

SCIENCE AND ARISTOTLE'S *AETHER*¹

Certain of the propositions of modern science seem to me to be nonsense, among them the assertion that apart from the material elements to be found in it, interstellar space is comprised of nothing. Science maintains 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 sun and *alpha centauri*, whatever constitutes this space, it cannot be nothing. I think science could answer these questions 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; that all assertions of the existence of something that cannot be measured are false. 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

¹ I have amended this paper slightly after considering certain objections raised to its theses. MJB, 20.06.2008.

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

and flourishing of Protestantism which, 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 Coelestium* 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 passed 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 Case Western Reserve University in the United States 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

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

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 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. In what follows I have melded the views of "the Philosopher" (as St Thomas designated him) and his disciple's refinement of those views to provide a coherent whole.

Decaen demonstrates why Aristotle saw the circular movement of the heavens as significant 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

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.

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 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 his reliance 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 applied univocally to (ie, do not signify exactly the same thing as) matter and form in other material substances. They are applied analogically⁹. This means that *aether* does not share the physical attributes of any other material thing. St Thomas says that matter and form in *aether* are so perfectly united that the one exhausts completely the potency of the other. It possesses a certain total and universal perfection that fulfils its potency for existence. There are a number of consequences. *Aether* is simple. It has no weight or lightness. It is incapable of generation or corruption: it lacks the tendency, present in every other material thing, to become something else (the principle of corruption). It

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'.

is incapable of growth or alteration. It is immutable, not subject to change in substance, quantity or quality, although apparently so in respect of place.¹⁰ It is not susceptible to the action of temperature or pressure. It 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 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*. In any event, there seem to be a number of positive attributes of this remarkable substance, attributes which go far to explaining issues so far unresolved by modern science.

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

¹⁰ The significance of this analysis derives from the metaphysical distinction of every material thing into ten categories comprised of its *substance* and nine *accidents*. *Quantity, quality* and *place* are three of the nine accidents. The distinction is elaborated later in the paper.

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

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.¹⁴ Accordingly, on this analysis *aether* is not simply a substance with supreme transparency, it is universally the substance that permits the passage of light. *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

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 itself affected by it. It touches, but it is not touched 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

This analysis, as Decaen says, seems to contradict the Newtonian assertion of equal and opposite reaction among bodies. But the two can stand together once *aether* is understood as (in St Thomas’s words) not sharing a common matter with, ie, being of a different order of materiality to, that of common bodies.

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...”

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*.

The sceptical scientist may remark that this property, if it exists, is hardly a positive one. On the contrary, it has profound effects and serves to explain issues that have troubled science for three hundred years, as we shall see shortly.

There is a third positive property, albeit negatively expressed. *Aether* does not, simply speaking, have location: it can be said to be “in place” only analogously. *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 (wherever that be) has no container. Rather *aether* is *the container of everything else*: it is coextensive with the universe. *Place* may be predicated of it only in an analogous fashion, just as “healthy” may be predicated, for instance, of climate conducive to health; or good food; or sound exercise; though health, taken properly and essentially, is the normally functioning organic constitution of a living body. Metaphysics does not accept the reality of what science asserts when it uses the word “space”. For metaphysics denies the existence of void, and “space” embraces void in its concept.²⁰

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 denominated a *fluxion*. Gravity appeared to operate instantaneously; it was not limited in its speed of operation as, for instance, is light. He rejected the concept of interstellar space as a 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 an attraction on another?

¹⁹ *Physics* IV, 5; (212 a, 22)

²⁰ Science speaks of “time and space”, metaphysics of “time and place”.

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*.

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 (eg, “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 save each of the two limbs of Aristotle’s thesis and earn Newton’s posthumous blessing. 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 the scope 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 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

I want to suggest that aether has an additional property. But before proceeding, a short excursus on the metaphysical view of light may assist.

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,*

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*.

passion, habitus (setting, or clothing) and *situs* (posture). To illustrate—Socrates is a substance: that he happens to be a teacher of 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 a garden is an accident (*where*).

One of St Thomas's commentators elaborates on the nine accidents, and on that of *quality* in particular, 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 rather 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"? Here is Aristotle.

"[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 '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

And St Thomas in his commentary—

"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. *Lux* is transmitted through the transparent; *lumen* through the diaphanous. He follows Aristotle in saying that *lumen* is to the diaphanous (e.g., air)

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.

²⁶ *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*.

what colour is to a bodily surface (*corporis terminatum*). Each is a *quality*, the accidental form of a *substance* which is receptive of it. Thus, a body can be coloured or uncoloured (black): from itself it is indifferent to the one or the other. The disposition in favour of the *quality* is present ready to be activated. Likewise, the diaphanous (say, air) can be lit or unlit (dark): from itself it is indifferent to one or to the other. Again, the disposition in favour of the *quality* is already present. 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 emitted by the light source, 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 correct. 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 fourth 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

Aristotle did not distinguish the heavenly substance from the 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

²⁹ The reader may recall that the pictures and movie footage of the 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 expression 'inertia' here as a phenomenon of matter, what Einstein means by the expression 'ponderable medium' cited in a later footnote, but in respect of matter's being. Anything of which matter is a component is limited in its being. It is this limitation in the material substances whose accidental potency it actuates that prevents light from illuminating 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, the atomic or molecular structure of each such medium must serve 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 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 in respect of other forms of energy such as x-rays.

to activation by light, it is in potency to activation by other qualities, the various forms of electromagnetic energy identified by science.

The speed at which light travels is not then, I suggest, a property of light (which for metaphysics is a *quality*) but of *aether* (a *substance*).³² Every *substance* influences the *qualities* it bears. To illustrate, the (*accidental*) form of cubeness induced in plasticine (to which form it is in potency) is determined by the nature of plasticine³³, so the *accidental* form of light induced in *aether* (to which it is in potency) is determined by the nature of that *substance*. Part of *aether's* determination is the speed with which light is actuated. In truth, then, *C* is not, as science thinks, the speed of light but the speed at which *aether* determines the development of that *quality*. It is, likewise, the speed at which it determines the development of other *qualities* to which it is in potency, *qualities* comprehended under science's category 'electromagnetic energy'.

Now Einstein lays down in his formula 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 of which it is the determinant, *aether*, and the formula assumes a new significance. It is yet another precise formulation of *aether's* agency.

In line with the thesis advanced in this paper, the scientific distinction *in vacuo*, is to be countered with the metaphysical one, *in aethere*. The scientist means by his expression that all other matter is excluded: effectively he asserts a void. The metaphysician denies the possibility of void: where no other (common) matter is present, *aether* is. All generation and corruption, all material activity, then, is following this argument, *in aethere*.³⁴

There is a problem for metaphysics—if not for science—the demands of the doctrine of *hylemorphism*³⁵. 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 business from a completely different perspective, that 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

³² The letter *C* that Einstein uses to stand for the 'speed of light' is taken from the Latin *celeritas*, meaning 'speed', or 'swiftness'.

³³ And is not any cube at all, but a plasticine cube, sharing the characteristics of plasticine and not those of another substance like glass, or iron, or wood.

³⁴ I repeat my earlier comment that this view is my own and not necessarily shared by other metaphysicians.

³⁵ A word derived from Greek signifying the compound of matter and form.

the *form* of another (water) in the substantial change: the *matter* stays the same. The old beings, oxygen and hydrogen, are replaced by the new, water. 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 is *quantity*, 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*.³⁶ 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. Another example: 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 fashion³⁷. On analogy, *aether* would contribute to a common material *substance* by cooperating with first accident, *quantity*, in facilitating the ordering of its material parts at the molecular level.

Decaen provides reasons for suggesting that *aether* is outside both time and place. I have already addressed *aether's* involvement in the establishment of place. Time is the number, or measure, of movement. But *aether* is, following the reasoning of Aristotle and St Thomas, immovable. It follows that it is outside time, or timeless. Since first he walked the earth man has measured time according to the rotation of the earth around its own axis, of the earth around the sun, and of the moon around the earth³⁸. The most perfect method of keeping time now is by means of atomic resonance.³⁹ If we accept that *aether* both determines the movement of the heavenly bodies and atomic resonance (as part of its governance of atomic structure), this would serve to confirm the link between *aether* and the establishment of time.

If these theses be accepted, it is *aether's* superiority over common matter that renders it the fit instrument for determining these parameters of our existence.

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

“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

³⁶ In V *Metaphysics*, lesson iii

³⁷ 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.

³⁸ Or in the regularity of repetition of the same sequence in consequence of these rotations.

³⁹ Cf. http://en.wikipedia.org/wiki/Atomic_clock

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.”⁴⁰

In particular, *quality* does not manifest in *aether* the characteristic change of properties it works in common material being⁴¹, because *aether* is ungenerable and incorruptible. 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 strictly, but only *per accidens*, as shown above. *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. 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.

Science after the Michelson-Morley Experiment

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 an outdated point of view. 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.”⁴²

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 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.

⁴⁰ *In II De Caelo*, l. 4. n. 3

⁴¹ *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.”

⁴² 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.

What do we conclude? The Michelson-Morley experiment was a success, not a failure. It established at the scientific level what Aristotle and, after him St Thomas, had maintained at the philosophical, that *aether* is not physically detectable. It was not science which erred in the conclusions drawn but the philosophy to which science had centuries before given its allegiance—materialism.

Others may agree with my difficulties over such current scientific concepts as “dark matter”, “black holes” and “curved space”, and wonder as I do whether they represent realities. Would science continue to posit them if it adopted Aristotle’s understanding of *aether*? Whatever the answer, there can be no doubt that science will make exponential advances if only it will rid itself of materialism’s stifling mindset.

Michael Baker

25th May 2008—*Corpus et Sanguis Christi*