

SCIENCE AND ARISTOTLE'S AETHER¹

Certain of the propositions of modern science seem to me to be nonsense, among them the assertion that, apart from the stars, planets, moons, asteroids and various atoms found in it, interstellar space is comprised of nothing. Science has long maintained that light waves and electromagnetic radiation do not require a medium in which to travel, yet it can offer no explanation as to how such energy is conveyed.

I asked a friend of mine qualified in science:

- Why, if space is largely comprised of nothing, does not this 'nothing' present an absolute barrier preventing sunlight, moonlight or light from the stars reaching the earth?
- How can something—light waves (or particles) or electromagnetic radiation (or planets, or asteroids, or stars, for that matter)—pass through this 'nothing'?

Anticipating the answer he gave to the latter question—"There is nothing to impede them"—I asked: Why, then, is the speed of light determinate (circa 300,000 kilometres per second)? Why is it not infinite?

The concept of ether as a medium was dismissed, he told me, early in the 20th century largely as a result of Einstein's work and following the celebrated Michelson-Morley experiment in 1887. Even in deep inter-stellar space there are millions of atoms per cubic metre. He conceded that the space between those atoms was no less puzzling than is the space between the nucleus and electron shell of every atom of every element. If this space were removed, he said, our planet would be reduced to the size of an orange. Experiments show that most of what we call 'matter' is nearly all free space. And, no, science cannot explain why the speed of light is limited.

There is a problem here which science will not face. It arises from a proposition whose truth is as self evident as that water runs downhill. It is this: *nothing does not exist*. If there is space between nucleus and electron, between the earth and the sun, between the earth and *alpha centauri*, whatever constitutes this space, it cannot be nothing. I think science could answer the questions posed here if only it were not fettered by a philosophy to which, for centuries, it has given its adherence; a philosophy which puts it in blinkers—materialism.

Materialism maintains that there is no reality in anything not material, by which it means, anything that cannot be measured physically. In the year 1500 there was hardly a materialist in the world. By the year 2000, there was hardly a thinker who was not a materialist. I have set out elsewhere the history of the development (or, as I contend, the decline) in thought which led via the systematic denial of Aristotle's doctrine of causality to the acceptance of materialism's banal imperatives.² The cause, I contend, was a religious one, the rise and flourishing of Protestantism which,

¹ This paper was first published on 25th May 2008. It was amended to address certain objections (on 20 June, 2008) and has now been further amended to refine its assertions and add further conclusions.

² Cf. *Pity the Poor Atheist*, at http://www.superflumina.org/pity_theatheist.html

despite its protestations of religion, is inchoately atheistic. Atheism cannot flourish unless philosophy is deprived of its ground in reality and Protestantism provided the catalyst for the necessary 'dumbing down' of thought. Materialism denies the influence of any cause but the *material*, reducing the other causes—*formal*, *efficient* and *final*—insofar as it concedes their influence at all, to accidents of the *material*.³

The scientific revolution is generally dated from 1543, the year of publication by Nicolaus Copernicus of his *De Revolutionibus Orbium Caelestium* and by Andreas Vesalius of his *De Humani Corporis Fabrica*. It began, thus, just as Protestantism and its atheistic tendency was taking root. When, in June 1661, the young Isaac Newton entered Trinity College Cambridge, the University followed the teachings of Aristotle in natural philosophy. Newton preferred the thought of Descartes, as he preferred the observations and inductive reasonings of astronomers Galileo, Copernicus and Kepler. He borrowed Aristotle's notion of *aether* as necessary to transmit forces between particles (among which he counted light)⁴ but, because he had rejected Aristotle's metaphysics, he misunderstood his teaching. Under the influence of Descartes' mechanistic views he treated *aether* as a greatly rarefied instance of common matter. He was to pass this misunderstanding to his successors.

In the 1860s James Clerk Maxwell established that light was a species of electromagnetic radiation and, using the data then available, he determined its speed in a vacuum at 310,740 kps. He wrote:

"The agreement of the results seems to show that light and magnetism are affections of the same substance, and that light is an electromagnetic disturbance propagated through the field according to electromagnetic laws."⁵

Science has now established that all electromagnetic radiation travels in a vacuum at a determinate speed, 299,792.458 kps, remarkably close to Maxwell's figure. As had Newton before him, Maxwell postulated the necessity of a luminiferous *aether* to carry these waves but the *aether* he assumed was, like Newton's, a greatly rarified common matter.

The experiment Albert Michelson conducted with the assistance of Edward Morley at what is now Case Western Reserve University in Cleveland, Ohio, in 1887 was designed to detect this postulated medium. They reasoned that however 'ethereal' it might be, *aether* must have mass. By means of an ingenious device Michelson invented (the 'interferometer') they took a source of white light and split it into two beams travelling at right angles to each other out to mirrors at a distance which returned the beams to a common detector. Any slight change in the amount of time the two spent in transit was detectable via the phenomenon known as *interference* where the combining of two sets of light waves slightly out of phase will manifest itself in a new (combined) wave pattern. They discovered no pattern not explicable

³ There are four causes of every effect: no more; no less. Two are intrinsic, that is, they remain in the effect, the *formal* and the *material*. Two are extrinsic, the *efficient*, and the *final*. See the earlier article for an elaboration of the respective functions of each.

⁴ Though later, under the influence of theosophy, he was to substitute for it alleged occult forces of attraction and repulsion.

⁵ In his paper *A Dynamical Theory of the Electromagnetic Field*, 1864

by experimental error. In other words, they could detect in this ethereal matter no indication of mass.⁶ If it was not detectable, how could it be said to exist?

Aristotle's Aether

In this summary of Aristotle's teaching on *aether* I have drawn on a paper by the American philosopher, Christopher A Decaen, published in *The Thomist* in 2004.⁷ Decaen uses the terminology of metaphysics which is foreign to minds trained in the simplistic categories of materialism. But the concepts of metaphysics are no less understandable than, in their disciplines, are those of the Special and General theories of Relativity and the theory of Quantum Mechanics. I have endeavoured to assist the reader with footnotes. Although St Thomas differed from Aristotle on a number of topics, on this one his mind followed that of Aristotle closely.

Decaen demonstrates why Aristotle saw the circular movement of the heavens as significative of a radical difference between the mundane and heavenly bodies.

"[T]he principal datum of nature that [Aristotle] wishes to explain with *aether* can be experienced firsthand by spending the night under the stars and watching their motion as the night hours pass. One finds himself at the center of a perfectly circular pilgrimage of stars traveling from east to west, as though each of the heavenly bodies [was] embedded on a dark orb revolving around the Earth. This nightly, and a related yearly, uniform circular motion of the stars should provoke a question: Why should this apparently natural motion occur in the sky, indeed in most of the cosmos, but not here below, where few things seem to move in circles without being coerced? This peculiarity [of circular movement] is all the more striking when one notices that these same heavenly bodies and their motions are never seen to change, much less corrupt or cease... This appearance of eternity and incorruptibility is strengthened by the astronomical records... 'For in all time gone by, according to all records handed on from one [generation] to the next, no change has ever appeared either in the whole of the containing heaven or in any proper part of it.'"

Reasoning that a void, a region not filled by a material substance, is physically impossible, Aristotle concluded that the heavens, the vast expanse between the visible heavenly bodies and the world in which we live, must be filled with an invisible material medium. Decaen again:

"Not only are the *stars and planets* made of a different kind of substance, but—given that such perfect transparency is present in something that manifests no signs of ordinary matter's downward or upward tendency, but either is perfectly yielding to the visible circular motion of the stars and planets, or moves with them—so must be the subtle matter surrounding them. Thus, Aristotle applies the name 'aether', or

⁶ The experiment has since been repeated on any number of occasions with much greater precision and the same results. Cf. article on the wikipedia website at http://en.wikipedia.org/wiki/Michelson%E2%80%93Morley_experiment

⁷ *Aristotle's Aether and Contemporary Science*. The paper was originally freely available on the internet. One must now subscribe to The Thomist's website < <http://www.thomist.org/> > to obtain access. The paper is divided into three parts: 1. *Aristotle's Celestial Substance*, where the author details Aristotle's teaching; 2. *The Fate of Aether in Classical Physics and the Special Theory of Relativity*, where he exposes the misunderstanding of Aristotle's concept by Newton and his successors; and, 3. *Contemporary Science's Resuscitation of Aether*, where he shows science's return to a sense of *aether* as essential to the theories of Relativity and of Quantum Electrodynamics.

more frequently, 'the first body', to whatever fills the volume of space between the moon and the outermost sphere of the fixed stars. It is itself 'the heaven... the continuous body in the place after the outermost circumference of the whole, in which are the moon, and the sun, and some of the stars [i.e., the planets].'"⁸

The modern scientist may mock Aristotle for relying on appearances which he can demonstrate to be illusory. But a moment's thought will show that the appearances are not so illusory after all. What is the apparent circular movement of the stars but a function of the rotation of the earth?—a circular movement. The earth rotates around its axis and it revolves—in a circle—around the sun. The other planets do the same. Earth's satellite, the Moon, also moves in a circle, around the Earth, and the moons of other planets do the same. The far galaxies demonstrate a circular pattern in the layout of their constituent stars. Why, then, should we mock Aristotle for ascribing circular movement as a property of his postulated *aether*? There is, moreover, other circular movement in the cosmos almost infinite in extent in which, as we shall see, *aether* seems intimately to be involved, that of electrons about the nucleus of every atom.

Although it is material, *aether*—the heavenly substance—does not share a common matter with other things. Matter and form in *aether* are not predicated univocally with matter and form in other material substances, but analogically.⁹ In other words *aether* does not share the physical attributes of other material things. St Thomas says that matter and form in *aether* are so perfectly united that the one exhausts completely the potency of the other. *Aether* lacks the tendency to become something else (the principle of corruption), and is as incapable of generation as corruption; incapable of growth or alteration. *Aether* is simple: it is immutable, not subject to change in substance, quantity or quality—though apparently so in respect of place.¹⁰ It has no weight or lightness. It is not susceptible to temperature or pressure. *Aether* is intangible enjoying, as Decaen remarks, the paradoxical characteristic that—

“being wholly impervious to alteration entails... [it] be perfectly pervious to something trying to press upon it.”

The scientist will doubtless contend that, since they are not verifiable experimentally, these asserted properties are nothing more than assertions. But he

⁸ Christopher A Decaen, *Aristotle's Aether and Contemporary Science*, op. cit., section 1 A.

⁹ A term (known in Logic as a predicate) may be either univocal, equivocal or analogous. A univocal term applied to two different objects signifies a character in each which is simply the same, as 'animal' when said of a dog, and of a cat. An equivocal term applied to two different objects signifies something in each which is simply unsame, as 'cricket', when said of an insect of the order *orthoptera* and when said of the game played with a ball and a bat. An analogous term applied to two different objects signifies something in each which is the same and something which is unsame, and more unsame than same. For example the predicate 'good' when said of a meat pie, and 'good' when said of a man signify two fundamentally different realities, yet with a degree of similarity which turns on the understanding of the good as that which all things appetise. In the one it signifies 'desirability on account of its pleurability to sense appetite and suitability to human nourishment'. In the other it signifies 'possessed of a character which is fitting to man'.

¹⁰ *Metaphysics* distinguishes every material thing into ten categories comprising its *substance* and nine *accidents*. *Quantity*, *quality* and *where* (place) are three of the nine. These distinctions are elaborated later in the paper.

will reach that conclusion not because he is a scientist, but because he is a materialist. If reason requires that we posit the existence of some thing, it is no answer to say that it is not detectable experimentally. Nor does it justify rejecting properties which reason may conclude the thing possesses. The ‘black holes’ and ‘curved space’ posited by Einstein’s General Theory of Relativity are not detectable experimentally. That is no reason for denying their existence if discernable effects justify no other hypothesis. It was precisely from discernable effects that Aristotle posited—and St Thomas endorsed—the existence of *aether*. There seem to be a number of positive attributes of this remarkable substance, attributes which go far to explaining issues that modern science has so far been unable to resolve.

The Properties of Aether

Transparency

The first is transparency. Aristotle regarded this as a positive nature and science seems, implicitly, to agree that transparency is not merely a privation. As Decaen says: “if darkness is the privation of light and colour, transparency cannot be.”¹¹ Both Aristotle and St Thomas understood light to be the “act of the transparent forasmuch as it is transparent”. Consistent with this, *aether* is the substance which universally is in potency to illumination. Decaen concludes to the existence of this quasi-sensible quality:

“[I]f we consider that nothing around us is perfectly transparent—one can see only so far even through air—and that the distance between the Earth and the stars is almost inconceivable, one sees that *aether* must be the most perfectly transparent substance in the cosmos.”

St Thomas suggested that all other bodies are called ‘transparent’ only by participation in the nature of *aether*, just as things are called ‘hot’ by participation in the nature of fire.¹² Aristotle has this to say:

“Neither air nor water is transparent because it is air or water. Each is transparent because there is contained in it a certain quality which is the same in both and is also found in the eternal upper body.”¹³

Modern science may provide a better explanation with its understanding that the atomic structure of every material thing is largely comprised of ‘space’. This vacuum at the atomic level presupposes, just as much as does that of inter stellar ‘space’, the presence of *aether*. Thus, the ability of transparent bodies (air, water, glass, etc.) to permit the passage of light may be explained by the fact that their atomic structures do not impede (or better, do not completely impede) the *aether* in their interstices from its proper operation. Accordingly, on this analysis *aether* is not simply a

¹¹ Christopher A Decaen, *Aristotle’s Aether and Contemporary Science*, op. cit., footnote 48.

¹² I rely here on Decaen’s citation of St Thomas in *In II Sententiae* d. 13, q. 1, a. 4; *Summa Theologiae* I, q. 67, a. 3; *In II De Anima*, lect. 14. n. 22; and *De Sensu*, lect. 6, nn. 7-9. The quote from the *Summa* does not go this far. I have been unable to check the other sources.

¹³ *De Anima*, Bk. 2, Pt. 7. The critical word here in the Greek is *phusis* which means ‘nature’, from which we get ‘physics’. One translation has it as ‘substance’ but this is inaccurate. I have translated it as ‘quality’. In a personal communication to the author, Dr Decaen puts it in this way. “I think the eternal upper body Aristotle is speaking about IS the aether... I think Aristotle is ... saying that air and water are transparent because they participate (less perfectly) in the nature of the aether itself, which (in this context) is simply perfect transparency...”

substance with supreme transparency, it is universally the substance that permits the passage of light.¹⁴ *Aether is the transparent*. Without it there would be no propagation of light. Without it we could not see the page in front of us.¹⁵

Non-reciprocal Agency

The second positive property might be termed 'non-reciprocal agency'. It was clear to Aristotle, as it was to St Thomas, that in the coming and going of the seasons, in the tides, and in other ways, the heavenly substance which included sun, moon and stars, affected the world below. Yet there was no evident reciprocity of effect. Aristotle concluded that *aether* affects ordinary matter but is not affected by it in return.¹⁶

"While usually the thing touching is touched by what it touches... still it also occurs... that only the mover may touch the moved, while the thing touched does not touch the one touching it..."¹⁷

And St Thomas in his commentary:

"Bodies act upon each other by touching... But this should be understood [only] when there is mutual contact as happens in those things that share a common matter... The heavenly bodies, however, because they do not share a common matter with inferior bodies, act upon them such that they are not acted upon by them; they touch and are not touched."¹⁸

Their analysis may seem to be grounded on a false premise for the apparent lack of reciprocity between the heavenly and mundane bodies can be explained, in large measure, by the immensity of the distances involved between them and by gravitational forces, issues of which the two philosophers were ignorant. Moreover, as Decaen says, it seems to contradict the Newtonian assertion of equal and opposite reaction among bodies. But, the influence of some force without reciprocal effect has scientific support as we shall see; and the acknowledgement of this characteristic in *aether* may explain issues that have troubled science for three hundred years. The apparent breach of Newton's law can, too, be resolved if *aether* is understood as being of a different order of materiality to common bodies.

In No Place

There is a third positive property, albeit negatively expressed. *Aether* does not, simply speaking, have location. *Place* is one of the nine predicaments (accidents) of every body. Aristotle defines it as "first immovable surface of circumambient body"¹⁹. But *aether*, the substance which, on this contention, fills the cosmos from the level of the atom to the periphery of the solar system, has no container. Rather, it is

¹⁴ I should say that this is not a view with which metaphysicians would necessarily agree. Neither Dr Decaen nor Dr Don Boland of Sydney's *Centre for Thomistic Studies* agree with my analysis

¹⁵ And this is not the half of it. Without *aether* the very atoms of matter could not exist. One need not even begin to think about the interaction of the heavenly bodies.

¹⁶ There is not room here to show that Aristotle's analysis is not necessarily contradicted by current cosmology which would isolate sun, moon and stars from the hypothesised aetherial matter. The reader should study Decaen's paper.

¹⁷ *De Generatione et Corruptione*, Bk 1, Pt. 6; and cf. footnote 50 in Decaen, *Aristotle's Aether and Contemporary Science*, op. cit.

¹⁸ *Commentary on the Physics of Aristotle*, Bk. 3, Lect. 4, n. 5; and cf. footnote 51 in Decaen, op. cit. Apparently St Thomas did not comment on Bk. 1, Pt. 6 of Aristotle's *De Generatione et Corruptione*.

¹⁹ *Physics* IV, 5; (212 a, 22)

aether which is the container of everything else. *Place* may be predicated of it, then, only analogously.²⁰

Source of Gravitational Force

Newton formulated his universal law of gravitation as directly proportional to the product of the masses of the relevant bodies and inversely proportional to the square of the distance between them. Yet he considered gravity not, as it is presently regarded, as a force of attraction but one of repulsion. Nor did he regard gravity as essential and inherent to matter. He attributed it to a discrete, independent, particle he called a *fluxion*. He rejected the understanding of interstellar space as a great vacuum, regarding it as filled with the fluent matter he had postulated. In correspondence with Richard Bentley, Master of Trinity College, he said this:

“That gravity should be innate, inherent and essential to matter so that one body may act upon another at a distance through a vacuum without the mediation of anything else, by and through which their action and force may be conveyed from one to another, is to me so great an absurdity that, I believe, no man who has in philosophic matters a competent faculty of thinking could ever fall into it.”²¹

Now, if *aether* is the intangible sea in which all matter subsists, it touches all matter. *Prima facie* then it provides the mediation Newton required. But there is a problem. If *aether* touches the heavenly bodies but is not touched by them in turn, it cannot be the medium of their mutual influence. What, then, is the source of gravitational force? Was Newton right when he said that there is nothing in a heavenly body such as the sun, earth or moon which requires that it exercise attraction on another?

My scientific friend said that our apprehension of certain of the conclusions of Einstein were ‘counter intuitive’. In other words, the findings which Einstein had postulated (e.g., ‘curved space’) were opposed to the natural inclination of the mind. Is there something similar here? What if, notwithstanding that gravitational force is predictable, and mensurable, and apparently a function of the mass of the bodies involved, it is generated not by the bodies themselves *but by the aether in which they subsist*? This conclusion would confirm Aristotle’s assertion of *aether’s* non reciprocal agency and Newton’s thesis. On this hypothesis, if we assume for the purposes of argument that Newton’s Universal Law of Gravitation is valid for all cases, it would demonstrate this element of *aether’s* agency with scientific precision.

Decaen provides this synopsis of recent discoveries in support of the proposition.

“According to accepted theory, the expansion of the universe should be decelerating due to the gravitational drag of massive bodies such as planets and stars. However, observations on a number of distant supernovae over the past ten years are suggesting that some hitherto unknown repulsive force from an unknown energy source is accelerating the expansion. And worse, this force does not appear to be

²⁰ As *healthy*, said properly and essentially only of a living body with normally functioning organic constitution, may yet be predicated of climate conducive to health.

²¹ The letters to Dr Bentley are, according to one internet source, dated 10 December 1692, 17 January, 11 February and 14 March 1693. I have been unable to locate the date of the relevant letter. The passage is apparently reproduced in an essay, *General Scholium*, appended to the Second (or Third?) Edition of his *Principia*. I have not checked the source. Cf. Wikipedia sub cap. *Newton’s law of universal gravitation*.

coming from one region of the universe; rather, it appears to be coming from all directions, or more specifically, from space itself. The comparison with Einstein's original idea of a 'cosmological constant', an irremovable repulsive force built into the texture of the universe, has been difficult to avoid, although for half a century it was common opinion that its addition to relativity theory was *ad hoc*. While little is certain about this accelerative force, one thing seems clear: As one physicist puts it, 'the energy density associated with the [new] cosmological constant is not possessed by matter or radiation, but by 'empty' space.'"²²

Determinant of the Speed of Light

Modern science is divided over whether light is comprised of waves or corpuscles. Metaphysics looks at the thing differently, not from the phenomena it manifests, but from the perspective of being.

"For there are diverse degrees of entity according to which there correspond diverse manners of be (*modi essendi*), and according to these degrees different things are classified."²³

Metaphysics recognises ten special modes of being in two categories, *substance* and *accident*. A *substance* is something that exists through itself: it may be characterised by the shorthand phrase 'be-in-self'. An *accident*, in contrast, is something that can only exist in another: in shorthand, 'be-in-other'. The mental distinction between 'be' and 'belong' is apposite: a *substance* 'be's'; an *accident* 'belongs' (to some *substance*).²⁴ There are nine accidents—*quantity*, *quality*, *relation*, *when*, *where*, *action*, *passion*, *habitus* (setting, or clothing) and *situs* (posture). To illustrate—Socrates is a substance: that he happens to be a teacher to his pupils is an accident (*relation*): a cow is a substance; its colour, brown, is an accident (*quality*): a dog is a substance; that it be clothed in a coat by its master to protect it from the cold is an accident (*habitus*): water is a substance; its presence in a pond in my garden is an accident (*where*).

One of St Thomas's commentators elaborates on the nine accidents as follows:

"Among all... [the] accidents it is proper to *quality* to render the subject formed and qualified... because *quality* among all the accidents properly ennobles and qualifies its subject. For while *quantity* quantifies and materialises its subject by extending it and ordering its material parts... the remaining predicaments either order their subject towards another, as does *relation*, or depend upon something extrinsic ordering it, as do the last six... What... essential difference does essentially, *quality* does accidentally, namely to form and qualify what is potential and formless..."²⁵

Is light a *substance* or an *accident*? Does it 'be in itself', or 'be in another'?

"[L]ight is the activity... of the transparent forasmuch as it is transparent... Light is, as it were, the proper colour of the transparent and exists whenever the... transparent is excited to actuality by the influence of fire, or something resembling

²² Christopher A Decaen, *Aristotle's Aether and Contemporary Science*, op. cit., Pt III C

²³ St Thomas Aquinas, *Disputed Questions about Truth* q. 1, a. 1: Sunt enim diversi gradus entitatis, secundum quos accipiuntur diversi modi essendi, et iuxta hos modos accipiuntur diversa rerum genera.

²⁴ My apologies to those who hate to see an apostrophe misused: my excuse is that I can see no other way of conveying the activity of the verb *to be*.

²⁵ *John of St Thomas* [1589-1644], *Cursus Philosophicus Thomisticus*. I, p. 609b; quoted in translation from the original Latin by Austin Woodbury Ph.D, S.T.D, in his *Ontology*, [Aquinas Academy text, Sydney, c.1965], p. 906, with minor alterations by the writer to simplify the text.

‘the uppermost body’; for fire, too, contains something which is one and the same with the substance in question... [Yet] light is neither fire, nor any kind whatsoever of a body, nor something given off by any kind of body—for in such a case it would itself be a kind of body. It is the presence of fire, or something resembling fire, in what is transparent. It is certainly not a body, for two bodies cannot be present in the same place.”²⁶

St Thomas comments on this teaching—

“But light (*lux*) differs from heat in this that light is a quality of first altering body which has no contrary: wherefore neither does light have a contrary, whereas heat does. And because there is nothing contrary to light, it is not possible for there to be a contrary disposition in its recipient: and because of this its matter, the transparent body, is always immediately disposed to its form. That is why illumination occurs instantaneously, whereas what can become hot only becomes so by degrees. The participation or effect of light in a diaphanum is called “luminosity” (*lumen*)...”²⁷

Both philosophers distinguish the light in a source (such as the sun) from the light in the atmosphere. As can be seen above, St Thomas calls the former *lux* and the latter *lumen*.²⁸ He follows Aristotle in saying that *lumen* is to the diaphanous (*scil.* air) what colour is to a bodily surface (*corporis terminatum*). The colour in each is latent and activated by light from a source, *lux*. For colour to be visible—to act upon the organ of sight—the medium must have light (*lumen*) in it.²⁹

Both Aristotle and St Thomas deny that light travels through its medium as if it was something like an arrow shot from a bow. They teach, rather, that light is the activation of a disposition present in the medium (whether transparent or diaphanous). The modern scientist may discount their approach because he can demonstrate that light *does* progress, but they are right. There is no process, for instance, in the lighting of Earth’s atmosphere: it is lit instantaneously. That light may require time to effect its qualitative activity over vast distances is accidental, occurring because the transparent and the diaphanous suffer from matter’s inertia.³⁰ The fifth property follows, I contend, on this inertia. It answers, moreover, the question why the speed of light is not infinite but determinate—limited to 299,792.458 kps *in vacuo*. It is *aether* that determines it.³¹

²⁶ Aristotle, *De Anima*, Bk 2, Pt. 7

²⁷ *In II De Anima*, lect. 14, nn. 6-7.

²⁸ Though occasionally he used *lumen* when he might have used *lux*.

²⁹ Which is not to deny that the source itself may be coloured, as the Sun is yellow-ish; as the star Sirius is blue-ish. The reader may recall that the pictures and movie footage of astronauts walking on the moon’s surface 40 years ago were largely devoid of colour, a consequence, these philosophers might have said, of the absence of any but a residual atmosphere. Among the many ‘space station’ pictures now available, those taken from outside the space vehicle manifest similar deficiencies in colour. It is otherwise when they show something with an atmosphere, such as the vehicle’s interior, or the earth.

³⁰ I am mindful of the findings of Michelson and Morley. I am not using the term ‘inertia’ here as if of a common material being, what Einstein, cited in a later footnote means by the expression ‘ponderable medium’. Unlike common matter, *aether* has no weight. Yet because it is material (and not immaterial) it cannot operate unlimitedly, as, e.g., by permitting the propagation of light at infinite speed.

³¹ Science can demonstrate that the speed of light slows in different transparent media, as e.g., in water, in glass and in diamond. The alteration in speed is indicated by the refractive index of the medium. That of typical glass is 1.5. This means that the speed of light in glass is $1/1.5 = 0.67$ times its speed in a vacuum. That of diamond is 2.41 giving a speed of only 0.415. If the argument advanced here avails,

Aristotle did not distinguish the heavenly substance from the heavenly lights it contains—sun, moon and stars. He conceived of *aether*, then, as *the luminescent*; and St Thomas reasoned that it was in virtue of this quality of luminescence that *aether* acts upon ordinary matter. Modern science seems to show that in addition to *aether's* potency to activation by light, it is in potency to activation by various other forms of electromagnetic energy.

Every *substance* influences the *qualities* it bears. To illustrate, the (*accidental*) form of heat induced in water (to which form it is in potency) is determined by the nature of water.³² So the *accidental* form of light induced in *aether* (to which it is in potency) is determined by the nature of that *substance*. *C* is not, as science thinks then, the speed of light but the speed at which *aether* determines the development of that *quality*.³³ *C* is, likewise, the speed at which *aether* determines the development of those other *qualities* of electromagnetic energy to which it is in potency.

In his celebrated formula Einstein lays down that the equivalence between mass and energy is a function of $C-C^2$ to be precise. If *C* is the speed at which *aether* determines the development of the *qualities* represented by the various species of electromagnetic energy, and one or other of these is the means whereby *aether* binds the nucleus and associated electrons in every atom, why should we be surprised that the equivalence between mass and energy is a function of *C*? Einstein's formula is misleading in appointing *C* as a property of light. Take it as a property of the matrix in which all atomic structure subsists and is determined, *aether*, and its true significance appears.

In line with the thesis advanced here, the scientific expression *in vacuo* is to be countered with the metaphysical *in aethere*. The scientist means by his expression that all other matter is excluded: he asserts a void. The metaphysician denies that this is possible: where no other (common) matter is present, *aether* is. All generation and corruption, all material activity then, is, following this argument, *in aethere*.

The Mode of Aether's Involvement

There is a problem for metaphysics—if not for science—the demands of the doctrine of *hylomorphism*.³⁴ Science looks at substantial change from the point of view of the phenomena detected. The formation of water occurs by the combination of what it identifies as one atom of oxygen with two of hydrogen. Metaphysics looks at

the atomic or molecular structure of each such medium serves to impede the facility of luminiference of the *aether* which permeates its structure. (Though, note that conceiving of *aether* in this way, on analogy with some fluid, is to misunderstand its nature. Rather is it to be said that the atomic, or molecular, structure of the medium penetrates the *aether*.) For substances which admit of no transparency, the atomic structure must provide a complete impediment to this facility *qua* light. But not necessarily in respect of other forms of energy; e.g., x-rays.

³² And is not any heat at all, but the heat peculiar to water, bound by that substance's limitations

³³ The letter *C* that Einstein uses to stand for the 'speed of light' is taken from the Latin *celeritas*, meaning 'speed', or 'swiftness'.

³⁴ A word derived from Greek signifying the compound of matter and form.

the business from the perspective of being. Water is formed when the *substantial form* of water combines with *prime matter*. It allows that the *form* of each of two *substances* (e.g., oxygen and hydrogen) may be corrupted in favour of the *form* of another (water) in the substantial change: but the *matter* stays the same. The old substances are replaced by the new. For metaphysics *substantial form* is the determinant of the nature of the new substance and on this *form* follow the nine accidents, the first of which “quantifies and... materialises its subject by extending it and ordering its material parts”. There is no other cause determining the nature of the new substance. How, then, could *aether* be involved in the process?

Metaphysics allows the involvement of a cause *per accidens*, a cause which contributes to the effect by removing something prohibiting the *per se* cause from producing its effect—a *conditio sine qua non*.³⁵ Thus, the sea is not a *per se* cause either of the becoming, or of the subsistence, of the fishes within it: yet it is an essential condition of both. In the same way, I suggest, *aether* is an essential condition of the subsistence—and in the case of living things, the generation—of all common material beings. Similarly, the opening of a tap is not a *per se* cause of the water flowing through it—the efficient cause is gravity—but it is an essential condition. The process called *catalysis* where the presence of some element or compound facilitates a chemical reaction operates in a similar fashion.³⁶ On analogy, *aether* may be understood as contributing to the existence of a common material *substance* by cooperating with first accident, *quantity*, in facilitating the ordering of its material parts at the molecular level.

Aether and Time

I have already addressed how *aether* cannot be said to be in place and how this superiority enables it to establish place for common material being. Time is the number, or measure, of movement or change. Now while *aether* is clearly moveable—for it adapts to the movement of every element of common material being—it is *per se* immutable, incapable of change, and therefore outside time. This superiority has, I suggest, a consequence. Since first he walked the earth man has measured time according to the rotation of the earth around its axis, of the earth around the sun, and of the moon around the earth.³⁷ The most perfect method of keeping time now is by means of atomic resonance.³⁸ If *aether* governs the movement not only of the heavenly bodies but of atomic resonance as part of its involvement in atomic structure, then *aether* is involved in the establishment of time.

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There is one final, metaphysical, comment to be made of this extraordinary substance. St Thomas says:

³⁵ In V *Metaphysics*, lesson iii

³⁶ Similar, but not the same, as a catalyst is not essential to the reaction. Science now identifies different types of catalytic operation including instances in which the catalyst is involved in the reaction and partly, or wholly, consumed. The original conception of *catalysis* is, however, of an element which contributes nothing but its presence.

³⁷ Or in the regularity of repetition of the same sequence in consequence of these rotations.

³⁸ Cf. http://en.wikipedia.org/wiki/Atomic_clock

“The celestial bodies are far from us not only according to quantity of spatial distance, but even more so in that few of their accidents fall under our senses, while it is nevertheless connatural to us that we proceed from accidents, i.e., sensibles, to cognising the nature of some thing... But the accidents of the celestial bodies are of a different notion altogether [alterius rationem] and are wholly disproportionate to the accidents of inferior bodies.”³⁹

In particular, because *aether* is ungenerable and incorruptible, *quality* does not manifest in *aether* the characteristic change of properties it works in common material being.⁴⁰ This explains why light in *aether* does not light it, nor heat heat it.

Of the other seven accidents, *when* and *where*—that is, time and place—cannot be attributed to it. *Relation* may be said of *aether*, but only analogously. Its relation to all creation might be compared to that of the sea to the fishes that subsist in it—as container to the contained; as the essential condition to material existence. Of the remaining four accidents, *action* may be attributed to it, but not *passion*, because *aether* acts, yet is not acted upon. But neither *situs* nor *habitus* are applicable; *situs*, because it consists in the order of the parts of its subject, but since the parts of *aether* are undetectable, neither is their order; and *habitus*, because this is taken from something outside the subject (yet not a measure of it); but nothing is extrinsic to *aether*. Rather, *aether* is extrinsic to everything else.

The Michelson-Morley Experiment was a Success

The Michelson-Morley experiment showed that the speed of light was constant in all frames of reference. In 1905 Albert Einstein published his special theory of relativity which drew *inter alia* on this conclusion. Einstein announced shortly after that luminiferous *aether* was outdated. Fifteen years later, however, he recanted.

“More careful reflection teaches us... that the special theory of relativity does not compel us to deny ether... [W]e may say that according to the general theory of relativity space is endowed with physical qualities; in this sense, therefore, there exists an ether... According to the general theory of relativity, space without ether is unthinkable; for in such space there not only would be no propagation of light, but also no possibility of existence for standards of space and time (measuring-rods and clocks), nor therefore any space-time intervals in the physical sense. But this ether may not be thought of as endowed with the quality characteristic of ponderable media, as consisting of parts which may be tracked through time. The idea of motion may not be applied to it.”⁴¹

This assessment has remarkable resonance with Aristotle’s teaching that *aether* does not share the attributes of any other material thing.

Christopher A Decaen closes his paper with what he calls “the resuscitation of *aether*” by contemporary science. In the working out (by Einstein’s successors) of the

³⁹ *In II De Caelo*, l. 4. n. 3

⁴⁰ *De Caelo* I, 3. Aristotle says: ““qualitative states and dispositions do not come into being without changes of properties. But we see that all natural bodies which change their properties are subject without exception to increase and diminution.”

⁴¹ In a lecture meant for his inauguration at the University of Leiden in 1920. Quoted in Albert Einstein, *Sidelights on Relativity*, trans. G B Jeffrey and W Perrett, New York, (Dover) 1983, 13, 15. And cf. footnote 106 in Christopher A Decaen, *Aristotle’s Aether and Contemporary Science*, op. cit.

General Theory of Relativity and in the field of Quantum Electrodynamics Theory—that is, in both the *macro* and the *micro* areas of its concerns—science is moving back to the view that some form of *aether* is essential.

What do we conclude? Far from being a failure, the Michelson-Morley experiment was a success, establishing at the scientific level what Aristotle and St Thomas had maintained at the philosophic, namely, that *aether* does not share the accidents of common material being and is immutable, which characteristic was demonstrated by the immutability of the speed of its proper accident, light.

There would seem to be one other corollary. The experiment showed the falsity of the thesis that matter is nearly all free space and that if the 'space' was removed the earth "would be reduced to the size of an orange". The 'space' is not something 'removeable'; it is *aether* and without its binding influence the atomic structure of all common material being would fail.

One may wonder whether 'dark matter', 'dark energy', 'black holes' and 'curved space' represent realities, or are merely conceptual constructions to account for phenomena not otherwise explicable. Would science continue to posit them if it adopted Aristotle's understanding of *aether*? One thing is certain, scientists will make exponential advances in understanding the majestic world of creation if only they will rid themselves of materialism's stifling mindset.

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Any scholar, any artist, will remark how the grasp of knowledge or art in his chosen field grows month by month, year by year. He may, too, mark a sudden realisation that bursts upon him. In the course of my studies I had understood that what science calls 'space', or 'void', is impossible. What filled the heavens, I was told, was extremely rarified matter. This explanation was hardly satisfactory but I assumed it represented the mind of Aristotle and St Thomas until I read the paper of Christopher A Decaen referred to above.

Then felt I like some watcher of the skies
When a new planet swims into his ken;
Or like stout Cortez, when with eagle eyes
He stared at the Pacific—and all his men
Look'd at each other with a wild surmise—
Silent, upon a peak in Darien.⁴²

Michael Baker

28th January 2012—*St Thomas Aquinas*

⁴² John Keats, *On First Looking into Chapman's Homer*. The reference to the new planet relates to the discovery in 1781 by Astronomer Royal, Sir William Herschel, of the planet *Uranus*, the first planet to be added to those known to the astronomers of antiquity. It hardly matters that his mention of Hernán Cortés was in error—it was another Spaniard, Balboa, who first "stared at the Pacific".