

Eddington on the Greatest Scientific Revolution of the 20th Century

Roger J. Anderton

R.J.Anderton@btinternet.com

Eddington (1928) based on a lecture given in 1927 talked about the Greatest scientific revolution of the 20th Century – and surprise to some people - it was not a revolution due to Einstein. Eddington was the person who supposedly proved Einstein correct in 1919.

Eddington says: “In 1911 Rutherford introduced the greatest change in our idea of matter since the time of Democritus.” [1]

Eddington explains: “The new ideas of space and time [of Einstein] were regarded on all sides as revolutionary; they were received with the greatest enthusiasm by some and the keenest opposition by other.”

While for the other revolution – that of matter:

Eddington: “The new idea of matter underwent the ordinary experience of scientific discovery; it gradually proved its worth, and when the evidence became overwhelmingly convincing it quietly supplanted previous theories. No great shock was felt.”

i.e this other revolution quietly happened without much fuss, while all the attention went to Einstein.

Eddington continues: “And yet when I hear to-day [this is in 1927] protests against the Bolshevism of modern science and regrets for the old-established order, I am inclined to think that Rutherford, not Einstein, is the real villain of the piece.”

In other words people were protesting at the change that happened in physics from its old version to its new version. But Eddington does not credit this change to Einstein, instead credits it to the change in our ideas of matter.

Now this new idea of matter was of course due to Boscovich.

Rutherford was just providing the experimental evidence for Boscovich’s theory.

Boscovich’s theory was the “real” scientific revolution of the 20th Century which went unnoticed because of all the fuss made with Einstein.

Eddington now explains this theory: “When we compare the universe as it is now supposed to be with the universe as we had ordinarily preconceived it, the most arresting change is not the rearrangement of space and time by Einstein but the dissolution of all that we regard as most solid into tiny specks floating in void. That gives an abrupt jar to those who think that things are more or less what they seem. The revelation by modern physics of the void within the [chemical element] atom is more disturbing than the revelation by astronomy of the immense void of interstellar space.”

“The atom is porous as the solar system. If we eliminated all the unfilled space in a man’s body and collected his protons and electrons into one mass, the man would be reduced to a speck just visible with a magnifying glass.” [2]

This is Boscovich’s theory.

Nietzsche has explained it thus: “For while Copernicus has persuaded us to believe, contrary to all the senses, that the earth does *not* stand fast, Boscovich has taught us to abjure the belief in the last part of the earth that ‘stood fast’ - the belief in ‘substance’ (*Stoff*), in ‘matter’ (*Materie*), in the earth-residuum and particle-atom (*Klumpchen-Atom*): it is the greatest triumph over the senses that has been gained on earth so far.” [3]

i.e. Boscovich gives a greater revolution than Copernicus.

Substance is mostly empty space filled with fields – unified field theory.

Eddington explains this revolution in connection with aether
(my comments in square brackets):

“Thirty years ago [this is pre-1927] there was much debate over the question of aether-drag – whether the earth moving around the sun drags the aether with it. At that time the solidity of the atom was unquestioned [the old theory] , and it was difficult to believe that matter could push its way through the aether without disturbing it. It was surprising and perplexing to find as the result of experiments that no convection of the aether occurred. [now to Boscovich’s theory--] But we now realise that the aether can slip through the atoms as easily as through the solar system, and our expectation is the other way.” [4]

Eddington goes onto believe that the classical scheme broke down and then needed to be changed by Einstein. I disagree with that point-of-view and have dealt with it in my many articles, namely – that mistakes were made and the transition from Newton to Einstein was all about mistakes.

Newton provided a scheme for physics to follow as Eddington notes, but he thinks ‘might be expected to follow’ because he thinks it needed changing. I do not think that. So allowing that Newton’s scheme did not need changing, Eddington explains it quite well:

“I am not sure that the phrase ‘classical physics’ has ever been closely defined. But the general idea is that the scheme of natural law developed by Newton in the Principia provided a pattern which all subsequent developments might be expected to follow. Within the four corners of the scheme great changes of outlook were possible; [okay to here] the wave-theory of light supplanted the corpuscular theory [bit wrong here – Newton’s theory was really wave-particle duality, so no supplanting of one light theory by another]; heat was changed from substance (caloric) to energy of motion; electricity from continuous fluid to nuclei of strain in the aether. [different math models are allowed as far as I am concerned] But this was all allowed for in the elasticity of the original scheme. [okay – very good- very important and its still the case] Waves, kinetic energy, and strain already had their place in the scheme; and the application of the same conception to account for a wider range of phenomena was tribute to the comprehensives of Newton’s original outlook.” [5]

Eddington thinks that scheme breaks down, I say it does not.

Eddington then discusses relativity; my critique of such similar relativity thoughts I have dealt with in my papers; so not worth going into again.

It is interesting to note that Eddington believes in aether, and modern interpretations of Einstein’s relativity is generally to think otherwise; so it worth looking at this issue:

Eddington on a non-material aether

Eddington’s ideas on aether are connected to his beliefs regarding relativity, he says: “The theory of relativity is evidently bound up with the impossibility of detecting absolute velocity.” [6]

I agree with that – velocity is relative not absolute, so there is not really absolute velocity; a problem here though is not everyone agrees on same meaning to “absolute”.

Eddington has considered the case of comparing observations made by physicists in a distant nebula with physicists on earth, he says: “if in our quarrel with the nebular physicists one of us had been able to be absolutely at rest, that would be sufficient reason for preferring the corresponding frame.”

i.e who is at absolute rest – the physicists on earth or in the distant nebula; answer is neither.

Eddington: “This has something in common with the well-known philosophic belief that motion must necessarily be relative. Motion is change of position r3relative to something; if we try to think of change of position relative to nothing the whole conception fades away. But this does not completely settle the physical problem. In physics we should not be quite scrupulous as to the word absolute. Motion with respect to aether or to any universally significant frame would be called absolute.”

Now – here I have a difference of wordings from Eddington. From my readings there are three things- relative, absolute and universal. I deny “absolute” since all constant velocity motion is relative, but “universal” is allowed. So his “universally significant frame” I would call “universal” not what he calls “absolute”. (If a group of observers all decide to define a certain frame as universally significant and they all want to use it then I would call it a “universal frame”; to call it “absolute frame” would I deem be an error because “absolute” would not mean the correct thing. Absolute means to be that there can only be one frame, which is false based on the idea of relative motion that says there is lots of frames. But allowing lots of frames does not bar a group of observers all deciding to use one particular frame that they might then call “universal.”)

This is one of the many issues where people have different wordings and have confused the issues due to that babel.

Eddington continues: “No aethereal frame has been found. We can only discover motion relative to the material landmarks scattered casually about the world; motion with respect to the universal ocean of aether eludes us. We say ‘Let V be the velocity of a body through the aether’, and form the various electromagnetic equations in which V is scattered liberally. Then we insert the observed values, and try to eliminate everything that is unknown except V. The solution goes on famously; but just as we have rid of the other unknowns, behold! V disappears as well, and we are left with the indisputable but irritating conclusion $0 = 0$. This is a favourite device that mathematical equations resort to, when we propound stupid questions. If we tried to find the latitude and longitude of a point north-east from the north pole we should probably receive the same mathematical answer. ‘Velocity through aether’ is as meaningless as ‘north-east from the north pole.’ [7]

Highly significant that we should talk about aether in correct manner else it becomes a meaningless concept, because as Eddington points out aether exists.

Eddington: “This does not mean that the aether is abolished. [from his previous argument] We need an aether.”

I reiterate - aether exists

Eddington: “The physical world is not to be analysed into isolated particles of matter or electricity with featureless interspace. We have to attribute as much character to the interspace as to the particles, and in present-day physics quite an army of symbols is required to describe what is going on in the interspace. We postulate aether to bear the characters of the interspace as we postulate matter or electricity to bear the characters of the particles.”

So – I reiterate – we postulate “aether”, although other terms like electromagnetic medium (if just dealing with electromagnetic waves) might be more appropriate. (unified field if deal with wave in unified field etc.)

Next comes the philosophical issue-

Eddington: “Perhaps a philosopher might question whether it is not possible to admit the characters alone without picturing anything to support them – thus doing away with aether at one stroke.”

i.e we have a lot of philosophic interpretation issues here and some of those deny aether.

But as far as Eddington is concerned he says: “But that [philosophic issues] is beside the point.”

So he dismisses philosophies that want to interpret things differently to his.

He proceeds-

Eddington: “In the last century [19th] it was widely believed that aether was a kind of matter, having properties such as mass, rigidity, motion, like ordinary matter. It would be difficult to say when this view died out. It probably lingered longer in England than on the continent, but I think that even here it had ceased to be the orthodox view some years before the advent of the [Einstein] relativity theory. Logically it was abandoned by the numerous nineteenth-century investigators who regarded matter as vortices, knots, squirts, etc., in the aether; for clearly they would not have supposed that aether consisted of vortices in the aether. But it may not be safe to assume that the authorities in question were logical.”

“Nowadays it is agreed that the aether is not a kind of matter. Being non-material, its properties are sui generis.” [8]

{sui generis is Latin expression, literally meaning *of its own kind/genus* or unique in its characteristics.)

I think it best to think of aether as field; when we think of wave travelling in aether – that should be wave travelling in field; for example- electromagnetic wave being wave in electromagnetic field or wave in unified field or wave in gravitational field et al. When we have such things as water waves, well – water itself is made of subatomic particles and those have fields.

Eddington continues with the issue of the properties of the aether: “We must determine them [the properties of the aether] by experiment; and since we have no ground for any preconception, the experimental conclusions can be accepted without surprise or misgiving. Characters such as mass and rigidity which we meet with in matter will naturally be absent in aether; but the aether will have new and definite characters of its own.”

I don't see this, I think properties of an aether probably are arbitrarily defined; i.e we could define different versions of aether.

Taking Eddington's point-of-view that his version of aether is not to have mass then Eddington continues: “In a material ocean we can say that a particular particle of water which was here a moment ago is now over there; there is no corresponding

assertion that can be made about the aether. If you have been thinking of the aether in a way which takes for granted this property of permanent identification of its particles, you must revise your conception in accordance with the modern evidence. We cannot find our velocity through the aether; we cannot say whether the aether now in this room is flowing out through the north wall or the south wall.”

I would say this only applied to the constant velocity case.

Eddington: “The question would have a meaning for a material ocean, but there is no reason to expect it to have a meaning for the non-material ocean of the aether.”

So re-iterating -- Eddington thinks the aether is non-material; interestingly some might think that metaphysical.

Eddington claims that there is no such thing as velocity through the aether.

I think that should be for just the constant velocity case; but enough for now.

References

[1] The Nature of the Physical World, A. S. Eddington, Cambridge at the University Press, 1929 (based on 1927 lectures) UK p 1

[2] *ibid* p1-2

[3] Nietzsche's Brave New World of Force: Thoughts on Nietzsche's 1873 'Time Atom Theory' Fragment & on the Influence of Boscovich on Nietzsche
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http://www.warwick.ac.uk/philosophy/pli_journal/pdfs/ansell_pearson_1_pli_9.pdf

[4] The Nature of the Physical World p 3-4

[5] *ibid* p 4-5

[6] *ibid* p30

[7] *ibid* p 30-31

[8] *ibid* p31

c.RJAnderton2010-03-11