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Pythagoreanism and Modern Models of Cosmology

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ABSTRACT:
Turning to the accumulated philosophical knowledge, the scientist almost always discovers that there are ideas in it which are far ahead of their time, but which can help in solving scientific problems of quite another historical epoch. In this respect one of the most revealing examples are associated with the discovery of heliocentrism and the General Theory of Relativity. Philosophical ideas and principles immanent in one or another particular science and serving for the solution of some problem of it form the very philosophical foundations of the given science. These, in turn, are by no means identical with the whole body of knowledge which philosophy creates.
By reflecting on the foundations of science and turning to the analysis of its arbitrary forms – namely cosmology – philosophical reflection elaborates ideas and principles that can play an essential role in a certain stage of scientific inquiry.

KEYWORDS: universe, center, Pythagoras, cosmology, inflanatory physics

INTRODUCTION

One of the most important categorial structures in contemporary philosophy of science is the way in which man's relation to the world around him is conceived as the only possible cognitive superposition, since there is simply no other known. For this reason, the categories of "space" and "time", detailed in the individual scientific problematic, although paradigmatically objectified, are always refracted through the prism of human experience. In this article we will try to show that modern philosophizing science, which often falls into gnoseological difficulties, especially related to the phenomena in the microworld, has in fact fallen into similar situations even since the dawn of its existence. As an emblematic example of this, we will point to the distinction between an objective and a phenomenological center of the Universe, already considered in the Pythagorean tradition. We will then bring this scientific theory into more recent times to show its consistency, despite the attacks against it by many established authorities in the history of philosophy and science.

1. "HESTIA" AS THE CENTER OF THE UNIVERSE

The renaissance of the Pythagorean notion of cosmology millennia after its emergence is associated with the idea that the Earth not only has a diurnal cycle of rotation but is also not stationary (located at the center of the Universe at a point, as assumed in Aristotelian scholasticism). It is about the existence of the so-called "central fire", in whose place Nicolaus Copernicus places the Sun.
The fact that these two types of motion lie undeniably at the basis of cosmology and physics, without undergoing any particular transformation until the present day, is indisputable. The question of the third

kind of motion of the earth is a little more complicated. The fact of the "heliocentric structure of the Universe" is regarded as unconditionally incontestable when speaking of the solar system and its modern conception, or as absolutely false when the sun is placed at the center of the world and the Universe. Thanks to the extant fragments of Philolaus and other writers, Copernicus knew that among the Pythagoreans there existed a notion of a “central fire” that was not identified with the Sun. In other words: for the Pythagoreans, the center of the solar system and the center of the Universe were not at all the same things. From a modern point of view, it is difficult to guess why Copernicus thought that the center of the Universe was only eight light-minutes away from the Earth, ignoring the Pythagoreans' theory. Perhaps he preferred to deal only with visible celestial bodies or was simply guided by considerations of not complicating the newly defended hypothesis. But that he placed the luminous Fire-Sun at the center of the world is, in our view, explained not simply by a desire to "set the Earth in motion". Here is what we mean. Among historians of science and philosophy, the question of the Pythagorean "central fire" is considered rather complicated. Analyzing the texts of Plato's dialogues “Phaedo”, “Timaeus” and “Philebus”, John Burnet concludes that the "doctrine of the central fire" belongs to late Pythagoreanism. Plato himself could have learned about it from Archytas, but only after he had already written his “Phaedo” (Burnet;1913, p. 274) According to Burnet, the roots of the heliocentric hypothesis must be sought in Empedocles' theory of the “Solar World”. “The essence of this theory”, he writes, “lies in the proposition that by “central fire” is actually meant the Sun, which in Philolaus is unjustifiably doubled. For this reason the latter explains the visible Sun as a reflection of the “central fire” (Burnet;1913, p.275) This conclusion is joined by Stegmüller and Diels (Pavlenko;1996) who suggest that the identification of the “central fire” with the Sun is associated with the name of Plato's disciple Heraclitus of Pontus, whom they – along with Aristarchus of Samos – also acknowledge as a co-author of the heliocentric hypothesis. In Burnet's words, Aristotle's attitude towards the heliocentric theory led to “Copernicus having to rediscover truth” (Burnet; 1913, p. 276)

Following this train of thought, we can speak of a peculiar tradition of reducing Philolaus' and his followers' Pythagorean school's conception of the “central fire” by emphasizing the latter's identity with the Sun. The consequent doubling of the luminaries is regarded as a false theory of the Sun appearing to be a “reflection” of the “central fire”. This approach makes it possible to see the opposite perspective of the emergence of the Copernican hypothesis, which in turn would help to situate the facts most correctly. The tendency to modernize and interpret ancient texts in terms of modern notions does not always prove particularly productive. Let us try to answer some questions: was the doubling of the lights – the “Central Fire” and the Sun – really the result of a misunderstanding of the “proper” rather than the reflected nature of light, or could there be another reason that escapes modernist conceptions; what did the Pythagoreans actually understand by the term “central fire”, given the properties of each fire to radiate heat and light?

The Pythagorean Cosmos implies the existence of a center or so-called “hestia” around which everything revolves, including the Sun.

The “hestia” is the center of the Cosmos. But here the question arises whether this center is the geometrical center of the Universe. An original answer to this riddle is given by Alexander Dobrokhotov: “Concepts such as “home”, “fire” and “center” lie at the basis of the morphologeme “Hestia”. For example, Delphi is the hestia of Hellas. This is so because Delphi is the “navel” of the world – the religious center of Ancient Greece, where the Sacred Fire burns” (Dobrokhotov;1980, p.25) Here we should not miss Plato's thesis about “hestia” – given by him in “Cratylus”. According to Plato, this term is epistemologically immanent to the notion οὐσία meaning “essence of things” and even pronounced by some as “hesia”.

It is for this reason that it is no coincidence that the concept of "hestia" occupies a significant place in the Pythagorean tradition. It appears as the source from which the fire, subsequently encompassing the entire Cosmos, originates. Plato's hermeneutical intuition, the validity of which is disputed or not accepted at all by the majority of historians, philosophers and philologists, nevertheless deserves some attention. In the definition of Dobrokhotov given above, he is not actually talking about a concept in the scientific sense. Hestia itself – as a fireplace – is not merely the formal geometrical center of the world. Given that the quintessence in Dobrohotov's study is being, we can unambiguously conclude that "hestia" is the being-center of the Universe. It "beingly clamps around itself" the whole Cosmos, holding it thanks to this in the order known to us.

Philolaus affirms the fact that the hestia is the first harmoniously arranged unity located in the center of the celestial sphere, and that the world is one and begins its genesis from the center. According to Count Trubetskoy (Trubetskoy; 1890), by "hestia" is to be understood a divine body formed before the beginning of the world and time, the breath of the hestia being necessary for the becoming of the latter. By this doctrine Pythagoras influenced Anaximenes, who recognized as the beginning of the world now the compressing now the expanding air.

2. PYTHAGOREANISM AND INFLANATORY PHYSICS

In our view, the Pythagorean concept of the Cosmos-Universe inspires one of the most plausible modern hypotheses about the genesis of the Universe. It is that the fire-fireplace-hestia is the same center from which the fiery expansion of the Universe originated. But even in modern scientific descriptions it is impossible to show the becoming itself, because apart from this Universe, which sets the pattern of creation, there is no other in the coordinates of which such a center could be distinguished. In the 1920's Friedmann (Friedmann;1922) discovered that the radius of the Universe (expressed by a scale factor) tends to zero at time t=0, and the density of matter and the tensor become infinite as space distorts. This is the so-called "initial singularity". The model of a hot Universe justified by the discovery of the short-wave background (relic radiation) with temperature T≈2.7K becomes generally accepted. In this model, the essential point is that the singularity turns out to be the genetic center from which the whole Universe is born. Moreover, the size of the region from which its visible part is formed is on the order of 10^{-4} . But in so far as it is the absolute available, the dispute about its geometrical centre becomes irrelevant. The Universe is expanding, but the "radius of expansion" is noted conventionally, since it is really a scale factor. The centre is expanding as a point, and therefore one could not speak of a center in the geometrical sense here.

The absence of a solid foundation for the separation of theories of the genesis of the cosmos into an independent discipline in the classical New-European sense, even in the formation of the inflationary scenarios of the 1970s and 1980s, provides an enormous scope for criticism and accusations of the inconsistency of the methods proposed by Albrecht Bethe and Linde (Linde;1990), since the latter attempt to convey to "empty" space the property of expanding. Up to this point in physico-cosmological science, it has been assumed that for an inertial system to be distinguishable, a material substrate must be present, be it a material body or a physical field. The point is that the expansion process is related to the scalar field φ, although other fields may figure in different scenarios. Here, the meaningful (semantic) point related to the "Pythagorean fire" could be found in the inflationary hypotheses related to the development of the vacuum energy thesis, the density of which is negative and is expressed by Gleaner's equation of state -

P=-ρ. The remarkable peculiarity of the negative energy density consists in the fact that, accumulated with the help of the field, it passes into thermal energy, which in turn becomes the cause of the birth of matter. The existence of this field in the whole space does not entail the existence of any associated measuring system. As argued by Linde (Linde;1990) the Lagrangian of Eq. has a relativistic invariant form independent of the values of φ. Essentially, a transition of the vacuum from a state where the minimum of the effective potential is located at zero to a state where this minimum is located at a point other than zero is observed. This process is called "vacuum state change"

The vacuum state change itself builds the theory of the so-called "breathing universe". As a result of the latter, the possibility of building the already known inflationary scenarios is opened. The emergent field φ leads to a change in the masses of those particles that interact with it. The latter, in turn, leads to a spontaneous symmetry breaking, since up to this point all vector mesons that carry energy have no mass, leading to the indistinguishability of the different types of interactions. After symmetry breaking, the temperature of the matter rises and the uniform scalar field φ vanishes. This is how the evolution of the "separately considered universe" has been described. In 1983, however, Andrey Linde (Linde;1990) first proposed a scenario of a chaotically expanding universe in which there could be an unlimited number of regions filled by the field φ, themselves giving rise to other regions filled by analogous fields. However, the classical description of expansion remains valid anyway, but only for the visible world. In other words, ignoring the fact that the evolution of a chaotically expanding universe (according to Linde) "has no end, and possibly no single beginning" (Linde;1990, p.211) the expansion of the observed by us Universe happens the way it has been described above.

Even today, recognizing that we live in a spherical world, we could find its geometric center, which itself does not necessarily coincide with the genetic one – the point of radius 10^{-33} serving as the origin of extension. The exteriorization power of the scalar field φ – the genetic source of the observed universe – can only be compared to the "Pythagorean fire".

By the act of "inhaling-exhaling" the Pythagorean "hestia" causes motion, and with it everything that serves as an indication of time. Inhalation and exhalation correspond to centripetal and centrifugal intensities in the Cosmos. Twentieth century cosmology established that the spherical state of the universe is characterized by "exhalation". The very Pythagorean conception of the breathing nature of "hestia" implies such a property of it, which was not then accepted by most thinkers. By concentrating the infinite (emptiness) in itself, the "central fire" makes it its own ingredient, and by limiting (literally putting a limit on the infinite) and defining it, it creates the world out of itself. Therefore, the cosmos, according to the Pythagoreans, is only that part of the world in which the "ordering" power of the hearth – the "hestia" – extends, given that the fire not only rules the "sky" from the center, but will also encompass its highest sphere – Olympus. As Trubetskoy figuratively puts it, Zeus – the ruler of the world – dwells in the "hestia" of Olympus: "the "hestia" is his altar, the ground of his throne, and Olympus is his heavenly abode; the "hestia" is the center of Zeus, from where he surveys and directs the world; Olympus is the indestructible wall, the fence of the world." (Trubetskoy;2010, p. 219) It sounds unbelievable, but the teachings of the ancients about the "ultimate sphere of the universe", which arose even before Pythagoras, find their peculiar confirmation in modern scientific notions. This is evidenced by empirical research in the discovery of circumstantial evidence of the presence of "walls" in the sphere of our universe. The presence of "walls" in the sphere – inhomogeneity of matter on huge scales – is one of the predictions of inflationary cosmology.

3. ROOTS OF MODERN COSMOLOGY

So, the very notion of "hestia" identifies order in the cosmos insofar as it constitutes its time and place. In criticizing the Pythagorean explanation of the structure of the universe, Aristotle once again – from the time of the creation of the Copernican system of the world – finds himself in the position of a thinker whose view of the Cosmos turns out to be false on several fundamental issues. In Chapter XI of Book I of the treatise "On the Heavens", he argues against "the origination of anything in the sense of a transition from non-being to being" and considers it "absolutely impossible." (Aristotle;2024; 280a 10-15) In Chapter X, he speaks of the impossibility and "ridiculousness" of any origination of the Cosmos at all. The philosopher also subjects to devastating criticism Plato's idea of the emergence (creation by a Demiurge) of the Cosmos from the chaotic state of matter – a kind of analogue of the modern vacuum that both theologians of the Church Justin Martyr and Clement of Alexandria will later call as "an evil formless substance", "a reason of chaos" (Radev;1994, p.733)

Perhaps without realizing it, modern cosmology continues the argument begun two and a half millennia ago between the Pythagoreans and Plato on the one hand and Aristotle on the other.

From what has been written so far, several main conclusions can be drawn. The first undoubtedly concerns the nature of evolution in scientific cosmology. There is no denying the fact that it passes under the sign of a constant return to the roots of European scientific-philosophical thought, whether the process has been realized or not. The other fact that becomes an apodictic reality is that the only path that can lead to an optimal explication of the non-obvious world is the language of mathematics, the basis of which is the strange parallelism between number and substance. As a result, a frantic search begins for the "equation of the universe" from which the material world itself in its concrete phenomenality will emerge as a corollary. In establishing General Relativity, Albert Einstein succeeded in formulating the equation of the universe by rethinking the field equation (Einstein;2005). The latter represents a sui generis similarity to the Pythagorean approach in the architectonic explanation of the universe. Here, of course, it is not the specific details that are meant, but the principle that gravitation can be understood as both a property of matter (the field) and a property of curved space (Davies;1982). In the latter case, it happens that physics derives from geometry, not the other way around. The attempt to make sense of a geometrodynamics by Einstein's disciples is a striking example in this respect. The other, no less serious, argument is the Wheeler-DeWitt wave function of the universe: ψ (h, i, j, φ), where h, i, and j are the three-dimensional spatial metric and φ is the matter field. (Mizner,Torrey,Wheeler;1973)

The Pythagoreans put the hestia or as Plato says, the οὐσία at the center of the world. Copernicus, as already mentioned, places Fire-Sun at the centre of the world. Then, under the influence of Aristotelianism, any existence of centers in the Universe is denied. Only in the twentieth century did the renewed Pythagorean idea of the "central fire", conceptualized as a singularity in the Big Bang theory, i.e. the fluctuation of the scalar field φ having a negative energy density, come to the fore again.

In seeing some of these new inflationary scenarios, we are witnessing a new epistemological arrival at the Pythagorean-Platonic roots of European science and philosophy. Every time cosmology turns to Pythagorean principles of explaining the Universe, we witness a qualitative leap in understanding its structure, and every time it moves away from them, there is stagnation.

In the sixteenth century, Copernicus himself turned to the mechanism of coming to the Pythagorean-Platonic tradition, which even two and a half millennia earlier had questioned the veracity of knowledge about the universe based on self-evident conceptions of the world. Then, towards the end of the seventeenth century, there was a kind of restoration of ancient materialism and empiricism. Aristotle's

conceptions of the Cosmos experienced a renaissance, mainly due to the notion, developed on English soil, that knowledge of φύσις could be founded only on the sensually perceptible qualitative world, and to the newly resurrected Democritus' idea of the relative infinity of the universe. It was only in the early twentieth century that a new epistemological arrival at the Pythagorean-Platonic tradition took place. Above all, the very creation of the Special and General Theories of Relativity served as a causal primus factor for doubts about the correctness of the apparent notions of the world (relativistic reduction of the length of space-time intervals, without any longer considering the equivalence of geometric and field explanations of the nature of gravity). This is not at all about the denial of the apparent (visible) qualitative world and the possibility of visible (experiential) verification of physico-cosmological knowledge. Now it is only assumed that this apparent world becomes adequately explicable and comprehensible when its interpretation is due to knowledge of the forces in the world of the non-apparent, and that there is not and cannot be a true chain of causal relations between these two worlds (the apparent and the non-apparent). This is why the Pythagorean and Platonist Galileo had a very difficult time in his discussion with Francesco Ingoli, and because he could not, as Aristotle's "qualitatism" required, demonstrate the de facto principle of inertial motion. The Pythagorean and Platonist Copernicus, on the other hand, could not make his opponents observe the triple motion of the Earth. It is precisely because of such "empirical prejudices" that most of the physicists at the beginning of our century cannot grasp what this expansion of "empty" (devoid of matter and radiation) space is.

CONCLUSION

Perhaps we could be accused of being too extemporaneous in exposing the connections and coherence between philosophical reflexivity and scientific mentality. We, however, believe that such a "qualitative" approach is not at all superfluous in this case, since the relevance between the above two concepts of our study can and should be demonstrated. The fact that we devote more attention to a philosophically considered cosmology should by no means lead to the claim that the relation of philosophizing to other fields of scientific description of being is denied or downplayed. Guided by our non-committal opinion, we believe that the example revealing the principles of a "philosophizing cosmology" is, if not the most, one of the most emblematic in the explication of the philosophy-science derivation.

Philosophical ideas and principles immanent in one or another particular science and serving for the solution of some problem of it form the very philosophical foundations of the given science. These, in turn, are by no means identical with the whole body of knowledge which philosophy creates.

By reflecting on the foundations of science and turning to the analysis of its arbitrary forms – including cosmology – philosophical reflection elaborates ideas and principles that can play an essential role in a certain stage of scientific inquiry. But their selective borrowing from philosophy, as well as their use in the solution of scientific problems, requires special preparation on behalf of both the scientist and theorist. Quite often, such preparation can be found in those great scientists who reconcile in their creative process the role of the concrete researcher and that of the philosopher-methodologist. There are many such names in the history of science: Galileo, Newton, Descartes, Leibniz, Einstein, Bohr ... They inspire a new impetus not only in science but also in philosophy.

Therefore, it should not be at all surprising that, turning to the accumulated philosophical knowledge, the scientist almost always discovers that there are ideas in it which are far ahead of their time, but which can help in solving scientific problems of quite another historical epoch. In this respect one of the most revealing examples is associated with the discovery of the General Theory of Relativity. Summing up the

experience of this creative act of his, Einstein noted that the physics of the twentieth century absolutely confirmed the truth of the theoretical-cognitive ideas of Immanuel Kant. Einstein himself was fond of saying (Schrödinger;1971) that this theory could be deduced intuitively a posteriori but could not be deduced inductively from experimental data. It is this situation, to which philosophy has contributed enormously, that he regards as the most important historical lesson in modern physics.

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