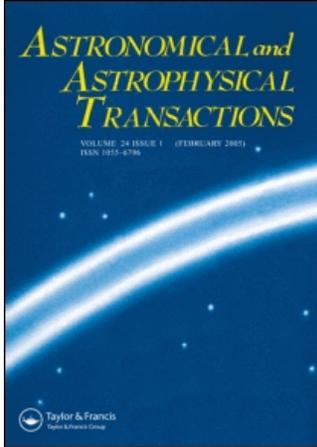


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THE DIFFERENT MEANINGS OF THE TERM 'OURANOS' AND THE IMPORTANCE OF AETHER IN ARISTOTLE'S WORKS *ON THE HEAVENS* AND *ON THE COSMOS*

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Aristotle in his work *On the Heavens* gives the three meanings of the term 'ouranos'. According to the great philosopher, ouranos is, firstly, the outer sphere in his geocentric model, secondly, the body that occupies the next place to the outermost circumference of the world and thirdly, the Universe as a whole.

The whole of the heavens, the whole cosmos, is spherical and moves continuously, and Aristotle (*On the Cosmos* B, 391b, p. 10) uses the term cosmos as a synonym for ouranos. This sense is quite common from Plato onwards.

Additionally, we describe the meaning of the term 'aether', since 'aether', the fifth element (quintessence), is very important now in cosmological research.

Keywords: Aristotle; Ouranos; Aether; Quintessence; Cosmology

1 THE DIFFERENT MEANINGS OF THE TERM OURANOS

Aristotle's astronomical and cosmological beliefs are cited in his work *On the Heavens*, Books A and B: beliefs about the form and the shape of the Universe, the movement of the fixed stars and of the planets, as well as their components. Of interest are the three different meanings of the term 'ouranos' (=sky or heavens) and the definition of the fifth element (aether).

Indeed, as stated *On the Heavens*, specifically in Book A, the great philosopher gives all three meanings of the notion 'ouranos' as well as the definition of the term aether. It reads (Aristotle, (1939) *On the Heavens*, Book A, Chapter IX, 278b, pp. 10–25):

'Let us first establish what we mean by ouranos and in how many senses the word is used, in order that we may more clearly understand the object of our questions.'

- (1) In one sense, we apply the word ouranos to the substance of the outermost circumference of the world, or to the natural body which is at the outermost circumference of the world; for it is customary to give the name of the ouranos especially to the outermost and uppermost region, in which also we believe all divinity to have its seat.

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- (2) Secondly we apply it to that body which occupies the next place to the outermost circumference of the world, in which are the moon and the sun and certain of the stars (*i.e.* the planets. The fixed stars are in ouranos no. 1); for these, we say, are in the ouranos.
- (3) We apply the word in yet another sense to the body which is enclosed by the outermost circumference; for it is customary to give the name of ouranos to the world as a whole.

The word then is used in these three senses, and the whole which is enclosed by the outermost circumference must of necessity be composed of the whole sum of natural perceptible body, for the reason that there is not, nor ever could be, any body outside the heaven.'

Ouranos is the word, which so far in Chapter IX of the book *On the Heavens* has been translated as 'world'. Elsewhere in the treatise it is rendered as 'world', 'heavens' or 'sky' according to that meaning of the three enumerated here that Aristotle is employing at any particular moment. In this passage a repetition of the Greek is unavoidable, since no one English word covers all the three senses which ouranos here are stated to possess.

It is clear that in the above passage (Chapter IX, 278b, pp. 10–25), according to Aristotle, 'ouranos' is firstly the outer sphere in his geocentric model of the Universe, obtaining space and including the fixed stars.

In his pseudoepigraphal work *On the Cosmos* the word ouranos, derives from the Greek words 'orion' (=boundary, limit) and 'ano' (=up, above, upper) (Aristotle (1955) *De Mundo*, (*On the Cosmos*) B, 391b, pp. 10–20)

'The centre of the cosmos, which is unmoved and fixed, is occupied by "life-bearing earth", the home and the mother of living beings of all kinds. The region above it, a single whole with a finite upper limit every where, the dwelling of the gods, is called ouranos. It is full of divine bodies which we call stars; it moves eternally and revolves in solemn choral dance with all stars in the same circular orbit unceasingly for all time.'

However, the area between the outer sphere and the Moon, which consists of homocentric spheres, which in their turn yield the planets, is also called 'ouranos'. These spheres could be, in one aspect, characterized as the planets' *spheres of influence*, as they are centred with respect to the orbital centre of the planets.

In addition, the Universe as a whole is named 'ouranos', that is anything enclosed by the outer sphere, including Earth.

2 AETHER, THE QUINTESSENCE

Therefore, according to the geocentric cosmological beliefs of Aristotle, the Universe is spherical with the Earth at its centre and it is enclosed within the sphere of the fixed stars. Between these two regions, there are consequent spherical layers, each having a different kind of 'body', that is consistence. Moving from the perimeter towards the centre we find bodies with a smaller degree of 'divinity', 'duration' and 'form', properties which give 'value' to a substance. The outer sphere and the included stars do not consist of 'pyr' (=fire) nor of any other of the rest of the elements, namely earth (dirt), water and air, but of a fifth element, the first body (the quintessence), which is called aether.

According to Aristotle ((1939) *On the Heavens*, Book A, Chapter III, 270b, pp. 22–25):

(They) gave the name aether to the uppermost region, choosing its title from the fact that it 'runs always' (aei thein) eternally. (Anaxagoras badly misapplies) the word when he uses aether for fire. (*i.e.* Anaxagoras derived the word from aithein. In a modern work this criticism would probably stand in a footnote. The derivation from aei and thein occurs in Plato's *Cratylus*, 410, B).

Aristotle ((1955) *De Mundo (On the Cosmos)* B, 392a, pp. 5–10) writes:

'The substance of the heaven and the stars we call aether, not as some think, because it is fiery in nature and so burns (they fall into error about its function, which is quite different from that of fire), but because it always moves in its circular orbit; it is an element different from the four elements (*i.e.* earth, air, fire and water), pure and divine'.

The author follows Aristotle in making aether a fifth element; the Stoics identified it with fire. He rejects the derivation of the world from the Greek verb 'aesthēsthai' (to burn) and relates it to 'aei thein' (move always) as Plato ((1926) *Cratylus*, 410 B) and Aristotle ((1939) *On the Heavens*, Book A, 270b, p. 22).

According to Simplicius ((1882–1895) *On the Heavens (On De Caelo)*, 119, p. 2):

'He criticizes Anaxagoras arguing that he does not etymologize correctly the name of aether deriving it from aithein which means 'to burn' and for that reason he uses that for fire'.

Literally for Anaxagoras, aether is the mass separated from the initial mixture, owing to the motion which 'The Mind' gave; it includes the thin, the dry, the hot and the shining and thus is pushed towards the perimeter of the spinning world.

Aether, which should be spelled aitheair, derives from a Greek sentence: 'aei thei peri ton aera reon', which means 'it always runs and flows about the air'.

According to Plato ((1926) *Cratylus*, 410B):

'The word aether I understand in this way; because it always runs and flows about the air, it may properly be called aitheair'.

Also Aristotle ((1951) *Meteorologica*, Book A, Chapter III, 119 b, pp. 23–30) writes:

'For what is called aether was given this name in antiquity. Anaxagoras seems to think that the name means the same as fire, since he considered that the upper regions are full of fire and that the ancients meant by 'aether' the substance, which fills them. In the latter belief he was right. For men seem to have supposed that the body that was in eternal motion was also in some way divine in nature, and decided to call a body of this kind aether (*i.e.* As if aether were derived from aei and thein, with a play on theios (divine) as well. For this etymology cf. Plato *Cratylus*, 410B [Aristotle, *De Mundo (On the Cosmos)* B, 392 a5], as it is different from all terrestrial things. For we maintain that the same opinions recur in rotation among men, not once or twice or occasionally, but infinitely often. For the doctrine of a recurrent cycle of knowledge cf. *De Caelo* A 3, 270b, 16, *Met.* L8, 1074b 1–14, *Politics* vii. 9, 1329b, 25).'

It is obvious that Anaxagoras etymologized aether from 'aithein' meaning to light up, to burn.

It is clear that, while the Greek philosophers from Ionia (Asia Minor) consider only four elements or four substances (*i.e.* earth, water, fire and air), Aristotle himself adds aether. Aether will then be the fifth element, namely the quintessence. According to Aristotle, as previously argued, this element shows particular properties, as it is unborn, ageless, imperishable, unchangeable and unable to grow or to deteriorate. Furthermore, it is found in the upper layers of the sky (the uppermost place) where the divine dwells (*i.e.* if we accept, as Aristotle argues, that the divine exists indeed). The later antiquity's Greek philosophers, such as Simplicius, but also the Byzantine and the Western scholars interpreted, altered and enriched Aristotle's theory.

The final outcome of this procedure was that the fifth substance, the *quinta essentia* of the Latins, came to mean the basic substance of each being, the core round which its whole existence evolves.

3 AETHER IN PHYSICS AND COSMOLOGY

In nineteenth-century physics, aether was a hypothetical substance, believed to be filling space (not only void but matter as well) and which was considered as the mean of the electromagnetic waves propagation (*i.e.* light and X-rays), (something equivalent to the elastic mean of acoustic wave propagation).

Leonard Euler considered aether ‘to be for light what the air for sound’.

Aether’s history is actually the history of the domination of the wave theory of light and the rejection of the equivalent particle theory.

Conclusively, it is very important that, as we speak about the fifth element, there is in fact a major problem concerning the cosmological constant. As Leibundgut and Sollerman argue (2001):

‘There is a big problem with the cosmological constant. In modern particle theories it is associated with the energy of the vacuum, but these theories also predict a value for the vacuum energy which derives by more 50 orders of magnitude from the cosmological observations. Although this has been a problem all along for supernova measurements have exacerbated this problem, by requiring a non-zero but small (<1) cosmological constant. For these reasons many theorists currently favour quintessence models. But this requires introducing a new particle field and corresponding potentials, which have to be fine-tuned to have an action like the observed one’.

Furthermore, they add the view of Ostriker and Steinhardt (2001): ‘Another candidate is the cosmological constant. With supernova result it appears that it should be re-introduced to explain the data. Another possibility is that cosmological constant is zero, but that there is a particle field that through its decay acts like a cosmological constant. It has now come to be known as the quintessence’.

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