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World as an Artwork: Aesthetic, Artistic and Mathematical Aspects of Plato's Cosmology[1]

Abstract

In this paper, we briefly reconsider the synthetic character of Plato's cosmological thought in the Timaeus and the Republic. At the core of Plato's cosmological theory stands a unique geometric method – thoroughly elaborated in the Timaeus – by which the structure of seemingly diverse artistic, natural, and socio-anthropological phenomena may be explained and understood. Plato repeatedly insists on the principle of musical analogy. In order to elucidate Plato's position, we employ several geometric diagrams and graphic representations.

Keywords: *cosmology, Plato's geometric method, proportion (analogy), art, nature*

Plato's severe critique of mimetic arts, which begins with poetry in Book III of the *Republic* and then, in Book X, considers all art to be mimetic and banishes it from the ideal state on metaphysical grounds, is not supposed to deprive arts of *mimesis* entirely, but only to redefine the notion of the artist and the source of his inspiration, that which he imitates.

The greatest of all artists, and the only artist in proper sense of the word, according to Plato, is the so-called Demiurge (*demiourgos*), the creator of physical world, resembling the monotheistic God of Abrahamic traditions.[2] The character of the Demiurge is anticipated within Book VII already,[3] as well as within the lucid, extraordinary passage in the concluding book of the *Republic*.[4] The very beginning of *Timaeus'* speech indicates that the Demiurge is

1 This research was funded by the Ministry of Science, Education and Technological Development of the Republic of Serbia within the projects 179064 and 179048.

2 See: Broadie, S., *Nature and Divinity in Plato's Timaeus*, Cambridge University Press, Cambridge 2012, pp. 7-26.

3 Plato, "The Republic," in Hamilton, E., Cairns, H. (ed.), *The Collected Dialogues of Plato*, Princeton University Press, Princeton, New Jersey 1989, 530a.

4 *Ibid.*, 596b-d. Within the context of Book X, the meaning of the passage is primarily ironic, but when considered from the viewpoint of the *Timaeus*, it represents an adequate description of Plato's Demiurge.

absolutely good[5] and that his creation is absolutely good and beautiful.[6] This is reiterated within the closing passages of the *Timaeus*: "all that is good is also beautiful."[7] Although the mathematical aspects of Plato's cosmology would fulfill their purpose on their own, Plato is very keen to incorporate them into a wider ethical, aesthetical and mythical framework.

The link between the beautiful and artistic was brutally broken in Book X of the *Republic*, but in the *Timaeus*, it is reestablished within the realm of mathematical objects, which serve the purpose of a paradigm of creation. Unlike artists who create worthless representations by imitating unstable, fluctuating sensory objects, the Demiurge imitates the perfection of mathematical objects, the pureness of transcendent Ideas. The source of his inspiration is the supposed mathematical essence of the world. Chaos lacks goodness and beauty, and the Demiurge's task is to set chaos into order (*cosmos*)[8] on the basis of a specific geometric principle. There is also an important place in the late dialogue *Philebus* which correlates the Idea of beauty, or absolute beauty, to the perfection of geometrical shapes, which – according to Plato – constitute the basis of reality (or at least, the basis of a model of reality). In *Philebus*, it is explicitly stated: "the straight line and the circle and the plane and solid figures formed from these by turning-lathes and rulers and patterns of angles … the beauty of these is not relative, like that of other things, but they are always absolutely beautiful by nature."[9]

We should never forget that geometry represents the basis of Plato's philosophy, as was supposedly pointed out at the entrance to Plato's Academy.

Timaeus' speech, therefore, integrates various aspects of reality on the basis of a unique geometric theory. The text contains numerous arithmetical and geometrical terms which can be studied independently from the mythical framework of the dialogue, and one can only assume that in its original form the *Timaeus* included the geometrical drawings as well. The two basic notions out of which entire Plato's cosmology derives are *the Same* and *the Different*, and it is said that they are mixed with *Being*.[10] Being is, supposedly, the substratum out of which the physical world is made. Same and Different, through which we experience the physical, sensory world, are represented by perfect, circular shapes. This is unambiguously stated several times.[11] Furthermore, in the opening lines of Timaeus' exposition, the entire universe (*kosmos*) is said to be spherical in shape, for "the sphere is the most perfect of all shapes and contains all the other shapes within."[12] The entire theory echoes the so-called Pythagorean concept of "the music of the spheres." One of the most striking passages is the one where Plato explains the structure of the "world soul" (the living essence of the universe) by the geometry of the great intervals of the

5 Plato, "The Timaeus," in Hamilton, E., Cairns, H. (ed.), *op. cit.*, 29e.
6 *Ibid.*, 30a.
7 *Ibid.*, 87c.
8 *Ibid.*, 30a.
9 Plato, "Philebus," in Hamilton, E., Cairns, H. (ed.), *op. cit.*, 51c.
10 Plato, "The Timaeus," 35a-b.
11 *Ibid.*, 36b-37a.
12 *Ibid.*, 33b.

Pythagorean musical scale: "He (the Demiurge) began to distribute the whole thereof into so many portions as was met; and each portion was a mixture of the Same, of the Different, and of Being. And He began making the division thus: First He took one portion from the whole (1); then He took a portion double of this (2); then a third portion, half as much again as the second portion, that is, three times as much as the first (3); the fourth portion He took was twice as much as the second (4); the fifth three times as much as the third (9); the sixth eight times as much as the first (8); and the seventh twenty-seven times as much as the first (27). After that He went on to fill up the intervals in the series of the powers of 2 and the intervals in the series of powers of 3 in the following manner: He cut off yet further portions from the original mixture, and set them in between the portions above rehearsed, so as to place two Means in each interval, one a Mean which exceeded its Extremes and was by them exceeded by the same proportional part or fraction of each of the Extremes respectively; the other a Mean which exceeded one Extreme by the same number or integer as it was exceeded by its other Extreme. And whereas the insertion of these links formed fresh intervals in the former intervals, that is to say, intervals of 3:2 and 4:3 and 9:8, He went on to fill up the 4:3 intervals with 9:8 intervals. This still left over in each case a fraction, which is represented by the terms of the numerical ratio 256:243. And thus the mixture, from which He had been cutting these portions off, was now all spent"[13] (see *Table 1*).

Description	Value	Interval Analogy	Ratio[14]
"one portion from the whole"	$\frac{1}{1} = 1$	Unison	AB
"a portion double of this"	$\frac{1}{1} : 2 = \frac{1}{2}$	Octave	$\frac{A0}{AB}$
"half as much again as the second portion, that is, three times as much as the first"	$\frac{1}{1} : 3 = 1 - \frac{2}{3} = \frac{1}{3}$	Perfect Fifth	$\frac{KB}{AB}$
"the fourth portion … twice as much as the second"	$\frac{1}{2} : 2 = 1 - \frac{3}{4} = \frac{1}{4}$	Perfect Fourth	$\frac{KB}{AB}$
"the fifth three times as much as the third"	$\frac{1}{3} : 3 = 1 - \frac{8}{9} = \frac{1}{9}$	Whole Tone	$\frac{PB}{AB}$
"the sixth eight times as much as the first"	$\frac{1}{1} : 8 = \frac{1}{2^3} = \frac{1}{8}$	Perfect Eighth	$\frac{AG}{AB}$
"the seventh twenty-seven times as much as the first"	$\frac{1}{1} : 27 = \frac{1}{3^3} = \frac{1}{27}$	Inferior Quarter-tone	$\frac{AN}{AB}$

Table 1. The great intervals of the Pythagorean scale that constitute the structure of the "world soul," according to Plato

13 *Ibid.*, 35b-36b.
14 See: *Fig. 1*.

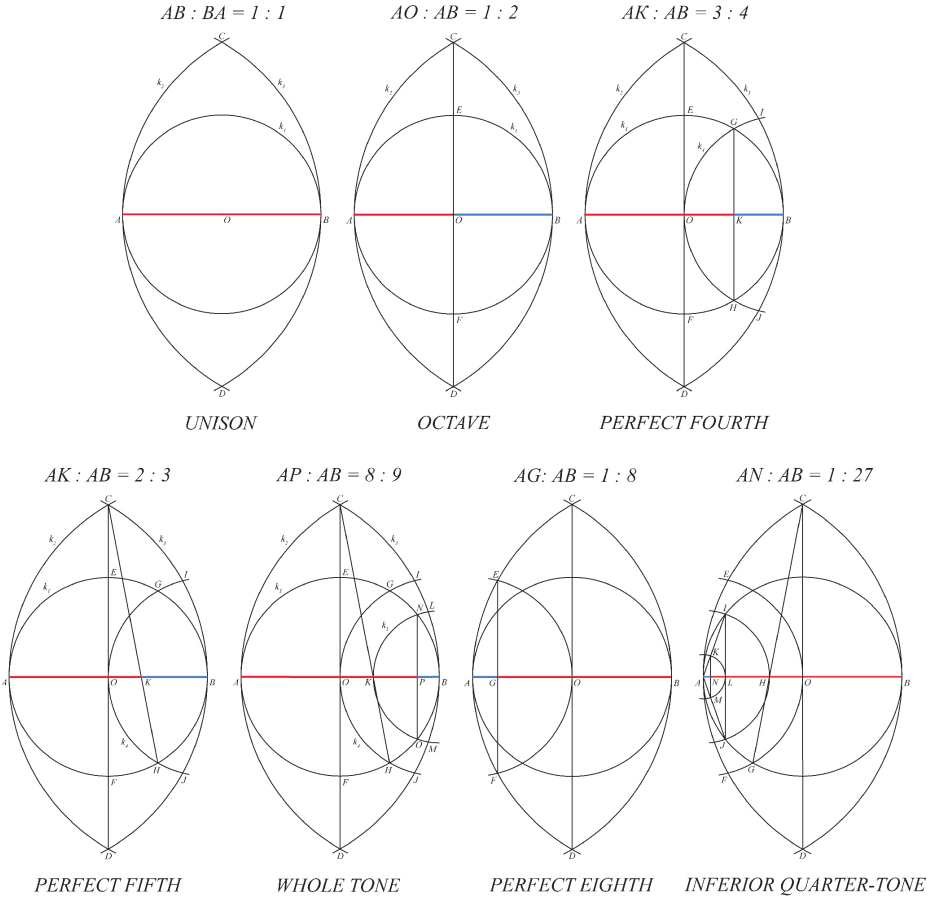

Fig. 1. Geometrical representations of the great intervals of the Pythagorean scale

One can realize from the aforementioned place in the *Timaeus* that Plato based the values of the small intervals of the musical scale on the identical mathematical principles conceived by the Pythagoreans (for example, Philolaus). The value 256 : 243 is called *diesis*, and is calculated in the following manner:

$$\frac{\text{fourth}}{\text{whole tone}^2} = \frac{4}{3} : \left(\frac{9}{8}\right)^2 = \frac{256}{243}.$$

Marić (1997) proposed,[15] and Milosavljević (2007) advanced the idea that Plato's geometrical approach is quite correct and that natural, measurable structures can be represented by this interplay of circles, interplay of radiuses. The idea that the experimentally obtained values concerning the water molecule structure (angles and distances) may be described by the same geometry by

15 See: Marić, I., *Platon i moderna fizika*, Društvo filosofa i sociologa Crne Gore, Nikšić 1997, pp. 11-128 and pp. 257-264.

which the intervals of the Pythagorean scale are brought into relation is very interesting and worth further exploring.[16]

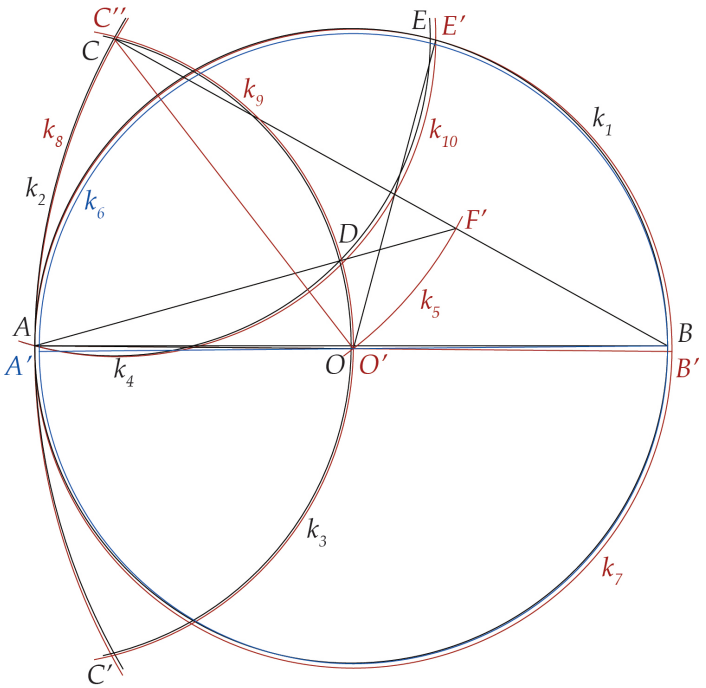

Fig. 2. The method of scalar-angular division by the Golden mean: $\frac{CO}{AB} \approx \frac{\sqrt{6}}{4}$(circumradius of a tetrahedron), $\frac{CF\prime}{AB} \approx \frac{CO\prime}{AB} \approx \frac{\sqrt{5}-1}{2}$(Golden ratio); and the angular values within the water molecule structure ($\angle AOE \approx 104.47°$ and $\angle A'O'E' \approx 105.50°$)[17]

It appears that the geometry of the Pythagorean scale, accompanied with the geometry of the Golden mean[18] and the geometry of Platonic, regular solids,[19] which all play pivotal roles in Plato's cosmology and physics, may enable better understanding of the ancient Greek natural philosophy, as well as contemporary theories about the structure of the universe and the corresponding experimental results.[20] The geometric construction of the scale reveals the characteristic angular values out of which the familiar linear aspects of the

16 Milosavljević, P., "Lestvična deoba po zlatnom preseku," in *Phlogiston*, Vol. 15, p. 58, Kandić, A., "The Physics of Social Processes," in *Skepsis Journal*, Vol. 22, Iss. II, p. 214 and Chaplin, M., *Water structure and science*, http://www.lsbu.ac.uk/water/ (October 26, 2014).

17 See: Hasted, J. B., "Liquid water: Dielectric properties," in Franks, F. (ed.), *Water: A comprehensive treatise*, Vol. 1, Plenum Press, New York 1972, pp. 255-309, Silvestrelli, P. L., Parrinello, M., „Structural, electronic, and bonding properties of liquid water from first principles", in *J. Chem. Phys.,* Vol. 111, pp. 3572-3580.

18 Plato, "The Timaeus," 31c-32a.

19 *Ibid.*, 54d-55c.

20 See: Milosavljević, P., *op. cit.*, pp. 54-63. Compare to the results in Luminet, J.-P., Weeks, J., Riazuelo, A., Lehoucq, R., Uzan, J.-P., "Dodecahedral space topology as an explanation for weak wide-angle temperature correlations in the cosmic microwave background," in *Nature*, Vol. 425, pp. 593-595.

Golden mean may be obtained, and this further enables the simple and ontologically-cosmologically meaningful construction of the regular pentagon (into of which pentagram, the Pythagorean symbol of health, may be inscribed). Pentagon represents the basis of *dodecahedron*, the "quintessential" element of the universe, according to Plato.[21]

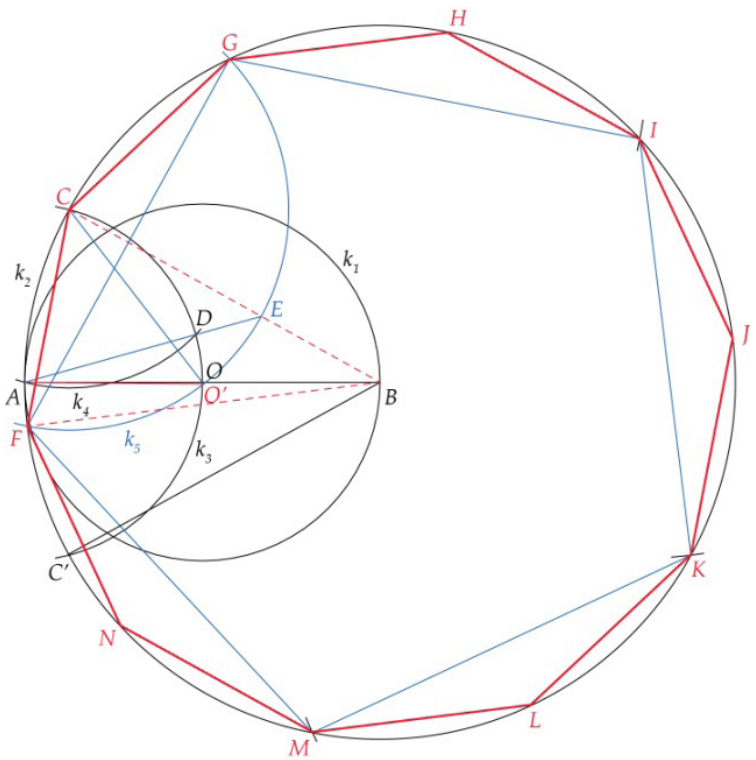

Fig. 3. The method of scalar-angular division by the Golden mean by which the forms of the regular pentagon and regular decagon can easily be constructed

Division of the one-dimensional magnitude by the principle of proportionality was discussed by Plato in the *Timaeus* (31c-32a) and the *Republic* (509d-511e), while the exponentiation within the second and third dimension was also discussed in the *Timaeus* (31c) and the *Republic* (546b-d). This is reflected in Plato's following claim: "…distinguishing one and two and three. I mean, in sum, number and calculation. Is it not true of them that every art and science must necessarily partake of them?"[22] In accordance with the Pythagorean mathematical principles of natural philosophy, Plato based his system of analogy on the division of the unit (monad) by the first three numbers and their mutual exponentiation (Plato's series), out of which the Platonic lambda is derived (see: *Table 2*).

21 Plato, "Timaeus," 55c.
22 *Idem*, "The Republic," 522c.

$\frac{1^1}{1}$	$\frac{1^1}{2}$	$\frac{1^1}{3}$	$\frac{1^2}{1}$	$\frac{1^2}{2}$	$\frac{1^2}{3}$	$\frac{1^3}{1}$	$\frac{1^3}{2}$	$\frac{1^3}{3}$
1	$\frac{1}{2}$	$\frac{1}{3}$	1	$\frac{1}{4}$	$\frac{1}{9}$	1	$\frac{1}{8}$	$\frac{1}{27}$

Table 2. Plato's series, out of which the Platonic lambda is derived

This approach indicates that Plato recognizes the analogy within the context of temporal arts (music) and spatial arts (architecture, sculpture, etc.), as he aims to visualize its simple mathematical principles by reduction to the identical geometric order. For Plato – just like the Pythagoreans – the constructible order of geometric elements and values represented the only real order, analogous to the natural order of spatial and temporal values which are derived one from each other.

The Pythagorean-Platonic description of the universe influenced Classical Greek art to a great extent, no matter whether it be music, sculpture, painting, etc. The application of the system of musical analogy and the Golden mean may be observed within architectural creativity as well, usually associated with the ceremonial activities and urban complexes built in honor of the deities. During the transition between the Classical and Hellenistic eras (5th-3rd century BC), the Amphitheater at Epidaurus was built, and its geometry displays the identical Platonic synthesis of proportional systems in a most immediate manner (see: *Fig. 4*).

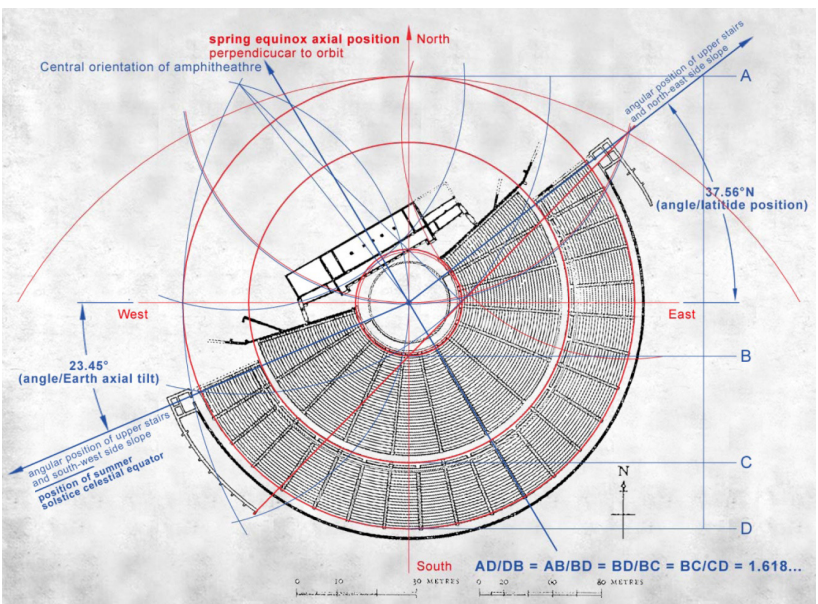

Fig. 4. Geometrical basis of the Amphitheater at Epidaurus (Peloponnese, Greece, 4th-3rd century BC). The proportioning of the base circle diameter according to the principle of the Golden series: $\left(\frac{AD}{AB}=\frac{AB}{BD}=\frac{\sqrt{5}+1}{2}; \frac{BD}{BC}=\frac{BC}{CD}=\frac{\sqrt{5}+1}{2}\right)$

It is important to emphasize that the elements of the circular form and the orientation of the Amphitheater, whose primary form was designed by the Ancient Greek sculptor, architect and athlete Polykleitos sometime between 340 and 300 BC, correspond to the transposition of the geometric-angular values of the north latitude (37.56°) and the tilt of Earth's axis (23.45°). The value of the Golden mean is observed within the proportioning of the base circle diameter (out of which the circular form of the Amphitheater is derived) by the principle of the Golden series ($\frac{AD}{AB}=\frac{AB}{BD}=\frac{\sqrt{5}+1}{2}$; $\frac{BD}{BC}=\frac{BC}{CD}=\frac{\sqrt{5}+1}{2}$). During the Roman period, the diameters of circular cut-outs which define the heights and the propagation of seating rows were aligned according to the Golden series. The aforementioned geometrical properties may have contributed to the acoustics of the Amphitheater, erected within the Asclepius' sanctuary, the urban complex dedicated to the deity of healing and health.

Plato's "great theory," therefore, aims to bridge the gap between diverse cognitive, artistic and experiential phenomena. In the *Republic* and the *Timaeus*, as well as other dialogues, Plato repeatedly insists on the principle of *musical analogy* by which the worldly and the transcendent, mathematical objects may be harmonized and brought into order. By introducing the character of the Demiurge, who creates the world by looking into the ideal, mathematical shapes, the properties of artwork are now loosely applied to nature in general, and *vice versa*. In Plato's view, myth, science, art, psychology, as well as the axiological notions of beauty and goodness, all seem to converge into one point, possessing a common mathematical ground. But such a synthetic, holistic approach is certainly not specific to Plato only. Many Classical Greek and Hellenistic artists were influenced by the Pythagorean-Platonic natural philosophy. Of particular importance is Polykleitos' Kanon which puts forward the principle of symmetry,[23] as well as Plato's "mysterious" geometrical (wedding) number,[24] which, as a numerical (arithmetical) expression of a specific angular value (see: *Fig. 2*, $\angle AO'C = 51.729°$), may be observed within many great sculptural and architectural compositions of the Classical epoch.[25]

Władysław Tatarkiewicz rightly concluded in his *History of Aesthetics* that Plato "not only proclaimed that beauty consists in measure and proportion, but also attempted to determine what these proportions precisely are."[26]

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23 Diels, H., *Predsokratovci. Fragmenti,* Sv. 1, Naprijed, Zagreb 1983, p. 342.

24 Plato, "The Republic," 546b-d.

25 See: Milosavljević, P., Kandić, A., Stojiljković, D., "Pythagorean Theory of Harmony: Natural Philosophical Aspects of Classical Greek Art and Aesthetics," in *Skepsis Journal*, Vol. 24 (to appear soon). Electronic version of the paper may be found at the following address: http://aleksandarkandic.com/papers/pythagorean-harmony.pdf (October 26, 2014).

26 Tatarkiewicz, W., *History of Aesthetics*, Vol. 1, Mouton, The Hague 1970, p. 117.