 'on the invisible things that concern mortals' (περὶ τῶν ἀφανέων περὶ τῶν θνητῶν). This interpretation suggests that Alcmaeon, as a physician with a global vision of the cosmos and human nature characterised by similar functioning mechanisms, focused on the difficulty of understanding the internal workings of the body and invisible diseases[62]. Overall, it's essential to recall that Alcmaeon's work is situated within the context of the late archaic and proto-classical wisdom (*sophia*), preceding the emergence of the specialised and disciplinary knowledge that characterises the Hellenistic period. Alcmaeon can be seen as a philosopher, scientist, physician, naturalist, politician, and minister of the sacred all at once. None of these roles detracts from the global vision of the Presocratic *sophos*, which encompasses both human and divine aspects, addressing the universe as a living whole. In the same way, experience, technical skill, and reasoning had to complement each other[63]. On one hand, clear knowledge (σαφήνειαν) belongs to the gods, and not to humans, especially about 'non-manifest things'. However, human thought—when forming reasonable judgments based on the signs that sensation presents to the brain (τεκμαίρεσθαι)—is not limited to merely receiving perceptions. The activities of 'having a mind' (φρονεῖν) and 'perceiving' (αἰσθάνεσθαι) are different and not the same (Theophr. *De Sens*. 25-26). Although sensations as hearing, seeing, smelling, and tasting are fundamental, thought, by combining sense data, operates on a higher level[64]. According to Aëtius *Plac*. IV 17, 1, for Alcmaeon,

'the directing part is in the brain' (τῶι ἐγκεφάλωι εἶναι τὸ ἡγεμονικόν), to the point that 'it is thus by this, which attracts odors by means of acts of breathing, that odors are perceived' (τούτωι οὖν ὀσφραίνεσθαι ἕλκοντι διὰ τῶν ἀναπνοῶν τὰς ὀσμάς). The same concept is found in a passage of Plato's *Phaedo* (96a-b), usually connected to Alcmaeon, where it is stated that it is the brain that provides the sensations (ὁ δ' ἐγκέ φαλός ἐστιν ὁ τὰς αἰσθήσεις παρέχων)[65]. This perspective depicts a framework similar to *MT* col. 56, where the use of the determinative O41 𓁐 denotes the superiority of the heart as the seat of the intellect: the senses are instruments with which the mind works, but it is only the mind that initiates action[66].

Alcmaeon, following the accounts of Calcidius and Theophrastus, is considered a precursor to empirical science and anatomical research based on observation[67]. Some scholars attribute to the Crotonian the fragment 125 Page of the lyric poet Alcman (*Schol. Pind*. I 1, 56), according to which 'experience is the beginning of learning' (πῆρά τοι μαθήσιος ἀρχά)[68]. A relevant reference model is found in Hippocrates (*Morb. Sacr*. 14; 17-20) and Socrates' argument in Plato's *Phaedo* (96a-b), which Aristotle further develops in the *Posterior Analytics* (2, 19, 100a 3 ff.)[69]. This topic is particularly controversial. The late Latin testimonium of the Neoplatonic philosopher Calcidius from the 4th century AD, which may be based on the work of Posidonius, claims that Alcmaeon was the first to perform human dissections to study the nature of the eye in the 5th century BC. However, this assertion is considered unreliable. It primarily serves to illustrate the ideas of sense perception expressed by Plato in the *Timaeus* (45c-d; 69d ff.) and, on the other hand, continues to primarily describe the discoveries made by Herophilus of Alexandria two centuries after Alcmaeon. Moreover, the passage from Calcidius is present in parallel in Galen, who defends the Platonic ideas of the *Timaeus* but does not cite Alcmaeon (*De Placit. Hippocr. et Platon*. 7, 1, 5). Theophrastus's text *De Sens*. 25-26 appears to be more detailed, likely the result of direct knowledge of the writing attributed to Alcmaeon, to which Aristotle would have replied (Diog. Laert. 5, 25). However, the vessels or channels (πόροι) that conduct sense perceptions to the brain are depicted in an elementary manner. This approximate description seems incompatible with the understanding one would expect from an anatomical investigation involving dissection[70]. A significant point is the expression from *De Sens*. 25-26, which states that 'all the senses are connected in some way to the brain' (ἁπάσας δὲ τὰς αἰσθήσεις συνηρτῆσθαίπως πρὸς τὸν ἐγκέφαλον). The use of the adverb πως, meaning 'in some way', suggests at least a somewhat uncertain understanding[71]. However, it is also possible to translate the adverb as 'in un modo o nell'altro', emphasising the different functions of the sense organs[72].

Alcmaeon's theories may have partially influenced Philolaus, who was also active in Croton in the 5th century BC. He held the view that the head is the principle of intelligence (κεφαλὰ μὲν νόου) and the brain possesses the principle of the human

being (ἐγκέφαλος δὲ <σαμαίνει> τὰν ἀνθρώπω ἀρχάν). According to this perspective, animals, on the other hand, are guided by the heart (καρδία δὲ τὰν ζώου). In line with Egyptian tradition and also the Shabaka Stone col. 56, Philolaus considers the heart the seat of life and perception (καρδία δὲ ψυχᾶς καὶ αἰσθήσιος)[73].

The crucial question is: how did Alcmaeon determine that the brain, rather than the heart, is the organ through which sense perceptions reach? Did he arrive at this conclusion through dissection and direct observation, or inference and reasoning? The studies have shown that it is impossible to find a consistent and coherent interpretation[74]. There are considerable doubts about the authenticity of the testimonium of Calcidius (4th century AD), which claims that Alcmaeon was the first to dissect a human body to investigate the nature of the eye. Additionally, Theophrastus' well-documented text on the doctrine of channels (πόροι) conveying sense perceptions to the brain has been criticised as fairly rudimentary[75]. These issues have led scholars to suggest that ancient Egyptian medicine probably influenced Greek culture. The Pharaonic tradition would have provided a valuable heritage of experiences and a source of anatomical observations derived from embalming practices[76]. The *Smith* and *Ebers* papyri reveal a solid understanding of the vessels/conduits of the head, including the temporal and occipital arteries, as well as the nerves that connect the brain to the eyes and spinal cord. These texts describe, for example, the effects of violent head trauma, whether or not there is cerebrospinal fluid leakage. Such injuries can lead to various body movements and conditions, such as meningism, basilar skull fractures, tetraplegia, aphasia, and altered consciousness. The impact on the sense organs, such as bleeding from the nasal cavities and ears, is also addressed[77]. Finally, in this context, possible connections have been suggested between Alcmaeon and the Indian physician Sushruta, who lived in the 6th century BC[78].

The clinical observation, likely made by Alcmaeon, was that the brain can also impact sense perceptions when subjected to unnatural movement, since it obstructs the vessels/channels, interrupting communication (Theophr. *De Sens*. 25-26), and not only consequences on body movements or bleeding from the sense organs, as described in the *Smith Papyrus*[79]. The functionally visible impacts of head trauma on sense perceptions would have led Alcmaeon to consider the brain as a hegemonic organ. In this context, the answer to the question of how he discovered the central role of the ἐγκέφαλος can be found entirely within Theophrastus' testimonium. The method appears to be based on reasoning or inference drawn from clinical observations, and not necessarily on surgical or anatomical examinations[80]. Furthermore, Alcmaeon's commitment was primarily concentrated on the study of the 'non-manifest things' (περὶ τῶν ἀφανέων), as stated at the beginning of Περὶ Φύσεως[81]. This focus inherently bans, even in the case of the interior of the human body, including the brain, autoptic observations through dissection. Indeed, what is not manifest, which is the overarching theme of the work, can only be accessed by humans through reasoning based on

signs (τεκμαίρεσθαι). Clear knowledge (σαφήνειαν), which for us moderns takes the form of empirical-scientific knowledge as certainty, is reserved solely for the gods. In this regard, classical Greek tradition contains numerous references to the difficulty or impossibility of studying the interior of the human body and hidden diseases[82]. An attempt at dissection, however, cannot be entirely dismissed in the current state of research, although it was probably limited, as has been noted, to the removal (*exsectio*) of an animal's eyeball[83]. Finally, this perspective is particularly relevant when we ponder that, regarding the study of the eye's nature emphasised by Calcidius, knowledge of the optic nerves as conduits-*mt.w* can already be found in chapter 854c of the *Ebers Papyrus*. It is reasonable, therefore, to assume that the medical and sacred colleges of the time, spanning between East and West (e.g., the Houses of Life in Egypt and the Asclepius Temples in Greece), shared this knowledge as a common heritage, especially after the complete Persian conquest of Egypt between the end of 6th and the beginning of 5th centuries BC, which facilitated access to the ancient sanctuaries of the land of the Pharaohs[84].

The argument becomes even more interesting when we consider that in Greece, after Alcmaeon, while Anaxagoras, Hippocrates, Plato and Strato considered the brain as the hegemonic organ, other important thinkers like Empedocles, Democritus and, still in the 4th century BC, Aristotle (who, moreover, was the son of the physician Nicomachus [*Suda* N 399]), then Diocles, Praxagoras, the Stoics and the Epicureans, referred to the heart in the Egyptian manner as the seat of the intellect, thought, and the soul[85]. In the Greek medical, philosophical, and scientific tradition, which included the writing attributed to Alcmaeon—considered worthy of reply by Aristotle (Diog. Laert. 5, 25)—there was likely no awareness of completely irrefutable proof derived from direct observation. This level of certainty became common after the anatomical studies conducted by Herophilus and Erasistratus of Alexandria during the Hellenistic period (late 4th to 3rd century BC) and later by Galen in the Roman era (2nd century AD)[86]. This feature is more relevant when we consider that the same perspective was also held by Philolaus, who was a fellow countryman and contemporary of Alcmaeon. As we noted, while he acknowledged the brain as the principle of the human being, he linked sense perception to the heart, following a view similar to that expressed in the Egyptian Text of Memphite Theology[87].

Returning to the specific argument of this paper, the inscription of the Shabaka Stone, although it was a cosmogonic rather than a medical text, when we consider the section that describes the heart and sense organs (col. 56), probably reflected precise medical doctrines prevalent in Pharaonic Egypt[88]. It has a basic logical structure that, despite some differences, is similar to Theophrastus' testimonium *De Sens*. 25-26. The *MT* provides a concrete example of the knowledge heritage that Alcmaeon likely benefited from, either directly or indirectly, as a starting point for his research in 5th-century BC Croton, renowned for its excellent physicians[89]. This view is especially

relevant given the long-standing connections that the Achaean city maintained with the Egyptian tradition, as archaeological finds confirm[90]. These links became further strengthened in the second half of the 6th century BC, partly due to the experiences of the doctor Democedes, who worked in Persia at the Achaemenid court of Darius I alongside his Saite colleague, the chief of physicians Udjahorresnet. Additionally, the arrival of Pythagoras in the West, whose teachings drew significant inspiration from contemporary Egypt, contributed to these cultural exchanges[91].

Bibliography, notes and references

1. Alcmae. 24 A 10 DK; R 6 LM; 48 WTL.
2. Alcmae. 24 A 5 DK; D 11-13, 15-16, 18-19 LM; 11 WTL.
3. See Mansfeld J, Alcmaeon: "Physikos" or Physician? With some remarks on Calcidius "On Vision" compared to Galen, Plac. Hipp. Plat. VII: In Mansfeld J, de Rijk LM (eds), Kephalaion: Studies in Greek Philosophy and its continuation offered to Professor de Vogel CJ. Assen: Van Gorcum; 1975. pp. 26-38; Vegetti M, Il coltello e lo stilo. Milano: Il Saggiatore; 1979; Von Staden H, Herophilus. The Art of Medicine in Early Alexandria. Edition, translation and essays. Cambridge: Cambridge University Press; 1989. pp. 189-192; Lloyd GER, Alcmaeon and the early history of dissection. Sudhoffs Archiv 1975;59:113-128; Id., Metodi e problemi della scienza greca. Roma-Bari: Editori Laterza; 1993. pp. 282; 302-303; 329; Crivellato E, Ribatti D, Soul, mind, brain: Greek philosophy and the birth of neuroscience. Brain Research Bulletin 2007;71:327-336; Lopez F, Democede di Crotone e Udjahorresnet di Saïs. Medici primari alla corte achemenide di Dario il Grande. Pisa: Pisa University Press; 2015. pp. 379-381; Huffman C, Alcmaeon, The Stanford Encyclopedia of Philosophy (Summer 2021 Edition); Edward N. Zalta(ed.). URL = <https://plato.stanford.edu/ archives/sum2021/entries/alcmaeon/>: 'It would be a serious mistake then to say that Alcmaeon discovered dissection or that he was the father of anatomy, since there is no evidence that he used dissection systematically or even that he did more than excise a single eyeball'.
4. Cf. Harris JR, The Legacy of Egypt. Oxford: The Clarendon Press; 1971. p. 112; Perilli L, Alcmeone di Crotone tra filosofia e scienza. Per una nuova edizione delle fonti. Quaderni Urbinati di Cultura Classica Nuova Serie 2001;69(3):64-66.
5. See *p.Smith* 1-8; 13; 17; 20; 31; 33-34; *p.Ebers* 854c. Cf. Breasted JH, The Edwin Smith Surgical Papyrus. Published in facsimile and hieroglyphic transliteration with translation and commentary in two volumes, voll. I-II. Chicago, Illinois: The University of Chicago Press; 1930. pp. I, 109-113; Sanchez GM, Meltzer ES, The Edwin Smith Papyrus: Updated Translation of the Trauma Treatise and Modern Medical Commentaries. Atlanta: Lockwood Press; 2012. pp. 33, 46, 61, 66, 74, 87-88; 121, 136, 150, 202, 214; Clayton J, Mental Illness in the Ancient Egyptian "Book of the Heart". A Reassessment of 854A-855Z of the Ebers Medical papyrus. Wallasey: Abercromby Press; 2022. p. 16; Aziz S, The Human Brain in Ancient Egypt. A Medical and Historical Re-evaluation of Its Function and Importance. Summertown Pavilion: Archaeopress Publishing Ltd; 2023. pp. 41-55. For the *mt.w*-conduits, see TLA *mt* (77310); Wb 2, 167.9-14; Grapow H, Grundriss der Medizin der alten Ägypter, VIII Bde. Berlin: Akademie-Verlag; 1954-1962. pp. I, 20-22; 72-76; II, 32; Bardinet Th, Les papyrus médicaux de l'Égypte pharaonique. Traduction intégrale

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6. Breasted JH, Ref. 5. pp. I, 14, 164-174. See Aziz S, Ref. 5. pp. 41-55. In order to the word for 'physician', cf. TLA *zwn.w* (130260); plural *zwn.w*.PL; Wb 3, 427.7-15. In this paper, we follow the transcription rules for hieroglyphic signs established by the TLA.
7. See Krause AC, Ancient Egyptian Ophthalmology. Bulletin of the Institute of the History of Medicine 1933;1:258-276; Ghalioungui P, The House of Life. Magic and medical science in ancient Egypt. Amsterdam: BM Israël Boekhandel en Antiquariaat NV; 1973. pp. 130-132; Leca AP, La medicina egizia al tempo dei Faraoni. Noceto (PR): Edizioni Essebiemme; 2002. pp. 225-236; Nunn JF, Ref. 5. pp. 197-202. About the word for 'eye', cf. TLA *jr.t* (28250); Wb 1, 106.6-107.20.
8. Krause AC, Ref. 7. p. 265; Clayton J, Ref. 5. p. 16; Aziz S, Ref. 5. pp. 45-46.
9. Plat. *Axioch*. 366a; Arist. *Hist. Animal*. 1, 16, 495a 11-18; Eroph. *T* 140c. See Ovio G, s.v. Oculistica. Roma: Enciclopedia Italiana Treccani; 1935. http://www.treccani.it/enciclopedia/oculistica_(Enciclopedia_Italiana)/; Lloyd GER, Ref. 3. p. 175; Von Staden H, Ref. 3. pp. 237, 252. *Contra* Schumacher J, Antike Medizin, Die Naturphilosophischen Grundlagen der Medizin in der Griechischen Antike, Zweite verbesserte Auflage. Berlin: Walter de Gruyter und Co.; 1963. pp. 75-77. Cf. Perilli L, Ref. 4. p. 60.
10. 24 A 5; 8; 10 DK; R 6 LM; 11 WTL.
11. Cf. Halioua B, La medicina al tempo dei faraoni, con la collaborazione di Bernard Ziskind. Bari: Edizioni Dedalo; 2005. pp. 80-81; Crivellato E, Ribatti D, Ref. 3. pp. 327-331.
12. Aziz S, Ref. 5. pp. 27, 36.
13. De Salvia F, Calabria antica ed Egitto: lineamenti d'una storia poco nota: In: De Salvia F, Murgano R(eds), Calabria antica ed Egitto. Atti del convegno Castello ducale di Corigliano Calabro CS, 15-15 dicembre 2004. Catanzaro: Centro Studi Bruttium Editore; 2012. pp. 29-30: since the 8th century BC, linked to Phoenician trade, a 'Via ionica degli Aegyptiaca' has been documented. It passes through 'i siti indigeni della Locride (Val Canale etc.), del Crotonese (Crichi), della Sibaritide (Macchiabate e Cozzo Michelicchio) e quello di Amendolara. Gli oggetti di tipo egizio di tale periodo sono costituiti da scarabei di faïence, autentici e d'imitazione'. For the Aegyptiaca found in the temple of Hera Lacinia at Capo Colonna (Crotone), cf. Spadea R, Il Tesoro di Hera. Bollettino di Archeologia 1994;88:20-22, n. 25, 29, 32, tav. VI a, b, d, g.
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16. Cf. Lopez F, Ref. 3. pp. 281-304. See Revillout E, Amasis et la chute de l'empire égyptien. Revue des questions historiques. Nouvelle Série 1906;36:5-30,353-394; De Meulenaere H, Herodotos over de 26ste Dynastie (2., 147 - 3., 15). Bijdrage tot het historisch-kritisch onderzoek van Herodotos' gegevens in het licht van de Egyptische en andere contemporaire bronnen. Leuven: Leuvense Universitaire Uitgaven, Instituut voor Orientalisme; 1951. p. 127 n. 16; Godron G, Notes sur l'histoire de la médécine et l'occupation perse en Égypte. In: Hommages à François Daumas. Montpellier: Publications de l'Université de Montpellier; 1986. pp. 285-297. In order to the word for 'chief physician', cf. TLA *wr-zwn.w* (450207); Wb 1, 329.11; Wb 3, 427.13-15.
17. Gomperz Th, Greek Thinkers. Vol. I. London: John Murray; 1901. p. 549; Filliozat J, Ref. 15. p. 236.
18. See Lopez F, Pitagora e l'Egitto. Le arti sapienti per la tutela della Vita. Pisa: Pisa University Press; 2019. pp. 55-110.
19. Alcmae. 24 A 5 DK; D 11-13, 15-16, 18-19 LM; 11 WTL. For Theophrastus (ca. 371/370-287/286 a.C.), see Stratton GM, Theophrastus and the Greek Physiological Psychology before Aristotle. London: G. Allen & Unwin; New York: Macmillan; 1917; Freeman K, The Pre-Socratic Philosophers: A Companion to Diels, Fragmente der Vorsokratiker. Oxford: Blackwell; 1949; Mansfeld J, Aristote et la structure du "De sensibus" de Théophraste. Phronesis 1996;41:158-188; Baltussen H, Theophrastus Against the Presocratics and Plato: Peripatetic Dialectic in the De Sensibus. Leiden: Brill; 2000. pp. 18-21; Wöhrle G, Tsiampokalos Th, Lammer A, Alkmaion von Kroton, Hippon von Metapont und Menestor von Sybaris. Berlin/Boston: De Gruyter; 2022. pp. 28-31.
20. BM EA 498 (= TM 111310).
21. See Bresciani E, Letteratura e poesia dell'antico Egitto. Torino: Einaudi; 1969. p. 14. The original text of the Shabaka Stone dates back to the Fifth Dynasty (ca. 2500-2350 BC). We have access to a later transcription made by King Shabaka, who reigned around 700 BC. It is based on a deteriorated ancient manuscript. This transcription was inscribed on a stele intended for the Temple of Ptah in Memphis, and it is now preserved in the British Museum in London (BM EA 498). The first part of the text reports the struggle between Horus and Seth, and the judgement of Geb, who elevated Horus to king of all Egypt and reunited the Two Lands (Upper and Lower Egypt) in the province of Memphis, where the Temple of Ptha was called the 'Balance of the Two Lands'. The second part has a cosmogonic character and is also referred to as the 'Text of Memphite Theology'. It states that the Demiurge Ptah created the world through the heart and the tongue, which represent the will and the word. These concepts are mythologically associated with Horus and Thot. This creation appears as an intellectual process using *logos*, which in Egyptian tradition contrasts with the Heliopolitan view that the world originated from the seed or spit of the god Atum. The content of columns 56-58 diverges from the topic of the previous text, which deals with the creation of the Ennead. It has sometimes been interpreted as a separate treatise, a *Naturlehre* on the function of the heart and tongue, even though it is not creation as such that is of interest, but rather the process, and the primacy of the

role of the mind/heart. Cf. Junker H, Die Götterlehre von Memphis (Schabaka-Inschrift). Abhandlungen der Preußischen Akademie der Wissenschaften zu Berlin 23. Berlin: Verlag der Akademie der Wissenschaften; 1939. pp. 59; 69-73; Junge F, Zur Fehldatierung des sog. Denkmals memphitischer Theologie oder Der Beitrag der ägyptischen Theologie zur Geistesgeschichte der Spätzeit. Mitteilungen des Deutschen archäologischen Instituts, Abteilung Kairo 1973;29:203; El Hawary A, Wortschöpfung: die Memphitische Theologie und die Siegesstele des Pije, zwei Zeugen kultureller Repräsentation in der 25. Dynastie. Fribourg, Göttingen: Academic Press, Vandenhoeck & Ruprecht; 2010. pp. 69-209; Ockinga BG, The Memphite Theology-Its Purpose and Date. In: Woods A, McFarlane A, Binder S (eds), Egyptian Culture and Society. Kairo: Supreme Council of Antiquities, Egypt; 2010. p. 102, with bibliography.

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23. The transcription of the hieroglyphic signs and the arrangement of the writing lines follow El Hawary A, Ref. 21. p. 133; XV Bild. 18. The main translations are essentially equivalent. See Breasted JH, The Philosophy of a Memphite Priest. With a Reproduction of the Memphite Slab. The Open Court 1903;16(8):478: 'The gods fashioned the sight of the eyes, the hearing of the ears, and the smelling of the nose, that they might furnish the desire of the heart. It (the heart) is the one that bringeth forth every successful issue. It is the tongue which repeats the thought of the heart'. Bresciani E, Ref. 21. p. 16: 'Gli occhi vedono, le orecchie odono, il naso respira: essi informano il cuore: è lui che permette ogni conoscenza, ed è la lingua che ripete ciò che il cuore ha pensato'. Wilson JA, The Theology of Memphis. In: Pritchard JB (ed.), Ancient Near Eastern Texts Relating to the Old Testament. Princeton: Princeton University Press; 1969. p. 5: 'The sight of the eyes, the hearing of the ears, and the smelling the air by the nose, they report to the heart. It is this which causes every completed (concept) to come forth, and it is the tongue which announces what the heart thinks'. Lichtheim M, Ancient Egyptian Literature. Vol. I, The Old and Middle Kingdoms. Berkeley: University of California Press;1973. p. 54: 'Sight, hearing, breathing—they report to the heart, and it makes every understanding come forth. As to the tongue, it repeats what the heart has devised'. Finnestad RB, Ptah, Creator of the Gods: Reconsideration of the Ptah Section of the Denkmal. Numen 1976;23(2):84: 'The eye sees, the ear hears, the nose breathes; they report to the heart; it is this (= the heart) which causes all cognition to originate, and it is the tongue which repeats the thought of the heart'. Bilolo M, Le créateur et la création dans la pensée memphite et amarnienne. Approche synoptique du "Document Philosophique de Memphis" et du "Grand HymneThéologique" d'Echnaton. Kinshasa: Menaibuc; 1988. p. 75: 'Les yeux voient, les oreilles entendent, le nez respire (l'air), ils informent le coeur. C'est lui qui fait/laisse sortir toute connaissance (et c'est) la langue qui répète ce que le coeur a pensé/conçu'. Allen JP(ed.), Genesis in Egypt: the philosophy of ancient Egyptian creation accounts. New Haven: Yale University; 1988. p. 43: 'The eyes' seeing, the ears' hearing, the nose's breathing of air send up to the heart, and *it* is what causes every conclusion to emerge; it is the tongue that repeats what the heart plans'. Sternberg-El

Hotabi H, Peust C, Das Denkmal Memphitischer Theologie. Texte aus der Umwelt des Alten Testamentes (TUAT) III. 6 (Ergänzungsband): Gütersloh; 2001. p. 173: 'Die Götterneunheit erschuf das Sehen der Augen, das Hören der Ohren und das Riechen der Nase, und sie (die Sinnesorgane) leiten es zum Herzen weiter. Dieses ist es, das alle Erkenntnis hervorbringt, und die Zunge ist es, die verkündet, was das Herz erdenkt'. David R, Religion and Magic in Ancient Egypt. London: Penguin Books Ltd; 2002. p. 123: 'Sight, hearing, breathing—they report to the heart and it makes every concept come forth. As to the tongue, it repeats what the heart has thought'. Zivie-Coche C, L'Egitto Faraonico. In: Dunand F, Zivie-Coche C, Dei e uomini nell'Egitto antico. Roma: "L'Erma" di Bretschneider; 2003. p. 80: 'Gli occhi vedono, le orecchie odono, il naso respira l'aria; essi informano il cuore. È lui che fa sì che ogni pensiero compiuto emerga ed è la lingua che trasmette il pensiero del cuore'. Assmann J, Creation through hieroglyphs: the cosmic grammatology of ancient Egypt. In: La Porta S, Shulman D (eds), The poetics of grammar and the metaphysics of sound and sign. Leiden/Boston: Brill; 2007. p. 26: 'That the eyes see, the ears hear, and the nose breathes air is in order to make report to the heart. This is what makes all knowledge originate. The tongue it is that repeats what is thought by the heart'. El Hawary A, Ref. 21. p. 133: 'das Sehen der Augen, das Hören der Ohren und das "Riechen" der Nase, sie erstatten regelmäßig Bericht vor dem Herzen, während es wiederum jegliches Verständnis (daraus) entstehen lässt und die Zunge umsetzt, was das Herz bedenkt'.

24. For an analysis of the formal differences between ancient Egyptian and Greek manner of writing, see Di Benedetto V, La medicina greca antica. In: Lami A, Ippocrate, Testi di medicina greca. Milano: BUR Rizzoli; 1983. pp. 5-48; Lopez F, Ref. 3. pp. 248-252. In the *MT* the organs mentioned are those of the god Ptah as Creator of the world (cf. El Hawary A, Ref. 21. pp. 69-209).
25. TLA *jr.t* (28250); Wb 1, 106.6-107.20; TLA *jr.wj* (28300); dual *jr*.DU; Wb 1, 108.1-2; Faulkner RO, A Concise Dictionary of Middle Egyptian. Oxford: Griffith Institute; 1962. p. 25; Allen JP, Middle Egyptian. An Introduction to the Language and Culture of Hieroglyphs. Cambridge: Cambridge University Press; 2000. § 4.7. Cf. Van de Walle B, Le sens de la vue et la vertu du regard dans la mentalité égyptienne: In Mélanges offerts à Jean Vercoutter. Paris: Éditions Recherche sur les civilisations;1985. pp. 365-374.
26. LSJ p. 1278, cf. *Il*. 24, 204; *Od*. 19, 211; Hdt. 9, 22. For the dual form, see Ar. *Nu*. 362.
27. TLA *m33* (66270); Wb 2, 7.1-10.7; Allen JP, Ref. 25. § 20.2.2. See LSJ p. 1244. Cf. *Il*. 24, 633; *Od*. 20, 373; Arist. *Po*. 1460a 14.
28. TLA *msḏr* (76230); dual *msḏr*.DU; Wb 2, 154.13-16; Gardiner AH, Egyptian Grammar. Oxford: Griffith Institute; 1994. p. 593.
29. LSJ p. 1274, cf. *Il*. 11, 109; *Il*. 18, 272; *Il*. 22, 454; *Od*. 12, 200; Hdt. 4, 129.
30. TLA *sḏm* (150560); Wb 4, 384.4-387.1; Gardiner AH, Ref. 28. p. 593.
31. LSJ pp. 53-54, cf. *Il*. 4, 331; *Od*. 12, 198; *Od*. 12, 389; S. *OT* 43; Id. *Aj*. 480; Id. *El*. 792.
32. TLA *fnḏ* (63920); Wb 1, 577.10-15; Von Deines H, Westendorf W, Wörterbuch der medizinischen Texte. Berlin: Akademie Verlag; 1961-1962. pp. 304-306; Walker JH, Studies in Ancient Egyptian Anatomical Terminology. Warminster: Aris & Phillips; 1996. p. 269; Gardiner AH, Ref. 28. p. 452; Faulkner RO, A concise dictionary of Middle Egyptian. Oxford: Griffith Institute; 1999. p. 98.
33. LSJ p. 1572, cf. *Il*. 16, 503; *Od*. 5, 456; Hes. *Sc*. 267; S. *Aj*. 918; Ar. *Nu*. 344.
34. TLA *ssn* (144080); Wb 4, 277.9-16; Faulkner RO, Ref. 32. p. 245; *ṯ3w* (174480), Wb 5, 350.12-352.29.

35. LSJ p. 1264, cf. Hdt. 1, 80; Ar. *Ra*. 654; X. *Mem*. 2, 1, 24; Pl. *Phd*. 96b.
36. TLA *ns* (87800); Wb 2, 320.8-17; Gardiner AH, Ref. 28. p. 575.
37. LSJ p. 353. For the affinity with the Greek perspective of "logos", cf. Breasted JH, The Philosophy of a Memphite Priest. With a Reproduction of the Memphite Slab. Zeitschrift für Ägyptische Sprache und Altertumskunde 1902;39:53-54; Allen JP, Ref. 23. p. 46.
38. TLA *sjʿr* (128000); Wb 4, 32.9-33.17; Allen JP, The Inflection of the Verb in the Pyramid Texts. Malibu: Undena; 1984. Cf. Menichetti M, Teologia Menfita. La Pietra di Shabaka. https://www.esonet.org/la-pietra-di-shabaka-teologia-menfita/ (24/05/2010); Ockinga BG, Ref. 21. p. 102.
39. LSJ p. 1699, cf. Th. 7, 70; Hp. *Art*. 30; Sor. 2, 85; Arist. *HA* 496b 12. See Vegetti M, Ref. 22. p. 92; Longrigg J, Ref. 22. p. 58.
40. TLA *ḫr* (400090); Wb 3, 131.3-21; Gardiner AH, Ref. 28. p. 585; LSJ p. 1496. For the translation of *ḫr* with the term 'to', see Lichtheim M, Ref. 23. p. 54; Finnestad RB, Ref. 23. p. 84; Allen JP, Ref. 23. p. 43; David R, Ref. 23. p. 123; Assmann J, Ref. 23. p. 26. For the superiority of thought over sense perceptions in Alcmaeon, see Guthrie WKC, A History of Greek Philosophy. Vol. I. Cambridge: Cambridge University Press; 1962. p. 344 n. 2; Mansfeld J, Ref. 3. pp. 26-38; Huffman C, Ref. 3.
41. TLA *ḥ3.tj* (100400); Wb 3, 26-27.19; Gardiner AH, Ref. 28. p. 580; TLA *jb* (23290); Wb 1, 59.10-60.11. The root of *ḥ3.tj* is linked to the adjective *ḥ3.wtj*, which means 'first' (TLA 854603). This connection helps to highlight the heart's primary and dominant role as a commanding organ. The term *ḥ3.tj* has been thought to refer to the heart from an anatomical perspective, while the lemma *jb* has been more closely related to emotions (Walker JH, Ref. 32. pp. 147-186). However, both *ḥ3.tj* and *jb* seem to be synonymous and used interchangeably (Ritner RK, The Cardiovascular System in Ancient Egyptian Thought. Journal of Near Eastern Studies 2006;65(2):100 n. 1; Aziz S, Ref. 5. p. 19). The heart was deemed the seat of justice, free-will, cognition, memory and action (Assmann J, The mind of Egypt: History and Meaning in the Time of the Pharaohs. New York: Metropolitan Books; 2002).
42. LSJ p. 1955, cf. *Il*. 6, 79; A. *Ag*. 176; Id. *Supp*. 204; S. *OT* 617; E. *IA* 924; Pl. *Hp.Mi*. 371a. See Mansfeld J, Studies in Early Greek Philosophy. Leiden/Boston: Brill; 2018. p. 206.
43. LSJ p. 1718, cf. Hdt. 4, 114; Th. 1, 3; Pl. *Alc*. 1, 132c; Pi. *P*. 3, 80; A. *Pers*. 361; Ar. *Pl*. 45. See Huffman C, Ref. 3. 'The word translated as understanding here is *suniêmi*, which in its earliest uses means "to bring together", so that it is possible that Alcmaeon simply meant that humans are able to bring the information provided by the senses together in a way that animals cannot (Solmsen F, Greek Philosophy and the Discovery of Nerves. Museum Helveticum 1961;18:151). Animals have brains too, however, and thus might appear to be able to carry out the simple correlation of the evidence from the various senses, whereas the human ability to make inferences and judgments (DK, B1 [τεκμαίρεσθαι]) appears to be a more plausible candidate for the distinctive activity of human intelligence'. The translators of Theophrastus' text generally do not distinguish between ξυνιέναι and φρονεῖν, but use a single semantic field that refers to the expressions 'to have intelligence' or 'understanding/thinking'. See Wachtler J, De Alcmaeone Crotoniata. Leipzig: Teubner; 1896. pp. 38-39: '*ratione*'; Diels H, Die Fragmente der Vorsokratiker. Griechisch Und Deutsch. Edited by Walter Kranz. Berlin: Weidmann; 1912. p. 135: 'denken' (only referring to ξυνιέναι); Stratton GM, Ref. 19. p. 89: 'understand/think'. Codellas PS, Alcmaeon of Croton: His Life, Work, and Fragments. Proceedings of the Royal Society of Medicine 1932;25(7):1041-1046: 'comprehend/understand'.

Cataudella Q, I frammenti dei Presocratici. Vol 1. Padova: Cedam; 1958. p. 188: 'avere intelligenza/pensare'; Pasquinelli A, I Presocratici. Frammenti e testimonianze, Vol 1. Torino: Einaudi; 1958. p. 108: 'avere intelligenza'; Vegetti M, Ref. 22. p. 92: 'essere cosciente/pensare'; Maddalena A, Ref. 22. pp. 239-240: 'capire'; Lami A, I Presocratici. Testimonianze e frammenti da Talete a Empedocle. Milano: BUR Rizzoli; 1991. p. 255: 'avere comprensione/intendere'; Longrigg J, Ref. 22. pp. 57-58: 'understand/thought'. Timpanaro Cardini M(ed.), Pitagorici antichi. Testimonianze e frammenti. Milano: Bompiani; 2010. p. 143: 'comprendere/ragionare'; D 11 LM: 'understand/thinking'; 11 WTL: 'verstehen'.

44. TLA *prỉ* (60920); Wb 1, 518-525.3.
45. Cf. Frenkian AM, L'Orient et les origines de l'idéalisme subjectif dans la pensée européenne. La Doctrine théologique de Memphis. L'Inscription du roi Shabaka. Tome 1. Paris: Geuthner; 1946. p. 73; Wallis Budge EA, An Egyptian Hieroglyphic Dictionary. Vol. I-II. New York: Dover Publications; 1998. p. I, 131; Hannig RH, Großes Handwörterbuch Ägyptisch-Deutsch. Mainz: Philipp von Zabern; 1995. p. 151.
46. TLA *'rq* (39640); Wb 1, 212.10-15; Faulkner RO, Ref. 25. p. 45.
47. TLA *nb* (81660); Wb 2, 234.3-236.5; Allen JP, Ref. 25. § 6.1.
48. TLA *kȝỉ* (163220); Wb 5, 83.5-84.1; Faulkner RO, Ref. 32. p. 283.
49. TLA *kȝ.t* (162980); Wb 5, 84.2-4; Gardiner AH, Ref. 28. p. 597; Bilolo M, Ref. 23. p. 78; Wallis Budge EA, Ref. 45. p. II, 782 B.
50. Cf. Wachtler J, Ref. 43. p. 40. '*Quocum optime consentit, quod omnem scientiam e sensibus manare Alcmaeo docuisse videtur*'. See Guthrie WKC, Ref. 40. p. 344 n. 2; Mansfeld J, Ref. 3. pp. 26-38. The detailed description of Theophrastus about the senses (24 A 5 DK; D 11-13, 15-16, 18-19 LM; 11 WTL) confirms the tradition that assigns to Alcmaeon a treatise *On Nature* (24 A 1-2 DK; D 1a-b LM; 17, 32 WTL) or with another title, to which Aristotle would have replied (Diog. Laert. 5, 25), written in the Doric-Achaean dialect of Croton or Greek-Ionic like the first Presocratics. See Codellas PS, Ref. 43. p. 1042; Burkert W, Lore and Science in Ancient Pythagoreanism. Cambridge: Harvard University Press; 1972. p. 222, n. 2; Perilli L, Ref. 4. pp. 66-69; Huffman C, Ref. 3. In order to the *MT*, see Bilolo M, Ref. 23. pp. 75-78; Allen JP, Ref. 23. p. 45. 'The senses serve as agents of the mind'. Cf. *infra* Ref. 66.
51. Emp. 31 B 110 DK; D 257 LM. Long AA (Transl. by), Thinking and Sense-Perception in Empedocles: Mysticism or Materialism. Classical Quarterly 1966;16(2):267. The words in italics are our modifications.
52. Cf. Hirzel R, Zur Philosophie des Alkmäon. Hermes 1876;11(2):240; Vlastos G, Review of Cornford FM. In: Furley DJ, Allen RA (eds), Studies in Presocratic Philosophy. London: Routledge; 1970. p. 47, n. 8; Barnes J, The Presocratic Philosophers. London: Routledge; 1982. p. 149; Talamo C, A proposito di Alcmeone e Ippocrate (Vorsokr. 24 A e Hipp. 'Morb. Sacr.' 14, 7). Rivista di filologia e di istruzione classica 1997;125(3):257-262; Mansfeld J, Ref. 42. p. 206.
53. LSJ pp. 1450-1451, cf. Pl. *Men*. 76c; Id. *Ax*. 366a; Arist. *Sens*. 438b 14; Id. *HA* 495a 11; Id. *PA* 656b 17; Id. *GA* 775a 2, 744a 2; Epicur. Fr. 250; Heroph. ap. Gal. 7, 89; Gal. 10, 268. See Harris CRS, The heart and the vascular system in ancient Greek medicine from Alcmaeon to Galen. Oxford: Clarendon Press; 1973. pp. 7-8; TLA *mt* (77310); Wb 2, 167.9-14; Grapow H, Ref. 5. pp. I, 20-22; 72-76; II, 32; Bardinet Th, Ref. 5. pp. 60-120; Nunn JF, Ref. 5. pp. 44-49; 115; Lang Ph, Ref. 5. pp. 12-14; Bubb C, Ref. 5. pp. 183-202; David R, Forshaw R, Ref. 5. pp. 7-8.

54. Theophr. *De Sens*. 39 ff. = Diog. Apoll. 64 A 19 DK; D 34-42 LM. Cf. LSJ p. 1944; *Il*. 13, 546; Hdt. 4, 2, 187; A. *Fr*. 230; S. *Ph*. 825. See Perilli L, Ref. 4. p. 60.
55. Emp. 31 B 89 DK; D 208 LM; B 84 DK; D 215 LM; A 92 DK; D 209 LM.
56. Emp. 31 B 105 DK; D 240 LM.
57. Cf. Solmsen F, Ref. 43. p.157; Long AA, Ref. 51. pp. 256-276; Wright MR, Empedocles: the Extant Fragments. New Haven: Yale University Press; 1981. p. 230. See Huffman C, Ref. 3.
58. LSJ p. 472, cf. *Il*. 3, 300; *Od*. 9, 458; Ar. *Nu*. 1276; Pl. *Phd*. 96b; Arist. *Sens*. 438b 25; Id. *Metaph*. 1013a 6.
59. TLA *ȝjs* (13); Wb 1, 2.10-11; Von Deines H, Westendorf W, Ref. 32. p. 2; Walker JH, Ref. 32. p. 265.
60. Alcmae. 24 B 1 DK; D 4 LM; 42 WTL. For the verb τεκμαίρομαι, see LSJ p. 1767; E. *Ph*. 180; A.R. 4, 217; X. *Cyr*. 4, 3, 21; Id. *Mem*. 1, 4, 1. On the noun σαφήνεια, see LSJ p. 1586; Pl. *Phrd*. 277d. Cf. Huffman C, Ref. 3. Vegetti M, Ref. 22. p. 21. A detailed review of these two terms in Greek sources can be found in Kouloumentas S, Alcmaeon and His Addressees. Revisiting the Incipit. In: Bouras-Vallianatos P, Xenophontos S (eds), Greek Medical Literature and Its Readers: from Hippocrates to Islam and Byzantium. London, New York: Routledge; 2018. pp. 7-22.
61. Cf. Alcmae. 24 B 1 DK: ‘Ἀλκμαίων Κροτωνιήτης τάδε ἔλεξε Πειρίθου υἱὸς Βροτίνωι καὶ Λέοντι καὶ Βαθύλλωι· περὶ τῶν ἀφανέων, περὶ τῶν θνητῶν σαφήνειαν μὲν θεοὶ ἔχοντι, ὡς δὲ ἀνθρώποις τεκμαίρεσθαι [...]’; Gomperz H, Zu Alkmaion Frg: I Diels. Philologische Wochenschrift 1928;48:1597; Dorandi T (ed.), Diogenes Laertius: Lives of Eminent Philosophers. Edited with Introduction. Cambridge: Cambridge University Press; 2013. p. 649, D 4 LM, and 42 WTL: ‘[...] Βαθύλλωι περὶ τῶν ἀφανέων· περὶ τῶν θνητῶν [...]’; Kouloumentas S, Ref. 60, p. 7: ‘[...] Βαθύλλωι περὶ τῶν ἀφανέων περὶ τῶν θνητῶν [...]’; Longrigg J, Ref. 22. p. 51, omits ‘περὶ τῶν θνητῶν’. See also Wachtler J, Ref. 43. pp. 36-37; Dettori E, Alcmae. fr.1 D.-K. Museum Criticum 1990-1993;25-28:45-57; Lebedev AV, Alcmaeon of Croton on Human Knowledge, the Seasons of Life, and Isonomia: A New Reading of B 1 DK and Two Additional Fragments from Turba Philosophorum and Aristotle. In: Vassallo Ch (ed.), Physiologia. Topics in Presocratic Philosophy and its Reception in Antiquity. Trier: Wissenschaftlicher Verlag; 2017. p. 227; Année M, Alcméon de Crotone. Fragments. Traité Scientifique en Prose ou Poème Médical? Paris: Vrin; 2019. pp. 17-33; Schubert Ch, Isonomia. Entwicklung und Geschichte. Berlin/Boston: De Gruyter; 2021. p. 157. For a detailed overview of the different hypotheses, cf. Kouloumentas S, Ref. 60. pp. 7-22, Table 1.1.
62. Gemelli Marciano L, Lire du début. Philosophie antique 2007;17:18-22: ‘[...] Βαθύλλωι· περὶ τῶν ἀφανέων περὶ τῶν θνητῶν [...]’.
63. Kerferd GB, The First Greek Sophists. The Classical Review 1950;64:8-10; Id. (1976), The image of the wise man in Greece in the period before Plato. In: Bossier F, Verbeke G (eds), Images of Man in Ancient and Medieval Thought. Studia G. Verbeke dicata. Leuven: Leuven University Press; 1976, pp. 17-28; Id., The Sophistic Movement. Cambridge: Cambridge University Press; 1981; Snell B, Il cammino del pensiero e della verità. Studi sul linguaggio greco delle origini. Ferrara: Gallio Editore; 1991. pp. 40-42; Kudlien F, Der Beginn des medizinischen Denkens bei den Griechen, von Homer bis Hippocrates. Zürich-Stuttgart: Artemis Verlag; 1967. pp. 15-30; Id., Medical Education in Classical Antiquity: In O’Malley CD(ed.), The History of Medical Education. Berkeley, Los Angeles, London: University of California Press; 1970. p. 4; Krug A, Medicina nel

mondo classico. Firenze: Giunti Gruppo Editoriale; 1990. pp. 24-26; Kingsley P, Reality: The Teachings of Parmenides and Empedocles. Inverness: The Golden Sufi Center Press; 2003; Nutton V, Ancient Medicine. London-New York: Routledge; 2004. pp. 113; 268-270; Gemelli Marciano ML, Empedocles' Zoogony and Embryology. In: Pierris A (ed.), The Empedoclean Κόσμος: Structure, Process and the Question of Cyclicity. Patras: Institute for Philosophical Research; 2005. pp. 373-404; Ead., Il ruolo della "meteorologia" e dei "discorsi sulla natura" negli scritti ippocratici. Alla ricerca di un "canone" per lo scritto medico? In: Giombini S, Marcacci F (eds), Il quinto secolo. Studi di filosofia antica in onore di Livio Rossetti. Passignano: Aguaplano-Officina del libro; 2010. pp. 179-198; Ustinova Y, Caves and the Ancient Greek Mind. Descending Underground in the Search for Ultimate Truth. Oxford: Oxford University Press; pp. 177-215; Cornelli G, In search of Pythagoreanism. Pythagoreanism as an historiographical category. Berlin: De Gruyter; 2013. p. 92 n. 245; Lopez F, Ref. 3. pp. 308-320; Id., Ref. 18. pp. 11-21.

64. Guthrie WKC, Ref. 40. p. 344 n. 2; Mansfeld J, Ref. 3. pp. 26-38.
65. Alcmae. 24 A 8 DK; D 13b and D 19b LM; 21 WTL. Cf. Hirzel R, Ref. 52. p. 240; Vlastos G, Ref. 52. p. 47, n. 8; Barnes J, Ref. 52. p. 149; Mansfeld J, Ref. 42. p. 206; Huffman C, Ref. 3.
66. See Menichetti M, Ref. 38; Bilolo M, Ref. 23. pp. 76-77. 'Nous sommes ici en présence d'une des premières conceptions épistémologiques, c'est-à-dire d'une des premières théories scientifiques sur la genèse de la connaissance que l'histoire écrite de la pensée humaine nous ait conservées. La connaissance comme un produit, comme une création ou une élaboration de la faculté pensante, sur la base de sensations extérieures que lui communiquent les organes des sens. Ces derniers étant définis comme organes d'information. L'actualité de cette explication de la genèse de la connaissance se révèle, entre autres, dans ce passage de la *Critique de la raison pure* d'Emmanual Kant. [...] L'analogie entre le Philosophe memphite et le Philosophe allemand réside en ceci que les deux considèrent: *primo*, la pensée comme un "produit" de la faculté pensante, de l'organe pensant; *secundo*, ce "produit" est élaboré, mis au point sur la base des informations fournies par les sens; *tertio*, ce "produit" est conditionné d'une part par les sensations extérieures, par les informations fournies par les sens et d'autre part, par le travail de la faculté pensante'; Ockinga BG, Ref. 21. p. 102: 'The senses (sight, hearing, breathing) are seen as providing information to the mind (heart), which bases its deliberations upon this data and then transmits them through the tongue/speech. The senses are instruments with which the mind works, but it is only the mind that initiates action'. Cf. El Hawary A, Ref. 21. p. 199, n. 563.
67. Guthrie WKC, Ref. 40. pp. 341-359; Vegetti M, Ref. 22; Vlastos G, Ref. 52. p. 47, n. 8; Fausti D, Alcmeone di Crotone. Studi Classici e Orientali 1973;22:85-110; Barnes J, Ref. 52. p. 149; Année M, Ref. 61. pp. 47-49.
68. Lanza D, Un nuovo frammento di Alcmeone. Maia 1965;17:278-80; Barnes J, Ref. 52. p. 610; Kouloumentas S, Ref. 60. pp. 7-22; Année M, Ref. 61. pp. 75-86. Cf. Perilli L, Ref. 4. p. 64. *Contra* Mansfeld J, Ref. 3. pp. 26-38.
69. Alcmae. 24 A 11; 2 WTL. See Hirzel R, Ref. 52. p. 240; Vlastos G, Ref. 52. p. 47, n. 8; Barnes J. Ref. 52. p. 149; Talamo C, Ref. 52. pp. 257-262; Huffman C, Ref. 3. Cf. Plat. *Phd*. 96a-b: 'Is it the blood, or air, or fire by which we think? Or is it none of these, and does the brain furnish the sensations of hearing and sight and smell (ὁ δ' ἐγκέφαλός ἐστιν ὁ τὰς αἰσθήσεις παρέχων τοῦ ἀκούειν καὶ ὁρᾶν καὶ ὀσφραίνεσθαι), and do memory and opinion arise from these (ἐκ τούτων δὲ γίγνοιτο μνήμη καὶ δόξα), and does knowledge

come from memory and opinion in a state of rest (ἐκ δὲ μνήμης καὶ δόξης λαβούσης τὸ ἠρεμεῖν, κατὰ ταῦτα γίγνεσθαι ἐπιστήμην)?'. Fowler HN (Transl. by), Plato. Euthyphro. Apology. Crito. Phaedo. Phaedrus. Cambridge, MA: Harvard University Press; 1914. pp. 331-333. For the brain as the central organ in the Hippocratic treatise *On Sacred Disease*, cf. Lopez F, Il pensiero olistico di Ippocrate. Percorsi di ragionamento e testimonianze Vol. 1. San Giovanni in Fiore-Cs: Edizioni Pubblisfera; 2004. pp. 103-109, with bibliography.

70. Cf. Solmsen F, Ref. 43. pp.150-197; Lloyd GER, Ref. 3. 1975. pp. 113-147; Mansfeld J, Ref. 3. pp. 26-38; Perilli L, Ref. 4. pp. 60-62; Huffman C, Ref. 3.
71. Mansfeld J, Ref. 3. pp. 26-38.
72. Perilli L, Ref. 4. pp. 66-67.
73. Philol. 44 B 13 DK; D 26 LM. See Huffmann CA, Philolaus of Croton: Pythagorean and Presocratic: A Commentary on the Fragments and Testimonia with Interpretive Essays. Cambridge: Cambridge University Press; 2013. pp. 85-87; 307-322; Id., Philolaus, The Stanford Encyclopedia of Philosophy (Winter 2024 Edition), Edward N& Uri Nodelman(eds), URL = <https://plato.stanford.edu/archives/win2024/entries/philolaus/>.
74. Cf. Perilli L, Ref. 4. pp. 66-67; Huffman C, Ref. 3.
75. Solmsen F, Ref. 43. pp.150-197; Lloyd GER, Ref. 3. 1975. pp. 113-147; Mansfeld J, Ref. 3. pp. 26-38; Huffman C, Ref. 3.
76. Cf. Harris JR, Ref. 4. p. 112; Perilli L, Ref. 4. pp. 64-67.
77. See Breasted JH, Ref. 5. pp. I, 109-113; Krause AC, Ref. 7. pp. 258-276; Ghalioungui P, Ref. 7. pp. 130-132; Leca AP, Ref. 7. pp. 225-236; Nunn JF, Ref. 5. pp. 197-202; Sanchez GM, Meltzer ES, Ref. 5. pp. 33, 46, 61, 66, 74, 87-88, 121, 136, 150, 202, 214; Clayton J, Ref. 5. p. 16; Aziz S, Ref. 5. pp. 41-55.
78. Saniotis A, Sushruta and Alcmaeon: A comparative analysis on the originators of neuroscience. Human Evolution 2023;38(3-4):211-220.
79. Cf. *p.Smith* 3; 4-5; 7-8; See Breasted JH, Ref. 5. pp. I, 109-113.
80. Cf. Mansfeld J, Ref. 3. pp. 26-38. Partially *contra* Perilli L, Ref. 4. pp. 55-79.
81. 24 B 1 DK; D 4 LM; 42 WTL.
82. See Gemelli Marciano L, Ref. 62. pp. 7-37, with reference to Hipp. *Arte* 9, 2; 11, 1; 11, 4; 12, 1; *Flat*. 1, 3; *Morb*. 4, 55, 6.
83. Lloyd GER, Ref. 3. 1975. pp. 113-147.
84. Cf. Lopez F, Ref. 3. pp. 321-326.
85. Solmsen F, Ref. 43. p. 192; Manuli P, Vegetti M, Cuore, sangue e cervello. Biologia ed antropologia nel pensiero antico. Milano: Episteme Editrice; 1977. pp. 36-37; 202 n. 18; Manzoni T, Aristotele e il cervello. Le teorie del più grande biologo dell'antichità nella storia del pensiero scientifico. Roma: Carocci; 2007. pp. 80-85; Lo Presti R, In forma di senso. L'encefalocentrismo del trattato ippocratico sulla malattia sacra nel suo contesto epistemologico. Roma: Carocci; 2008.
86. Cf. Mansfeld J, Ref. 3. pp. 26-38; Vegetti M, Ref. 3; Von Staden H, Ref. 3. pp. 189-192; Lloyd GER, Ref. 3, 1975. pp. 113-128.
87. Philol. 24 B 13 DK; D 26 LM. See Huffman C, Ref. 73. pp. 85-87, 307-322; Id., Ref. 73. Winter 2024 Edition.
88. See Bilolo M, Ref. 23. pp. 75-81.
89. Hdt. 3, 131. See Lopez F, Ref. 3. pp. 363-365.

90. Cf. Spadea R, Ref. 13. pp. 20-22, n. 25, 29, 32, tav. VI a, b, d, g; De Salvia F, Ref. 13. pp. 29-30.
91. See Lopez F, Ref. 3. pp. 290-294; 325-333; Id., Ref. 18. pp. 55-104. We do not know whether Alcmaeon was a Pythagorean. See Huffman C, Ref. 3. 'The overwhelming majority of scholars since 1950 have accordingly regarded Alcmaeon as a figure independent of the Pythagoreans [...], although, as a fellow citizen of Croton, he will have been familiar with their thought'. Cf. Guthrie WKC, Ref. 40. p. 341; Burkert W, Ref. 50. p. 289; Kirk GS, Raven JE, Schofield M (eds), The Presocratic Philosophers. Cambridge: Cambridge University Press; 1983. p. 339; Lloyd GER, Methods and Problems in Greek Science. Cambridge: Cambridge University Press; 1991. p. 167; Kahn C, Pythagoras and the Pythagoreans. Indianapolis: Hackett; 2001; Riedweg C, Pythagoras: His Life, Teaching, and Influence. Ithaca/London: Cornell University Press; 2005. p. 115; Année M, Ref. 61. pp. 99-100; Primavesi O, Aristotle, Metaphysics A: A New Critical Edition with Introduction. In: Steel C (ed.), Aristotle's Metaphysics Alpha: Symposium Aristotelicum. Oxford: Oxford University Press; 2012. p. 447. *Contra* Zhmud L, Pythagoras and the Early Pythagoreans. Oxford: Oxford University Press; 2012. pp. 121-124; Id., Sixth-, fifth-, and fourth-century Pythagoreans. In: Huffman CA (ed.), A History of Pythagoreanism. Cambridge: Cambridge University Press; 2014. pp. 97-102. The bibliographic abbreviations used in this paper are as follows: BM EA = British Museum, Egyptian Antiquities; DK = Diels H, Kranz W, Die Fragmente der Vorsokratiker. 6th ed. Dublin, Zürich: Weidmann; 1952; LM = Laks A, Most GW, Early Greek Philosophy. 9 volumes. Cambridge, MA, London: Harvard University Press. 2016; LSJ = Liddell HJ, Scott R, A Greek-English Lexicon. Oxford: Clarendon Press; 1996; *MT* = Memphite Theology; TLA = Thesaurus Linguae Aegyptiae, Web app version 2.2.1.1, ed. by Tonio Sebastian Richter & Daniel A. Werning on behalf of the Berlin-Brandenburgische Akademie der Wissenschaften and Hans-Werner Fischer-Elfert & Peter Dils on behalf of the Sächsische Akademie der Wissenschaften zu Leipzig (accessed: 30.6.2025); TM = Depauw M, Gheldof T, Trismegistos. An interdisciplinary Platform for Ancient World Texts and Related Information. In: Bolikowski Ł, Casarosa V, Goodale P, Houssos N, Manghi P, Schirrwagen J(eds), Theory and Practice of Digital Libraries - TPDL 2013 Selected Workshops (Communications in Computer and Information Science 416), Cham: Springer; 2014. pp. 40-52; Wb = Erman A, Grapow H, Wörterbuch der ägyptischen Sprache, Bd. I-VIII. Berlin: Academie Verlag; 1971. WTL = Wöhrle G, Tsiampokalos Th, Lammer A, Ref. 19.