

A review of Aristotle's claim regarding Pythagoreans fundamental Beliefs: All is number?

Uma revisão da alegação de Aristóteles sobre as crenças fundamentais dos Pitagóricos: tudo é número?

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ABSTRACT

The question-statement, "All is number?", the title of Zhmud's famous 1989 article in *Phronesis*, opens a challenge to the extremely important Aristotelian testimony that "all is number" was the fundamental definition of Pythagorean philosophy. Such a challenge is anything but easy, especially when one considers that, so far, the histories of both ancient philosophy and ancient mathematics seem to have no doubts that this definition is correct. This paper aims to submit Aristotle's claim that the Pythagoreans believed that "all is number" to critical review. Our analysis of the many ways in which Aristotle states the thesis that "all is number" will reveal, beyond merely semantic variations, a fundamental theoretical contradiction that Aristotle himself seems incapable of solving. Three different versions of the doctrine are in fact present in the Aristotelian doxography: (a) an identification of numbers with the sensible objects; (b) an identification of the principles of numbers with the principles of things that are; (c) an imitation of objects by numbers. While versions (a) and (c) seem to identify numbers with the material cause of reality, in terms ("imitation") reminiscent of Plato, version (b), numbers as formal causes of reality, is an Aristotelian reconstruction of the Pythagorean theory. Aristotle would have been pushed to such a reconstruction by the difficulty he found in accepting the Pythagorean material notion of number, and by considering it closer to its sensitivity, strongly marked by the reception of that same theory in the Academic realm.

Keywords: Ancient Philosophy, Pythagoreanism, Aristotle, numbers, ontology.

RESUMO

A pergunta, "Tudo é número?" no título do famoso artigo de 1989 de Zhmud, deixa aberto um desafio para o extremamente importante testemunho aristotélico de que "tudo é número" era a definição fundamental da filosofia pitagórica. Tal desafio não é nada simples, especialmente quando se considera que, até então, as histórias tanto da filosofia quanto da matemática antiga parecem não ter dúvidas de que esta afirmação é correta. Este artigo pretende submeter à avaliação crítica a alegação de Aristóteles de que os pitagóricos acreditavam que "tudo é número". Nossa análise dos muitos modos nos quais Aristóteles enuncia a tese de que "tudo é número" revelará, para além de variações meramente semânticas, uma contradição teórica fundamental que o próprio Aristóteles parece incapaz de resolver. De fato, três versões diferentes da doutrina estão presentes na doxografia aristotélica:

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(a) uma identificação dos números com objetos sensíveis; (b) uma identificação dos princípios dos números com os princípios das coisas que existem; (c) uma imitação dos objetos pelos números. Enquanto as versões (a) e (c) parecem identificar, em termos que lembram Platão ('imitação'), os números com a causa material da realidade, a versão (b), a saber, números como causas formais da realidade, é uma reconstrução aristotélica da teoria pitagórica. Aristóteles teria sido levado a tal reconstrução pela dificuldade que encontrou para aceitar a noção pitagórica material de número, e por considerá-la, para seu gosto, fortemente marcada pela recepção da mesma teoria no ambiente da Academia.

Palavras-chave: Filosofia Antiga, Pitagorismo, Aristóteles, números, ontologia.

The Porphyrian summary and a significant absence

A Porphyrian summary of Pythagoras' most famous doctrines immediately brings us to the heart of the problem: there is no escaping the fact that his account contains no reference to mathematics or astronomy, or even to cosmology or politics, despite the critical role these doctrines have played in the definition of Pythagoreanism in other strata of the tradition, in particular the Aristotelian texts.

Let us consider the passage:

Some of his [Pythagoras'] statements gained almost general notoriety: (1) that the soul is immortal, (2) that it transmigrates into other species of living beings, (3) that, periodically, what once happened, happens again, nothing is absolutely new, and (4) that all living things should be considered of the same genre. It seems that Pythagoras himself introduced these beliefs in Greece for the first time (Porph., VP: 19, my translation).

The absence of a reference to numerical theory is significant for understanding how to define the historiographical category of Pythagoreanism that otherwise seems to largely depend on a link to numbers. Such an absence suggests the need for a closer consideration of the history of the assignment of a mathematical theory to ancient Pythagoreanism.

Although Zeller himself was confident that Philolaus' theories that number is the essence of all things, along with the doctrines of harmony, the central fire, and the spheres, were core pillars of Pythagoreanism, contemporary criticism challenges the alleged Aristotelian *dóigma* that in Pythagoreanism, "all is number".

The interpretative tradition, led in recent times by Frank (1923), has become accustomed to regarding all Pythagorean mathematics as an Academic invention created after Philolaus' fragments, which must be considered spurious. The influence of Frank's skepticism is such that even Cherniss (1935), who disagrees with Frank about the value of Aristotle's testimony, agrees with Frank's interpretation of the connection between the Aristotelian *dóigma* that "all is number" and ancient Pythagoreanism. The consensus of such scholars is especially impressive when it comes to the value to be given to Philolaus' fragments, which we regard as one of the fundamental *loci* of this debate:

The fragments attributed to Philolaus are surely spurious, since they contain elements that cannot be older than Plato. Erich Frank has gathered the evidence against the fragments; and, apart from his own theory as to their origin and his conclusion of certain very weak arguments [...] his analysis makes it superfluous to restate the overwhelming case against them (Cherniss, 1935, p. 386).

More recently, authors like Burkert (1972, p. 238-277) and Kirk *et al.* (1983, p. 324) have subjected Frank's arguments to critical review. Especially significant are Huffman's efforts, both in his 1988 article and especially in his monograph devoted entirely to Philolaus and the problem of the authenticity of his fragments (Huffman, 1993)—the first book devoted entirely to the philosopher of Croton after Boeckh's 1819 monograph.² This review offers new hermeneutical perspectives and, along with Zhmud's recent studies (1989, 1997, and now 2012 and 2013), represents a cornerstone in the definition of the place of mathematics in the construction of the Pythagorean tradition.³

² For general agreement with Frank's skepticism, see, among others, Burnet (1908, p. 279-284) and Levy (1926, p. 70ff.). It is certainly not correct to agree, therefore, with Spinelli (2003, p. 145, n. 345), when he "dispatches" the question of the authenticity of the fragments in this way: "despite much that has been written for and against them, the whole argument is exposed, in an appropriate manner, only in the work of three writers: Bywater, Frank and Mondolfo."

³ In truth, Frank himself, in his subsequent writings, retreating from a position which, in extreme and, in a sense, paralyzing skepticism, could not resist other scholars' criticisms. In fact, in 1955, he readily admitted that "it can hardly be doubted that Pythagoras was the originator of this entire scientific development: he was a rational thinker rather than an inspired mystic" (Frank, 1955, p. 82). Nevertheless, in his review of Von Fritz's book on Pythagorean politics, Frank's skeptical verve is still strongly present (Frank, 1943).

Three versions of the Pythagorean doctrine of numbers

The question-statement “All is number?”, the title of Zhmud’s famous 1989 article in *Phronesis*, opens a challenge to the extremely important Aristotelian testimony that “all is number” was the fundamental definition of Pythagorean philosophy.⁴ Such a challenge is anything but easy, especially when one considers that, so far, the histories of both ancient philosophy and ancient mathematics seem to have had no doubts that this definition is correct (see, Heath, 1921, p. 67; Guthrie, 1962, p. 229 ff.; Huffman, 1988, p. 5, 1993, p. 57).

Reasons for this confidence are not absent. Indeed, in Aristotle, the assignment of the doctrine of “all is number” to the Pythagoreans is recurring and ultimately summarizes his interpretation of Pythagoreanism.

Aristotle states a number of times that:

- (1) “They thought the elements of numbers to be the elements of all things
- (2) and the whole heaven to be a harmony and a number” (*Met.* 986a 3).
- (3) “Numbers, as we said, are the whole heaven” (*Met.* 986a 21).
- (4) “They say numbers are the things themselves” (*Met.* 987b 28).
- (5) “Those [philosophers] say that things are numbers” (*Met.* 1083b 17).
- (6) “They’ve made the numbers to be things that be” (*Met.* 1090b 23).

Six times, Aristotle makes the Pythagoreans affirm that reality as a whole (*tà ónta, tón hólon ouranón, tà prágmata*) “is a number”.

In contrast, seven other times, Aristotle seems to suggest that the Pythagoreans say something slightly different:

- (1) “There is no other number than the number by which the world is constituted” (*Met.* 990a 21).
- (2) “For the Pythagoreans there is only the mathematical number, but they say that it is not separate and that, but that sensible substances are composed of it
- (3) because they build the entire heaven with numbers” (*Met.* 1080b 16-19).
- (4) “It is impossible to say that [...] the bodies are made of numbers” (*Met.* 1083b 11).
- (5) “They assumed that real things are numbers, but not in a separate way, rather, that real things are composed of numbers” (*Met.* 1090a 23-24).

(6) “They derived the physical bodies from the numbers” (*Met.* 1090a 32).

(7) “Those who believe that heaven is made of numbers reached the same result as them [the Pythagoreans]” (*De caelo* 300a 16).

In the above quotes, Aristotle makes the Pythagoreans claim more precisely that the foundation of the world is *ex arithmón*, that is, that numbers are constitutive of and therefore immanent in the world.

This variability of the Aristotelian *lectio* marks his whole approach to Pythagoreanism (Burkert, 1972, p. 45). This is not the only case where Aristotle shows some difficulties in expressing Pythagorean doctrines in the terms of his philosophy. Here the presentation of the doctrine of “all is number” by Aristotle is, at worst, contradictory, and at best presents three different versions.⁵ In addition to the first version, which identifies numbers with sensitive objects, two other versions are provided by Aristotle.

The second identifies the principles of numbers with the principles of the real things:

The so-called Pythagoreans are contemporary and even prior to these philosophers [Leucippus and Democritus]. They have applied first in mathematics, making them grow, and nurtured by them, believed that their principles were the principles of all beings (*Met.* 985b 23-26).

This claim is closely related to the above quote from *Met.* 986a 3, which is stated in terms of *stoicheia* instead of *archai*.

The third version is that real objects *imitate* numbers, as suggested by a famous passage in which a parallel is drawn with the Platonic conception of *participation*:

The Pythagoreans say that beings exist by imitating the numbers. Plato, on the contrary, says it is by participation, changing only the name. In any case, either one or the other neglected equally to indicate what participation and imitation of ideas mean (*Met.* 987b 11-14).

The first claim, that “things are numbers”, is clearly inconsistent with the other two. Cherniss (1935, p. 387) rightly notes that Aristotle seeks to reconcile the first claim with the second, that numbers are principles of all things. His attempt depends on his claim that the Pythagoreans derived all of reality from the number one, a theory that is not present in the sources, and apparently confuses Pythagorean cosmology

⁴ Although some suggestions in this direction had already been made by Huffman 1988 in his paper on the role of the number in Philolaus’ philosophy, the comments were not reported in Zhmud’s article (1989, p. 292, n. 62), because they were developed in parallel.

⁵ Cherniss (1935, p. 386), Zhmud (1989, p. 284-286) and Huffman (1993, p. 60) reproduce that same tripartition.

with their theory of numbers (Cherniss, 1935, p. 39). Aristotle himself seems to recognize that this approach is bankrupt:

These philosophers also did not explain how the numbers are causes of substances and being. Are they causes as limits of greatness, and just as Eurytus established the number of each thing? (For example, a number for man, one for the horse, reproducing with pebbles the shape of the living beings, similar to the numbers that refer to the figures of the triangle and the square [...]) (Met. 1092b8-13).

Aristotle's reference to Eurytus introduces a theory known as "numerical atomism," according to which numbers are the real things because numbers (thought of as *psêphoi*, pebbles) are the material of which all real things are made. With good reason, indeed, Cherniss (1951) notes that in this way, numbers can identify any kind of phenomenal object:

Numbers are held to be groups of units, the units being material points between which there is 'breath' or a material 'void'; and they quite literally all identified with phenomenal objects as aggregations of points, without, of course, considering whether these material points were themselves divisible or not. This was rather a materialization of number than a mathematization of nature, but it undoubtedly seemed to the Pythagoreans to be the only way of explaining the physical world in terms of those genuinely mathematical propositions which they had proved to be independently valid (Cherniss, 1951, p. 336).

Tannery (1887b, p. 258ff.), Cornford (1923, p. 7ff.) and even Cherniss (1935, p. 387), fascinated by Eurytus's primitive atomistic-numerical method, found it to be quite old. They all essentially follow Frank's hypothesis (1923, p. 50) that the theory was borrowed by Archytas from Democritus. Not coincidentally, the citation from *Met.* 985b 23-26 refers to the atomists Leucippus and Democritus. Moreover, it has been suggested that some of Zeno's arguments against plurality presuppose a Pythagorean theory of numerical atomism. However, Burkert (1972, p. 285-288) and Kirk *et al.* (1983, p. 277-278) have raised serious doubts about this assignment, and there are many arguments for both views. However, we cannot mention all of them here.⁶

In any case, it is not hard to imagine that the material nature of Pythagorean numbers has an archaic sense, without needing to postulate a theory of numerical atomism.

This sense is summed up quite well by Nussbaum's now classic definition:

[T]he notion of arithmós is always very closely connected with the operation of counting. To be an arithmós, something must be such as to be counted—which usually means that it must either have discrete and ordered parts or be a discrete part of a larger whole. To give the arithmós of something in the world is to answer the question 'how many' about it. And when the Greek answers 'two' or 'three' he does not think of himself as introducing an extra entity, but as dividing or measuring the entities already in question (Nussbaum, 1979, p. 90).

On this interpretation, the number is still "itself a thing" (Burkert, 1972, p. 265). Burkert rightly notes, in the same context, that it should not be forgotten that the *arithmos* has a certain "aristocratic sound," which refers to what "counts" in the sense of being important, "worthwhile" to count. The term can be so approximated to the pre-Socratic *arche*.

Thus, the second sense of "all is number," by which the principles of numbers were the principles of all things, corresponds more readily to what Cherniss (1935, p. 390) defines as an "Aristotelian construction of the Pythagorean theory." Aristotle would have been led to this synthesis, on the one hand, by his difficulty in accepting the overly simplistic material notion of number as analogous with Eurytus' pebbles, and on the other hand, by considering it more logical to understand the existence of Pythagorean numbers in the same way as the Platonists treated them, that is, by considering the *arithmoí* as *archaí*. But with this move, Aristotle shifts the problem of a Pythagorean theory of numbers into an Academic sphere. In fact, Frank (1923, p. 255) suggests that the source of this "misunderstanding" in Aristotle is in fact Speusippus; therefore, part of the Academy was deeply connected to the Pythagorean traditions. Speusippus is directly quoted by Aristotle in the *Metaphysics* (1085a 33) when he mentions those "according to whom the point is not one, but similar to one" that is, *hoíon tò hén*. The *point*, in fact, plays a central role in Speusippus' work; Speusippus was both a scholar of Philolaus and had openly declared that he based his writings on the latter. This statement is located in fragment 4 (Lang), preserved by Nicomachus as part of his book *On the Pythagorean numbers*. This fragment is clear evidence of the Academic origin of the principles of the Pythagorean theory of numbers. In this vein, Speusippus asserts that "when considering the generation: the first principle from which greatness generates is the one, the second the line, the third the surface, the fourth the solid" (44 A 13 DK = Fr. 4 Lang).⁷

⁶ For arguments against Frank's thesis, see Cherniss (1935, p. 388-389). For arguments against the controversial Zenonian thesis, see Burkert (1972, p. 285-289).

⁷ Cherniss (1935, p. 391) considers the probability of Aristotle having also derived entirely from Speusippus the list of opposites from *Met.* 986a 22, though simply as the most well-rounded list that was available to him—without denying, therefore, the possibility that there could be other lists that could be originally Pythagoreans.

The first sense in which “all is number” also contradicts the third sense, that is, the idea of a *mímēsis* of the numbers by real objects. In fact, this thesis is mentioned by Aristotle only once (*Met.* 987b 11), in a passage in which the Pythagorean conception is identified with the Platonic one of *participation*. This makes Cherniss (1935, p. 392) and Zhmud (1989, p. 186) consider it quite likely that Aristotle was trying to diminish the originality of the Platonic idea of *méthexis* by pointing to Aristoxenus, whose antagonism towards Plato is well attested. Indeed, Aristoxenus’ testimony reproduces the same idea of imitation: Pythagoras “likens all things to numbers” (fr. 23, 4 Wehrli, 1967).

In fact, other passages in Aristotle refer to something very similar to the concept of *mímēsis* by using words that involve a conception of similitude:

Since just in the numbers, precisely, more than in fire, earth and water, they thought they saw many similarities of what is and comes into being; for example, they believed that a certain property of numbers was justice, another soul and intellect, yet another the moment and opportunity and, in a few words, similarly with all other things (*Met.* 985b 27-32).

Therefore, it is in this sense of *homoiōmata* that the reference to *mímēsis* must be understood.⁸

The analogy between numbers and Eurytus’ pebbles (*Met.* 1092b 8-13) also relates to conceptions of similitude and imitation. Alexander of Aphrodisias, in his commentary on Aristotle’s *Metaphysics*, explains the reasoning that would have led to the imitative connection between justice and the number four:

*Assuming that the specific nature of justice be proportionality and equality, and realizing that this property is present in numbers, for this reason the Pythagoreans used to say that justice is the first square number; [...] This figure some used to say it was four, as it is the first square, and also because it is divided into equal parts and is equal to the product of these (indeed, it is two times two) (In *Metaph.* 38, 10 Hayduck).*

Burkert (1972, p. 44-45) notes that this conception of *mímēsis*, even if the terminology is Aristotle’s, must correspond to a pre-Platonic theory. The fundamental idea of magic or of Hippocratic medicine is that of a “two-way” match between two entities (body and cosmos, art and nature). In this specific case, there is a two-way match between the cosmos and numbers—the cosmos imitates numbers, and vice versa. Cornford (1922) considered this idea of imitation rather ancient, precisely because of its *mystical* nature; he uses etymology (*mimos* = actor) to connect the term to Dionysian cults and the fact that the protagonists of the cults play the role of god himself:

At that stage ‘likeness to God’ amounts to temporary identification. Induced by orgiastic means, by Bacchic ecstasy or Orphic sacramental feast, it is a foretaste of the final reunion. In Pythagoreanism the conception is toned down, Apollinized. The means is no longer ecstasy or sacrament, but theōria, intellectual contemplation of the universal order (Cornford, 1922, p. 143).⁹

Against these hypotheses, however, the fact that Aristotle does not actually indicate the imitation of *prágmata*, but of abstract realities such as justice, time, etc., plays an important role.¹⁰ In any case, even though one may concede that Aristotle is here referring to a proto-Pythagorean, acousmatic, doctrine, in the following page (*Met.* 987b 29), he argues forcefully that the Pythagorean and Platonic notions of *méthexis* assigned to numbers differ.¹¹ This would suggest, in this case, that a controversial anti-Academic intention would perhaps be the most appropriate explanation of the reference to *mímēsis*.¹²

We can conclude that the three versions of the doctrine “all is number” (that of identification, of numbers as principles, and of imitation) are imperfectly articulated and ultimately contradictory within Aristotle’s work.

However, it is significant that Aristotle never mentions that the three different *lectiones* of “all is number” belong to different groups of Pythagoreans. He seems to consider them, if not coherent among themselves, at least reconcilable, and refers to them all without distinction as defining the “so-called Pythagoreans.”

Recognition of this fact has led several authors to adopt conciliatory solutions to the problem. First of all, Zeller himself. Although Zeller felt that Aristotle’s testimony should be read

⁸ See for this approach Centrone (1996, p. 107-108).

⁹ Casertano (2009, p. 67) also agrees with the possibility of this “mystic numbers” origin.

¹⁰ Burnet (1908, p. 119), on the other hand, warns that one should not take these passages seriously: “They are mere sports of the analogical fancy.”

¹¹ The term “proto-Pythagoreanism” is introduced here as a new term because it is necessary to distinguish between this first founding moment of Pythagoreanism and the development of Pythagoreanism during the fifth century BC, which is still “pre-Socratic,” but which is in writing and corresponds to the era of the immediate sources of Plato and Aristotle. For the uses and meaning of the analogous term “proto-philosophy”, see Boas (1948, p. 673-684).

¹² This is also one of the reasons forcing one to reject Burnet’s hypothesis (1908, p. 355) and Taylor (1911, p. 178ff.), taken up also by Delatte (1922, p. 108ff), whereby Pythagoras would be the inventor of the theory of the Platonic forms. Thus, Burnet (1908, p. 355): “the doctrine of ‘forms’ (*eidē*, *idéai*) originally took shape in Pythagorean circles, perhaps under Sokratic influence.”

with all due care, its historical proximity to the Pythagorean doctrines should support its authenticity. Thus, for Zeller:

No doubt that in Aristotle's exposure we must seek first of all and only his own way of seeing, and not an actual and immediate testimony of reality, however even in this case [that of the numerical theory], everything speaks in favor of a recognition of the fact that his way of seeing was based on a direct knowledge of the actual connection of the very ideas of Pythagoreanism (Zeller and Mondolfo, 1938, p. 486, my translation).

Frank (1923, p. 77, n. 196) and Rey (1933, p. 116), seeking to show the possibility of the compatibility of the three versions of "all is number", imagine that Aristotle understood the different versions to be logically derived from one another. Rey draws up a proposed compromise between the version of numbers *being* the things and that of numbers *imitating* things: numbers would be things when considering their nature and would imitate things when one considers their properties (Rey, 1933, p. 356ff.).¹³ More elaborate is Raven's conciliatory argument (1966 [1948], p. 43-65), whereby:

To suppose, as so many scholars appear to suppose, that Aristotle was hopelessly confused about it, is not only to lay a very serious charge at his door, but also, incidentally, to demolish the main basis upon which any reliable reconstruction of Pythagoreanism must be erected (Raven, 1966 [1948], p. 63).

In an open controversy with Cornford (1923, p. 10) and his idea that Aristotle failed to distinguish two moments of Pythagoreanism (a first one on the idea of the materiality of numbers, and a second one where the Pythagoreans would be more concerned with the numerical make-up of reality), Raven instead proposes a radical inseparability of the *dual* use of these senses within ancient Pythagoreanism.¹⁴ Aristotle would thus simply be getting a conception of nature as "equal to numbers" from Pythagoreanism, that is, constituted by an aggregation of spatially extended units (Raven, 1966 [1948], p. 62). However, numbers would not constitute only the *matter* of reality, but would also be the origin of the qualitative differences that distinguish each material object from others. This is the only way one might think either version of the *imitation* and of the number of the *principles* as articulated with the first version.¹⁵

At the very least we can say that the idea of *mimēsis* that Aristotle attributed to the Pythagoreans shares little with the

Platonic conception of *mimēsis* according to which phenomenal realities mimic the forms, in the sense of being "similar to" supra-sensible realities of a higher ontological level. If this observation is correct, what Aristotle must attribute to the Pythagoreans when speaking of *mimēsis* cannot be anything other than a generic correspondence between things and the numerical relationships that explain them and make them intelligible. Casertano summarizes the matter very well:

Immanent intelligibility, therefore, and not transcendent to the same things. This is why the Pythagorean formula, 'things are numbers' and 'things are similar to numbers', are not contrasted, but rather are expressions of the same basic intuition, which is one of homogeneity between reality and thought, between the laws of reality and the laws of thought: to comprehend things is essentially to mirror them, to reproduce at the mental level that fully intelligible structure, which is characteristic of material reality (Casertano, 2009, p. 65, my translation).

Although the fundamental insight of the Pythagoreans, an attempt to understand the nature of numbers by analogy with the nature of the world, is clear, the fact is that the Aristotelian attempt to reconcile the different versions of the theory does not seem at all successful.

If, moreover, we think that the main version of the Pythagorean doctrine, that of the identity of number with realities, pays obedience directly to the controversial intention of Aristotle with regards to Platonism, making him consider the Pythagorean *arithmōs* a material cause, in opposition to the Platonic *militancy* in favor of its being a formal cause (Cherniss, 1935, p. 360), this makes it difficult to appeal to the Aristotelian "all is number" as a genuine and pure piece of historiographical evidence for the foundations of Pythagoreanism.¹⁶

Difficult, but not impossible, I would say.

First solution: The Aristotelian reduction

In fact, two solutions have been proposed to the problem of whether Aristotle's claim that "all is number" accurately describes Pythagorean philosophy.

The first engages in a radical challenge of the validity of the Aristotelian testimony, even coming to deny that a doc-

¹³ For the criticism of Frank's and Rey's proposal, see both Cherniss (1935, p. 386) and Burkert (1972, p. 44, n. 86).

¹⁴ Cornford (1923, p. 10) says in effect that: "Aristotle himself draws attention to the two diverse ways of making numbers 'the causes of substances and being', which, in my view, are characteristic of the two different schools of Pythagoreans".

¹⁵ See Guthrie (1962, p. 230f.) for a similar idea.

¹⁶ Centrone (1996, p. 105) notes in this sense that "l'interesse [di Aristotele] per il pitagorismo, i cui pregi in definitiva consistono solo nell'assenza dei difetti propri della filosofia dei platonici, non è soverchiente, ed è anzi determinato proprio dalle affinità con le dottrine platoniche".

trine of number belongs *tout court* in proto-Pythagoreanism. There is no lack of reasons for this challenge, and they center on the fact that no testimonies earlier than Aristotle attest to this doctrine. Zhmud's article (1989), quoted above, begins with this argument, and we will follow it step-by-step.

Zhmud's article operates in the context of determining the criteria for identification as a Pythagorean. His fundamental concern is to consider the impression that the Aristotelian text seems to give, that is, that "someone who speaks of numbers" would be the best definition of a Pythagorean. The use of the criterion of numbers to identify a Pythagorean (Zhmud, 1989, p. 272) would be either circular or question-begging. Indeed, despite several attempts in this regard, no historian—says Zhmud—has succeeded in finding any doctrine about numbers in the pre-Aristotelian sources on Pythagoreanism (Zhmud, 1989, p. 272).

With these arguments in mind, Zhmud admits only two possible explanations for Aristotle's testimony: either the expression "all is number" belongs to an ancient and secret teaching of the "divine" Pythagoras, which must have been directly revealed to Aristotle and first published by him, or the expression "all is number" was not actually a Pythagorean doctrine.¹⁷ This second possibility corresponds to the classic position of Burnet, in which "Pythagoras himself left no developed doctrine on the subject, while the Pythagoreans of the fifth century did not care to add anything of the sort to the school tradition" (Burnet, 1908, p. 119).¹⁸

Although not surprising, given the aforementioned studies of Cherniss suggesting that Aristotle's own "historiographic" method freely reformulated the doctrines of his predecessors in his own terms, it is important to ask what would make Aristotle falsely attribute such a doctrine of "all is number" to the Pythagoreans.

Our arguments so far have given a crude first response to this question. Aristotle was faced with a great diversity of Pythagorean sources, both ancient (Hippasus) and closer to him (Ecphantus, Philolaus, Archytas). However, for purposes internal to Aristotle's *Metaphysics*, this plethora of Pythagoreans needed to be brought back to a common denominator, under a *school* that would somehow fit into the theoretical-historical course that Aristotle intended to draw on in his doxography.

Without reducing Pythagoreanism to a set of core theoretical doctrines, it would have been impossible to find a place for it inside the agonic model by which Aristotle describes the history of his predecessors (Cherniss, 1935, p. 349). For example, only in this way could the Pythagorean *archē* be an antagonist of the Ionic material cause. At the same time, terminological imprecision in the Pythagorean sources (which

Aristotle himself complains about in *Met.* 1092b 1-13) allows the postulation of Pythagorean numbers as the precursor of the Platonic formal cause. Even if number did not already have this dual valence, Aristotle would probably have invented it, for it fits to perfection within his doxographic model.

Thus, the postulation that "all is number" would have been Aristotle's solution to a historiographical problem, and in some ways the beginning of a long tradition which, starting with Zeller (Zeller and Mondolfo, 1938, p. 435), reduced the category of Pythagoreanism to the narrow limits of this metaphysical doctrine.

Second Solution: Philolaus

The first solution leaves us at a hermeneutic impasse: Aristotle himself invented a historiographic category ("the so-called Pythagoreans") and a doctrinal common denominator defining it ("all is number"). A second solution seeks to avoid tracing the category back to a mere invention by undertaking a reassessment of the Pythagorean sources of the fifth century BC for possible historical references to Aristotle's term "so-called Pythagoreans".

Starting from an important observation: the great number of references to Pythagoreanism and their theory of numbers in Aristotle reveals an indisputable fact: Aristotle must have really had several Pythagorean texts on his desk.¹⁹ The certainty with which Aristotle presents some statements about the Pythagoreans seems to presuppose his access to a sufficiently broad literature of their authorship. Consider the debate on whether the Pythagoreans considered the world to be generated or not. Aristotle says it is impossible to doubt it: "There is no reason to doubt whether the Pythagoreans do or do not introduce generation of things which are eternal" (*Met.* 1091a 13). Likewise, he appears to be absolutely certain that the Pythagoreans had not philosophized about sensible bodies: "They did not say anything about fire nor earth, or on other bodies" (*Met.* 990a 16-17).

Moreover, tradition informs us that Aristotle devoted at least two books to the Pythagoreans, not to mention the works devoted specifically to Pythagoras or particular Pythagoreans such as Archytas.²⁰ Any account of who the "so-called Pythagoreans" to whom Aristotle wants to assign the doctrine of numbers were depends, for the most part, on the possibility of identifying the subjects of these books. However, tradition only tells us of books on Philolaus and Archytas. As Aristotle seems to deal with Archytas separately from the rest of pythagoreans, it is likely that the books of Philolaus constitute Aristotle's Pythagorean sources.

¹⁷ So says Zhmud (1989, p. 275): "If we do not wish to think that the central dogma of Pythagorean philosophy was secret, then it would be quite reasonable to suppose: either this dogma was not central, or it was not a dogma at all. Only very few of those who write about Pythagorean philosophy arrive at such a paradoxical conclusion." On the practice of secrecy in the earlier Pythagorean community, see Cornelli (2013, p. 71ss.).

¹⁸ Gigon (1945, p. 142) follows the same idea.

¹⁹ Burkert (1972, p. 236), Zhmud (1989, p. 281), Huffman (1993, p. 57) and Centrone (1996, p. 105) agree on this.

²⁰ For extensive discussion of these works and references, see Burkert (1972, p. 29, n. 5).

It is important to point out, again, that it is no wonder that this same methodological conclusion has not been reached before, that is, the problem to which the doctrine "all is number" was intended as a solution was the study of Philolaus' fragments. Much of the tradition, beginning with Cherniss himself (1935, p. 386), could not pursue this direction because the texts of Philolaus were considered spurious in the wake of Frank 1923. Only after the "rediscovery" of the value of an essential part of Philolaus' fragments, first with Burkert (1972, p. 218ff.), and then with Huffman (1988, 1993), did that path become possible.

The recent reassessment of the historical value of Philolaus' fragments, therefore, allows new, previously impossible, hermeneutical steps.

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