

## PHILOSOPHICAL ROOTS OF COSMOLOGY

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**Abstract.** We shall consider the philosophical roots of cosmology in the earlier Greek philosophy. Our goal is to answer the question: Are earlier Greek theories of pure philosophical-mythological character, as often philosophers cited it, or they have scientific character. On the bases of methodological criteria, we shall contend that the latter is the case. In order to answer the question about contemporary situation of the relation philosophy-cosmology, we shall consider the next question: Is contemporary cosmology completely independent of philosophical conjectures? The answer demands consideration of methodological character about scientific status of contemporary cosmology. We also consider some aspects of the relation contemporary philosophy-cosmology.

From the very beginning of ancient philosophical thought, cosmology became an integral part of philosophy and the most important one. This early stage of philosophy was interpreted among historians for a long time as a naive speculation about the world, prolonging mythic presentations dominated among people at earlier stages of civilizations. But, John Burnet's book, *Early Greek Philosophy*, at the beginning of the Twentieth century, deeply changed perspectives about this period. Burnet insisted that the early Greek philosophy had a *scientific character*.<sup>1</sup> It is strange that one century after Burnet's book, the early Greek philosophy is often considered as naïve and mythic.

The scientific character of Greek philosophy is expressed in looking for causal connections. Science itself presents a system of explanations of causal connections. An important part in the body of science is an experiment, which determinates a decision in the dialog between hypothesis and subject of investigation. It is wrong to think that Greeks did not know experiment. There is evidence in Empedocles experiments with *clepsydra* – a special instrument constructed for experimental purposes.<sup>2</sup> Although Greeks haven't sophisticated instruments like the science of the XXI century, still it is possible to reach scientific results even with simplest instruments and by observation.

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<sup>1</sup>Barnet, Dž., *Rana grčka filozofija*, Beograd: Zavod za udžbenike i nastavna sredstva (2004), pp. 9-41.

<sup>2</sup>*Ibid.*, pp. 38, 261-2.

After being acquainted with Babylonian astronomy and an abundance of empirical material, Greeks try to give a unique theory of the world.<sup>3</sup> Contemporary science insists on this cosmological task as well. There is a chain of different theories from Tales to Leucippus. This chain of theories represents a continuity in which one theory follows another. In addition, every subsequent theory tries to eliminate weaknesses of the previous theories and to explain a great deal of phenomena. It is a process valuable for changes of paradigms in the contemporary science as well. What is important is that the previous theories are abandoned based on arguments, observation and proposals of the better solutions. This is really what is core of rational and scientific thought. If we compare how people resolved disputes between rival theological schools in early Christianity thousand years after Greeks, with the scientific disputes among Greeks, we can see that the solutions were solved by voting on Councils. That was a way how the theological theory wins.

What are often influenced theoreticians to say that early Greek thought is not scientific is the fact that Greek theories were wrong. But, the truth is not essential character of the scientific theory. It is a method. A lot of contemporary theories were wrong, but it does not diminish their scientific character. For example, Einstein's stationary model of the Universe was wrong, and Friedman's model corrected it.

First theoreticians tried to give a unique theory which would explain macrocosm and microcosm. The same aspiration appears in developed contemporary cosmology in the eighties of the XX centuries – it is "astroparticle physics" or "kosmomikrofizika" in Russian language. Academician Zeldovich was the initiator of the foundation of the new discipline.<sup>4</sup> The first theoreticians considered "water" as the stuff from which the Universe is created of (Tales), or "air" (Anaximenes). Because these hypotheses are wrong, it is often interpreted that early philosophers only guessed or, like in poetry, choose these entities arbitrarily, building some kind of mythic presentation. However, if we carefully investigate the preserved fragments, it is possible to see that they postulated "water" or "air" thanks to their detailed observation of natural processes. They exposed arguments in favor of their hypotheses trying to build a coherent theory. The genuine observational-theoretical activity, for example, is obvious in the work of Anaximander. He considered the "infinity" (apeiron) as stuff, and it is a high speculative notion. All early theories are speculative (searching for the hidden causes of phenomena), rational (using arguments in making decisions), and empirical (explaining phenomena by saving them, not ignore). Roughly speaking, these three characteristics guarantee their scientific status. European science was developed on this line of thinking and was extended around the world. Early cosmology was a central theme; therefore it lies at the very beginning of the scientific thought. It can be now paradoxical that cosmology today is denied as a hard science, and the other sciences which were separated from the philosophy later have that status. We shall come back on this problem at the end of this article.

In early cosmology the arguments from meteorology and, after that, from physiology were used. The fact that the heavens was the subject of observation causes

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<sup>3</sup>Kirk, G. S. and Raven, J. E., *The Presocratic Philosophers*, Cambridge: Cambridge University Press (1957), Ch. 1.

<sup>4</sup>Sazhin, M. V., *Sovremennaya cosmologiya*, Moskva: URSS (2002), p. 12. In Russian.

that meteorological events were not separated from astronomical. Later, Anaxagoras used physiological arguments in order to explain transformation of stuff. "When we eat fruit or drink water we use simple food. But, how something which is not hair becomes hair, and something which is not meat becomes meat." (fr. 10) The fact that these areas were not clearly separated does not speak against a scientific character of early Greek thought. It is a natural path of differentiation of knowledge.

Anaxagoras developed very speculative cosmology and theory of matter. His basic materials are seeds (spermata). Mind (Nous) plays the role of an agency which produces differentiation. There are no elementary units which we can achieve, division is infinite. Multiplication is also infinite, therefore macrocosm is infinite. The basic postulate runs: Everything is contained in everything (in physical world). Namely, because of high speculative character of this theory, it could be revived in the modern theories under the name of fractal cosmology,<sup>5</sup> founded by D'Albe and Charlier. Empirical evidences speak that visible cosmos is fractal ordered, what gives plausibility to the theory.

Many concepts and formulations of Greek cosmology have survived up today and we can meet them in contemporary theories, often in different forms. For example, what we now call the principle of homogeneity, we meet in Anaxagoras' work, or Aristotle's interpretation of Anaximander (Physics G 4, 203): "Why can be more empty space at one place than at another?" Some other questions are: Is the cosmos infinite or limited? Does the cosmos have the beginning or the end? Other problems can also be recognized, such as: multiplicity of worlds, motion as a cause of differentiation. The Greek answer to the last problem was the theory of *dyne*, whirlpool motion which shapes cosmos. Contemporary problem in Standard model which is analogue to it is: Why does the Universe expand? The concept of vacuum has survived up today, etc. We can conclude that early philosophy, with its orientation to cosmological problems, essentially contributed to the beginning of the scientific thought. The theoretical level that was achieved in that period is very respectable; no matter how naïve it can appear to us or no matter how many errors they committed with their results.

What is the current situation in the contemporary cosmology? Is cosmology completely liberated from philosophical impacts? The answer is – yes, but only in the limited areas. Each attempt of generalization or integrative exposition in the contemporary cosmology is necessary linked with the philosophical ideas. One attempt is the Barrow and Tipler's book, *The anthropic cosmological principle*.<sup>6</sup> It is well known that the first two hundred pages, almost third part of the book, are dedicated to the philosophical theories, which discuss the anthropic principle and the connected problems of teleology. These contents are not only linked with Greek philosophy, but also with West-European philosophy, particularly with the period from the XVIII to the XX century.

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<sup>5</sup>Grujić, P., "Some epistemic questions of cosmology", *Foundations of Science* (2007), pp. 62-65. The same author: *The Concept of Fractal Cosmos: I. Anaxagoras' cosmology*, and *The Concept of Fractal Cosmos: II. Modern cosmology*.

<sup>6</sup>Barrow, J., and Tipler, *The anthropic cosmological principle*, Oxford: Oxford University Press, 1996.

In some recent discussions about anthropic principle, although the attempts to liberate it completely from philosophical-teleological connotations are met, particularly from the theological interpretation, it is impossible to deny that it has philosophical roots.

There are some serious philosophical problems concerning time and space in general theory of relativity, and, *ipso facto*, in Standard cosmological model. In this case cosmology is not liberated from philosophy.

Another important problem concerns methodological status of contemporary cosmology. Cosmology (astronomy) frequently has no opportunity to use genuine experiments. It must use observation under the restrictions in order to verify its hypotheses. This is one reason why people deny character of hard science to cosmology. In order to develop their investigations, cosmologists, as well as astronomers, rely on so-called *cosmological principle*<sup>7</sup> – conjectures about isotropy and homogeneity of the Universe. It is important to notice an emphasis on the *principle*. This means that we are not occupied only by empirical facts. Because astronomers are limited to one point of observation (we observe from the Earth and our Solar System) it is not possible to verify if the Universe is homogeneous and isotropic when observed from some other galaxy. So, it is an important fact that cosmology and astronomy are not purely empirical sciences, but speculative ones as well. *Eo ipso* so are the cosmological models, developed on collected "empirical" material.

Cosmology would never be in the circumstances as the other empirical sciences, such as for example chemistry, because it is oriented to the great dimensions and constrains that are imposed on human being as knowing subject – we live in very small part of the Universe. It means that enlargement of our knowledge about cosmos will be always based on the same principles, postulates, and that cosmology will be hardly liberated from philosophy.

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<sup>7</sup>Ćirković, M., *Uvod u vangalaktičku astronomiju*, (monografija) Univerzitet u Novom Sadu, pp. 48-50.