Science in Context (2021), **34**, 209–225
doi:10.1017/S0269889722000175

RESEARCH ARTICLE

Killed by its own obituaries: Explaining the demise of the ether

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Argument
In this paper I follow the demise of the ether in the first half of the twentieth century to show how the first *obituaries* of the ether were instrumental in creating an object with specific and largely simplified properties related to, but different from, nineteenth-century ethers. I suggest that writing the history of dead objects (or objects an author wants to be dead) is not epistemologically neutral but, on the contrary, it involves a reformulation of the object itself. I show that this was indeed the case with the ether: those arguing for its demise in the early twentieth century tended to overlook as irrelevant one of the ether's most important properties, namely being the seat for the transmission of electromagnetic waves. Instead, they emphasized the contradictions between other properties of previous ether(s), so as to advocate for its disappearance.

Keywords: Ether; epistemic objects; Einstein; Lodge; Eddington; obituaries; historical epistemology

1. Introduction

Reflecting on the depressing situation of his worlds, Victor Jakob, the fictional German physics professor and protagonist of Russell McCormmach's novel, *Night Thoughts of a Classical Physicist,* regrets Einstein's dismissal of the ether as superfluous. "What became of Drude's favourite expression *physics of the ether*?," he asks, arguing that the ether "conceptually unified" all that was known in physics, and without it "physics threatened to become chaos"—a chaos similar to that which Europe had experienced in the Great War (McCormmach 1982, 102). He notes that Drude and others seemed happy to jump on the bandwagon, since they "had long conceded that one could get on with physics by doing away with the word *ether* and speaking instead of the *physical properties of space,*" but adds that, in his opinion, this linguistic trick "didn't change anything" (Ibid. Emphasis in the original). Jakob's night thoughts picture a process of transformation of the ether from being a concept or, more precisely, a tool for conceptual unity, to the ether as a word, simply a name, that could be substituted by expressions such as "physical properties of space." And this looked to him like an unfair nominalist stratagem.

If Jakob had been right, and following his line of thought, the same trick could be used to bring the word "ether" back to use in contemporary physics. And some scientists have indeed tried, particularly in the field of cosmology (Kragh 2012; Kragh & Overduin 2014, ch. 2). For instance, the physicist and Nobel laureate Frank Wilczek argued that most twentieth-century developments in quantum field theories had never really done away with the ether, if only because they were based on the notion of fields; and yet the actual word—ether—was seldom used, because "quite undeservedly, the ether has acquired a bad name" (Wilczek 1999, 11). Half a century earlier, and presenting a new theory of gravitation, American astrophysicist and cosmologist Robert H. Dicke also regretted the abandonment of the word ether, arguing that "with empty space having so many properties, all that had been accomplished in destroying the ether was a semantic trick" (Dicke 1959, 29). Granted, he claimed, "this was a useful trick, however, as the mechanical connotation of the old name had been left behind" (ibid.).

But perhaps the most famous attempt to resuscitate the use of the word "ether" was Paul A. M. Dirac's 1951 Letter to the Editor in *Nature*, "Is there an Æther?," in which he argued that, according to his "new theory of electrodynamics[,] we are rather forced to have an æther" (Dirac 1951b, 907). As Aaron Wright (2018) recently argued, Dirac's use of the word in its most classical expression, with the grapheme "æ" rather than an "e," was a deliberate anachronism partly aimed at advertising his alternative "New Classical Theory of Electrons" (Dirac 1951a) in the face of what he regarded as the appalling state of mainstream Quantum Electrodynamics after the War.

Interestingly, in the same year, and independently from Dirac, Edmund T. Whittaker defended the preservation of the same title for the highly revised second edition of his old book, *A History of the Theories of Aether and Electricity*. From his point of view, in the early decades of the century, "the word "æther" fell out of favour, and it became customary to refer to the interplanetary spaces as 'vacuous';" but things had recently changed and in modern quantum electrodynamics "the vacuum has come to be regarded as the seat of the 'zero-point' fluctuations of electric charge and current, and of a 'polarisation' corresponding to a dielectric constant different from unity" (Whittaker 1951, preface). With this, he claimed, "it seems absurd to retain the name 'vacuum' for an entity so rich in physical properties, and the historical word 'aether' may fitly be retained" (ibid.).

These examples point at the multiple uses of the word ether (or æther) by those advocating for its resuscitation and, implicitly, at the difficulties of writing historically about the ether in the past. What is it exactly that Wilczek, Dicke, Dirac or Whittaker wanted to bring back? As physicist Dennis Sciama (1978) said, the word ether seems to be constantly *transmogrified*, always at hand for rhetorical purposes, but seldom with the same meaning. And this is one of the central problems with any history of the ether: is it a word with a clear, well-defined meaning for the historian? And, related to that, was it ever clear what the ether stood for, even at the time, in the late nineteenth century, when most physicists took its existence for granted?

Following Hasok Chang's (2011) characterization, I would like to regard the ether as an epistemic object with a historicity about it, independently of the question about its truth-bearing qualities. Thus, rather than a history of the theories of the ether, as Whittaker's book title implies, I suggest paying attention to the historical processes that tried to shape an object for the word ether. In other words, rather than assuming people knew what they were talking about when using the term and when trying to discern whether or not such an entity existed, a more interesting task for historians would be to look at the multiple agents (epistemic, theoretical, cultural, material, esoteric and exoteric, etc.) that struggled to shape its meaning and its role in the physical sciences, broadly understood. The tradition started by Ludwik Fleck's (1935) work and loosely defined as historical epistemology may help better understand the competing processes that coalesced in trying to mold the ether *qua* epistemic object, and thus also throw light on the unsuccessful attempts to recuperate it in the twentieth century.

In this larger project, the question of the demise of the ether needs further explanation, not simply in the sense of better understanding the historical reasons for its abandonment, but also in the sense of looking at how the explanations of its disappearance helped shape the non-existing epistemic object. And this is the reason for the title of this paper, where "explaining" is used in four senses, each of which will be developed in the following sections of the paper. First, I shall have a look at the received view on the death of the ether developed by some of the most influential historians of science in the second half of the twentieth century. At a time when the history of science was emerging as an independent field, with the history of physics at its center and with the philosophy of science as its older brother, stories around the ether helped the different philosophical schools as an example of revolution (in the Kuhnian tradition), fallibilism (à la Popper) or experimentalism (for the positivist schools). My interest in this section will not be so much the use of this historical case by philosophers of science but, on the contrary,

https://doi.org/10.1017/S0269889722000175 Published online by Cambridge University Press

the implicit philosophy of science that permeates the main historical accounts of the demise of the ether.

Secondly, the demise of the ether needs to be explained incorporating areas other than pure physics, extending the narrative to other exoteric circles such as engineers, popular knowledge, physics dilettantes and agents in the arts, for instance. Here I will draw from the recent volume *Ether and Modernity* (Navarro 2018) where the ether is shown to be present in multiple milieus through the 1910s and 1920s, not as a remnant of the past but as an object of modernity. With this I want to add a new element to Graeme Gooday and Daniel Mitchel's convincing challenge to the traditional use by historians of "belief in the ether" as a probe to discriminate between classical and modern physics (Gooday & Mitchell 2013, 730-6). While Gooday and Mitchel argue that a number of physicists and electrical engineers claiming to believe in the ether in the late nineteenth century did not actually use it in their everyday work, we also find that many scientific and cultural agents in the first third of the twentieth century actually used and regarded the ether as a modern entity in order to make sense of their work as popularizers, engineers, artists or experimentalists.

Thirdly, I propose exploring the ways in which physicists and popularizers explained the death of the ether in the decades where the object was still a matter of heated dispute. These I call the "obituaries of the ether," by which I mean the early accounts of its death by those actors working to develop a new ether-less physics, as well as those simply reporting its death to the public in the immediate aftermath of its demise (Navarro 2020). As Andrew Pickering once wrote, "the historian of science has to come to terms with the fact that the scientists have got there first" (Pickering 1984, 3), by which he meant that most early histories of physics were first shaped by the accounts given by the very actors of the events or their immediate disciples. I suggest that beyond their common whiggism or lack of historical perspective, the early accounts of the death of the ether given by those who advocated for its disappearance were part of the story of its demise, and not simply passive narrators.

Fourthly, these three senses of "explaining" may help us better understand why "ether" became a cursed term, banned from the stage of science unlike other objects of twentieth century physics: from "fields" to "particles," from "atoms" to "electrons"— all these names remained, even though the objects to which they referred were undergoing constant transformations. More than this, however, they will show that accounts of the death of the ether actually created a new epistemic object, the non-existing ether, with clearer, better-defined properties than its living counterpart, thus challenging the often-simplistic accounts of the disappearance of the ether.

2. Histories of the demise of the ether

In July 1949, the octogenarian Robert A. Millikan joined the celebrations for Einstein's seventieth birthday with a panegyric in the *Reviews in Modern Physics* centered on his 1905 achievements. Millikan's narrative of the road to special relativity was meant to emphasize his own personal views on physics, namely that "modern science is essentially empirical, and no one has done more to make it so than the theoretical physicist Albert Einstein" (Millikan 1949, 343). Indeed, Millikan praised Einstein's "energy and capacity which very few people on earth possess," as much as the "extraordinary skill and refinement" of Michelson and Morley's experiment. Millikan continued stressing the heroic task of both experimenters and theoretician, noting that:

> Th[is] unreasonable, apparently inexplicable experimental fact was very bothersome to 19th century physics and so for almost twenty years after this fact came to light physicists wandered in the wilderness. . . . Then Einstein called out to us all, "Let us merely accept this as an established experimental fact and from there proceed to work out its inevitable consequences," and he went at the task. (ibid.).

https://doi.org/10.1017/S0269889722000175 Published online by Cambridge University Press

However praiseworthy Einstein's creativity as a theoretician might have been, Millikan was eager to stress the priority of experiment in physics, not of theory, in tune with his own scientific career and ideas. And the narrative of an intrinsic, causal link between the experimental disappearance of the ether and the theoretical solution was fit for that purpose. Similarly, as early as 1935, in *The Logic of Scientific Discovery*, Karl Popper had used this episode as yet another example of his fallibilism, when he mentioned the "famous example" of the "Michelson Morley experiment which led to the theory of relativity" (Popper 1959, 90).

That supposed historical link, to which Gerald Holton referred as having "long been a part of the folklor" (sic), was also very useful for pedagogical purposes (Holton 1969, 135). Indeed, for years after the publication of Einstein's paper on special relativity, Michelson and Morley's null result was the only experimental ground to support an otherwise very esoteric theory. And from there emerged a long tradition of "implicit history of science" in physics textbooks (ibid., 141). As a matter of fact, as we shall later see, Einstein himself was partly responsible for such a supposed link since, though always denying any major role of the experiments in his intellectual itinerary, he used Michelson and Morley's as support to explain his theory from 1915 onwards (Stachel 2002, 171-190). Holton also argued that this tradition responded to what he called the "experimenticist" philosophy of science, which reigned supreme in many universities in the mid-twentieth century.

Together with Millikan's quote above, Gaston Bachelard's contribution to Paul A. Schlipp's 1949 volume *Albert Einstein: Philosopher-Scientist* is one of the major examples of this use of Michelson and Morley's experiment as an *experimentum crucis*: "As we know, as has been repeated a thousand times, relativity was born of an epistemological shock; it was born of the 'failure' of the Michelson experiment" (Bachelard 1949, 566). Bachelard went on to argue that there is no such thing as a negative result because "in a well-performed experiment everything is positive," since it "proceeded from an *intelligent* question, a question which had to be asked" (ibid.). Einstein, he continued, "submits to experience, to 'reality'," to the "new reality" shown by the null result of an experiment (ibid., 567).

Bachelard needed this chronological link between Michelson and Morley's results and Einstein's formulation as proof of the priority of experiment over theory as the "correct" philosophy of science:

> Where, then, must the philosophy of science find its initial convictions? Must it give precedence to the lessons to be found in the beginning of experience, or in the end of experience? By building upon the first structures or upon the final structures? We shall see that the latter is correct, that it is *l'esprit de finesse* which reveals the foundations of *l'esprit gémoterique*. (Ibid.)

Similarly, the philosopher Hans Reichenbach (1949) also made Einstein an empirically-based physicist, arguing that his relativity theory relied on the Michelson experiment.

As for more explicitly historical works from the mid-nineteenth century, Holton mentions a few books, like Henry A. Boorse and Lloyd Motz's 1966 *The World of Atoms*, where the authors mitigated and reshaped the impact of Michelson's experiment on Einstein, arguing that "the legacy of the Michelson-Morley experiment to atomic theory was tremendous, if indirect" (Boorse & Lloyd 1966, 373). According to these authors, this experiment became one of the foundations of relativity insofar as it proved that "the speed of light is the same for all observers, regardless how they may be moving" (ibid.). It should here be noted that, while the previous examples emphasized that the null result of the ether-drift experiments challenged the very notion of an absolute space, the latter case stresses a different consequence of the same experiments, namely, the constancy of the speed of light.

And this brings us back to the argument of this paper. As we have seen, in these historical accounts the null result of the Michelson-Morley experiment was a good example of the priority of experiment over theory and, only implicitly, of the empirical proof that the ether did not exist.

This was more explicit when the absence of an ether drift was interpreted as a sign of a profound uneasiness with the concept of absolute space. The relationship between ether and absolute space was made more explicit by Max Jammers in his influential 1954 *Concepts of Space,* where he explicitly said that the problem of the ether is the problem of absolute space, and thus, that the abandonment of the latter automatically cancelled the very possibility of the former (Jammers 1954, 99, 142).

This is, of course, not a given. Perhaps the most obvious example of the fact that Michelson and Morley's interferometer results did not inevitably imply a rejection of the ether comes from Michelson himself who, towards the end of his life, would refer to "the beloved old ether (which is now abandoned, though I personally still cling a little to it)" (Michelson 1928, 342). Michelson agreed that relativity theory, against which he had no significant qualms, had proven the idea of an ether qua absolute space inconsistent. But since a non-ether physics opened up the problem of the propagation of light-waves, he still "hoped that the theory may be reconciled with the existence of a medium, either by modifying the theory, or, more probably, by attributing the requisite properties to the ether" (Michelson 1927, 161). Needless to say, Michelson did not sympathize with the quantum theory of light, which he regarded as "resuscitations of the exploded corpuscular theory" that only "raise more difficulties than they explain" (ibid.). Thus, Michelson was happy to retain the *word* "ether," while transforming its meaning.

Moving away from the "experimenticist" tradition, the disappearance of the ether also played a significant role in Thomas Kuhn's *Structure of Scientific Revolutions*, but in a way that differs from the previous stories. This is evident in chapters seven, eight and nine, "Crisis and the Emergence of Scientific Theories," "The Response to Crisis" and "The Nature and Necessity of Scientific Revolutions," where Kuhn argues that the very theoretical presence of the ether, not its experimental falsification, was responsible for the crisis of Maxwellian physics. Interestingly, Kuhn offers a *longue durée* narrative of a crisis in waiting, saying that "the technical problems … began to enter normal science with the acceptance of the wave theory of light after about 1815, though they evoked no crisis until the 1890s" (Kuhn 1996, 73). The un-detectability of an ether drift became an experimental anomaly, demanding more accurate experimental work as well as creative theoretical explanations. The latter triggered the tradition of model building of the ether in the second half of the nineteenth century, while Michelson and Morley's interferometer was only one more episode on the experimental side. Even with those results "there was still no conflict excepting that between the various articulations" (ibid.).

Thus, according to Kuhn, the need to articulate a theoretical model for the ether became part of normal science in nineteenth-century physics, and it was only after the many attempts at creating a coherent such model failed that the crisis emerged; not following one specific experimental result. We should remember that Kuhn was using this example, together with the Copernican revolution and the end of phlogiston, as a way to infer his general description of scientific revolutions. The parallelisms and generalizations he wanted to draw are obvious in his statement that "in practice … as has happened again and again in scientific development, the required articulation proved immensely difficult to produce" (Kuhn 1996, 74). He continued by adding that

> Just as Copernicus' astronomical proposal, despite the initial optimism of its author, created an increasing crisis for existing theories of movement, so Maxwell's theory, despite its Newtonian origin, ultimately produced a crisis for the paradigm from which it had sprung. Furthermore, the locus at which that crisis became most acute was provided by the problems we have just been considering, those of motion with respect to the ether. (ibid.)

Three things are worth noting here. First, that contrary to Millikan's description at the beginning of this section, the crisis described by Kuhn was mainly theoretical rather than experimental. Second, the very structural presence of the ether in classical optics first, and Maxwellian electrodynamics later, was a ticking clock of a crisis that sooner or later was going to happen. Thus, rather

https://doi.org/10.1017/S0269889722000175 Published online by Cambridge University Press

than a sudden unexpected empirical result, the anomaly, ulterior crisis and final abandonment of the ether came from theoretical developments showing internal inconsistencies. With this, Kuhn stressed the fundamental identification between the ether and classical physics. Any attempt to associate the ether with modern physics was hence deemed impossible. And third, Kuhn turned the ether into the very "locus" of the crisis, identifying the dichotomy between classical and modern physics with the disputes about the existence of the ether. Indeed, in his book, the crisis of classical physics coalesces around the very existence of the ether, which "prepared the way for the emergence of relativity theory" (ibid, 72).

An alternative, much more recent historiographical approach is the one offered by sociological and constructivist schools. In their *The Golem: What Everyone Should Know about Science* (1993), Harry Collins and Trevor Pinch used the Michelson-Morley experiments as one of their examples to challenge the notion of *experimentum crucis*. Far from considering the experiments of the 1880s as proof that the ether was shown not to exist, they rather argued the opposite: that their failure was interpreted as a sign that the experimental technique should be improved. A nuanced history of the responses to the experiments, expanding up to the late 1920s, showed that the rejection of the ether on experimental grounds was very rare.

Also drawing from the resources of Social Studies, the book *Masters of Theory: Cambridge and the Rise of Mathematical Physics* gave an alternative account of the demise of the ether. Describing the pedagogical regimes of nineteenth-century Cambridge, Andrew Warwick related *belief* in the ether to the use of specific mathematical techniques and the culture of problem-solving embedded in the coach system of the Mathematical Tripos: the "ontological reality of the ether derived from the mathematical techniques … taught in Cambridge" (Warwick 2003, 428). Warwick used this explanatory framework to argue against the common idea that reluctance to accept Einstein's special relativity in Britain was due to the strong belief in the ether. Instead, he suggested that, by the beginning of the twentieth century, the ether played no heuristic role, and yet was still an implicit element in the mathematics and the pedagogy of Cambridge. From this point of view, the demise of the ether was the result of a deeper transformation in what physics was and how it was meant to be practiced. Only when the British tradition abandoned the idea that a physical explanation involved the creation of some sort of mechanical model, which could be described using traditional, continuous, mathematical techniques, did the ether become irrelevant.

As I mentioned in the introduction, the aim of this section was to show the implicit philosophical and historiographical approaches that shaped the major historical accounts of the demise of the ether produced by historians. Certainly, many philosophers of science have used this case study to exemplify many particular philosophical theses. While interesting, those uses of the death of the ether fall beyond the scope of this paper.

3. Like Schrödinger's cat: The ether in the early twentieth century

In his *When Physics became King*, Iwan Rhys Morus (2005) delivers a coherent narrative of nineteenth century physics, in which the ether is "the crowning glory" (275). This was an epoch, he argues, which symbolically ended with the disappearance of the ether: "The end of the ether as a viable physical construct marked the end of the nineteenth century's imperial physics as well. The ether had encapsulated the hopes and the hubris of late Victorian physical science" (280). The decline of European industrial empires, claims Morus, came hand in hand with the demise of the ether: "Just as the ether was coming apart at the seams during the early years of the twentieth century, so was the culture that produced it" (280). Following Staley (2005) and Gooday and Mitchell (2013), we have already noted the challenges to this identification between ether and classical physics that Morus' account takes for granted. More recently, the collective project *Ether and Modernity* has expanded upon this, by revealing several loci where the ether or, perhaps more accurately, *talk* about the ether, was regarded as part of modernity (Navarro 2018).

In the early 1920s, most Western countries saw the creation of national radio broadcasting corporations. Wireless technologies had transformed maritime and early aviation communications and, after the Great War, they were ripe for a new market: entertainment for the masses in domestic settings. The radio set soon became a household good in many upper- and middle-class families, or a focal point around which people convened in the local public houses. The radio was certainly modern—perhaps the most modern technology in post-war societies—and, for many ordinary people, it became the means through which news about something called "the ether" was first heard. Indeed, the wireless amateur, the technician, the electrical engineer or the suspicious user needed simple explanations about the mechanisms that enabled a concert from the Royal Albert Hall, for instance, to be heard in the furthest end of the country. And the ether performed this epistemic task by providing the medium through which this otherwise mysterious technology could work (Navarro 2016).

The narrative was quite straightforward. In order to explain the functioning of the radio set, the first step was to talk about electromagnetic waves. Just like the waves of water familiar to the public from their experience of rivers and oceans, electromagnetic waves, they were told, navigate in an unseen medium called the ether. The analogy was too powerful to abandon, especially if public authorities in science, like Oliver Lodge, championed for its existence. Thus, while some theoretical physicists were abandoning the ether and pronouncing it dead, many popular lectures—aimed at a diversity of publics—were simultaneously "materializing" the ether, especially when such lectures were broadcast live on the radio.

In his analysis of the rhetorical devices used in these speeches and writings, Michael Whitworth points at the fact that when Lodge says, for instance, that "The waves that we are now using will get to the Antipodes" (Lodge 1925a, 242), "the 'now' of the original broadcast implies the medium of transmission between speaker and audience and reconnects abstractions with the audience's immediate physical situation" (Whitworth 2018, 33). In so doing, the ether ceased to be an esoteric entity of high physics speculation and became part of daily experience for the radio listener. Also, the analogy between the radio antenna and the eye, both instruments that can observe ether vibrations, brought the ether closer to common experiences.

These lectures had a potential audience of up to one million listeners, and their printed version in the *Radio Times* had an estimated readership of up to 750,000. A revised version of these lectures became the core of Lodge's *Ether and Reality*, a bestselling book with over 25,000 copies sold in only five years. The book's aim seemed to be "not to communicate what the ether is, but rather to establish the conditions for its possibility and to evoke what it does," with the use of common sense, everyday analogies (Whitworth 2018, 42). Indeed, this was the strategy of much of the rhetoric in places like the popular journal *The Wireless World*, where sections like "Who is Who in the Ether" not only promoted the identification between radio broadcasting and ether, but also gave the latter a place in the modern technological world.

A stronger point was made when addressing an audience of technicians, engineers and "the great army of wireless amateurs and experimenters … always enthusiastic about ether waves" (Lodge 1925c, preface). In his book, *Talks about Wireless: With some pioneering history and some hints at calculations for wireless amateurs,* Lodge cautioned "the younger generation, who are so enthusiastically utilizing and perhaps improving the latest inventions" not to be "misled by any misapprehensions of the Theory of Relativity into supposing that that theory dispenses with the ether merely because it succeeds in ignoring it" (15). "You can ignore a thing," he added, "without putting it out of existence" (15-16). While one could formulate Relativity without the ether, there were many other problems, such as light, electricity, magnetism, etc., which Lodge could only see explained by making use of an ether. And thus, he noted, one should be grateful to this entity: "We are utilizing it every day of our lives; and it would be ungrateful as well as benighted if we failed to render due homage to its omnipresent reality and highly efficient properties. It lies at the origin of all electrical developments, and forms the basis for this new and broadcast method of communication" (16).

The call to be grateful and not to dismiss the ether is unmistakable, as is its religious undertone. As a matter of fact, Lodge concluded *Ether and Reality* by referring to the ether as the "living garment of God" (Lodge 1925b, 179). For him, as for many theosophists at the time, the material and the energetic, the natural and the supernatural were intrinsically connected, and the ether was the vehicle for such continuity (Morrison 2007, ch. 2; Noakes 2019). This was particularly relevant for the many bereaved mothers, fathers and spouses who had lost their children or husbands in the War, as Lodge himself had. *Raymond, or Life and Death,* written by Lodge after the death of his own son in the battle of Gallipoli, provided a scientific-looking hope of a life everlasting to many mourning people (Noakes 2018).

Thus, Lodge used his authority among electrical engineers as one of the founding fathers of wireless technologies to spread the good word about the ether as an element of modern technologies. At the same time, he was embracing modern forms of Christianity in the face of the crisis of traditional Anglican churches in the aftermath of the War, as well as being one of the most relevant scientists in supporting and encouraging spiritualism and psychical research. In both instances, the ether was the instrument of his modernity.

Lodge's rhetorical techniques can be regarded as modern, or even modernist, as Gilliam Beer (1996) once showed. But perhaps this link between the ether and modernism in the arts can be seen more clearly in the work of some painters in the early twentieth century. As Linda Henderson (2004, 2018) has shown at large, the ether of space as understood in popular culture, with all its mysterious and under-defined properties, became one of the common tropes in articulating a discourse for some of the new modernist forms of art. Together with the visual impact of X-rays and radioactivity, the ether, as the place where matter and energy—and even matter and spirit—meet, was useful in making sense of new artistic forms that explored the limits of the traditional representations of space and time. For people like the Italian futurist Umberto Boccioni, the Russian Vasili Kandinsky or the French Marcel Duchamp, the ether was "the ultimate sign of continuity and signified a realm of continuous cohesion and diffusion, materialization and dematerialization, coursed through by forces and vibrating waves" (Henderson 2004, 452).

Not surprisingly, many such allusions to the ether came hand in hand with references to the fourth dimension in Relativity. But the "operative words" more often used were not space-time and relativity, "but rather terms such as invisible, energy, ether, vibration, and fourth dimension" (Henderson 2004, 458). The interesting point here is that the ether, and not necessarily relativity, was "the armature of the cultural matrix that stimulated the imaginations of modern artists and writers" (Ibid.).

Cultural milieus, however, were not the only arena in which the ether was commonplace. According to Roberto Lalli's (2018) scientometric analysis, talk about the ether in American scientific journals peaked, rather than declined, in the mid-1920s. This was partly due to the repetition of Michelson and Morley's experiments in search for more accuracy and in the hope of getting an alternative result, one that would keep unchallenged the "common sense" notion of the ether. American scientists had gained prestige on the experimental front in optics and in electromagnetism, so the search for higher accuracy in the experiments of the first American Physics Nobel Prize winner was only natural. First— there was a need to keep the foundational worldview and beliefs upon which this experimental culture lay intact, and this relied on the existence of an ether. Second—"it was illogical for many American physicists to dismiss a concept on the basis of an experiment that, according to them, could not work without that concept" (Lalli 2018, 158).

As mentioned in the previous section, Michelson himself was reluctant to accept that his experiments would inevitably lead to the abandonment of the ether. In the mid-1920s, it looked like the physicist and astronomer Dayton C. Miller might set things right using the interferometer at the Mount Wilson Observatory. Miller had envisaged that repeating the Michelson-Morley experiment at high altitudes and over a long period of time (over a number of years so as to account for potential seasonal changes) might give a different result. Finally, in the spring of 1925, he announced that "there is a relative motion of the earth and ether … of approximately

https://doi.org/10.1017/S0269889722000175 Published online by Cambridge University Press

nine kilometers per second" (Miller 1925, 314). This opened up a state of "confusion" which, in Lalli's words, also provoked a "deep rift between theoretical research and experimental activities" (Lalli 2018, 167). The controversy lasted a number of years, only to then prove Miller wrong on the experimental front. Ironically, towards the end of the decade, the experiments that Miller had designed to defend an American culture of precision backfired and shattered the prestige of the old "style of the one-man work, which united the instrument-builder and the experimenter. . . . Miller's approach was beginning to be perceived as obsolete" (Lalli 2018, 169).

Miller's efforts to find some ether drift, however small, had been triggered by his dislike of Einstein's relativity, which was undermining the very foundations of the physics he was used to practicing. As a matter of fact, he argued that "the Theory of Relativity postulates an exact null effect from the ether-drift experiment which had never been obtained in fact" (Miller 1925, 217). Miller's dislike for Einstein's theory was not personal, but his attempts received much attention and support by the astronomer Charles L. Poor and the engineer Arvid Reuterdhal, both of whom were strongly campaigning on all fronts against relativity and against Einstein himself, often with anti-Semitic undertones. Towards the end of the 1920s, and following the example of the so-called *Academy of Nations* created in 1921 by anti-Einstein campaigners, a number of German nationalists set up the *German Society for Universal Ether Research and Comprehensible Physics*, a name that placed the ether firmly at the core of their anti-Semitic, anti-Einstein and anti-relativity campaigns (Wazeck 2009, 293-302). In so doing, they were placing the ether at the very center of their political and ideological campaigns, thus tainting the ether with a new moral load: that of becoming a flag for anti-Semitism.

In light of these and other examples, Massimiliano Badino and I have suggested that the "multiple lives" of the ether in the first decades of the twentieth century may help to explain why it ultimately disappeared. One could think of the ether as an "interstitial concept": "plastic and pliable enough to be adapted to diverse contexts, because it was no longer a specific object but rather a multidimensional concept able to serve a number of epistemic, symbolical, social, political, emotional, moral and even scientific functions, some of which, in contrast, were perfectly in tune with modernity" (Badino & Navarro 2018, 12). Perhaps this was one of the ether's major weaknesses. Having too many epistemic roles ultimately meant it had none. In other words, rather than delaying the demise of the ether, this multiplicity of presences of the ether may constitute another explanation for its disappearance. The ether became politically tainted, culturally flexible and increasingly contradictory. Those who wanted to save it were, perhaps, unintendedly accelerating its death.

4. Early obituaries of the ether

In writing histories or *biographies* of scientific objects, the historian of science is always faced with the problem of their identity. What is it exactly that one is trying to talk about? When should a history of the atom, for instance, begin? The usual reference to the Greek Democritus and Leucipus seems totally anachronistic, and so might nineteenth-century "indestructible" atoms be when compared to their twentieth-century homonymous counterpart. Some traditions within so-called historical epistemology refer to the "robustness" or the "recalcitrance" of the objects, which is a very helpful tool through which to give continuous accounts of changing epistemic objects. In the case of discontinued entities that, like the ether, simply vanished from the scientific stage, this problem disappears: attempts to modify and accommodate the concept to new epistemic needs can be easily disregarded as irrelevant or stubborn presences of the undead. In this context, we should go back to Chang's (2009) distinction between whiggish and triumphalist histories of science and pay attention to the fact that histories of past objects often create new, presentist objects: the non-existing ones.

In this context I suggest paying more attention to what I call the *obituaries* of the ether, namely, the early accounts of its demise given by physicists, engineers, philosophers and popularizers at the time when its existence or its properties were still contentious (Navarro 2020). What might have earlier been regarded as annoying inconsistencies yet to be resolved, may, in time, easily turn into absurd contradictions that historians see as the very cause of the object's death. This has been one usual strategy in the received histories of the ether, as we saw in section 2. Lord Salisbury's famous statement in 1896, saying that the ether seemed only to be "the nominative case to the verb to undulate" (Salisbury 1894, 5), suddenly became part of a *common feeling*, Michelson and Morley's interferometer null results were retrospectively given the status of *experimentum crucis*, and Pierre Duhem's (1893) famous criticism to the English school of physics confined the ether to a particular place and time.

While obituaries easily contain whiggish historical explanations to help the logical narrative, they may also play a role in reinforcing rather than challenging the robustness of the deceased object. The need to give a consistent account of what the object *was* may easily turn into an exercise of demarcating its limits, highlighting its properties and unifying its history. That was the main criticism Simon Schaffer made of the classic 1981 volume, *Conceptions of Ether: Studies in the History of Ether Theories, 1740-1900*, edited by Geoffrey Cantor and Jonathan Hodge (Cantor and Hodge 1981). While acknowledging the diversity of ether *theories*, the editors ended up creating an object that might not have existed in a continuous way, except perhaps for the preservation of the name. In the following, thus, let us explore a few such early accounts of the non-existence of the ether to see what strategies were used (Schaffer 1982).

While there had always been physicists opposed to any idea of the ether, prior to 1905, the most significant criticisms came from those opposed to the excesses of the model-making tradition. Famous among them were those triggered by the publication of Oliver Lodge's (1889) *Modern Views on Electricity*. For instance, the mathematician Karl Pearson complained that "to 'explain' the ether by mechanism is … to put the cart before the horse" (Pearson 1893, 133). Moreover, with so many "cog-wheels, elastic bands, bell-cranks, racks, et hoc genus" needed in modeling the ether, "the amount of grease necessary to keep the crystal spheres moving would have destroyed their harmony" (ibid.). On the other side of the Channel, Pierre Duhem declared that "we thought we were entering the tranquil and neatly ordered abode of reason, but we find ourselves in a factory" (Duhem 1893, 71). In both cases, it is not so much the ether as such that is being challenged; rather, what was at stake was a global challenge to a particular, model-making based way of doing physics.

The same can be said about the new positivism at the turn of the century. With his theory of cognition based only on sense impressions or, as he would call them, "elements," Ernst Mach tried to purify physics from metaphysics, which he regarded as unnecessary and illegitimate constructions of the mind. Force, atoms, and even matter became subjective inventions that had to be abandoned. Yet not even Mach (1893) rejected the ether, "which scientifically is something more valuable than the doubtful notion of the absolute space" (in Kostro 2000, 22). More radical on this particular matter, however, was Wilhelm Ostwald, who thought the ether was an unnecessary hypothesis, especially when he embraced energeticism. If energy was "a real substance—better, the only real substance of the so-called external world," he said, then "we no longer have a need to search for a carrier of it … [t]his allows us to recognize radiant energy as existing autonomously in space (Ostwald 1893, 1016).

If not the first, indeed the most famous obituaries of the ether were produced by Einstein himself. But he did so in several stages. In his 1905 founding paper on Special Relativity, Einstein claimed that the "luminiferous ether … will prove to be superfluous inasmuch as the view here to be developed will not require an 'absolutely stationary space' provided with special properties" (Einstein 1905, 38). The ether that was here declared unnecessary, rather than dead, was a reduced version of the previous ethers, namely his role as an absolute reference frame or stationary space. Interestingly, in previous standard explanations of the ether, for instance Maxwell's (1878) and

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Larmor's (1911) collaborations in the *Encyclopedia Britannica*, this aspect was only secondary to its nature. It was not until 1907, in his more pedagogical review article on relativity, that Einstein named the Michelson and Morley results as the experimental trigger to the theory of relativity. This, as is well known, was a post-hoc reconstruction and not a historically accurate account (Stachel 2002; Staley 2008; van Dongen 2009). Around 1909, with his further development of the theory of quanta of light, Einstein "killed" another ether, or another aspect of it: its central role in transmission of light, as the medium of electromagnetic waves. By equating light with particles, the intermediary medium became expendable (Einstein 1909).

These obituaries informed much of the pedagogy of the theory of relativity. But Einstein was also responsible for much later confusion. As is well known, in 1920 he resurrected the ether or, to be more accurate, imagined a new "space-time ether." The intricacies of his lecture in Leiden, with the presence of Hendrik A. Lorentz, whom Einstein held in high esteem, have been explored in depth (van Dongen 2012). The challenging thing about this episode is the extent to which this can be considered an attempt to resuscitate the old ether, to transform it while preserving the word, or to contribute to its final and total demise. Indeed, those who wanted to preserve the ether used Einstein's 1920 lecture as a rectification and an authoritative argument in defense of their cause, while others saw it as a transformation of the old ether.

But the third option is also possible. As the Spanish physicist Blas Cabrera explained in 1922, "it is not the resurrection of the previous [ether], which science has already buried, but a totally new creation that Einstein himself promotes without amending his previous thought" (Cabrera 1923, 302). Here it is worth mentioning a comment in passing by Jürgen Renn, who suggested that Einstein's 1920 ether was simply proof that he had killed another classical physics tenet, namely, the separation between space, time and matter which General Relativity had replaced with a more relational metaphysics. For Renn, it was unfortunate that Einstein chose the word "ether" to refer to the new notion of space-time, because he "probably did not think of what might happen when historians of science try to establish a continuity between the present and the past in which the undead can hardly be distinguished from the living" (Renn 2003, 1130). In other words, suggesting a new, totally different meaning to the word "ether" was not only proof that he considered the ether "dead enough to make a resurrection of the term with a new meaning unproblematic," but also a way to finish it off (ibid.).

Interpreting Einstein's 1920 resuscitation of the ether as an implicit obituary may work if we take into consideration the reason why I suggest obituaries are historiographically relevant, namely, as tools for the transformation of the previously existing object into a different, non-existing object. Arthur Eddington, Einstein's champion in Britain, also tried to preserve an ether à la Einstein, but with a more nuanced rupture with the past. As early as 1918, Eddington stated that "The phenomena, electromagnetic as well as gravitational, will all be described by the $g_{\mu\nu}$, which represents the state of strain of this space-time. This space-time may be materialised as the aether, and the aether-theory does in fact attribute electromagnetic phenomena to strains in this supposed absolute medium" (Eddington 1918, 79-80). As time went by, and true to his idealist, structuralist and anti-materialist philosophy, Eddington preserved talk about the ether not so much in continuation with previous conceptions but as a way to emphasize a total shift in the foundations of physics. Placing the discussion around the existence or not of the ether might overshadow the idea that other basic notions in physics—like matter, particle, force or space—were also experiencing profound transformations.

The place where this is made most obvious was in Eddington's 1935 book *New Pathways of Science*. At a time when the ether had largely been abandoned, Eddington continued to defend it, but with a very particular twist, namely, that abandoning the ether could only be the product of giving up a representational, realist mode of doing physics. The ether could only be dismissed if other common-sense notions followed suit:

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> There is no space without aether, and no aether which does not occupy space. Some distinguished physicists maintain that modern theories no longer require an aether—that the aether has been abolished. I think all they mean is that, since we never have to do with space and aether separately, we can make one word serve for both; and the word they prefer is "space." I suppose they consider that the word aether is still liable to convey the idea of something material. But equally the word space is liable to convey the idea of complete negation. At all events they agree with us in employing an army of mathematical symbols to describe what is going on at any point where the aether is—or, according to them, isn't." (Eddington 1935, 38)

Eddington's old friend and major popularizer of modern physics, James H. Jeans, was also keen to stress the rupture of the new physics with the Victorian tradition. For him, however, the disappearance of the ether was the cornerstone of such transformation. In his 1929 *The Universe around Us*, Jeans made it clear that "physical science left off trying to explain phenomena and resigned itself merely to describing them in the simplest way possible" (Jeans 1929, 329). And the example he chose with which to describe this shift towards what he called "a simpler science" was the ether:

> The Victorian scientist thought it necessary to "explain" light as a wave-motion in the mechanical ether which he was for ever trying to construct out of jellies and gyroscopes; the scientist of to-day, fortunately for his sanity, has given up the attempt and is well satisfied if he can obtain a mathematical formula which will predict what light will do under specified conditions. (Jeans 1929, 329)

The indirect accusation of insanity and the link between mental health and simplicity cannot elude the reader. Jeans was advocating for a mathematical turn of physics, and it was with this approach in mind that Jeans pronounced the ether dead: "The ether has dropped out of science, not because scientists as a whole have formed a reasoned judgment that no such thing exists, but because they find they can describe all the phenomena of nature quite perfectly without it" (Jeans 1929, 329). Reminiscent of Einstein's 1905 comment, this one too reflects that the strategy of irrelevance, not falsification, was the way to do away with the ether.

In a chapter on "Relativity and the Ether" in his 1930 *The Mysterious Universe*, Jeans addressed and dismissed those who, like Eddington, wanted to preserve the word "ether" for the continuous space-time of relativity. From his point of view, "as the hypothesis of relativity is the exact negation of the existence of the old ether, it is clear that any ether that relativity can allow to remain in being must be the exact opposite of the old ether" (Jeans 1930, 104). From this Jeans concluded that "it seems a mistaken effort to call them by the same name" (ibid.).

Ironically, Jeans' obituary gave a highly detailed description of the reasons why an ether had been needed in physics. He was addressing an audience that might have never heard of the ether, and which came to know about it through his extensive account. Devoting a whole chapter in a book on modern physics to something he regarded as non-existent looks a bit excessive. Moreover, this is a pattern we find in many popular books on physics in the 1920s and 1930s: negation of the ether came hand in hand with the creation of a space for it to be present, if only to be rejected.

More poignant than a dismissive obituary, however, is silence in the face of a loss. Explanations like Jeans' might induce some readers to hear about the ether for the first time and be convinced of its need rather than dissuaded. Another strategy was not to mention the ether at all. One example is particularly telling: that of John Ambrose Fleming, inventor of the thermionic valve and a key agent in the development of wireless technologies at the Marconi Company.

In 1902, Fleming gave a series of lectures at the Royal Institution. These were turned into a book that turned out to be very successful (re-issued a number of times in the following years), and which was often quoted in articles, lectures and books on wireless matters throughout the 1920s. In that book, the ether was a most real thing, since "there is abundant proof that it is not merely a

https://doi.org/10.1017/S0269889722000175 Published online by Cambridge University Press

convenient scientific fiction, but is as much an actuality as ordinary gross, tangible, and ponderable substances" (Fleming 1902, 192). The train of thought was the standard one we saw in the previous section: light and radiation were waves in a medium, analogous to ripples in air and water.

In January 1922, Fleming gave the Christmas lectures at the Royal Institution for a second time, and published them in extended form both in weekly installments in the periodical *The Wireless World* and as a book with the title *Electrons, Electric Waves and Wireless Telephony*. In these, Fleming (1923) gave a rather detailed account of the mathematics of waves, the constitution of matter, including the recent developments in atomic theory by Rutherford and Bohr, as well as Planck's quantum theory, the basics of electricity, magnetism and Hertzian waves, and then moved on to technical details about gramophones, telegraphy and wireless transmission. Surprisingly, in such a detailed book and contrary to what he had done in his Christmas lectures twenty years earlier, Fleming did not mention the ether—even once—either to defend or to challenge its existence. Silence about the ether was the best way to pronounce it dead, without the need of a eulogy or an obituary.

Perhaps equally harmful were the attempts to talk about an ether about which "its essential nature must for ever remain unknown, and, in fact, unknowable" (Corrigan 1928, 105), or to dismiss it as a "philosophical necessity more than anything else" (110). Turning to philosophy or to metaphysics was hardly conducive to the ether's preservation. William H. Bragg, for instance, queried whether the question about the existence of the ether made sense at all:

> This is a question which we ask at once. And yet when we come to think what answer we shall give, we begin to doubt whether there is any real meaning to the question, whether in fact it is a proper question at all. We soon get into deep waters if we try to picture to ourselves what is meant by "really existing." Fortunately we need not try: and ought not to try. (Bragg 1933, 18-19)

References to metaphysical notions were particularly unwelcome to Marxist scientists and popularizers, which served as a further inducement to dismiss the ether. In his book *Modern Science*, the Scottish mathematician and philosopher Hyman Levy described the old ether as a "special fictitious substance … invented solely for the purpose of 'explaining' the special difficulties away," a kind of "verbal trick," a "convenient dump into which all our difficulties could be flung or explained away by the simple expedient of saying 'The ether is like that'" (Levy 1939, 59). Described thus, the ether was no more than a "lying excuse" or, worse, it was "metaphysical" (ibid.). Interestingly, this argument was not too different from the one given by some anti-materialists who, like Alfred N. Whitehead, complained that in the "materialistic form of an all-pervading ether," the ether was "evidently a mere idle concept … a barren virgin" (Whitehead 1920, 78). Contrary to Levy, however, they argued that the ether "merely subserves the purpose of satisfying the demands of the materialistic theory" (ibid.).

Certainly, not all Marxists tried to do away with the ether, and that was particularly clear in post-revolutionary Russia, where physicists argued for preserving or dismissing the ether with the use of the new orthodoxy of Marxist arguments. Thus, while physicists like Yakov Frenkel, Igor Tamm or Abram Ioffe embraced modern relativity and quantum mechanics, and explicitly rejected the ether, more conservative physicists, such as Kliment Timiriazev or the electrical engineer Vladimir Mitkevich, preserved the ether and denounced the former "for promoting idealism" (Kragh 1999, 241. See Johnson 1991, ch. 7 and 8). The thing to emphasize here is that, in contrast to the idealism of Jeans or Whitehead, for instance, the ether could also be buried from a materialist conception. In both cases, the philosophical argument for its preservation or rejection seemed a post-hoc justification.

One other way to kill the ether was by imagining an explosion in the number of ethers. Rather than falsification, rejection or simple uselessness, some obituaries explained the death of the ether as the result of having to imagine infinite ethers, one for each moving system. In their attempts to preserve an ether, some physicists had suggested the existence of local ethers as a way to explain the FitzGerald contraction and the null result of the Michelson-Morley experiments. As

https://doi.org/10.1017/S0269889722000175 Published online by Cambridge University Press

philosopher and early defender of relativity in Britain H. Wildon Carr put it, the principle of relativity rests on the absolute constancy of light propagation from any reference framework. In terms of ether, this would mean that "instead of one absolute ether filling space, … we must conceive the ether to be carried with and belong to every system of movement" (Carr 1913, 414). But this multiplication of ethers to infinity "is precisely the same thing as to suppose there is no ether" (ibid.). Or, in the words of physicist George P. Thomson, in the face of suggestions that the de Broglie waves might be explained in terms of a sub-ether, with such an inflation of ethers "space is becoming overcrowded" (Thomson 1930, 11).

Finally, not all obituaries of the ether relied on Relativity or the Michelson-Morley experiment. On occasion it was the discovery of the electron, as the first elementary particle, that had supposedly paved the way for the disappearance of the ether. In his amusing popular book, *Within the Atom: A Popular View of Electrons and Quanta,* John Mills, fellow of the American Physical Society, argued that "with the discovery of the electron … the ether rapidly lost its importance and finally with the work of Einstein it has ceased to be a necessary postulate in physical science" (Mills 1922, xii). The reason behind this was that quantum physics had introduced a new way of understanding radiation, in which "the electrons may vibrate in orbits without loss of energy to surrounding systems" (ibid.). To clarify things, the author explained the relationship between the quantum theory of the atom and the ether: "This in itself is an argument against an all-embracing ethereal medium, for if it was capable of absorbing energy at all from a vibrating electron we should expect it to do so continuously" (120).

Incidentally, in this popular and, it should be said, rather humorous book, the author makes an interesting point, warning against popularizing the new physics through its history, since then "the terminology of the older physics of the ether is unavoidable" (Mills 1922, xii). This relates to, for instance, Eddington's emphasis on connecting the possible demise of the ether to the larger transformation of the ontology and methodology of physics. That is why, ironically, later in Mills' book we find a supposed dialogue between an electron, a proton, energy, the author, the general reader and the scientist, where the latter two communicate through "ether waves," later referred to as "the same *hypothetical* medium" (136).

Thus early accounts of the death of the ether used a diversity of explanatory strategies: from positivist and Marxist anti-metaphysics to instrumentalism and conventionalism; from a rejection of the old word "ether," to references to modern relativistic space-time, or dismissive silence; from an emphasis on the quantum aspects of radiation to mockery of the potential inflation in the number of ethers; and, indeed, from experimental falsification to the claim of "not needed"—or the agnostic "unknowable." Interestingly, however, in most cases these obituaries worked as an instrument, creating a space for the ether to be explained to the public, albeit in a way different from what Maxwell and Larmor had done in their articles for the Encyclopedia Britannica. The strengths of the ether in those accounts, primarily being the necessary medium for the transmission of electromagnetic waves, became only secondary or even irrelevant to the identity of the deceased ethers. At the same time, a side property, like the fact of it being a potentially absolute reference framework, became center stage. Obituaries were, thus, instrumental in changing the face of the ether.

5. Conclusions

"The sick man of theoretical physics." The expression was used by Albert Einstein in a supposed dialogue between a relativist and a critic of relativity in an article in *Die Naturwissenschaften* in 1918 (Einstein 1918, 701). When asked about the final death of the ether, Einstein's alter ego qualified that "The sick man has had a fluctuating fate; I don't think at all one could say he is dead now" (701). Moreover, he distinguished between the multiplicity of ether models before Lorentz, which existed "in a variety of forms of existence, changing from author to author" and the one that "under Lorentz … became rigid, embodying coordinate systems 'at rest'" (702). Since a "distinguished system of motion does not exist" in the old theory of relativity, there was no room for such Lorentzian ether; but the general theory of relativity takes into consideration that "empty space . . . has physical qualities," which "can well be interpreted by speaking of an ether" (ibid.).

In this short dialogue, Einstein captures the question that permeates the narrative of this paper, namely that the death of the ether points at the question of this epistemic object's identity. As we have seen, the demise of the ether poses some historiographical problems which this paper has tried to unveil, and which transform the apparently easy question about the end of the ether into a complex conundrum. The first section showed how simple stories about the demise of the ether were helpful for different philosophical agendas, either empiricist, Popperian or Kuhnian. The case study was fit for purpose, but assumed the existence of an epistemic object that either was always problematic and the source of the fatal crisis of classical physics (Kuhn) or experimentally proved to be wrong (empiricist and Popperian). In all cases, however, there was no doubt that the entity to have vanished from physics was clearly understood and well defined.

The next section showed that the ether remained alive and even modern in scientific, technological, cultural and popular milieus while negotiating its demise in other forums. This dual status, dead and alive at the same time, but for different purposes and with different meanings, also challenges the assumption of the ether as a well-defined object. Perhaps this multiplicity of existences was partly responsible for its ultimate demise. Responding to Wilczek's comment quoted above that "quite undeservedly, the ether has acquired a bad name" (Wilczek 1999, 11), one could argue that precisely this inflation of ethers, or of attempts to preserve or resuscitate it, was partly responsible for a well-deserved bad reputation of the name "ether."

Finally, a preliminary exploration of the ways in which the ether was said to have disappeared from science in the first third of the twentieth century, in what I have called the *obituaries* of the ether, points at the creation of a partially new epistemic object: the non-existing ether. Its properties could be more clearly defined, the attributes of the non-existing ether more clearly demarcated, thus putting an end to certain research avenues or speculations as well as cursing a name.

And this brings us to the fourth sense of explaining posed in the introduction. Can the historian *fully* explain the demise of the ether? In a way, the reflections above point to a negative answer, since—inevitably—the historian would end up producing another obituary, another account of a non-existing object, thus implying a certain necessity for its disappearance, both as a concept and as a name. But history is totally contingent. And while my aim is in no way to attempt to bring the ether back to life in physics, to support those who are trying to do so, or to imply that the ether was unfairly abandoned, my suggestion is that history could have been different and that one can perfectly think of a world in which Einstein and Eddington's 1920s ether, or Dirac's 1951 version, might have taken root, in which case a continuous history of the ether would have, of course, looked totally different while preserving most of its episodes intact.

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Cite this article: Navarro, Jaume. 2021. "Killed by its own obituaries: Explaining the demise of the ether," *Science in Context* **34**:209–225. doi:10.1017/S0269889722000175