

# The cosmology of Democritus

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**Abstract.** Cosmological views of Democritus have been analyzed.

**Key words:** Democritus, Cosmology, Atomic Theory, Inflation Theory

## Космологията на Демокрит

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Анализиран е космологичният светоглед на Демокрит.

## 1 Introduction

Democritus is one of the most famous natural philosophers of ancient Greece – especially for his theory on the atoms. Information about Democritus is supplied by the doxographer Diogenes Laertius (3rd century A.D.), who reports:

*Democritus was the son of Hegesistratus, though some say of Athenocritus, and others again of Damasippus. He was a native of Abdera or, according to some, of Miletus. He was a pupil of certain Magians and Chaldaeans. . . Afterwards he met Leucippus and, according to some, Anaxagoras, being forty years younger than the latter. . . As Apollodorus writes in his “Chronika”, he should have been born during the eightieth Olympiad (460-457 B.C.), while according to Thrasylos in his work with the title “The ones before reading the books by Democritus”; he was born in the third year of the seventy-seventh Olympiad (470-469 B.C.) being (as he says) one year younger than Socrates. . . According to Demetrius in his book Men of the Same Name and Antisthenes in his Successions of Philosophers, he travelled into Egypt to learn geometry from the priests, and he also went into Persia to visit the Chaldaeans as well as to the Red Sea. Some say that he was associated with the Gymnosophists in India and went to Aethiopia. (Diogenes Laertius, 1925: 443-445).*

Also the geographer Strabo writes:

*And if one must believe Poseidonius, the ancient dogma about atoms originated with Mochus, a Sidonian, born before the Trojan times. (Strabo, 1967: 271).*

Additionally Sextus Empiricus reports:

*And Democritus and Epicurus, atoms, unless one should regard this opinion as more ancient and –as the Stoic Poseidonius asserted– derived from a certain Phoenician called Mochus. (Sextus Empiricus, 1968: 175).*

Finally Diogenes Laertius writes that:

*There are some who say that the study of philosophy had its beginning among the barbarians. They urge that the Persians have had their Magi, the Babylonians or Assyrians their Chaldaeans, and the Indians their Gymnosophists. . . Also they say that Mochus was a Phoenician, Zamolxis a Thracian, and Atlas a Libyan. (Diogenes Laertius, 1925: 3).*

From the above ancient Greek texts we can conclude that Democritus had received a variety of studies. Thus, his philosophy –including the part of natural philosophy– was influenced with the beliefs of the places he had visited.

## 2 Some interesting views

Democritean view about ‘time’ may be seen from the following citation of Sextus Empiricus:

*It seems, too, that there is ascribed to the physicists Epicurus and Democritus a conception of time such as this – Time is a day-like and a night-like phantasm. (Sextus Empiricus, 1968: 301).*

It is interesting that the time as perceived by Democritus and ordinary people is what we call today ‘Newtonian time’, measured with our clocks and calendars, constitutes only the projection of the Riemannian relativistic dimension ‘time’ inside and over an Euclidean space or a Minkowski space, i.e. a ghost of what is time in reality. As Albert Einstein writes:

*For us, the sworn in physicists, the distinction between past, presence and future is only an illusion, even if it is so persistent. [A letter of A. Einstein to the family of his dead friend Michel Besso on March 21<sup>st</sup> 1955 – as cited in *Le Temps* by Étienne Klein (1995: 38)].*

Another interesting question considered by Democritus, was the problem of the structure of our Galaxy. Democritus, according to Achilles Tatius (4th century A.D.), believed that:

*Others say that the Galaxy consists of very small and dense stars, that to us appear united due to the large distance from heaven to Earth, as an object powdered with many grains of salt. (Achilles Tatius, 1898: 55).*

Intuitively he assumed that the nature of the Milky Way is similar to the observational fact obtained by Galileo Galilei 1610 A.D., when, turning his small telescope towards it, he realized –as he reports in his book *Nuncius Sidereus* (1610)–, that:

*Est enim GALAXIA nihil aliud, quam innumerarum Stellarum coacervatim consitarum congeries (in latin) or La GALASSIA infatti non e altro che un ammasso di innumerabili stele disseminate a mucchi (in italian in Avviso astronomico, 1610), that is in English translation: In fact the Galaxy consists of a mass of innumerable stars, being placed one close to the other by swarms.*

Democritus also tried to understand the way our senses work. According to the doxographer Aetius (1879: IV 8, 10.A.), as it is translated in Kirk's et al. book:

*Leucippus, Democritus and Epicurus say that the perception and thought arise when images enter from outside, neither occurs to anybody without an image impinging.* (Kirk G.S. et al., 1983: 428).

As we realize from the above passage, Democritus considers that the senses are just the result being caused when 'images', radiations as we could say today, of external origin (from the field of the real world of thinking) stimulate the organs of our senses. The result of these stimuli (the senses) does not, according to Democritus, consist an objective reality. As has already been mentioned, Charles Muses and Arthur M. Young in their book *Consciousness and Reality: The Human Pivot Point* state:

*All the objects we can observe are three-dimensional images formed by waves stationary or moving under the influence of electromagnetic and nuclear processes. All the objects of the world are three-dimensional images formed electromagnetically, images of a super hologram, if you wish.* (Muses, C. and Young, M.A., 1972: 33).

In addition, we note the views of Democritus on the equality of action and reaction. As Aristotle states:

*Democritus, however, in disagreement with all other philosophers, held a view peculiar to himself. For he says that action and reaction are the same and alike, for (he declares) it is not possible for things which are 'other' and different to be affected by one another, but even if two things which are 'other' do act in any way upon one another, this occurs to them not in as much as they are 'other', but because some identical property belongs to them both.* (Aristotle, 1965: 229).

The definition of action – reaction is: "For two interactive bodies, the force from the first one is equal with the opposite of the force from the other" (Alonso / Fimm, 1980: 180).

### 3 The terminology in the texts of Democritus

The most important thing, when we want to analyze the views which are mentioned at the ancient texts from the modern point of view, is to study in detail the meaning of the terms that appears. Simplicius (*Phys.* 28, 4. A) according to Kirk et al. (1983), reports that:

*He posited (Leucippus) innumerable elements in perpetual motion –namely the atoms– and held that the number of their shapes was infinite, on the ground that there was no reason why any atom should be of one shape rather than another, for he observed too that coming-into-being and change are incessant in the world. Further he held that not being exists as well as being, and the two are equally the causes of thing coming-into-being. The nature of atoms he supposed to compact and full, that, he said, was being, and it moved in the void, which he called not being and held to exist no less than being. In the same way his associate Democritus of Abdera posited as principles the full and the void (Kirk G.S. et al., 1983: 416).*

Or in another translation

*Leucippus... posited the atoms as unlimited and ever moving elements and an unlimited multitude of shapes among them on the grounds that they are no more like this than like that since he observed that coming to be and change are unceasing in things that are. Further, he posited that what is, is no more than what is not, and both are equally causes of what comes to be. For supposing the substance of atoms to be compact and full, he said it is 'being' and that it moves in the void, which he called 'not being' and which he declares is not less than what is. His associate Democritus of Abdera likewise posited the full and the void as principles, of which he calls the former 'being' and the latter 'not being' (Simpl. Commentary on Aristotle's Physics 28. 4).*

Most probably, as the previous thesis evidences, Democritus had moreover understood that the field where our senses operate is but a subjective arbitrary division our senses create out of the space of not-being ( $\mu\eta\ \omicron\nu = \text{mi on}$ ), in order to perceive as sensed beings some interpretations (projections) of the properties of the not-beings. This view is supported by the fact that Democritus believed, as we will see, that one (out of many) sensed world is created when in the total 'void' space of the Universe ( $\mu\eta\ \omicron\nu = \text{mi on}$ ), is formed a partial 'great void' (a section of a more general space of the Universe), within which many bodies concentrate (Diogenes Laertius, 1925: 441-443).

Also Simplicius, according to Kirk et al. (1983), reports that:

*Democritus... calls space by these names –the void, nothing, and the infinite– while each individual atom he calls –thing [nothing without not], the compact, and being (Aristotle on Democritus, quoted by Simplicius 294, 33, Kirk et al., 1983: 414).*

It appears that Democritus describes the ‘*τοπος* = *topos*’, i.e. what we call today ‘mathematical space’, using the words void (*κενον* = *kenon*), nothing (*ουδεν* = *ouden*) or infinite (*απειρον* = *apeiron*). The void for him coincides with the notion of not being. The not being according to Democritus (quotation 2) has an existence in no way inferior to that of the sensed being, since it also possesses a nature and substance of its own.

Similarly he calls the being, full (*πληρης*), identifying it with the notion of atoms, thus calling the being, compact (*ναστων* = *naston*) and not (*δεν* = *den*). The Greek word ‘*δεν* = *den*’ means, in exact English translation, ‘not’. These words, if used alone, have no meaning both in Greek and English. They simply declare the denial of the fact that follows.

As a conclusion, Democritus was supporting that only the atoms and the void are true, the *being* and the *not being*, and these cannot be understood with our senses. Everything else, everything we can see, hear or touch, is a very small piece of the real world –creation of our senses– composed by these “*first elements*”.

According to Aetius:

*Others say that the sensed are physical, but Leucippus and Democritus that we think them as such, from our personal opinion and our impressions. Nothing is true or perceivable, except from the first elements, the atoms and the void. For only these exist physically, and all the rest happen from differences in position, in class and in shape* (Aetius, 1879: IV 9, 8).

Or another passage with the same meaning:

*Leucippus and his associate Democritus declare the full and the empty [void] to be the elements, calling the former ‘what is’ and the other ‘what is not’. Of these the one, ‘what is’ is full and solid, the other, ‘what is not’, is empty [void] and rare. (This is why they say that what is, is no more than what is not, because the ‘void’ is no less than the body is). These are the material causes of existing things* (Aristotle, 1956: 31).

According to the famous physicist and astronomer John Archibald Wheeler: The notions of time and space do not represent the nature of reality, but the images of the human cognition (1968: 243).

This view is in agreement with the thoughts of the ancient Hindu philosophers (it has already been reported that Democritus had traveled to India and studied there), as the former Greek ambassador in India and writer D.C. Velissaropoulos reports in his book *The History of Indian Philosophy*. In this book writes that for this topic they believed that:

*The feeling of the existence of separate and specific tangible objects, instead of the realization of the real continuous flow, is the result of imaginary and arbitrary divisions of the continuous and permanent flow of becoming* (1975: 283).

In the text of Democritean cosmology that follows, some words appear with a specific meaning, which we must make clear. In the texts of the Loeb’s

Classical Library there is the phrase ‘*vast empty space*’ but the exact translation of the phrase that Democritus uses is ‘*great void = megala kena = μεγαλα κενα*’ (Democritus is not referring to the space which is empty of matter). Also, the phrase ‘*light ones*’ is been used but the exact translation is ‘*thin*’ (not by the ordinary meaning). This word describes a variety of bodies similar to each other. We point out that the Greek word for thin is also ‘*lepton*’ (λεπτον = lepton).

#### 4 The cosmology of Democritus

In further we will analyze and comment the cosmological views of Democritus and earlier of Leucippus. Let us see what Diogenes Laertius writes about the views of Leucippus, which had been also accepted by Democritus:

*[Leucippus believed that] the worlds are formed when atoms fall into the void and are antangled with one another, and from their motion as they increase in bulk arises the substance of the stars. . . This is how the worlds are formed. In a given section many atoms of all manner of shapes are carried from the unlimited into the vast empty space (great void). These collect together and form a single vortex (whirl), in which they jostle against each other and, circling around in every possible way, separate off, by like atoms joining like. And the atoms being so numerous that thy can no longer revolve in equilibrium, the light ones pass into the empty space (great void) outside, as if they were being winnowed, the remainder keep together and, becoming entangled, go in their circuit together, and form a primary spherical system. This parts off like shell (a thin material membrane is detached), enclosing within it atoms of all kinds, and, as these are whirled round by virtue of the resistance of the centre, the enclosing shell becomes thinner, the adjacent atoms continually combining when they touch the vortex (whirl). And again, even the outer shell grows larger by the influx of atoms from outside, and, as it is carried round in the vortex (whirl), adds to it self-whatever atoms it touches. And of these some portions are locked together and form a mass, at first damp and miry, but, when they have dried and revolve with the universal vortex (whirl), they afterwards take fire and form the substances of the stars (Diogenes Laertius, 1925: 441-443).*

The above text is the exact translation from the Loeb Classical Library translation in which an important matter appears. We have used translations from both Loeb Classical Library and G.S. Kirk et al. (1983) book and it seems that they use different words to describe the very same thing. Anyway, in order to avoid the possibility someone to misunderstand the meanings of Democritus, we must make clear that the void (in this case the great void) is not the empty space but a substance as real as the atoms and more full than the materials. As a result, we found out more suitable the (word) ‘void’, and not ‘empty space’, which we will use from now on. Similarly we use the word ‘whirl’ instead of ‘vortex’.

With this quotation as a basis, the main steps of the cosmic creation, according to Leucippus and Democritus were the following:

#### 4.1 In the beginning there was the full and the void

Prior to the events described in the previous quotation, as already has been mentioned, initially there was the total creation (not being = void = infinity), inside which were floating the atoms (being). The system (being + not being) was beyond the perceptual capabilities of the human senses, since (as already has been mentioned) the atomic philosophers were supposing that: The full and the void, i.e. the atoms and space, are true and objective realities outside of the field of the human senses (Aetius, 1879: IV 9, 8 and Democritus, 2002: 13).

As can be seen, with the unified system [full + void] (= atoms + space) Democritus replaces a previous Greek prehistoric system, that of the Orphic Chaos and Erebus, without -of course- suggesting the identification of the respective partial components of the system.

#### 4.2 Creation of the ‘great voids’

As Diogenes Laertius reports: In a given section many atoms of all manner of shapes are carried from the unlimited into the vast empty space (great void) (Diogenes Laertius, 1925: 441).

In this phase, in the frame of the total original space of the Universe (not being = void = infinity) many partial ‘great voids’ (megala kena =  $\mu\epsilon\gamma\alpha\lambda\alpha \ \kappa\epsilon\nu\alpha$ ), i.e. smaller sub-spaces of the total space, are created.

It is an interesting fact that Democritus seems to be especially intrigued about the ‘cause’ (the great voids) that, as we shall see, forced the atoms to accumulate into small regions, and not about the cause that created the great voids themselves. For this reason he fashions the notion of the partial voids-spaces as the cause for the subsequent accumulation of the atoms, but without explaining the physical process of their formation.

#### 4.3 Local collapse of ‘atoms’ in the ‘great voids’, formation of the ‘whirl’

As Diogenes Laertius reports: *In a given section many atoms of all manner of shapes are carried from the unlimited into the vast empty space (great void). These collect together and form a single vortex (whirl), in which they jostle against each other.* (Diogenes Laertius, 1925: 441).

In this phase, non-perceivable parts of the being (atoms), originated from the total non-perceivable creation of the Universe (infinity + atoms = void + full = not being + being), tend to occupy the created ‘great voids’, generating for each one of them a corresponding ‘whirl’ ( $\delta\iota\nu\eta$ =dini). With the entry of atoms inside the sub-spaces of the ‘great voids’ are created the perceivable through the senses ‘worlds’, perhaps infinite in number and contained in the total non-perceivable set ‘being + not being’ (atoms + void = Universe).

Also in the case of Democritean Cosmology the material is being led from the funnel of the whirl to the edge of the cord, since, as we shall see the final result of the whirl is a sphere of limited dimensions. At this point it should be emphasized that Democritus and the other presocratic philosophers knew

very well, as we shall see, the natural phenomenon of the whirl. This leads to the conclusion that by the term Democritus refers to the specific and known phenomenon of the whirl. Let be noted that in a common natural whirl in general we can distinguish two regions, the funnel and its narrower and tighter ending, similar to a twisted cord.

All the previous thoughts, as in the Cosmology of Alcman (Danezis et al., 1999: 125-130), lead us to the conclusion that, if we want to describe using modern scientific terminology the views of Leucippus and Democritus in respect to what existed before the perceivable Universe was created and to how we were led to the starting point of the cosmic creation, a convenient possibility might be the creation of the Universe through a white hole. The difference between the cosmological system of Alcman and the one of Leucippus / Democritus is that the atomic philosophers, being experts on the scientific knowledge of their time, expose in greater detail their views attaching to them a series of scientific (for their era) explanations. The notion of whirl in particular renders the cord of Alcman easier to understand, while the spherical condensation of 'not thin' materials makes more concrete the notion of the Alcmanian  $\tau\epsilon\kappa\mu\omega\rho = \text{tekmor}$ .

The coincidence of the views of Leucippus and Democritus about the creation of the Universe with those of Alcman leads to questions, such as whether the atomic philosophers knew the Alcmanian Cosmology and, moreover, whether their views consist the lost or destroyed continuation of the text of Alcman, where he continued the exposition of his cosmological proposal.

In the context of Democritean Cosmology appears, with a physical etiology (explanation), the idea of the existence of many perceivable worlds like ours within the frames of the created 'great voids'. The idea of the existence of many 'worlds' inside successive 'heavens' consists an older presocratic view. But the complete physical explanation and description of a Universe including an infinite number of perceivable worlds was given by the atomic philosophers and in particular Democritus.

Hippolytus, according to Kirk et al. (1983), refers that:

*Democritus holds the same view as Leucippus about the elements, full and void. . . he spoke as if the things that are were in constant motion in the void, and there are innumerable worlds, which differ in size. In some worlds there is no sun and moon, in others they are larger than in our world, and in others more numerous. The intervals between the worlds are unequal, in some parts there are more worlds, in others fewer, some are increasing, some at their height, some decreasing, in some parts they are arising, in others failing. They are destroyed by collision one with another. There are some worlds devoid of living creatures or plants or any moisture* (Hippolytus, 1857-1866: I, 13, 2, Kirk G.S. et al. 1983: 418).

In this passage, as in several previous ones, one can clearly discern the view that the natural laws can be different in the various worlds and hence totally different events can be generated.

But let us see what the modern cosmological theories have to say about the existence of many worlds. According to the inflation cosmological proposal of A. Guth and A. Linde, in the original non-Euclidean, hence non-perceivable, Universe there was two known scalar fields: The 'inflation field'

and the ‘Higgs field’. The inflation field and the associated phenomena are the reason for the expansion of space (void, not being), while the Higgs field is responsible for the kind of natural laws establishing themselves inside the expanding space. These two fields, as it has been proved, exist everywhere in the Universe, and their presence is betrayed from their influence on the elementary particles.

However, the scalar fields are not constant and, as proved by quantum physics, undergo unexpected fluctuations and variations. If the fluctuations cause a large increase in the intensity of the inflation field, then in this region the Universe begins to expand much faster, creating a bubble (generation of a great void). This effect can be produced continuously in different regions of the original non-perceivable Universe (creation of an infinite number of great voids). This implies that if we conceive the Universe as a homogeneous bubble, every new perturbation in it will create a new bubble of the universe (great void). In this way Andrei Linde (1989, 1990, 1994) and Alan Guth (1984, 1988, 1989, 1998) answered the question that Leucippus and Democritus could not answer: How the great voids are created.

As mentioned by the astronomer Martin Clatton Brok as cited by M. Talbot:

*By its own definition the word Universe includes everything. Therefore it is preferable to speak about many worlds, imagining that the Universe branches out to an infinite number of these. We know of only one such world. There are open and closed worlds. There are some fully structured and some chaotic. In some of them life never appears. In some others it exists, but in an elementary form. Finally, in a very few worlds life thrives (Talbot, M., 1993: 39).*

The bubble spaces are initially limited by irregular limits that continually smooth down, and tend to expand with velocities approaching the speed of light. Later on, the limits of the bubbles can possibly shrink with much lower velocities. On this basis, the Big Bang theory describes the creation of just one bubble, inside which we find ourselves, and not of the total Universe of the infinite bubbles.

It should be noted that, if in the original non-perceivable Universe there were a set of specific natural laws, the Higgs field would have changed it in the produced bubbles (great voids). This means that every bubble (great void) will eventually have its own set of natural laws.

It should be mentioned that Linde’s model is an elaboration of the inflation theory, which predicts the existence of a Universe with many bubbles in space-time, perhaps ruled by different natural laws.

In 1982 American physicists Andreas Albrecht and Paul J. Steinhardt (1982: 1220) announced similar results. It is interesting to note that the views of the Universe that Leucippus and Democritus pioneered have an advantage that are somewhat compatible with the cosmological views of contemporary science.

#### 4.4 Formation of spherical system of perceivable matter with simultaneous ejection of material in the external void

According to Diogenes Laertius:

*And the atoms being so numerous that they can no longer revolve in equilibrium, the light ones pass into the empty space (great void) outside, as if they were being winnowed, the remainder keep together and, becoming entangled, go in their circuit together, and form a primary spherical system (Diogenes Laertius, 1925: 441).*

Due to the rotating ‘whirl’, there is first a separation of the ‘similar’ from the ‘dissimilar’. Next the rotation ceases and a system is created consisting of ‘thin bodies’ ‘leptons’ (not small in dimensions, nor atoms) that advance towards the external void (space) as if being hurled, while the rest, the ‘non-thin’ (thick = hadra), remain united and becoming entangled approach each other and form initially a spherical system. We must emphasize that the Greek word for thin is ‘lepton = λεπτον’ as the word leptons that describes a certain category of particles and the word for not thin, ‘hadron = αδρον’ as the word hadrons.

It is interesting to note that the new term ‘thin bodies’ is used in order to set these bodies apart from all the others that have already been mentioned.

The hurling and the expansion of the ‘thin’ material according to Leucippus and Democritus is not a result of the explosion of the spherical system formed by the ‘non-thin’ materials, but instead they occur together with the creation of the spherical condensation, as a result of events taking place at the edge of the ‘whirl’, since there the ‘similar’ have separated from the ‘dissimilar’ and equilibrated, and the bodies cannot rotate anymore.

Consequently, Leucippus and Democritus support that from a mixture of ‘thin’ and ‘non-thin’ bodies (leptons + hadrons) that is in equilibrium and does not rotate, the hurling of the thin ones towards the exterior creates an opposite motion, a contraction, of the ‘non-thin’ ones, that tend to form a small but dense spherical structure of matter.

As it is evident from the respective quotation, at the end of the whirl, where it meets the great void, there is a limited in space, momentarily non-rotating and in equilibrium, spherical condensation of ‘non-thin’ (not small in dimensions or atoms) material. The sphere occupies a very small space of the ‘great void’, because how else could be the described ‘thin’ material hurled into the external space if the initial sphere occupied this space? It is interesting that at the limits of the whirl, towards the region of the ‘great void’, and before the formation of the spherical condensation, the material of the non-perceivable Universe (space + atoms) consists of an ‘exotic’ for our senses ‘matter’, indescribable by the atomic philosophers, that later on it separates into two constituents, the ‘thin’ and the ‘non-thin’ (thick = hadra), which in a later phase were to form the ‘matter’ that is known today to our senses, according to the atomic philosophers.

#### 4.5 Formation of a thin membrane onset of a rotational motion of the universe

According to Diogenes Laertius:

*This parts off like shell (thin membrane), enclosing within it atoms of all kinds, and, as these are whirled round by virtue of the resistance of the centre, the enclosing shell becomes thinner, the adjacent atoms continually combining when they touch the vortex (whirl). And again, even the outer shell grows larger by the influx of atoms from outside, and, as it is carried round in the vortex (whirl), adds to it self what ever atoms it touches.* (Diogenes Laertius, 1925: 441-443).

At this stage, from the central spherical condensation of ‘non-thin’ (hadrons) material detaches a membrane, i.e. a thin shell of ‘non-thin’ matter. This membrane starts rotating, while material from it is carried towards the central spherical condensation ‘due to the whirl’. But which whirl? The original ‘whirl’ was carrying material from the non-perceivable Universe of the ‘being’ + ‘not being’ to the world of the ‘great void’, that is the spherical accumulation of ‘non-thin’ material we mentioned. On the contrary, the whirl referred here leads from the ‘world’ of the ‘great void’ to the original spherical accumulation of ‘non-thin’. This means that the whirl mentioned here is of opposite direction in respect to the first. In other words, the atomic philosophers propose a cosmological system of two whirls of opposite polarity [(+) and (-)]. The first evolves outside the world of the ‘great void’ and the second inside. But both lead to a common region, which forms the beginning and the end of the world of the ‘great void’.

### 5 Conclusions

If we summarize the views of Leucippus and Democritus about the structuring of the Universe using the corresponding modern scientific terminology, we can generally discern two periods:

1. The process before the creation of the spherical condensation and of the great voids, when the Universe [being + not being = void + atoms] consisted a non-perceivable entity (logos), a situation that Hesiod describes as Chaos and Erebus: ‘From Chaos came forth Erebus and black Night’ (*Theogony*, 1914: 123).

2. The process after the creation of the great voids and of the spherical condensation, which is interesting to analyze by phases:

- a. Originally there is an initial spheroidal condensation in a small space of a very large quantity of ‘thin’ and ‘non-thin’ material. The violent hurling of the “thin” material forces as a reaction the “non-thin” material to contract and to rotate violently.

- b. The violent contraction of a very large mass of material creates internal energetic processes that generate and propagate outwards a shock wave, resulting to the ejection through an explosion of a large quantity of matter from the surface of the spherical condensation, i.e. of a material membrane

that starts to rotate rapidly. It is interesting to note the similarities of these processes with the processes when a star reaches the evolutionary phase of a nova or of a supernova. The violent ejection of material from the surface during this stellar phase, forces its central regions to contract violently, a process that leads the star to become, according to its mass, a white dwarf, a neutron star, or a black hole.

c. After the ejection of the membrane's material, the remaining spherical condensation, which should be enormous (the entire mass of the local Universe), continues to contract as a reaction, which has similarities with the creation of a black hole in modern science. The material of the membrane of the surface layers that had been ejected revolves now around some kind of modern black hole as some kind of modern accretion disk, being led towards the singularity of the black hole, using modern terms.

This discussion leads to the conclusion that, back in the 5th century B.C., Leucippus and Democritus had formulated a very pioneering view about the creation and evolution of the Universe, which involves many, intuitively developed, ideas which are not incompatible with modern science.

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