

THE PROBLEM OF THE INDEFATIGABLE ÆTHER

I cannot but regard the ether, which can be the seat of an electro-magnetic field with energy and its vibrations, as endowed with a certain degree of substantiality.

Hendrik Lorentz (1909)

From this it follows that one can reach a satisfactory theory only if one is able to dispense with the ether hypothesis.

Albert Einstein (1909)

According to the general theory of relativity space without ether is unthinkable.

Albert Einstein (1920)

With the new theory of electrodynamics we are rather forced to have an ether.

Paul Dirac (1951)

Three physical realities—the cosmological fluid, the microwave background radiation, and the quantum mechanical vacuum—all serve to revitalize in a new guise the concept of the aether.

William Craig (2008)

There is no ether at all. This is now the received wisdom following Einstein's work.

Frank Close (2009)

Like Afghanistan, the aether is an ancient battleground. It seems that those who take to either field will be worn down. When I say this he looks unhappy. Maybe he was for the war. It's the first time I have found him waiting at the door. Does he not have a key? Or does he want me to believe he doesn't? Whatever. I'm about to add these to my list of questions apropos this job when she shows up. So for a while it is the two of them.

The aether is a name for some ideas. She's heard of this; there's recognition in her eyes. The aether problem is, I say, a contradiction: Why did it die? And why is it not dead?

Aethers are an old idea. The word's spelling tells its age: 'æ', pronounced like 'ea' in meat, is a letter known as 'ash', the initial letter of the names of ancient

kings in what's now England. By 1000 CE it is the last letter in the English alphabet and aethers are already old. Wikipedia says Hindu philosophy and Greek mythology both invented the idea. The Hindu word's आकाश, pronounced akasha; the Greek's αἰθήρ, or aither

To the Greeks the aether was the substance of the clear sky. Other aethers had exotic properties. Aristotle's aether had a tendency to move in circles, thereby helping him explain the motion of the stars. I use this to show Frank—or maybe both of them—two early trends in scientific thought. One is a tendency to seize on explanations that just relocate the need for explanation. The other is: This often leads to real advancement of our knowledge. Its product in the short term is new words. It's an essential product. It gives people means to talk and think about ideas that, ill-defined though they may be, need names if they are ever to achieve a better definition. Aristotle's aether died out long ago. But like a Cheshire grin some vestige of his thinking sticks around.

Is it hope or reason tells me my detective has a way with words? After all he doesn't have much more. It shouldn't take him long to see that language is a tool for anyone who, like him, wants to wrestle an idea to the ground. The word 'aether' is a good example. Thinking about anything that's not been thought before is wont to need new words. Until it achieves currency, a new word rests on explanations that use old ones. What is truly new about a word is distilled over time by intertwining of the minds of those who use it with the world that they inhabit. So first, to give it meaning, they must have and share the word.

Thus with the aether. The distillation of its meaning goes on to this day. Words are subject to a kind of natural selection. So, supposedly a scientific concept, ever and anon the aether falls. A glance at Ngram Viewer shows me how 'the ether' climbs from 0.5 in 1825 to 4 per million of the words in books in 1910 and then falls back to 0.5 by 1985. No coincidence, its turning point is Einstein's SR era. Today it has a tawdry edge, a lack of something that the French call *politesse*, in certain circles. Its use might be polite yet it cannot be suave. But, like that cat—we thought he was a goner—it keeps on coming back. Today its count is 1.0.

So, why does aether keep on keeping on? Maybe it's that as ideas of space continue to evolve, they share a common thread: Space must be something. It's hard to make sense out of it as nothing. Indeed it seems that each attempt to treat it as a nothing comes up with another something. As the French are fond of saying: *Plus ça change, plus c'est la même chose*.

By the 1880s it is well accepted light is a vibration or a wave. This idea seems to need an aether. It is obvious that a vibration needs a Something that vibrates. Thus light is conceived as a vibration of a fine, extremely stiff, transparent substance. It's called luminiferous to differentiate it from the previous aethereal ide-

as. It fills space. It provides a ‘background’ so that light’s behavior may be understood. Thompson, not yet Kelvin, not yet at the end of physics, is a big proponent. Then in 1887 it falls into disrepute when Michelson and Morley show that motion through the aether does not change the speed of light. Experiments in search of it continue till 2000 but none finds it. But this begs the question of what ‘it’ is. Or ‘it’ isn’t as the case may be.

Lorentz, for example, specifies an aether he says might be, but Michelson and Morley cannot find it. It is rigid. It fills everything. It carries light waves, but does *not* provide a Special Frame.

Then Einstein takes the aether through a left turn followed by a right turn and thus parks it on a little-traveled street. It’s like this: In conceiving SR, Einstein finds he has no need for aether. This *allows* him to reject it; and he does—he takes the left turn, though he has no need. It seems the concept of a Special Frame offends him. That is, he rejects it by *mistake*. Lorentz’s aether *has* no Special Frame. So, though SR doesn’t need an aether, it is still an option. Not to Einstein! And at this moment Einstein’s whim is physics fashion. Physics takes the left turn with him. Lorentz and his aether are as good as gone.

I find an essay by Saunders and Brown that condenses Einstein’s after-SR view: ‘The ether ... is now redundant.... In the absence of radiation and ponderable matter there is no substance, there is empty space.’ Of course he doesn’t know that measurements will later show that ‘radiation and ponderable matter’—what he can see—are less than five percent of everything. Knowing this, he might not think of space as empty.

A decade later GR bursts upon the scene. The next twist in the tale is little noticed. Einstein finds that he has reinvented aether. It emerges from GR. Lorentz writes to Einstein showing how the aether is contained in Einstein’s own equations. Einstein soon adapts his thinking. This is what I call his right turn:

I admit that the general theory of relativity is closer to the ether hypothesis than the special theory. This new ether theory, however, would not violate the principle of relativity, because the state of this ... ether would not be that of a rigid body in an independent state of motion.

This is not to say Einstein *adopts* Lorentz’s aether. Rather, he accepts that he now has his own. He likes Lorentz’s view that matter can’t affect it. In fact, as Craig says later, ‘Lorentz’s conception of the aether was virtually equivalent to space itself.’ Einstein’s idea is that space and gravity are two sides of a coin. This means a new aether; his view is: So let it be. By 1920, the existence of the aether and his view of it become embroiled in German politics and anti-Semitism. Out of this somehow his aether is a hawk that never gets to fly.

The aether’s death at Einstein’s hand inhibits scientists from thinking of

space as a Something. Yet if it could speak it might, like Twain, exclaim, ‘The report of my death was an exaggeration.’ In 1917, like Lorentz, Gustav Mie writes Einstein, saying his space *is* the aether. Outside science I find traces of it in the literary scene. Churchill, in his history, *The Second World War*, has a chapter, ‘The Offensive in the Æther.’ He even keeps the ash! For a concept with such ancient antecedents, these are desultory days. But it seems to me that recently it may be on the comeback trail. There’s Craig. And Wilczek writes a recent book about the ether (minus ash). He says it is ‘the primary ingredient of physical reality.’

For Frank—hers or mine that is, not Wilczek—the Problem of the Indefatigable Æther is: What to make of it? It’s like Freddy Krueger; though it dies it won’t stay dead. GR ensures that there are new contenders for the job. Is it not astounding? Einstein makes his reputation once in ushering the aether out and then a second time by bringing it back in. Some physicists, like Close, neglect the second.

And why do other physicists keep coming back to this discredited idea? Why does it seem to get them so confused? Why do they have clear ideas on what the aether isn’t and such vague ideas on what it is?

Why would I make so much fuss about the aether? To my way of thinking it is basic; it comes down to space. Either space is Something or it’s not. That seems simple. But a moment’s thought about it makes it hazy. Is the aether *in* space? If *it’s* everywhere what need is there for space? My style is more direct than Craig’s: Maybe aether *is* space?

Midnight as the bus hums underneath the San Diego Freeway it comes clear. Whipping Boy. Clear, as they sang, in pictures of here. He and I are looking at too many pictures. He doesn’t need to solve the problems with the aether. *His* question comes to this: If the aether is, how did it come to be? The aether is the kind of thing that would be there from the Beginning.