Dualism in Alcmaeon of Croton: some considerations

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ABSTRACT

Starting from the available, and after emphasising how a sort of dualistic conception can be identified in every aspect of the doctrines attributed to Alcmaeon, this article aims to reflect on the concept of dualism itself and its interpretation and application in ancient Greek thought, it argues that Alcmaeon's conception cannot be understood by referring exclusively to Pythagorean philosophy or its Aristotelian interpretation, but is the mirror of an archaic yet enduring mentality, rooted in the relationship that the subject establishes with his surroundings. It will therefore examine the Greek conception of number, reflecting also on the existence and meaning of the grammatical category of the dual, which in many ancient languages – including, in addition to Greek, Sanskrit and Old Slavonic – distinguishes the set of two from the singular and the plural; It will also focus on the concept of the relationship between two quantities or entities as fundamental to the understanding of reality, while also referring to C.G. Jung's interpretation of the idea of duality and the role of the binary system in representing the world in the digital environment.

Keywords: Alcmaeon - Duality - Binary models

One, two, three: what is a number?

It is well known that the Greek term ἀριθμός does not fully correspond to our concept of "number"[1]; rather, it expresses the notion of a "countable cluster," a "set," or "collection". Aristotle speaks of ἀριθμὸς ᾧ ἀριθμοῦμεν and ἀριθμὸς ἀριθμούμενος[2], and the great mathematician Oskar Becker, who among many other things made fundamental contributions to the understanding of Platonic concepts deeply rooted in mathematics, such as that of ideal numbers, pointed out that the first of these Aristotelian concepts corresponds to our natural numbers, seen as counting tools, whereas the second referred not so much to numbers as to finite, discrete pluralities, which we should render as *Zwilling*, *Drilling*, *Vierling*—that is, something like "gemini, trigemini, quadrigemini"[3]. Thus, ἀριθμός expresses a set, however small, a multiplicity; this means that, if we want to render ἀριθμός as "number," then neither *zero* (which the Greeks knew but did not conceptualize, as can be observed in the tables of Ptolemy's *Almagest*) nor *one* are properly a number. Moreover, as I wrote concerning Proteus' seals (see note 1), the etymology of ἀριθμός speaks clearly in this respect: Per Persson has clarified that the radical element *ar-, (a)re-, re-; (a)ri, rei-* means *fügen*, *passen*, *ordnen*, *zurechtmachen*—that is, it expresses the notion of juncture, connection, hence subsequently a proper ordering, development of an original sense of *Aufeinanderlegen beim Holzbau*, *Aufstapeln von Hölzern* (Pokorny 69). Moreover ἀρθμός meaning "bond" confirms that the concept by its nature implies a plurality of elements, a series of parts, since a combination, a connection cannot be said of one alone[4].

However, *two* also has, in Greek, an ambiguous role: as in all languages that possess the peculiar nominal and verbal form known as the dual, two entities form a pair, which is itself an entity, distinct both from one and three; only the latter properly expresses multiplicity. The dual, in the Greek grammatical and linguistic (indeed mental) system, is no longer singular but not yet plural; it is not yet a "countable cluster" but another form of unity. Only from three onwards can one speak of plural, multiplicity, and thus properly of set, collection, connection, and ἀριθμός.

Counting in base two

It is precisely in the *two*, in the pair, that most human societies have identified the hinge upon which all that exists revolves. The American mathematician (though Italian by adoption) Abraham Seidenberg, in fundamental studies on the ritual origin and spread of the use of numbers and counting practices among populations worldwide, observed the universal diffusion of counting in base 2[5]. He wrote:

> *Counting may seem to be an elementary process that any human being would come upon by himself, yet the fact that many groups of savages cannot count beyond 2 makes us realize that the process is an advanced one. Over most of aboriginal Australia one finds essentially only two number words, 'one' and 'two': many of the tribes are reported definitely as not counting*

beyond 2, and as indicating higher multiplicities by the word 'many,' while others go a little further by compounding these words—for example, expressing 3 as 'two-one,' 4 as 'two-two,' and 5 as 'two-two-one.' A similar method of counting, the so-called 2-system, is found in New Guinea, in South America, and in South Africa.

This uniformity at every latitude, Seidenberg continued, is surprising and demands explanation: some have proposed to see in it a mind, the human mind, reacting and working similarly under analogous conditions, what would later be called *the psychic unity of mankind*[6]. What relation, then, asks Seidenberg, what connection of the mind with itself or with the environment could have led to choosing two as the base of computation? An answer had already been suggested by the mathematician Levi Leonard Conant, who in a late nineteenth-century study on the origin of the concept of number hypothesized that the centrality of the number two was rooted in the very act by which the individual originally became aware of the difference that separated him from the *other*, namely the realization that two objects could be distinguished from one another but at the same time be conceived and represented as a pair.[7] In this, he had been preceded at least by Wilhelm von Humboldt, whose ideas will be discussed later. If, moreover, expressions such as "two-one" for three, "two-two" for four, and so forth, were used to express multiplicities greater than two, this would have been due to "conceptual poverty." As observed in the following table by Seidenberg, many populations across the world, independently of one another, compose higher quantities by putting the concept of two always in the first place (as in $3 = 2+1$), before the one, which serves merely an integrative function:

PURE 2-COUNTING

(with at least $2 + 2$, $2 + 2 + 1$)

South America

Left to right:

Zamuco (K, p. 233)	$2 + 1, 2 + 2, ..., 2 + 2 + 2 + 2 + 1$
Arara (K, p. 101)	$2 + 1, 2 + 2, 2 + 2 + 1$
Bakairi (K, p. 102)	$2 + 1, 2 + 2, 2 + 2 + 1, 2 + 2 + 2$
Cayapo (K, p. 241)	$2 + 1, 2 + 2, 2 + 2 + 1, 2 + 2 + 2$
Crengez (K, p. 239)	$2 + 2, 2 + 2 + 1$
Apinage (K, p. 240)	$2 + 1, 2 + 2, 2 + 2 + 1$
Krao (K, p. 240)	$2 + 1, 2 + 2, 2 + 2 + 1, 2 + 2 + 2$
Canella (K, p. 240)	$2 + 1, 2 + 2, 2 + 2 + 1, 2 + 2 + 2$
Cotoxo (K, p. 247)	$2 + 1, 2 + 2, 2 + 2 + 1$

Australia

Bottom to top:

South Narrinyeri (WS, p. 62)	$2 + 2, 2 + 2 + 1, 2 + 2 + 2, 2 + 2 + 2 + 1$, etc.
North Kuri (WS, pp. 102, 113)	$2 + 1, 2 + 2, 2 + 2 + 1$
Minyung (WS, pp. 137, 135)	$2 + 1, 2 + 2, 2 + 2 + 1, 2 + 2 + 2$, etc.
Kana (WS, pp. 53, 57)	$2 + 1, 2 + 2, 2 + 2 + 1$
(Gualluma [Clement, p. 192)	$2 + 2, 2 + 2 + 1$; see Neo-2-Counting)
Kohoyimidir (WS, pp. 214, 210)	$2 + 1, 2 + 2, 2 + 2 + 1$
Kauralgal (WS, p. 198)	$2 + 1, 2 + 2, 2 + 2 + 1, 2 + 2 + 2, 2 + 2 + 2 + 1, 2 + 2 + 2 + 2$
Gumulgal (WS, p. 208)	$2 + 1, 2 + 2, 2 + 2 + 1, 2 + 2 + 2$
Torres Straits (Haddon, p. 303)	$2 + 1, 2 + 2, 2 + 2 + 1, 2 + 2 + 2$

New Guinea

Parb (R [W], p. 343)	$2 + 2, 2 + 2 + 1$
Sisiami (R [W], p. 344)	$2 + 1, 2 + 2, 2 + 2 + 1$
Anal; Arop (R [N], p. 330)	$2 + 1, 2 + 2, 2 + 2 + 1$

South Africa

Bushman (Stow, p. 18)	$2 + 2, 2 + 2 + 1, ..., 2 + 2 + 2 + 2 + 2$

Aristotle and the Decimal System

It took very little to Aristotle and the Aristotelians – who had by then acquired completely different ways of interpreting reality, their guiding principle being not anthropology but a self-referential rationalism – to classify these practices as infantile and barbaric: in the *Problemata* (910b 23-911a 2) we read that the most widespread counting system in Greece during the Hellenistic age was a base-ten system, which replaced the more archaic pentadic system, based on 5 – that is, our decimal system:

Διὰ τί πάντες ἄνθρωποι, καὶ βάρβαροι καὶ Ἕλληνες, εἰς τὰ δέκα καταριθμοῦσι, καὶ οὐκ εἰς ἄλλον ἀριθμόν, οἷον β, γ, δ, ε, εἶτα πάλιν ἐπαναδιπλοῦσιν, ἓν πέντε, δύο πέντε, ὥσπερ ἕνδεκα, δώδεκα;

Why, the author asks, do all people, both barbarians and Greeks, count up to ten, rather than stop at another number, such as 2, 3, 4, or 5, and compose larger numbers not by combining any two numbers, for example five-one, five-two, but starting from ten and saying ten-one (eleven, ἓν δέκα), ten-two (twelve), and so forth? The author attempts to answer, and asks:

"Is it perhaps because ten is a perfect number? ... Or because the bodies that move in the sky are nine in number? ... Or because all humans have ten fingers?" Then he adds, with a startling oversimplification, that "among all humans, only one people, the Thracians, count by fours, and this happens because their memory, like that of children, cannot go beyond...":

μόνοι δὲ ἀριθμοῦσι τῶν Θρᾳκῶν γένος τι εἰς τέτταρα, διὰ τὸ ὥσπερ τὰ παιδία μὴ δύνασθαι μνημονεύειν ἐπὶ πολύ, μηδὲ χρῆσιν μηδενὸς εἶναι πολλοῦ αὐτοῖς.

It is known that other systems besides the decimal, such as that of the Thracians so dismissively set aside by the Aristotelian, had a precise role starting from the archaic age. Anthropologists and historians have repeatedly observed that human societies at every latitude and moment in their history have shown a clear tendency to see the world in terms of polarities, and Geoffrey E. R. Lloyd has done so excellently for the Greek thought. This holds true for daily experience, for social organization, for cosmology—which often, as happens especially in Chinese and Indian culture, represents the perfect counterpart to social and political structure—as well as for ethics and logic.

The role of duality in Alcmaeon: Aristotle's testimony and the meaning of ἐναντίον, πολλά, δύο

The exemplar of this idea in the Greek world is Alcmaeon of Croton. Considered, all too generously, the father of almost every aspect of Greek "scientific" thought, one fact is undeniable regardless: there is no aspect of his theories, which according to surviving testimonies seem to have touched many fields, that does not refer to some form of dualism. Aristotle, for his part and despite his prejudices when referring to his predecessors, expresses this concept pointedly when he reports that for Alcmaeon δύο τὰ πολλὰ τῶν ἀνθρωπίνων. The passage from Aristotle is the famous one from *Metaphysics* 986a22-b3:

*ἕτεροι δὲ τῶν αὐτῶν τούτων τὰς ἀρχὰς δέκα λέγουσιν εἶναι τὰς **κατὰ συστοιχίαν** λεγομένας, πέρας ἄπειρον, περιττὸν ἄρτιον, …· ὅπερ τρόπον ἔοικε καὶ Ἀλκμαίων ὁ Κροτωνιάτης ὑπολαβεῖν, καὶ ἤτοι οὗτος παρ' ἐκείνων ἢ ἐκεῖνοι παρὰ τούτου παρέλαβον τὸν λόγον τοῦτον· … ἀπεφήνατο [δὲ] παραπλησίως τούτοις· φησὶ γὰρ εἶναι **δύο τὰ πολλὰ τῶν ἀνθρωπίνων**, λέγων τὰς ἐναντιότητας οὐχ ὥσπερ οὗτοι διωρισμένας ἀλλὰ τὰς τυχούσας, οἷον λευκὸν μέλαν, γλυκὺ πικρόν, ἀγαθὸν κακόν, μέγα μικρόν. οὗτος μὲν οὖν **ἀδιορίστως ἀπέρριψε** περὶ [986b1] τῶν λοιπῶν, οἱ δὲ Πυθαγόρειοι καὶ πόσαι καὶ τίνες αἱ ἐναντιώσεις ἀπεφήναντο. παρὰ μὲν οὖν τούτων ἀμφοῖν τοσοῦτον ἔστι λαβεῖν, ὅτι **τἀναντία ἀρχαὶ τῶν ὄντων**[8].*

Aristotle's testimony is notoriously obscure; the association of Alcmaeon with the Pythagoreans has often been questioned or has required exegetical efforts, and in fact what emerges is not proximity but rather the distance of Alcmaeon from the more famous colleagues. Saying δύο τὰ πολλὰ τῶν ἀνθρωπίνων does not amount to imagining oppositions, as Aristotle explains (λέγων etc.), but rather pairs, associations; indeed, in the same text Aristotle struggles to define these pairings as accidental and not precisely determined in functional συστοιχίαι, those tables and columns of which he was so fond for their teaching effectiveness[9]. Aristotle, absorbed by his logic, does specify that Alcmaeon's pairs are τυχούσας and not διωρισμένας, he says that Alcmaeon even ἀδιορίστως ἀπέρριψε, tossed things about at random, with an adverb that is an Aristotelian favorite and a verb with a clearly pejorative value—if the closest example is that in Theophrastus' *Characters* (XIX 4) where ἀπορρίπτειν ἀπὸ τοῦ στόματος means "to spit" while speaking, or in Galen even "to vomit" (*Comp. med. sec. loc*. XIII 162,17 K.), and already in Herodotus (I 153) has a pejorative meaning with reference to words. Yet Aristotle does not give up trying to categorize the δύο τὰ πολλά with examples that we may suspect are actually his own, introduced by the exegetical οἷον, "for example," which betrays his need to frame Alcmaeon within the broader schema he has outlined. It is no coincidence that tradition attributes to Aristotle a *Contra Alcmaeonem* (Πρὸς τὰ Ἀλκμαίωνος), which reveals the full distance between them.

To my mind, the specific meaning of the terms ἐναντίον / ἐναντιότης / ἐναντίωσις, on which Aristotle bases his table of contraries, has often been overlooked: unlike the more abstract later forms, the substantivized ἐναντίον, especially in the age commonly ascribed to Alcmaeon, does not necessarily express opposition; it primarily means, as its obvious etymology indicates, "that which is in front," or "facing," being "face to face" with someone, as Patroclus in *Iliad* IX 190 οἱ … ἐναντίος ἧστο, or moving toward someone, as in *Iliad* VI 251. It expresses otherness, emphasizes separateness, distinction, the possibility of confrontation, actually the presence of someone or something beyond the self, of an object that by its very existence reveals and enables the existence of the other[10].

In Aristotle's passage, then, what seems to be implied for Alcmaeon is not a list of contraries, but the very concept of duality.

The τὰ πολλά, in the archaic philosophical context typically opposed to ἕν, evidently does not mean "the majority of things", which would be a trivial and vague commonplace but rather the totality of the manifold, the whole of phenomenal reality in its irreducible multiplicity. To emphasize the distance from the Pythagoreans, but also from Aristotle himself, there is the further specification that what Alcmaeon refers to are τὰ ἀνθρώπινα, not τὰ ὄντα nor ἀρχαί, despite the final formula of the cited passage operating an inversion (τὰναντία ἀρχαὶ τῶν ὄντων)[11]: the field of inquiry, albeit broad, is precisely delineated as having a phenomenal dimension, which one must imagine certainly included biology but no less the political and social domain, even the cosmological one insofar as it directly concerns human action – not, however, an abstract ontological dimension.

Decisive is the δύο: whose meaning, as already mentioned, requires an interpretation going beyond mere numerical significance. While Becker focused on the distance separating the concept of number in antiquity from modern mathematical conceptions, and Paolo Zellini endeavored to trace identities and roots of a concept both decisive and elusive[12], what remains is the ambiguity of the *two*, caught as it is between the indivisible unity represented by the even-odd one and the multiplicity of the plural world, which requires at least three components. Its special status, attested by the existence of the grammatical dual form, is not unique to the Greeks: this form is found in Sanskrit, Paleo-Slavic languages, Arabic, Hebrew, and Egyptian, and elsewhere. It is equally, and perhaps even more noteworthy that this peculiar linguistic form appears both in populations considered culturally refined, such as the Greeks—where, as Wilhelm von Humboldt observed, the dual persisted longest in the most elaborate dialect, Attic—and in populations regarded as 'archaic' and less civilized, such as the New Zealand Aborigines or the Inuit of Greenland.

The binary system, as mentioned, represents one of the most primitive and universal forms of numerical organization. Numerous civilizations, as noted by Seidenberg and others, essentially have only two number words, one and two, and larger multiplicities are indicated by a generic "many", not far from Alcmaeon's τὰ πολλά, which according to Aristotle's testimony is related to δύο.

In Pythagoreanism, this relation between one and two, between monad and dyad, is the pivot around which, it can be said, an entire system revolves, in which the one/monad is indivisible, the two/dyad is differentiation, and since matter is the condition of possibility for differentiation in the natural world, it relates to the dyad as the possibility of differentiation in number, as Iamblichus was to argue[13]. The dyad is formless, as is matter: and it is in this duality that the possibility of perception, movement, metamorphosis, and the original relation of one thing to another—λόγος, which is primarily the relation between entities (and especially mathematical entities)—resides. Logos is the golden key to the interpretation of the world, the most typical and deeply rooted concept of Greek culture.

Duality and the dual: W. von Humboldt and C. G. Jung.

This apparent limitation of numerical systems is actually expression of an essentially cognitive structure. Duality, as mentioned, presents itself to the mind as soon as one becomes aware of the presence of the other as different. This process can be observed in every civilization in the development of the newborn. The distinction between self and other constitutes the first act of differentiation through which the subject constitutes itself as such; it is the original matrix of all dualistic thought[14]. Contemporary cognitive psychology and neuroscience, which identify the capacity to distinguish between self and non-self as one of the crucial moments in the development of what we call consciousness, likewise highlight the centrality of this process. However, it would be an oversimplification to consider self and other as opposites: rather, they constitute a new unity, that of the dual, in which each half guarantees the entity and identity of the other. You, he, are non-I[15], but you are precisely insofar as and to the extent that I exist.

Wilhelm von Humboldt, in the masterful *Über den Dualis*, shows a keen awareness of this dimension when he demonstrates that the concept of duality (*Zweiheit*) permeates not only linguistic structures but the entire organisation of human thought: *two* is not simply the first element in the numerical series following *one*, but represents a specific mode of existence and relation. The dual does not limit itself to the concept of the pure and simple number two, as one of many elements in the series of numbers, but rests on the concept of duality and is at the same time a singular collective of the number two, since the plural only exceptionally and anomalously can reduce multiplicity to unity, as demonstrated by cases where a plural subject takes a singular verb. The dual, says Humboldt (§ 18), thus simultaneously shares, as a form of plurality and indication of a closed whole, the nature of singular and plural: it does not express number per se, but a set of two things constituting something unto itself, which however differs from the sum of the two things discussed, so much so that, as Albert Cuny pointed out, when expressing the concept of 'two wolves,' the dual suffix alone is insufficient and the numeral must be added. That is, when it is not already known the things ati issue are two (as with paired organs of the body), the numeral is necessary[16].

A set of two objects is immediately perceivable as something enclosed, placed midway between the single object and a group of multiple objects, and it is known, verifiable by anyone, that the visual perception–mental processing sequence can immediately identify up to four separate elements, that is, two pairs placed side by side (IIII), whereas counting becomes neceassary if beyond four (IIIII or IIIIII).

In this sense, the concept of duality pertains equally to the domains of visible and invisible, presenting itself both to those who turn inward to their inner dimension and to those who look outward. It is a constant regulating the laws of thought and the endeavor of perception, but also the very structure of the human body and the orga-

nization of nature. Anyone who has addressed the topic came to observe—and von Humboldt was among the first to give systematic form to otherwise occasional observations—that the first observable manifestation of duality in humans is the division into two sexes and all concepts deriving therefrom. Yet even more immediate and ancient is the division of the human and animal body into two equal halves, with paired limbs and sensory organs that only function correctly together— just consider vision and the crossover and exchange of work of the two eyes in the optic chiasm. This bilateral symmetry is reflected in all aspects of our life, influencing even aesthetic taste and art, besides being critical for phenomena enabling life itself, such as homeostasis, the balanced state characteristic of higher animals allowing them to maintain constant system parameters despite changes in the external setting. An obvious reference is the two hemispheres of the brain, and it would be easy to list phenomena of nature that present themselves in dual form or are perceived as such: day and night, earth and sky, land and waters, right and left, high and low, but also archetypal forms of thought—not only the one opposing self and world, but those expressed, for example, in the very acts of analysis and synthesis, laying down and lifting up (downbeat and upbeat in musical terms), familiar and foreign, good and evil, being and not-being[17]. The world, with its metamorphoses, finds full expression in language.

Between self and other, Carl Gustav Jung saw an antithetical tension. "Every tension of opposites culminates in a release, out of which comes the 'third'. In the third, the tension is resolved and the lost unity is restored. Unity, the absolute One, cannot be numbered, it is indefinable and unknowable; only when it appears as a unit, the number one, is it knowable, for the 'Other' which is required for this act of knowing is lacking in the condition of the One. Three is an unfolding of the One to a condition where it can be known—unity become recognizable; had it not been resolved into the polarity of the One and the Other, it would have remained fixed in a condition devoid of every quality"[18]. The appearance of the other alongside the one also brings the sensation of something alien, thus opposed, as in the ἐναντία of Aristotle'. Thus, the idea of right and left as purely spatial positioning is overlaid by that of the other as something "sinister," wrong, crooked, and thereby also opposition "of auspicious and inauspicious, and even good and evil" (Ibid.). For this reason, Jung further says, according to medieval and early modern alchemists God did not praise the second day of creation, because on this day (a Monday = *dies lunae*) the *binarius*, the devil as number two, 'doubt', the origin of evil, the *quadricornutus binarius,* was born. The sixteenth century philosopher and physician Gerard Dorn – so Jung –, had argued in favor of the entry of the devil as a fourth element into the Trinity, and as a proof he had mentioned the peculiar description of the second day of Creation in the *Book of Genesis*: "Dorn thinks that God created the binarius on the second day of Creation, when he separated the upper waters from the lower, and that this was the reason why he omitted to say on the evening of the second day what he said on all the others, namely that 'it was good'.

The emancipation of the binarius, Dorn holds, was the cause of confusion, division, and strife"[19]. And, as Jung adds elsewhere, "two implies a one which is different and distinct from the "numberless" One. In other words, as soon as the number two appears, a unit is produced out of the original unity, and this unit is none other than that same unity split into two and turned into a "number" [20]. *Binarius*, indeed, the *numerus infamis* according to Thomas Aquinas, is devil because it separates, brings conflict, or at least sows ambiguity—the διάβολος which renders the Hebrew *śāṭān*, the adversary, the lord of διαβολή, slander, deceit, falsehood, conflict.

But language itself, von Humboldt says, arises from and is made possible by a duality, since every act of speaking is an interlocution, and the speaker—even when addressing multiple people—speaks as if before a unity, in a relation that remains that between two entities: speaker and listener(s). Even when alone, a person speaks with himself as with someone else. The intimately dialogical dimension of language is also that of thought, suggesting that duality is not simply a feature of the objective world, but the very condition of possibility for knowledge and communication.
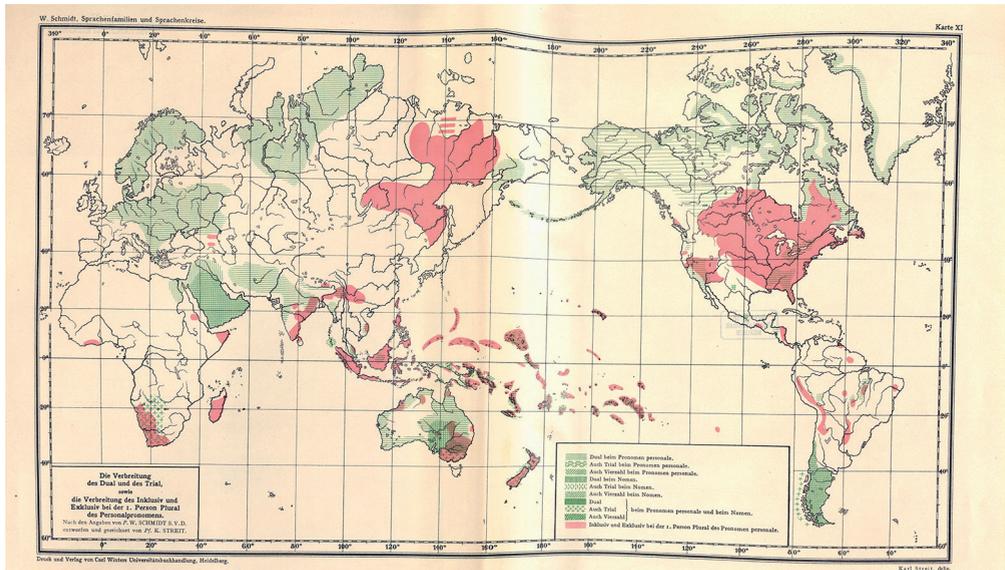

Fig. 1. The distribution of various forms of the dual and the trial in the languages of different continents (graphic elaboration by K. Streit, based on information provided by P.W. Schmidt, 1926)

The division into two as God's choice according to Christianity

Christianity also traces the dual structure of reality back to a specific will, a choice: at the beginning of the fourth century, Lactantius, in *De opificio dei* (X 41B p. 291), speaking of the double parts of the body, after having spoken about the eyes, observes, with regard to the nose:

> *Nasi vero pars superior usque ad medium solida formata est ...: quas ipsas Deus quam mirabili, quam divina ratione molitus est, ut tamen hiatus ipse nasi oris speciem non deformaret ... At id velut pariete per medium ducto **intersepsit atque divisit**, fecitque ipsa **duplicitate** pulcherrimum. **ex quo intelligimus, quantum dualis numerus, una et simplici compage solidatus, ad rerum valeat perfectionem**[21].*

The division into two, the dual, the pair, is thus a sign of perfection, a divine choice and not, instead, merely a classificatory occasion in order to better organize the world and facilitate the knowledge of things.

Occurrences and features of dualism in Alcmaeon

Alcmaeon combines his dualistic approach with the idea of a brain that processes data coming from the outside via perception. In his mindful search for an explanation of the external-internal relation, he reflects those same deeply-rooted convictions and anthropological and cultural features which have led to the extraordinary spread of dualistic theories. Alcmaeon is a child of a time in which it is difficult to situate him, as we seek to avoid the undue normalizations of those who forged the notion of "Presocratics."

Alcmaeon's dualism shows itself mainly in his conviction of δύο τὰ πολλά—further trivialized by Isocrates, who generalizes a simplified schema[22]—namely not the pairs of contraries that Aristotle strives to identify but the very principle of duality on which both the natural world and the human body, which is part of that world, rest. While finding a place in nearly every aspect of his thought the dualistic vision takes on particular relevance in what we consider properly medical theories, especially where Alcmaeon maintains that what guarantees health is only balance (*isonomia*, a term not coincidental nor merely metaphorical, perhaps with political implications, but above all an early intuition of forms of homeostasis, as it seems) among the different forces active in the body, whereas disease arises when one of them, taking the form of quality, excessively predominates over the other (*monarchy*)[22]. It is Aëtius (V 30,1, fr. 4 DK = Ps. Plut. Plac. 911A2) who informs us more precisely, when he observes that Ἀλκμαίων τῆς μὲν ὑγιείας εἶναι συνεκτικὴν τὴν ἰσονομίαν τῶν δυνάμεων, ὑγροῦ, ξηροῦ, ψυχροῦ, θερμοῦ, πικροῦ, γλυκέος καὶ τῶν λοιπῶν, τὴν δ᾽ ἐν αὐτοῖς μοναρχίαν νόσου ποιητικήν ("Alcmaeon (says that) the equality of the forces, wet, dry, cold, hot, bitter, sweet, and the others, produces health, while diseases arise when one prevails over the others.").

While one might notice, as has been done[23], that this dualistic approach to medicine influenced the subsequent development of the Hippocratic humoral theory as it reaches maturity in *De natura hominis*[24] and, in less completed form, in other writings of the *Corpus Hippocraticum*, and while the idea that health depends on balance among opposing forces is widely known as a fundamental paradigm throughout the history of medicine and physiology—from Italic medicine to Empedocles—it is more signifi-

cant to see how such a principle was applied to a peculiar conception of soul and body, and of their reciprocal relation. Alcmaeon draws, indeed, a sharp distinction between rational faculties, which he attributes to the brain (considered the seat of thought), and bodily functions: and this separation between mental and physical faculties represents one of the earliest examples of mind-body dualism in the history of Western thought, overcoming the continuity between the two dimensions which is clearly attested already from the Homeric poems and which continuously resurfaces[25].

It is worth noting how Alcmaeon's dualism differs from later philosophical dualisms. His is not an absolute metaphysical dualism like Plato's, but rather a functional dualism based on the observation of natural and physiological phenomena.

It is also important to clarify that the balance of which Alcmaeon speaks is not a static condition but a dynamic one. The δυνάμεις, the different powers or qualities, are not opposed to the point of mutually canceling each other, but coexist in a productive tension. Clearly distinct both from Ionian monism, which tends to reduce multiplicity to a single principle, and from the static dualism of certain Pythagorean or Parmenidean positions, this conception speaks rather of a moving balance, continually re-established through the interaction of different forces.

The lists of pairs of qualities, whether in Aristotle or Aëtius—wet/dry, hot/cold, sweet/bitter—indeed reflect categories that have become fundamental to sensible experience and medical practice, but seem rather to be later simplifications, typical of times when the depths of archaic thought had already become alien and unattainable.

Well known, and well formalized by Guthrie, is also the fact that Alcmaeonic dualism extends into the sphere of knowledge, as appears from what Theophrastus records (*De sensibus* 25, A5 DK): Ἀλκμαίων μὲν πρῶτον ἀφορίζει τὴν πρὸς τὰ ζῷα διαφοράν. ἄνθρωπον γάρ φησι τῶν ἄλλων διαφέρειν ὅτι μόνος ξυνίησι, τὰ δ᾽ ἄλλα αἰσθάνεται μὲν οὐ ξυνίησι δέ. Man, Alcmaeon says, distinguishes himself from other animals because he alone is able to understand (ξυνίησι), whereas other beings do perceive (αἰσθάνεται), but do not reach synthesis (as a resolution of the conflict between thesis and antithesis). With the distinction between αἴσθησις and ξύνεσις, namely an essential step in the development of Greek epistemology, the concern is not so much to distinguish between different grades of knowledge, but to identify two qualitatively different cognitive modes: one, shared with animals, destined to supply the raw data of experience; the other, exclusively human, able to process these data into a 'rational' synthesis. Theophrastus adds that Alcmaeon should be classified among those who hold that perception occurs through the dissimilar, μὴ τῷ ὁμοίῳ. In so doing he distinguishes him from an ancient, and already Homeric and Empedoclean tradition, thereby attributing to him a conception of knowledge as a relation of alterity rather than identification, between two separate and heterogeneous entities.

The most often cited fragment of Alcmaeon, B1 DK, preserved by Diogenes Laertius (VIII 83), adds a further dimension to Alcmaeonic epistemological dualism and re-

quires no further comment: περὶ τῶν ἀφανέων, περὶ τῶν θνητῶν σαφήνειαν μὲν θεοὶ ἔχοντι, ὡς δὲ ἀνθρώποις τεκμαίρεσθαι, the distinction between certainty and conjecture, between the divine and the human, perhaps between the visible and the invisible (though the text remains uncertain in the opening part), introduces a vertical dimension of dualism, complementary to the horizontal one between perception and understanding.

Even in Alcmaeon's cosmological conception, features of a dualistic vision appear: that which distinguishes the mortality of the linear course of human life (fr. 2 DK), in which beginning and end do not coincide and once it is set in motion has no possibility of return, from the immortality of the stars and their course which, being circular, is uninterrupted. Planets and fixed stars, for Alcmaeon, move in opposite directions (A4 DK), and this opposition of celestial motions reflects in turn the dualistic structure of the universe, in a complementarity that is not conflictual—not once more a matter of contraries—and ensures the order and harmony of the cosmos. In this system, the human soul occupies a peculiar position (A12 DK): immortal, of a nature similar to the divine nature of the stars, trapped in a mortal body, it in turn has a relation of complementarity whit the body, and participates in a conception that presents obvious resonances with central themes in Pythagoreanism and Platonism[26].

Alcmaeon's is a pervasive dualism, applied to physiology, epistemology, and cosmology alike, and characterized by a dynamic vision of balance between complementary forces. It is not a philosophical theory, but rather a heuristic principle that conceives duality not as division or conflict, but as complementarity; not as destructive opposition, but as productive tension; not as stasis, but as dynamic equilibrium. "The division into two was necessary in order to bring the 'one' world out of the state of potentiality into reality. Reality consists of a multiplicity of things. But one is not a number; the first number is two, and with it multiplicity and reality begin," observed Jung in his *Mysterium Conjunctionis*, referring to a belief current in the Middle Ages[27].

A ritual origin for Alcmaeon's dualism?

As for the origin and meaning of this dualism, one may perhaps entertain a hypothesis different from conventional theories, which locate the foundations of Alcmaeon's theory either in the empirical observation of nature and the body or in Pythagorean influence. Both Wilhelm von Humboldt and Abraham Seidenberg, along with anthropologists and historians of mathematics, have pointed out the link between dual structures of thought and specific ritual practices—such as creation rituals that included the equal alternation of male and female figures appearing on stage, and the balance of pairs in processions. Without dwelling on examples here—which are readily available in the relevant literature—we need only recall the universally known case of the *Book of Genesis*, where God "created them male and female," or the pairs that Noah brought onto the ark, two by two, male and female, as God had commanded.

Seidenberg suggests that, in accordance with ritual usage, where word accompanies action, a pair immediately appeared on the ritual stage after being announced. This, he adds, may explain the origin of number in its association with divinity: in this sense, numbers would not have existed prior to their ritual application, i.e., as tools to invoke the divine; and this would also account for the widespread use in many cultures of binary counting, in pairs, as well as the classification of numbers into even and odd—known at least in Egypt, Babylon, India, China, and among populations in Africa, South and North America, and Oceania. Seidenberg also traces the Pythagorean notion of a central fire back to this same origin: "the actual central fire around which ten participants in a ritual arranged themselves"[28].

The dating of Alcmaeon, still uncertain between the end of the sixth century and the middle of the fifth, becomes crucial here. To consider him a proto-scientist with an empirical approach, a modern idea of the brain's function, and the practice of dissection, has always seemed unwarranted, and has rightly raised perplexities following earlier, excessive enthusiasm. His idea of the pair's dynamic complementarity, the balance of qualities, lends itself more readily to a grounding in ancient practices such as rituals, which might better explain the pervasive nature of the dualistic scheme in ancient cultures, including the Greek. The Pythagoreans' later rigidity in numerological oppositions would then necessarily be the result of subsequent developments and hybridizations—consistently with the distance Aristotle sensed between them and Alcmaeon, though he did not know how to explain it. In both archaic ritual and in Alcmaeon's conception of nature and medicine, dualism is never a mere opposition, but a process directed toward the creation or maintenance of life. The equal alternation of male and female in ritual, and of one pair with the next, would also be consistent with the idea of balance guaranteed by isonomy, as parity among the forces at play. This, while not excluding the political resonances often noted in the scholarly literature, would lend plausibility and historicity both to the one and to the others.

Addendum

Not far removed—if at all—from such perspectives is the concept of "twoness" formulated by the Dutch mathematician Luitzen Brouwer, the founder of the school of metamathematical thought known as "intuitionism" in the early twentieth century, and at the same time wary of all mathematics and rationalist exaltation when applied to life. "Intuitionist mathematics," Brouwer explains, "is an essentially language-less activity of the mind having its origin in the perception of a move of time, i.e. of the falling apart of a life moment into two distinct things, one of which gives way to the other, but is retained by memory. If the two-ity thus born is divested of all quality, there remains the empty form of the common substratum of all two-ities. It is this common substratum, this empty form, which is the basic intuition of mathematics"[29].

This statement, in a conception wherein intuition is the sole criterion of truth on which mathematical thought can rely, and numbers are abstract, intuitable notions—thus lacking the kind of existence that conceptual realism claims for them—finds in the intuition of pure twoness, which enables the subsequent construction of finite ordinal numbers, the fundamental phenomenon of mathematical thought.

Bibliography, notes and references

* Rather than offering yet another detailed re-examination of the fragments attributed to Alcmaeon or a further specific investigation, the aim of this contribution is to propose a comprehensive interpretation of a concept that appears to be pervasive in what we know of Alcmaeon, by seeking a different contextualization. I follow the structure used for the oral presentation. Bibliographical references will be deliberately limited to the essential, and, as regards Alcmaeon, to a few more recent contributions, assuming familiarity with the established bibliography, which is, in any case, easily accessible; among them, the comprehensive and insightful overview by Guthrie WKC, A History of Greek Philosophy. Vol. I. Cambridge: Cambridge University press; 1962. pp. 341-359, still stands out.

1. I discussed this in Perilli L, Quante sono le foche di Proteo? Numeri e numerali nella Grecia arcaica e classica. In: Inglese A (ed.), Epigrammata 4. L'uso dei numeri greci nelle iscrizioni. Atti del Convegno di Roma, 16-17 Dicembre 2016. Tivoli; 2017. pp. 1-54, whence the concepts outlined in these opening lines are summarized.
2. Aristot. *Phys.* 219b 5-9.
3. Becker O*, Zwei Untersuchungen zur antiken Logik. I: Zum Problem der platonischen Idealzahlen (Eine Retraktation). Wiesbaden Klassisch-Philologischen Studien 1957;17:21.
4. Persson P, Beiträge zur indogermanischen Wortforschung. vol. 2. Uppsala-Leipzig: A.B. Akademia bokhandeln; 1912. pp. 741ff., 856, and especially p. 636; see Walde A, Pokorny J, Vergleichendes Wörterbuch der Indogermanischen Sprachen. vol. 1. München-Bern: Gruyter; 1959. pp. 69-76.
5. Seldenberg A, "The diffusion of counting practices". Univ. of California Publications in Mathematics 1960:3(4);215-300 (here p. 216).
6. Cf. on this subject Tambiah SJ, Magic, Science, Religion, and the Scope of Rationality. Cambridge: Cambridge University Press; 1990. p. 1 ff.
7. Cf. Conant LL, The Number Concept: Its Origin and Development. New York-London: Macmillan and co; 1896.
8. "Others among these same thinkers say that there are ten starting-points arranged in columns: limit-unlimited… This is the way in which Alcmaeon of Croton also seems to have taken things, and either he got this account from them or they got it from him. For Alcmaeon too made claims quite similar to theirs, since he says that most things relating to humans come in twos [*rather "human things in their plurality are two"*], mentioning not definite contraries, as these thinkers did, but random ones—for example, white and black, sweet and bitter, good and bad, great and small. He threw out indefinite suggestions about the rest, whereas the Pythagoreans made claims both about how many contraries there are and what they are. From both of these, then, we can grasp this much, that the contraries are the starting-points of beings." (trans. C.D.C. Reeve).

9. The initial sections of *Topics* show this explicitly. See Perilli L, How Aristotle named his sources. On πάρασημαινεσθαι and related terms. Wiener Studien 2025:118;7-20, with further bibliography.

10. A clear manipulation is that of Alexander of Aphrodisias, who, in closely—indeed slav-ishly—following Aristotle, ends up attributing to him even more than he actually says: cf. *Alex. Aphrod. In Metaph.* 41,32–42,11: ἱστορεῖ δὲ ὅτι τινὲς τῶν Πυθαγορείων τὰς ἀρχὰς δέκα ὑπετίθεντο ἐναντιώσεις, ὃς καὶ πρῶτος τέλειος ἀριθμὸς αὐτοῖς ἐστι, κατὰ συστοιχίας τινὰς τιθέντες, εἰς ἃς ἀνῆγον καὶ τὰ ὄντα. καὶ τίνες αὗταί εἰσιν, ἐκτίθεται· πέρας γὰρ καὶ ἄπειρον, … ἱστορεῖ δὲ ὡς καὶ Ἀλκμαίωνος τοῦ Κροτωνιάτου τὸν αὐτὸν τούτοις τρόπον περὶ τῶν ἀρχῶν ἀποφηναμένου· εἰς γὰρ ἐναντίωσίν τινα ἕκαστον τῶν ὄντων ἀνάγειν ἐπειρᾶτο καὶ οὗτος ὡς ἀρχῶν οὐσῶν τῶν ἐναντιώσεων. διαφέρει δὲ τῶν Πυθαγορικῶν ὅτι οἱ μὲν δεκάδας ποιοῦντες ταύτας μὲν ἐξετίθεντο ὁρίζοντες, ὁ δὲ τὴν τυχοῦσαν ἐναντίωσιν ἀρχὴν ἔλεγεν ἀδιορίστως· οὕτως δὲ πᾶσα ἂν ἐναντίωσις ἀρχὴ γίνοιτο αὐτῷ. κοινὸν μὲν οὖν τῶν Πυθαγορικῶν, οἳ ταύτης ἐγένοντο τῆς δόξης, καὶ Ἀλκμαίωνος τὸ ἐναντίας λέγειν εἶναι τὰς ἀρχὰς τῶν ὄντων· πόσαι δὲ καὶ τίνες αὗται, τῶν Πυθαγορικῶν ἴδιον.

    ("He reports that some of the Pythagoreans posited ten pairs of opposites as principles—this being, moreover, for them the first perfect number—arranged in sequences, to which they also reduced the things that are. And he lists what these are: limit and unlimited... He also reports that Alcmaeon of Croton expressed himself on the principles in the same manner as they did: for he too attempted to reduce each existing thing to some opposition, holding that opposites were principles. He differs from the Pythagoreans in that they, making ten such pairs, set them out and defined them, whereas Alcmaeon, in an unde-termined way, claimed that any given opposition could be a principle; thus, for him, any opposition could become a principle. What is common, then, between the Pythagoreans who held this view and Alcmaeon is the idea that the principles of beings are opposites; but as to how many and which they are, that is proper to the Pythagoreans.")

11. Starting from this closing formula, Asclepius—like other commentators on Aristotle—misunderstands, providing a clear example of how such testimonies could be simplified, manipulated, or at least adapted: cf. Asclep. *In Metaph. A–Z* 39 (sim. *Alex. Aphr.*) λέγων εἶναι δύο τὰ πολλὰ τῶν ὄντων, διότι τὰ ἐν γενέσει καὶ φθορᾷ ἐξ ἐναντίων συνίστανται…

12. See, among the many contributions, at least the dense Zellini P, Numero e logos. Milano: Adelphi; 2010.

13. Cf. Bostock G, The Sacred Tetraktys: The Number Symbolism of the Pythagoreans. (available online).

14. On dualism, the subject of numerous anthropological studies, I will limit myself here to referring only to the 21 volumes by Fontaine PFM, The Light and the Dark: A Cultural History of Dualism. Amsterdam: J.C. Gieben; 1986; see also. Lange A, Meyers EM, Reyn-olds BH, Styers R (eds), Light Against Darkness. Dualism in Ancient Mediterranean Reli-gion and the Contemporary World. Göttingen: Vandenhoeck & Ruprecht; 2011.

15. See von Humboldt W, Über den Dualis. Gelesen in der Akademie der Wissenschaftem am 26. April 1827. Berlin: Gedrucktin der Druckerei der Koniglichen Akademie der Wissen-schaften; 1828. p. 24.

16. Cuny A, Le nombre duel en grec. Paris: C. Klincksieck;1906. p. 67.

17. von Humboldt W Ref. 15. § 22.

18. Jung CG, A psychological approach to the dogma of the Trinity. In: Read H, Fordham M, Adler G, (eds) The collected works of CG Jung vol. 11. Psychology and religion: east and

west. New York: 1958. p. 119. (ed. or. Versuch zu einer psychologischen Deutung des Trinitätsdogmas. In: Symbolik des Geistes. Zurich: 1948).

19. Jung CG, Psychology and religion. Zürich: Rascher; 1940. p. 104 n., also in: The collected works of Jung CG, Ref. 18. p. 60 n. 47.

20. Jung CG, A psychological approach to the dogma of the Trinity. Ref. 18. p. 118

21. "Indeed, the upper part of the nose up to the middle is formed solid...: which very parts God fashioned with such a marvelous, such a divine reason, so that nevertheless the opening itself of the nose would not deform the appearance of the face... But He separated and divided this by drawing a wall through the middle, as it were, and made it most beautiful by this very duality. From this we understand how much the dual number, solidified in one and simple structure, avails for the perfection of things.".

22. Cf. Isocr. *Antidosis* 268,7… εἰς τοὺς λόγους τοὺς τῶν παλαιῶν σοφιστῶν, ὧν ὁ μὲν ἄπειρον τὸ πλῆθος ἔφησεν εἶναι τῶν ὄντων, Ἐμπεδοκλῆς δὲ τέτταρα καὶ νεῖκος καὶ φιλίαν ἐν αὐτοῖς, Ἴων δ᾽ οὐ πλείω τριῶν, Ἀλκμέων δὲ δύο μόνα, Παρμενίδης δὲ καὶ Μέλισσος ἓν, Γοργίας δὲ παντελῶς οὐδέν ("Regarding the doctrines of the ancient sophists, of whom one affirmed that the things that are were infinite in number, Empedocles [said that there were] four, including strife and friendship; Ion no more than three; Alcmaeon only two; Parmenides and Melissus one; Gorgias absolutely none"). Even Plato seeks a common line but does not seem to grasp the profound significance of the schemes he recalls; evidently, times had changed, as had the intentions: cf. Plat. *Soph.* 242c8–e2: ὁ μὲν ὡς τρία τὰ ὄντα, πολεμεῖ δὲ ἀλλήλοις …· δύο δὲ ἕτερος εἰπών, ὑγρὸν καὶ ξηρὸν ἢ θερμὸν καὶ ψυχρόν, συνοικίζει τε αὐτὰ καὶ ἐκδίδωσι· τὸ δὲ παρ᾽ ἡμῖν Ἐλεατικὸν ἔθνος, ἀπὸ Ξενοφάνους τε καὶ ἔτι πρόσθεν ἀρξάμενον, ὡς ἑνὸς ὄντος τῶν πάντων καλουμένων οὕτω διεξέρχεται τοῖς μύθοις. Ἰάδες δὲ καὶ Σικελαί τινες ὕστερον Μοῦσαι συνενόησαν ὅτι συμπλέκειν ἀσφαλέστατον ἀμφότερα καὶ λέγειν ὡς τὸ ὂν πολλά τε καὶ ἕν ἐστιν, ἔχθρᾳ δὲ καὶ φιλίᾳ συνέχεται ("One tells us that there are three beings, and that sometimes they're somehow at war with each other, while at other times they become friendly, marry, give birth, and bring up their offspring. Another one says that there are two beings, wet and dry or hot and cold. He marries them off and makes them set up house together. And our Eleatic tribe, starting from Xenophanes and even people before him, tells us their myth on the assumption that what they call "all things" are just one. Later on, some Ionian and Sicilian muses both had the idea that it was safer to weave the two views together. They say that that which is is both many and one and is bound by both hatred and friendship." Transl. N.P. White).

23. Many scholars have dealt with the topic of isonomy; a recent significant contribution regarding its political parallelism is 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: Cambridge University Press; 2014. pp. 78-95; see also Sassi MM, Ordre cosmique et isonomia. Philosophie antique 2007:7;189-218. On the relationship between health, disease, and politics, see Kouloumentas S, The body and the polis: Alcmaeon on health and disease. British Journal for the History of Philosophy 2014:22(5);867-887.

24. It suffices to refer to the excellent analysis by Guthrie, cited above in the note to the title.

25. Cf. e.g. Hippocr. *Nat. hom.* 4,1, p. 172 J. τὸ δὲ σῶμα τοῦ ἀνθρώπου ἔχει ἐν ἑωυτῷ αἷμα καὶ φλέγμα καὶ χολὴν ξανθήν τε καὶ μέλαιναν, καὶ ταῦτ᾽ ἐστὶν αὐτέῳ ἡ φύσις τοῦ σώματος.

26. On this, I have proposed some reflections in: Perilli L, Sinesthesia. Traces of archaism in the conception of sight and hearing in the Hippocratic Corpus. Antiquorum Philosophia 2020:14;23-50.

27. On the soul in Alcmaeon, see in particular Mansfeld J, Alcmaeon and Plato on Soul. Études platoniciennes 2014:11; (online), which offers new and, as always, pertinent considerations.

28. Jung CG, Mysterium conjunctionis. A inquiry into the separation and synthesis of psychic opposites in alchemy. In: Collected works (Ref. 18). Princeton: Princeton University Press; 1970. vol. 14. p. 462 (orig. ed. Untersuchung über die Trennung und Zusammensetzung der seelischen Gegensätze in der Alchemie. Zürich: 1955-56. p. 659).

29. Seidenberg, A. The ritual origin of counting. Archive for History of Exact Sciences 1962:2;1-40. It might make sense here to verify whether the arguments deployed by Magali Année in her 2019 edition of Alcmaeon, especially regarding the attention given to the prosodic-phonic dimension of the few lines of Alcmaeon that have come down to us (in contrast with the traditional conception of Alcmaeon as an author of scientific prose), can find support or not in this ritual dimension. However, this will be a task for another occasion. It is worth recalling that Laura Gemelli Marciano has also suggested paying attention to the phonic and performative dimension in the poem of Parmenides, see her Parmenide: suoni, immagini, esperienza, St. Augustin: 2007.

30. Brouwer LEJ, Historical Background, Principles and Methods of Intuitionism. Paper read to Section A of the South African Association for the Advancement of Science, in South African Journal of Science1952: Oct.-Nov.; now in Heyting A (ed.), Brouwer JLE, Philosophy and Foundations of Mathematics. Amsterdam: 1975. pp. 508-515.