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FROM THE INFINITY (APEIRON) OF ANAXIMANDER IN ANCIENT GREECE TO THE THEORY OF INFINITE UNIVERSES IN MODERN COSMOLOGY

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Abstract

The notion of the infinite, with the modern meaning of the term, was first introduced by the Greek philosopher Anaximander (6th Century BC).

Anaximander introduced the *apeiron* (*the boundless*) as the beginning of everything (the first principle). According to his theory, the *apeiron* is undefined and ever moving. It gives birth to the contradictory terms of warm and cold, and of moist and dry, and their perpetual strife. Man is able to comprehend the result of this eternal process from the vast plurality of things and the infinite number of Universes.

The cosmological aspect in Anaximander's theory is beautiful; innumerable worlds are born from the *apeiron* and absorbed by it, once they are destroyed. Thus, the *apeiron* is related to the eternal, throughout time, cosmological procedure.

The cosmological problem of the vastness of the Universe or of the innumerability of Universes is an elementary philosophical problem, while the Theory of Big Bang bounded with the notion of time-space, is a starting point for understanding the models that describe our Universe.

Key words: Presocratic philosophy, Ionia, Anaximander, apeiron, infinity, cosmology

1 INTRODUCTION

Presocratic philosophy was born in the Greek cities of Ionia at the end of the 7th Century BC. At this time and place BC, philosophical views were quickly developed as nowhere else in Greece. Conclusively, the belief that the gods controlled the world, interfering randomly into the lives of men, was no longer able to give satisfactory answers to the demands of knowledge or to the ethics of that time.

The School of Miletus (Thales, Anaximander, Anaximenes) combined ancient mythology with rational thinking and sought all the forces that compose nature. The Presocratic philosophers explored the principal cause of the Cosmic creation, as well those forces on which the Universe and humanity itself are founded.

The philosophers were mainly concerned with the natural world, studying the reality that surrounded them. The Ionian philosophers, lived and taught in Asia Minor, observed closely the physical phenomena and their contribution in questioning the validity of the myths was crucial. They tried to derive all possible conclusions from the observation of nature, using plain logic. The problem of the primary substance ('arche') was one of the concerns of the Greek natural philosophers; questions arose about the structure, nature and the way that our world was made. These philosophers probably were more concerned in explaining the why in the phenomena, based on a certain theory, rather than the nature or the how of the phenomena.

Nevertheless, a swift and rather unexpected displacement from the mysticism and religionism to causality was made at that time. It was a change that revealed the eminence of Ancient Greek philosophy and had an enormous impact on the whole world.

Naturally, we should not overlook the fact that most of the Greek Presocratic philosophers were actually physiologists, as they tried to define the 'arche', the primary substance from which all things came.

Thales from Miletus (624-546 BC), the father of ancient Greek philosophy, believed that water was the basis of all things and the principle of the Universe. The importance of water in life and nature was probably the main reason that made Thales came to this conclusion. According to Diogenes Laertius: *"His doctrine was that water is the universal primary substance and that the world is animate and full of divinities"* [1]. Anaximander (610-540 BC), Thales' student, gave to the 'apeiron' (the infinity), this quality: *"He laid down as his principle an element which is unlimited without defining"* [2].

Considering the ancient Greek philosophical views, which treated matter as equal to water, air or fire, we conclude that the notion of 'apeiron' of Anaximander derives from the Greek preposition a- (*without*) and the Greek word 'peras' (*boundary, end*), standing for that with no beginning and no end throughout time, and unconfined in space.

This term is crucial when arguing how the foundations of Cosmology and of Ionian Physics sprang from myth; something that we consider to be the first revolution of Science. It was then, that Greek philosophers tried to answer two fundamental questions which puzzled them deeply: The beginning and the form (shape) of the Cosmos. This effort set them to be the fathers of philosophical thinking and the founders of Science.

In addition, the idea of multiple or many Worlds, an argument that was derived from the effort to understand the Universe, posed for us as astronomers, many questions for further research. Physics and Astronomy are not and should not be separated from philosophy.

Questions set in antiquity, as the existence of many or multiple Worlds, the infinite or the definite of the Universe, and the Big Bang Theory among others, awake once more, bearing

fundamental existential philosophical problems. Questions that remain unknown, given the fact that the fate of the Universe remains unknown!

2 THE APEIRON OF ANAXIMANDER

Anaximander (610-540 BC) lived during the same period as Thales. He was his student and after his death he took over his School. Many scholars hold him as equal to his teacher, and as the first, with Empedocles of Acragas (500-428 or 483-430 BC), to introduce experimental research of physical phenomena. In fact, he was the first to give a scientific view of the World, free from myth, stating in his work [3]. Anaximander introduced the prospect of an infinite Universe endless in time and space.

Anaximander believed in the existence of a natural law, a kind of cosmic justice, which kept the four primary elements in balance. These elements were perpetually in strife, due to their different texture and non-homogenous consistency. For Anaximander, the natural balance should be kept eternally, preventing an element from overtaking the rest. This argument led to the rejection of Thales, who proposed water as the first principle of the Cosmos, because it was contradictory to the idea of natural justice and balance: should an element reject the others and prevail over them, then the World not only would be different but it would move into destruction.

The important argument in Anaximander's theory is the philosophical idea of an eternal and unchangeable cosmological essence, from which all things are derived and finally return. This primary cosmological essence exists outside the four primary elements and is identical to the infinite (apeiron). In his early Cosmology, the *apeiron* (the boundless) is a substance self-defined, unchangeable, unable to die and indestructible. It is something without shape or characteristics, has no boundaries both in time and in space and bears undefined qualities. The *apeiron* is un-ending and indestructible and that is the reason why the worlds are born and return back to it consequently.

Many scholars argued that the *apeiron* was a primary material or a primary substance, which was undefined in its quality ; unformed, indestructible and un-constricted in time and space.

Anaximander, however, believed that the *apeiron* was actually changing into the four elements, which in turn, interacting with one another, gave all things. They, in turn, decayed and, returned back to the *apeiron*. He based his philosophical beliefs on the definition of the word 'arche', having both the meaning of the beginning as well as the meaning *ruling* (from the Greek verb 'archo').

He also mentions an *arche* (a beginning), which was not similar to any other *arche* or element of the Cosmos, that is, an *arche* which encloses all and rules all. According to Aristotle: "So the 'unlimited' cannot be derived from any other principle, but is itself regarded as the principle of the other things, 'embracing and governing all'… This unlimited, then would be the divinity itself, being 'immortal and indestructible' as Anaximander and most of the physicists declare it to be" [4].

Anaximander and his teacher rejected completely the anthropomorphic view of sexual reproduction between divine beings, a view that was the basis for all mythological Cosmogonies of that time. Anaximander assumed, that the womb of the Cosmos, mainly the *apeiron*, was able to give life. In fact, life begun with the *fruitful seed,* placed inside the cosmological egg. The seed fertilized its opposite, detached from the *apeiron,* and its growth took place inside a sphere of fire, including a cold mass. In the initial phase of creation, the two opposites moved apart: the warm including the dry and the cold including the moist. After the effect of the warm, the dry and the moist were separated, the sea and the land were formed. The result of the warm acting on the cold was moisture, which yields life. According to Aetius, Anaximander assumed that the sea was what was left from this primary moisture [5].

It seems that Anaximander also used the word *apeiron* with a more abstract meaning, like the mathematical term for infinite. Possibly, he considered it to be a vast material mass or a primary nebula. Additionally, he might have used it for a natural force or energy, unconstricted in time and probably with no internal structure. Many scholars agreed that the *boundless* comes out of the warm and the cold, which were later driven apart, the former developing an outer sphere of fire, namely the 'pyr' (= fire), and the latter the air, water and earth, inside Cosmos. These elements were combined and then driven apart, forming the sea and the land, while from the split of the sphere of fire and after the capture of 'pyr' in rings, the Sun, the Moon and the stars were formed. Finally, by the heat of the Sun and through the currents caused by the movement of the heavenly bodies, the water evaporated, creating the air.

According to Pseudo-Plutarch: *"Anaximander said that the 'Infinite' was solely responsible for the coming-to-be and the passing-away of the universe. Anaximander states that the various heavens have been secreted out of this Infinite, as more generally have been all the worlds, which are infinite in number. He declared that passing-away and (much earlier) coming-to-be take place as they all repeat a cycle from infinite time"* [6].

Diogenes Laertius as for as the apeiron of Anaximander, notes that: *"Anaximander, the son of Praxiades, was a native of Miletus. He laid down as his principle an element which is unlimited without defining it as air or water or anything else. He held that the parts undergo change, but the whole is unchangeable"* [7].

The Universe, according to Anaximander, was infinite and the Worlds innumerable. From the *apeiron,* immortal and indestructible, the 'opposites' were formed, by its eternal movement, and were carried inside it. This means that Anaximander believed that the opposite elements fire and water could not co-exist in harmony; they were in eternal strife.

Unfortunately, only a small fragment of Anaximander's famous book 'Of Nature' has survived the ages. Simplicius in Aristotle's Physicorum, from Theophrastus, gives only a general account for the *meaning of apeiron*, with a paraphrase about the creating and destroying of the Worlds, and an accurate statement, describing the relation between the cosmological factors, under a *repaying* justice:

> *"Anaximander said the apeiron to be the beginning of all things; all the heavens and the worlds came from it; the birth comes from it and all things return back to it, once they are destroyed. In*

> *this way the justice and repayment is given, for the un-justice that they have done to one another, through time"* [8].

G. S. Kirk, J. E. Raven and M. Schofield [9] are of the opinion that Anaximander believed in a sequence of individual worlds, which were produced by and return to the *Infinity*. This leads to the conclusion that Anaximander probably pictured a vibrating Universe.

Aristotle (384-322 BC) arguing about the infinite and the way that Anaximander used this term, says:

> *"All things are the beginning or have a beginning, namely an origin; if this was, then there will also be an end; the immortal is un-destroyable, as Anaximander and many other philosophers say"* [10].

Aristotle in his work *Physics* (*Physikes Acroaseos*), argues the infinite of Anaximander. He is very interested in the absolute beginning, which has a double mission, being both the cause of matter and the cause of motion ([11]. The effort to combine the *divine* with motion is held for the *apeiron* and *immortal* of Anaximander, as stated in his fragments [12].

As stated from Aetius [13] and Simplicius [14], Anaximander was of the opinion that *the apeiron* was the source of many worlds.

We conclude, that Anaximander believed that all things derive from the *apeiron* and as Aetius and Simplicius stated, a thousand worlds are born and destroyed, as will ours one day. Anaximander, as well as Democritus, believed that an infinite number of cosmological systems exist in our Universe, a view that remarkably approaches the modern astrophysical beliefs. Anaximander might have different definitions for the terms Cosmos and Universe in his cosmological approach. He held Earth to be the centre of our World but he was not of the opinion that Earth is the centre of a Universe, which holds a million different Worlds.

Nevertheless, according to other studies, Anaximander placed Earth in the centre of a spherical Universe, while the rest of the planets were in orbit around Earth: *"That the earth, which is of spherical shape, lies in the midst, occupying the place of a centre"* [15].

Also, according to other studies, the later views of Anaximander express clearly the belief in a geocentric arrangement of the Cosmos, inside the spherical Universe, which he describes. This explains why Earth stays in the air, in the centre of a huge sphere. Earth is in the equilibrium in the middle of the Universe, because of the equal distances from the ends of this sphere, with the stars fixed on the inside of it.

3 OTHER PHILOSOPHERS ABOUT INFINITY

According to the philosophical and cosmological approach, the infinite stands for the Universe, and nature as a whole. More specifically, it is related with matter and its movement. We understand the *infinite* as a contradiction to the *finite*. These two philosophical notions, are dialectically related, and express the opposite qualities of matter, as the philosophical object,

which exists in space and in time and eternally moves. We understand matter as something finite, because its various forms (specific objects, functions and qualities) are also finite in space and in time. On the other hand, we understand matter as having an infinite characteristic, due to its non-stop movement; an inexhaustible, eternal process of transformation into an endless, qualitatively and quantitatively, variety of things, shapes and qualities. This is, respectively, the visible and surrounding Universe and also the illusive 'dark' matter, possibly existing inside an anti-parallel Universe.

Similar views to Anaximander about an infinite cosmic being or about the infinite number of Universes have been expressed by other Presocratic philosophers, like Heraclitus, Melissus, the fathers of the Atomic Theory Leucippus and Democritus, the Pythagoreans, Plato, Aristotle and finally the Neoplatonic philosophers.

It seems that the idea of *apeiron* is one among the most ancient and most used notions in Presocratic philosophy.

According to Pythagoras the world itself was boundless. Democritus similarly used the word *apeiron* with reference to the *nothingness* of space and to the *non-being.*

Epicurians also taught the infinity of the worlds and the Eleats believed that the essence of the Universe was infinite, a view that Plato accepted. To the contrary, the Stoics believed that only space was infinite but the World finite. Neoplatonists held only God as infinite and consequently, the World, a creation by the infinite God, was finite in time.

Additionally, the Cosmological Systems of Anaximenes (585-525 BC) and Diogenes Apolloniates (510-400 BC) are strongly influenced by Anaximander. More specifically the former was the student of Anaximander and continuer of his work, and, although he holds 'aer' (*air*) to be the beginning of the world, he puts the *apeiron* in opposition to the definite things, which were produced from it.

> *"Anaximenes said that the origin of all things is the air, and that it is infinite in extent, but definite in its qualities; and that all things are generated by a kind of condensation, and contrary rarefaction, of this air. Change, however, existed from all time"* [16].

In addition to that, according to Simplicius:

> *"Anaximenes of Miletus, son of Eurystratus, who had been an associate of Anaximander, said, like him, that the underlying substance was one and infinite. He did not, however, say it was indeterminate, like Anaximander, but determinate; for he said it was Air. It differs in different substances in virtue of its rarefaction and condensation"* [17].

As Diogenes Laertius mentions:

> *"Diogenes of Apollonia, son of Apollothemis, was a natural philosopher and a most famous man. Antisthenes calls him a pupil of Anaximenes; but he lives in Anaxagoras time… The doctrines of Diogenes were as follows. Air is the universal element. There are worlds unlimited in number, and unlimited empty space"* [18].

Diogenes considered the Universe to be infinite and to include innumerable Worlds. These Worlds were definite and moved inside this infinite space. He believed that our World was the best of all the possible ones, because the phenomena –which it yielded– were arranged in a specific way. To maintain this order, a spiritual force should be present, namely the 'Noese' (understanding, comprehensiveness); it placed things into an order and supervised the maintenance of perfection. This fundamental belief stood for the air and at the same time was called god, representing the spiritual Mind ('Nous') of Anaximander and Anaxagoras, which made the World.

The Pythagoreans and Plato believed infinite to be a vast and shapeless beginning, which consisted along with its opposite, the *finite* ('peras'), the basic parts of *that which is* ('On'); this is the passive beginning of the World and gives matter, needed for every creation. Conclusively, the infinite is a fundamental part of the Pythagorean thinking (the infinite and the finite in the known Pythagorean list of opposites) and handles the number as the beginning of time. The Pythagoreans believed the world to be a synthesis of opposites and to be created from something infinite, in addition to the notion of *finite* and the belief about a musical harmony in the Universe.

Pythagoras treated the One as equal to the unit, the perfect and primary number, which is the essence of all creation and at the same time the creator of the material unity of things, and, of course the sole principle of all other beings [19]. The One is unique, everything and eternal. However, the One, identical to finite, is a contradictory term to the infinite. This leads, from the One-Everything point of view, to a contradiction between essence and phenomena. According to Aristotle Pythagoreans believed that good derives from the finite and evil from infinite: "*For evil is a form of the unlimited, as in the old Pythagorean imagery, and good of the limited*" [20].

Plato (427-347 BC) classified the *being,* inside the structure of the World, as follows: a) the *infinite*, b) the *finite,* c) the mixture of the *infinite* and the *finite* and d) the *cause* of this mixture. He holds the *infinite* for something without decoration and definition.

The teachings of Plotinus are a reaction to the beliefs of Aristotle and the Stoics about matter. As reference he uses the platonic Philebus "*How is the infinite number of things which come into being this unity"* and *"They put infinity immediately after unity"* [21], where he mentions the *infinite.*

Democritus (460-370 BC) seems to have a more concrete and materialistic view concerning the *infinite,* because he speaks about an infinite number of atoms and therefore beings and phenomena. There is an argument however, considering Democritus to hold the void for the *infinite*:

> *"His opinions are these. The first principles of the universe are atoms and empty space; everything else is merely thought to exist. The worlds are unlimited; they come into being and perish. Nothing can come into being from that which is not nor pass away into that which is not. Further the atoms are unlimited in size and number, and they are borne along in the whole universe is a vortex, and thereby generate all composite things – fire, water, air, earth; for even these are conglomerations of given atoms"* [22].

As for as the view of Leucippus, Diogenes Laertius says that:

> *"He declares the All to be unlimited, as already stated; but of All part is full and part empty. (by the "full" is meant matter, atoms: by the "empty", space); and these he calls elements. Out of them arise the worlds unlimited in number and into them they are dissolved"* [23].

According to Simplicius: *"Leucippus and Democritus say that there are infinite Worlds inside the infinite void, which were formed from an infinite number of atoms"* [24]. One, from these infinite Worlds, is our own.

Leucippus and Democritus are considered to be the founders of the Atomic Theory, a theoretical, cosmological system with an organic unity, which probably was the greatest scientific conquest of the ancient Greek thought.

Democritus, wanting to add his own view on the structure of the World, tried to include in the Atomic Theory the beliefs of Parmenides and Heraclitus. Thus, the belief that there is a point, beyond which the atoms cannot be more divided and therefore stay as un-changeable entities, is close to the view of Parmenides, about a stability, beyond the changing World; a stability which only our thought can approach. Additionally, Democritus mentions a variety of combinations of atoms. These combinations are formed during an eternal movement, adopting the view of Heraclitus on an eternally moving world.

According to the Atomic Theory, the atoms form infinite number of shapes, and due to their spiral movement, are jointed together forming fire, air, water and earth, that is the four primary elements. Indeed, the two philosophers were of the opinion that the degree of the density of things was proportional to the number of atoms coming together; these things were eternally moving inside the *void*. Their movement causes a continual whirling, which is responsible for the connection of the atoms. It is from these atoms, that all things and Worlds arise.

Leucippus and Democritus believed the Universe to be infinite and atomistic; its innumerable and full with life Worlds, were merely the result of the accumulating of atoms. Through the whirling movement of these accumulations the Worlds are created; some look like our own and some are completely different.

Hippolytus writes:

> *"Worlds are infinite in number and vary in shape. In some of them, nor Sun nor Moon exist, others have bigger and others have more Suns and more Moons. The distances between the worlds are unequal and in this part of the void may there be more worlds and in an other fewer. And other worlds still developing, and others reached the peak and others decay, others are born and others disappear. The worlds are destroyed when they collide. There are also worlds bare of plants and animals and with no water"* [25].

According to Aristotle, the *infinite* exists only as something that *is possible to be* ('en dinamei') and not as something that *really is* ('energy'). This shows that he agreed with the infinite movement and time but rejected the idea of an infinitely spatial Universe.

The platonic notion of God is related to the view of *infinite,* rejecting the negative meaning and holding only the positive. An exception is the theory of Parmenides (ear. 5th Century BC), who handles the *infinite* as the beginning of all things. Also, the Neoplatonic philosophers consider the *infinite* to stand for God. The Platonic, and later Neoplatonic belief about the evil, fallen from the good, was adopted from the Christian scholars. This view is used and strongly projected by the idealistic theological philosophy, which defines the *infinite* as the product of consciousness. To the contrary, the materialistic philosophical view, handles the *infinite* as a quality of time and space, under a mathematical and cosmological prospective. Also, the dialectical-materialistic concept of the *finite* and of the *infinite* derives from the positive side of Hegel's idea about this subject. Hegel was the first to mention the dialectical relation between the *finite* and the *infinite* [26].

4 THE INFINITE NUMBER OF WORLDS IN THE ANCIENT GREEK THOUGHT

Xenophanes of Colophon (565-488 BC) considered the Universe to be eternal, without being initially created. He taught that only the partial Worlds are subject to continuous change. According to Diogenes, Xenophanes believed in the existence of many and identical worlds: *"Xenophanes, a native of Colophon, the son of Dexius, holds that there are four elements of existent things, and worlds unlimited in number but not overlapping <in time>"* [27].

Melissus from Samos (5th Century BC), student of Parmenides, holds the Universe for something unique, infinite, full, motionless and homogenous. According to Diogenes Laertius: *"Melissus, the son of Ithagenes, was a native of Samos and pupil of Parmenides. In his view the universe was unlimited, unchangeable and immovable, and was one, uniform and full of matter. There was no real, but only apparent, motion"* [28].

Simplicius [29] mentions that Anaxagoras (500-428 BC) believed in the existence of an infinite number of Worlds, a view also shared, as mentioned, by Leucippus and Democritus.

Diogenes Laertius presents two epistles from Epicurus (341-270 BC) to Herodotus and Pythocles, which show the views of the philosopher on the plurality of the Worlds. The first epistle is addressed to Herodotus and deals with physics:

> *"Again, the sum of things is infinite… Moreover, the sum of things is unlimited both by reason of the multitude of the atoms and the extent of the void. Moreover, there is an infinite number of worlds, some like this world, others unlike it. For the atoms being infinite in number, as has just been proved, are borne ever further in their course. For the atoms out of which a world might arise, or by which a world might be formed, have not all been expended on one world or a finite number of worlds, whether like or unlike this one. Hence there will be nothing to hinder an infinity of worlds*" [30].

The second epistle is addressed to Pythocles and deals with astronomy or meteorology:

> *"A world is circumscribed portion of the universe which contains stars and earth and all other visible things, cut off from the infinite, and terminating [in a boundary which may be either thick or thin, a boundary whose dissolution will bring about the wreck of all within it]"* [31].

Additionally, Metrodorus of Chios, the teacher of Epicures, according to Aetius notes that: *"Is absurd a single corn to grow in a field and one world in the infinite. The fact that they are infinite in number derives form the fact that there is an infinite number of causes. If the world was finite, but the causes of its creation infinite, the worlds would also be infinite, because where are infinite causes, there are infinite results. And causes are the atoms or the elements"* [32].

Generally speaking, we can say that the notion of infinite cannot be perceived, but is a product of intellectual thinking, combined with imagination.

There are two methods of how it is possible for the notion of infinite to be formed in human consciousness:

a) Empirical: according to this, the complete understanding of the notion of finite forms the notion of infinite. In this way, there is no infinite as such, but is a dynamic process of production through the continuous increase or decrease of finite.

b) Idealistic: infinite pre-exists all creation and is a concept that must be understood as primary and complete and not as a derivative of other finite realities (the actual existing).

In modern philosophy there are many proposals concerning the infinite. Space, time and matter, among others, are considered from most philosophers and scientists to be infinite. However, there is often confusion between the absolute and the relatively infinite. The former by definition denies any introduction of limit to its content, being a primary and complete notion and an undividable unity (idealistic infinite), whereas the latter is only presented as with no definite limit (empirical infinite). The relatively infinite presents a reformation possibility of finite, but the absolute infinite is considered to be a complete and whole entity. With the absolute infinite we place ourselves outside any concept of magnitude. Thus, between the relatively and the absolute infinite, there is a qualitative rather than a quantitative philosophical distinction.

5 INFINITY IN MODERN COSMOLOGY

As astrophysicists, we consider the infinity of the Universe to be a philosophical issue. Nevertheless, modern Cosmology is also based on philosophical principles.

The modern approach of this ontological problem was first made from Albert Einstein (1879-1955), who tried to give, developing the Theory of General Relativity, a scientific answer to the problem of the infinite or definite space. Crucial to this effort was the non-Euclidean

Geometry, developed by the great German mathematician Georg Friedrich Bernhard Riemann (1826-1866). Riemann introduced the idea of the curved space, suggesting a spherical Universe (with a positive curvature), which was on the one hand finite, and on the other hand indefinite.

One of the greater problems of modern Cosmology is the question of whether the Universe is infinite. Perhaps, its infinity is a delusion. It is possible that the Universe is finite and the delusion of its infinity is created by the spatial curving of light, possibly more than once. Every time, by each curve, an icon of a galaxy may be formed, and thus the infinity of forms, just like in a room filled with mirrors.

According to the Theory of Relativity, space is a dynamic medium, which, depending on the mass distribution in it, may be curved in three different ways, based on three different geometries, the Euclidian, that of Riemann and that of Nikolai Ivanovich Lobatschewsky (1793-1856).

Because we exist inside space, it is impossible to observe the notion of its curvature, even to understand it indirectly. We are able to measure the curvature form side parameters, such as gravitation and the geometric disaffirmations of images.

Einstein, through the cosmological constant, which he added in his equations, came to the conclusion of a *static* Universe, which, though finite, was unlimited.

The famous Russian mathematician and cosmologist Aleksandr Aleksandrovich Friedman (1888-1925) worked the initial equations of Einstein and suggested a model of an expanding-and-contracting Universe, in which time and space are both finite but with no spatial limits. Friedman suggested in 1922 the existence of a non-static Universe, which initially expands slowly and then contracts, due to the forces of gravity in-between the galaxies [33].

Edwin Hubble (1889-1953), the famous American astronomer, gave in 1929 evidence for the expanding of the Universe, observing the galaxies drifting apart from one another.

Friedman's hypothesis also mentions two more models, both referring to a Universe with infinite space and infinite time.

The views of the Presocratic philosophers take their rightful place, among the modern views of Astrophysics.

Hugh Everett III, student of the professor John Archibald Wheeler at Princeton University, was one among the first who, in the 1950, applied the laws of Quantum Mechanics to Cosmology. He supposed a universal wave function and studied the influential effects between different regions of the Universe. In amazement, he discovered that the same effects could explain a procedure of producing *copies* of the Universe! These copies were the result of a group of possible results of this influence. This theory is known as the 'Explanation of the Many Worlds, of multi Worlds or branched Universe' (1957). According to this theory, the observer is not involved in the procedure of the quantum measurement, a factor considered in the probabilistic explanation of the Ψ wave-function of Copenhagen. The theoretical analysis of the branched Universe is able to give as many independent *copies* as the possible results. M. Gell-Mann and J. B. Hartle studied the approach of H. Everett III and suggested an alternation

of his theory, the 'Decoherent Histories', under which, the Universe can evolve in many ways, each having a specific possibility. This theory indicates that our Universe has already chosen one. There is also, according to other theories, the possibility that our Universe does evolve in many ways, from which we only comprehend one.

Hugh Everett III expressed the philosophical belief that *"The Universe is continuously divided into a remarkable number of parallel realities. In such a Universe, not only does an un-definable number of worlds exist, but also in the same Universe, all the possible results of any incident co-exist". Furthermore, he suggested "a Universe that is constantly divided into a huge number of branches (worlds), which derive from the reactions between the millions of components. Additionally, inside this Universe, every quantum change that happens in any star, in any galaxy or in any far-off corner of the Universe, divides our world into a zillion copies of itself"* [34].

Apart from these theories, there is the view of the famous Indian astrophysicist Jayant Narlikar [35], which most of the astronomical community accepts. According to Narlikar, the Universe that we conceive, in only one, from the infinite other expanding Universes, which all together form a Hyper-Universe.

Taking that into consideration, we can deal with the whole process of creation, as a liquid with bubbles, each bubble representing one of the many independent Universes. It seems that the ideas of the ancient Greek philosophers, are expressed with physical terms and confirmed. As the Russian physicist Andrei Linde, teaching since 1990 Physics and Cosmology at the University of Stanford, describes it ([36], [37], [38]), if we picture the Universe as a homogenous bubble, the creation of every new perturbation inside this bubble, causes a new bubble in the Universe. This is the image of a 'self-creative and expanding Universe', which unfolds in a way, which mathematicians call 'fractals'. A fractal print has the quality of auto-similarity, meaning that each and every small piece of the print is an identical copy of the whole design.

The space-bubbles are primary confined within undefined limits; these limits expand and unfold, with a speed relevant to that of light. As argued, the theory of Big Bang describes only the formation of a single bubble, and not the fractal Hyper-Universe of bubbles. Each bubble has its own physical laws and consequently different mathematical structures. As cited in [38], the astronomer Martin Clatton Brock says:

"By definition, the word Universe includes everything. Consequently, is rather preferable to speak about numerable worlds, imagining that the Universe is divided in many of these. We know only one of them. There are open and closed worlds. There are partial structural and there are chaotic. In some of them, life may never rise. Is some others, life does exist, but only in an elementary form. Lastly, in very few, there is abundance of life" [39].

6 CONCLUSIONS

The problem of the vastness of the Universe is basically a philosophical one. Having the apeiron (the boundless) related to the *Chaos* of Hesiod or to the *infinite worlds* of Epicurus and the atomic philosophers, we realize that these problems are.

The cosmological idea of time-space, as presented through the General Theory of Relativity, is related to the Theory of the Big Bang, a theory that is also the starting point of the three models of A. A. Friedman: the zero, positive and negative curvature.

According to this theory, the Universe was created 15-20 billion years ago, from a big explosion, from a point with infinite (theoretically) density and temperature, and which caused an infinite curvature in time-space. This point has a mathematical peculiarity by which the known physical laws do not apply. As a result, astrophysicists turned to the Quantum Theory of Gravitation, which as we believe, may overcome the difficulties in physically conceiving the subject. Could they also overcome the inconceivable notion of the infinite?

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