

# Actants at Any Depth:

Bruno Latour and Henri Bergson at The Surface of Science

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## **Introduction**

This article seeks to employ the dialectic of 'surface/depth' to reassess the value of enquiries in the "human sciences" into the problematic nature of the semantic basis and the theory-ladenness of scientific texts.<sup>1</sup> It posits simply that while sociological and speculative studies of scientific work often proceed in what may be thought of as an 'unscientific' manner, these humanist studies can nevertheless be understood to expose deficiencies in the models of explication and transmission that are deployed in the empirical and formal knowledge-making apparatuses of such scientific texts. The argument proposed is that humanist studies of science do a different kind of intellectual work to scientific studies, although the former work, at its highest, may also be seen, in its own way, as *scientific* work.<sup>2</sup> At the very least it may be seen as cooperative in the production of scientific knowledge, albeit, as it were, at the 'surface' of detailed scientific explications. In pursuing this thesis, I will examine the work of two French humanist social scientists and philosophers, Bruno Latour and Henri Bergson. The work of each, I argue, can be seen to expose important problems with the communication of particular scientific experiments that are not recognised by the physicists who perform these experiments. Throughout the article, I will sometimes speculate on the possibility that this humanist work 'at the surface' may also be consequential for the deeper work of theoretical and experimental physics, although I wish to situate this speculation within the history of the criticism by physicists of just such a mode of speculative attestation.

First, however, I shall sketch out the terrain of the article and the conception of surfaces and depths that will be adopted and applied herein. In the physical sciences, 'surfaces' and 'depths' can be said to be observable in all material objects. Today, the world of experimental particle physics can be said to ever more excitingly reveal to us the objects or the surfaces that reside at previously unknown material depths. Here, molecular, atomic, and subatomic particles are thinkable as

kinds of surfaces that are deeply (at different depths) embedded or enfolded within other surfaces. In this particle world, and under this empirical *epistêmê*, it can often seem that if one is equipped with a sophisticated enough technical instrument and if one adopts the right technique (*technê*), then the depth to which the human eye or mind can travel, can find new surfaces, is infinite. It can seem as though the “experimental access” of physics to formerly unknowable phenomena such as electromagnetic radiation and field quanta, to the constituents of subatomic matter and so on, is limitless.<sup>3</sup> But the actual work of the modern physicist is never a pure event or discovery of these surfaces and depths as such. It must also be reproduced on another—some might say less material, some might say virtual—surface: that is, the semiotic, hermeneutical and semantic surface of textual inscription, the site at which this knowledge is enunciated in graphemic or semeic language. Thus physics requires, ultimately, a transfer of knowledge across what appears to be the increasingly *accessible* natural (*physis*) site of the physical experiment, a site with its own typology of surfaces and depths, to the site of the text (*logos*), which traffics in a different, albeit parallel typology of surfaces and depths, meanings and definitions. It is this seemingly age-old distinction or dialectic between the *physis* and the *logos* that continues to perturb and haunt humanists (specifically those in sociological science studies and in speculative philosophy<sup>4</sup>). It is this dialectic that this article theorises about, in an attempt to reify and attest to the work of those humanists that encounter physics in non-specialist language—despite the problematisation of their efforts by physicists throughout the twentieth century.<sup>5</sup>

In the first section of this article I am motivated by Isabelle Stengers’ innovative work on the neutrino’s “paradoxical mode of existence” to propose that the 2013 announcement in the field of particle physics of the discovery of the Higgs boson emblematises two aspects of the broad distinction between *logos* and *physis*.<sup>6</sup> In this opening section it will be argued, firstly, that the discovery of the Higgs boson itself depends on the assumption common in the natural and physical sciences, that knowledge is generated as a result of piercing unperced ‘surfaces’ and of revealing previously unknown ‘depths.’ Secondly, it will be argued here that the *announcement* of this discovery may be read as an instance of the problems associated with the kinds of transfer of knowledge between scientific event and textual communication that I have adumbrated above.

Following this, I will then turn to the broader phenomenological and transdisciplinary relation between the social sciences and physics, although the terms in which I study this relation shall not be my own invention. Rather, I will consider (and adopt) one of Bruno Latour's many contributions to science studies: namely, his schematic development of a material-semiotic approach to textuality in his actor-network theory (ANT) and in his language and theory of 'actants' or actors as a way of encountering the textual production of physical science.<sup>7</sup> In the final section, I want to focus specifically on the example of Latour's loosely semiological analysis of Einstein's popular explications of the theory of relativity. Moreover, I will follow the scholarly threads that have led researchers in the field to compare Latour's work to Henri Bergson's: particularly to the latter's objection to parts of Einstein's principles of equivalence and to his concept of simultaneity, which developed into special and general relativity. In the final paragraphs of the article, I will examine the way in which Bergson's claims apropos Einsteinian relativity came under scrutiny and then were summarily dismissed in the early twentieth century, in the same way that Latour's claims have been examined and dismissed more recently.

### **Do Surfaces and Depths 'Matter'?**

It was more than fifty years ago that the philosopher and "zen-popularist"<sup>8</sup> Alan Watts, in a recorded lecture titled "The Nature of Consciousness" observed how physics had, long ago, abandoned one of its foundational enquiries<sup>9</sup>:

Long, long ago, physicists stopped asking the question 'What is matter?' They began that way. They wanted to know, what is the fundamental substance of the world? And the more they asked that question, the more they realized they couldn't answer it, because if you're going to say what matter is, you've got to describe it in terms of behavior, that is to say in terms of form, in terms of pattern [...] You take your microscope and you look at it, and instead of just this block of stuff, you see ever so many tinier shapes. Little crystals. So you say, 'Fine, so far so good. Now what are these crystals made of?' And you take a more powerful instrument, and you find that they're made of molecules, and then you take a still more powerful instrument to find out what the molecules are made of, and you begin to describe atoms, electrons, protons, mesons, all sorts of sub-nuclear particles. But you never, never arrive at the basic stuff. Because there isn't any.<sup>10</sup>

While we may find things to doubt in the mystic's knowledge of physics and its history, it is likely that those whom Watts knew in the physics departments in the US, perhaps at Berkeley, *had* stopped seeking the so-called "basic stuff." The imperatives of the Second World War had meant that the whole field of physics theory, including quantum mechanics and questions about the basis of matter, so contested and exciting at the start of the century, had fallen out of fashion in the physics departments across American universities. This is the view advanced by MIT physicist David Kaiser in his history of twentieth-century physics in the US.<sup>11</sup> With the quantum revival of the 1960s, however, Watts' description of the demise of one of physics' fundamental questions seems out of date. Explicit or not, the focus of projects in physics, since the '60s, has clearly returned to the question of the nature of matter's 'basic stuff', and in ever more positivistic and exciting ways. In June 2012 and again in March 2013, two groups of physicists analysing the data collected at CERN's Large Hadron Collider (LHC)—the separate ATLAS and CMS collaborations—independently announced the discovery of a new resonance at a particular level of mass. The discovery, each group announced, involved the detection of the Higgs boson: the yet-unconfirmed "cornerstone" of the so-called standard model of particle physics—the model that describes how elementary particles and a set of forces between them lead to all matter and most "higher interactions" in the universe.<sup>12</sup>

In a broadly paradigmatic (Kuhnian) or epistemical (Foucauldian) sense, we can say that the work at the LHC and its associated publicity emblematises the post-war return to the troubling but tantalising question of what resides at the "bottom" of deep (subatomic) surfaces. This is a question Kuhn might still perhaps associate with the history of discovery in physical optics, which is a subject discussed extensively in his work.<sup>13</sup> However, it might also be said of this specific event that we have witnessed an instance of the seamless, perhaps the *total*, co-constitution or co-integration of the theoretical and a practical elements of an area of knowledge in quantum physics. It should be remembered that the Higgs boson was indeed only a "theoretical" part of a proposed model prior to its actual "discovery" as a real-world artefact. It was only this confirmatory *discovery*, rather than the hypothetical development of this boson in the 1960s, that authorised the Royal Swedish Academy of Sciences to award Peter Higgs and François Englert the Nobel physics

prize in October 2013.<sup>14</sup> Predicted discoveries such as this, as Isabelle Stengers notes, do not represent a “normal” interaction between rational experiment and nature, but rather the suturing together of the theoretical and the practical—the “mutual involvement of two realities undergoing correlated expansions.” On the one hand there is the “dense network of our practices and their histories,” which includes the written history of the Higgs boson—a written work that predates the boson’s discovery.<sup>15</sup> On the other, there are “components and modes of interaction that populate what is referred to as the “physical world,”” which we can now say includes, as confirmed by the LHC, the Higgs boson as one such mode of interaction. This, again, may be read as an interlocution between *physis* and *logos*, nature and language.

The many ways in which the predicted “reality” is said to become mutually involved with the discovered “reality” might on one level seem insignificant if, in any case, the two realities are scientifically demonstrated to coextend. Nevertheless, the paradoxical way in which the span of human history was said to depend on the Higgs boson was interesting enough to prompt Nicolas Mendoza to make it the subject of a short opinion piece in *Al Jazeera* in 2013. Mendoza was struck by the way that Rolf-Dieter Heuer, CERN’s Director General, responded to a journalist who had asked about the “relevance” of the discovery for non-scientists. For Mendoza, Heuer’s response—that “if the Higgs boson did not exist then you (and everybody else) would not exist”—made it seem, in his view, “absurd to even consider that [human] existence might be determined by orders of things different than subatomic particles.”<sup>16</sup> Mendoza’s attitude is not anti-scientific; rather, it acknowledges that the “powerful language used to build the narrative of the LHC [and the Higgs]...makes the issues of knowledge [and knowledge-making] hard to think freely about.”<sup>17</sup> There is something restrictive in Heuer’s explanation, which has to do with its clean distinction between humans and the boson we discover. As Heuer went on to say, we as humans can be said to “receive our autonomy” by dint of the discovery of the boson. It emphasises the importance of the discovery by reference to the boson’s creation of humans—those by whom it is now discovered—while it underplays the role of the human in discovering it. A question to do with the character of human knowledge becomes, in Heuer’s hands, a question about the nature and activity of external objects. This failure on Heuer’s part to distinguish sufficiently in his answer between human knowledge and the

objects or elements that constitute this knowledge indicates the difficulty in clearly distinguishing, in the physical sciences, between nonhuman elements or actors and their human discoverers. Even before the announcement of the Higgs, Bruno Latour described this mode in which an experiment or experimental result is accorded “an autonomy [that we humans] do not have.” Here the experiment is a generative process in which we as humans are ourselves (re)imbued with an autonomy that we had previously lacked.<sup>18</sup> In this way, the results of scientific experiments are valorised as a testament to our increasing sovereignty as they simultaneously are said to remind us of the way in which the deterministic aspects of prior *epistêmês* had deprived us of the same. To place this notion in the context of the dialectic of surface and depth, here we are concerned with the apparently implacable and unstable distinction between the ‘depth’ of the knowledge we ascertain about nonhuman objects that is generated in an experimental trial, and the surface of the historical practices. Specifically, when we speak of surfaces, these are those semiotic or semantic practices that have to do with the creation of language, including the creation of what Latour calls “factishes”, that are exercised by humans to represent the trial.<sup>19</sup>

### **Can Bosons be Actants?**

Bruno Latour’s analyses of the language and practices deployed in the texts of physics through the framework of Actor-Network Theory represents a valuable contribution to contemporary philosophy of science. To summarise the range of specific ways in which Latour apprehends matter vis-à-vis the theories of physics would call for more space than the present article affords. Accordingly, I will here attempt only a brief and suggestive outline of the differences between his arguments about matter and those formulated by “substance theorists.”<sup>20</sup> As a starting point, we could say that for Latour there is no “deep” substance, no Kantian “thing in itself,” only relative hierarchies of translated and negotiated alliances and influences—including some that are traitorous and treacherous—between what he calls “actors” or “actants.”<sup>21</sup> Actants, for Latour, are material agents that have their own unique account of becoming, and of becoming identifiable as such through discovery. To think about objects as actants rather than as substances, as things that are not dependent on notions such as ‘essences,’ is to abandon not only Kantian thinking, but also the long tradition of metaphysics

beginning with Aristotle's postulation that substances "signify a certain 'this,'" that they are "numerically one" and that they are (yet) "able to receive contraries" such as "sickness and health, and paleness and darkness."<sup>22</sup> Substances, although invisible, remain real and enduring through time. As Graham Harman explains:

For Aristotle, individuals are substances—and substances are deeper than their accidents and their relations to other things, and capable of enduring despite changes in these inessential features. For Latour, by contrast, an actant is not a privileged inner kernel encrusted with peripheral accidents and relations. After all, this would make a thing's surface derivative of its depth... [Rather,] a thing is so utterly concrete that none of its features can be scraped away like cobwebs or moss. All features belong to the actor itself: a force utterly deployed in the world at any given moment, entirely characterized by its full set of features.<sup>23</sup>

Actants are thus not determinable as substances whose permanent, for-the-moment-invisible depth may at some time be revealed behind a surface, in contrast to other inessential or non-substantial aspects, which are subject to alterations. Actants are more radically concrete than this; they are determinable or identifiable only in terms of their striated and individuated relations, often accidental, with others. So defined are they by these alliances that, as Harman remarks, "the more they are cut off from these relations, the less real they become."<sup>24</sup> Unlike the Aristotelian substance, which by comparison is abstract and static, an actant possesses no surfaces or depths that are not the very same as those that are consubstantial with its autonomy as a singular or "numerically one" object that is "fully deployed," and thus exerts influence over other actants, in the world.<sup>25</sup>

However, far from being a denial of the existence of concrete matter or of substances in general, Latour's particular object-oriented philosophy can be seen as a refinement of the notion that there is no "basic stuff" of the kind described by Watts. The same is true of the "cosmopolitical" response to science advanced by Isabelle Stengers. That is, Latour and Stengers both acknowledge the interconnectedness of "forces" that are, properly thought, irreducible, such as the character of cooking as compared with the character of working as a biological and biochemical researcher studying and manipulating a material such as algae. Although those employing such different approaches "do not value the same materials," they "like to do the same things with them."<sup>26</sup> This suggests that these

procedures of interaction share common features relating not simply to our human senses and methodologies, but also the nature of these materials. However, Latour and proponents of irreductionist object-oriented philosophy problematise foundational epistemological conceptions of matter and substance by announcing a *finitude of depth*<sup>27</sup> (that no thing can be reduced to its essence or substance), as they implicitly proclaim the birth of a new ‘evental’ metaphysics. This is a kind of ‘actualism’ that valorises not the ‘relativism’ or ‘relationism’ (*pace* Leibniz) by which the sizes and depths of objects are adjudged, but firstly a relativity of actants, always aborescent, always becoming, and secondly a relativity of their acts or actions. Entities are not things constituted epiphenomenally by their surfaces and depths. They are rather only provisionally deducible in the ‘evental’ context of the scientific encounter wherein the infinite list of a thing’s features, relations, and influences are apprehended. In pharmacology, the word “promiscuous” has been used to describe a “compound’s pharmacological-molecular activity” when it affects “multiple targets”: that is, the wide extent of the compound or metabolite’s actions within a specific organ or system.<sup>28</sup> By contrast, “selective” denotes a compound that “hits no more than one target.”<sup>29</sup> In Latour’s conceptualisation of irreduction, depths and surfaces become metaphors for a similar kind of promiscuity with respect to an actant’s activity, metonyms for the diversity of those interactions that environ the actant and the specific features of these interactions. Thus, the principles of “reduction” yield

plain, clean surfaces. But since there are many surfaces, they have to be ordered, and since they each occupy the whole of space, then they fight one another...To escape, we have to eliminate almost everything, and whatever is left grows each day...”<sup>30</sup>

An actant’s surface, then, is not plain or clean, but complex, dirty, and thus perhaps even *deep*. In extension of this principle, Latour also argues that the “strength” of an actant—its “durability”—is determined by the richness and frequency of its relations with others (akin to promiscuity in pharmacology), suggesting that the surface is a *temporal* as well as physical quality.<sup>31</sup>

But if this is so, how are we to determine an actant’s identity—whether it essentially exists, or where it begins and ends—if not by the surfaces of its material

substrate, its physical corpus? For Latour, a determination like this is precisely the task of the scientific trial. The “trial” is paramount to the verifiable discovery of how ‘deep’ relations and acts might be distinguished from the identification of merely a ‘surface’ impression of an actant’s essence (so-called). And yet even then trials themselves may call forth no more than an *exegetical* explanation from the actant:

Is an actant essence or relation? We cannot tell without a trial (...) To stop themselves being swept away, essences may relate themselves to many allies, and relations to many essences. An actant can gain strength only by associating with others. Thus it speaks in their names. Why don't the others speak for themselves? Because they are mute; because they have been silenced; because they became inaudible by talking at the same time. Thus, someone interprets them and speaks in their place. But who? Who speaks? Them or it? *Traditore-traduttore*. One equals several. It cannot be determined. If the fidelity of the actant is questioned, it can demonstrate that it just repeats what the others wanted it to say. It offers an exegesis on the state of forces, which cannot be contested even provisionally without another alliance.<sup>32</sup>

The actant on trial is thus well placed (in fact, it is only then that it is appropriately placed) to give what Harman calls a “public performance” by which it is adjudged and knowable.<sup>33</sup> And since such a public performance is not limited to speech acts, body language, or even ‘actions’ so much as the actant’s potential reactions in a “trial” setting, it is distinguishable, for Harman, from theories of human performativity (such as Judith Butler’s<sup>34</sup>) as well as from theories of human speech acts (speech-act theory) advanced by theorists like John Searle. Thus Harman observes that “what [Latour] gives us is not speech-act theory, but *actor-act* theory.”<sup>35</sup> In this way, for Harman, Latour transcends a range of “stale dualisms”—perhaps including the dualism (stale or not!) of surface and depth—and no doubt including the distinction between language and nature that I have introduced above. As Latour points out, there is nothing special about “language that allows it to be distinguished from the rest for any length of time.”<sup>36</sup> Of course, it is notable that Latour will recurrently metonymise actantial action *as* the deployment of language, as in the example from the long quote above. Throughout his work, he observes that actants “speak,” “translate,” talk at the same time, and even offer “exegeses.”

In any case, the emphasis in reality is not on the speech-acts of actants, but on the evidence, in a trial, of those properties by which actants may be said to be constituted. What is interesting about Latour's proposal of the trial as the ultimate site of technical determination (*technê*) for distinguishing 'essence' from 'relation' is the reliance that this places on an emergent property in the form of a reaction to appear. For Harman, a "real emergence" of the kind that satisfied the Latourian standard "cannot be merely functional/relational, but must amount to the generation of new autonomous things." For if it were otherwise, "we would have a final layer of atomic microparticles," and it appears that we do not (as continuing studies into the Higgs field—and in particle physics generally—may be seen to demonstrate). Thus, it is not simply a question of a thing's relation with others that determines its existence (or strength) as an actant, but the appearance of wholly independent emergent properties that may appear at any "level of the world," shallow or deep. Harman's explanation of why this must be so for Latourian object-oriented-philosophy is worth quoting at length:

And though [Latour] never passes the reality downward to an artificial stopping point in the purported final kingdom of quarks [and Higgs bosons], he does [incidentally] pass it upward to the outward effects an actant has on its neighbors. But the buck must never be passed in either direction. The reality of an object belongs to that object—not to its tiny internal constituents, and also not to the larger collectives in which it is immersed.

Here we begin to see how the notion of a surface or a depth itself becomes simply an imitative or mimetic abstraction out of which the emergence of "new autonomous things" may be traced at "each level of the world." And yet none of these are witnessable or explicable in any more privileged way than another. For Latour, it can be said that the interactivity and participatory rituals (*methexis*) by and between actants, and the emergences that reveal or betray them to us, are no less real for their having been misread or for their not having been intuited through the optic.<sup>37</sup> that is privileged or dominant at a particular time. On the contrary, it is precisely the viewer's (or better yet, the trialler's) participation with and within this order that disturbs the possibility of an objective physics. In seeking to "pass the buck of reality downwards," observation of actants becomes a mediated practice in which an array of presupposed optical and hermeneutical

fields—political, philosophical, physical—play their own part in affecting that which emerges, if indeed anything does emerge. What is more significant than this in Latour, however, is the notion that it is not simply these human relations with the actant that affect our observation and engagement with it as such. On the contrary, it is any relations that the actant may have, or have had, with any other nonhuman thing at all, including the very relation with *materiality itself*, which, for Latour, is just another mode of actantiality. Thus, the discovery of the Higgs boson is not a discovery of that actant so much as a discovery that its resonance can participate in a *methexis* with the range of those materials which have been organised so as to make this participation possible using CERN’s LHC.<sup>38</sup>

As Harman forcefully argues, Latour thus presents a persuasive “critique of matter,” which appears to be a form of idealism. However, we perhaps need not go so far as this with Latour to find an application for his general conceptualisation of network theory in respect of the Higgs boson. Could we not argue (adopting the idiom) that the physicists at the LHC have been engaged not simply in the process of identifying an altogether new “actant,” but rather in “underwriting” new proofs for the potential “strength” of this actant over others?<sup>39</sup> In this way, could we not say, contra Latour, that the Higgs boson and the neutrino<sup>40</sup> are presented by physicists as more significant kinds of particles than others? that the buck is being passed downwards? Latour argues that this need not be so; that no actant need be so privileged, as one merely constitutes an individual perspective on all the rest: that “[e]very actant makes a whole world for itself.”<sup>41</sup> If we think through the same matters with Stengers, who addresses this issue from a slightly different point of view—that is, through a reconstruction of science’s “ecology of practices”—we can offer an alternative to Latour’s position. We can say that the trial at the LHC verifies not only the existence of these actants but also the physicist’s foreknowledge of them, and that therefore the actants have become, with their discovery, at once creatures of both the physicist’s inventiveness and of nature. Of course, the nonhuman “proofs upon which the legitimacy of [their] existence within physics depends” are supposed to give the physicist the “power to claim that [these particles] had existed for all time and in all places.” They are supposed to justify us in overlooking the interaction or event by which they were discovered—in fact, to erase it—so that a claim can be made that the Higgs is part of the “ingredients not of human history but of the history of the universe.”<sup>42</sup> (These suppositions are

clearly behind Heuer's remarks.) It is in this way, Stengers argues, that such actants come to exist with "all the characteristics of a real "actor.""<sup>43</sup> The discoveries of physicists must thus be regarded to be wholly independent of the human devices and practices that identified them. They are again akin to the "natural substances"<sup>44</sup> of Leibniz, or the enduring "substances" of Aristotle.

### **Latour and Semiotics: Reading the Surface of Science**

In developing his theory of actants, Latour becomes a semiologist on two levels. On the one hand, his work carries on a technical study of the textual representations of objects and of materiality after Étienne Souriau,<sup>45</sup> Greimas and other structuralists. So for example in his essay on Einstein, "A Relativistic Account of Einstein's Relativity," Latour attends to the strategies and tactics through which the structures of Einstein's non-specialist science text is maintained: the 'positioning', 'stacking,' 'framing,' and 'captation' which are used among the text's other features. On the other hand Latour is also a semiologist of culture. He applies a rigorous technical theory to the socio-political, philosophical and historical conditions through which these textual structures have emerged and are maintained. While Latour's methodology offers more than these sociological and semiological frameworks, one cannot ignore the fact that he recurrently frames the encounter with scientific texts and with culture in terms of signification. When he invokes the expression "*Traditore-traduttore*" [Translator-traitor], and employs other metonymies for an actant's behaviour so as to illustrate the continuous discordances and fissures between actants, he also affirms the primacy of signification within the methectic or participatory structure of these interactions. Yet this is of course also one of the ways in which Latour is able to challenge the specialist discourse of physics and its own 'translations' of nature. When he interrogates the book on relativity theory that Einstein authored for a non-specialist readership, he focuses on the work as a translation of the physical theory into a narrative form. Here, as Latour suggests, the concept of the 'frame of reference' as it is understood in physics is reexpressed by Einstein; consequently, it attains a different, and a less stable, meaning.<sup>46</sup> In view of his emphasis on signification, Latour's critics have argued that his attempt to apply semiotic notions to theoretical physics, and specifically to Einsteinian relativity, fails on the basis that Latour mistakes Einstein's pedagogy—his attempt to teach relativity to

non-physicists through his book—for the theory of relativity itself. Alan Sokal and Jean Bricmont claim that Latour completely misunderstands the ‘frame of reference’ concept in the physics. According to them, he is so bewildered on this point, he is led, through his semiological and narrative analysis of Einstein’s non-specialist book, to include a ‘third observer’ or third frame of reference in the theory whereas there should only be two.<sup>47</sup> These critics also excoriate the manner in which Latour observes that Einstein employs a “shifting in” and “shifting out” of narrators, arguing that this is an example of Latour’s wider semiotic misreading of physics and the “sociological bias” that he brings to his study of science as a whole.<sup>48</sup>

What seems to be ignored or only hastily acknowledged in these criticisms is that Latour’s “misunderstanding” of the reference-frame is a necessary part of an argument that is engineered as a broad critique of the illusoriness of this nonhuman referential system. It is an attempt to relocate the human scientist/subject (in this case Einstein) as an operator in the process of the explication of the theory, with its narrational shiftings in and shiftings out. As Latour argues, the strength of an actant (and a theory) is, when trialed, often demonstrable as its “tiered array of weaknesses,” both in physics and philosophy.<sup>49</sup> In this case, Einstein’s mobilization of the reference frame is argued to be weakened in its non-specialist explication insofar as it is always under the command of its “enunciator.” It is always a tool or technic in the hands of the individual who must compose (and apply) the theory, who must do the “lowly work” of physics by “building and relating frames to one another in such a way that some kind of stable form can be maintained which can, then, be cumulated, combined, and superimposed” on the physical world.<sup>50</sup>

Thus, Latour describes the way in which Einstein, as the “enunciator” in his text, “shifts-out” of the text only to have other actants (“delegated observers”)—characters or agents who are clearly *not Einstein*, but yet are written, invented and abstracted *by Einstein*—“shift-in” to the text in his place. These delegated observers, moreover, become more than simply the sum of their operations. While they are the produced abstractions of an enunciator, they are yet actants, as all things are, and as such, these abstractions must be regarded in the same way as all others. They must undergo the Latourian trial. Thus, Latour must ask: how did these actants *emerge*? How were they transformed from the abstractions of an

enunciator, from the dull and unstructured hypotheses of a theorist, to the actants that we now see before us, the bright and structured theses that must be trialed? Latour gives shape to the process:

Einstein's first move in this text is to bring the abstractions back to the inscriptions and to the hard work of producing the them. This shift of emphasis from abstraction to inscription will allow Einstein to transform the usual frame of the traditional Newtonian narrations into actants that can be altered (shortened, slowed down, elongated, rotated).

More significant than Latour's recharacterisation of Einstein's delegated observers as merely actants, as agents that must be equipped with "clocks and rulers" to metrologically order the narrative—to give "meaning" to "a statement of the time of an event"<sup>51</sup>—is his notion that enunciators make "gains" in so articulating their theories. Latour identifies the "weakness" of the authorial enunciator as one that is constituted by his or her claim to have accumulated knowledge. In enunciating a physical theory, for instance, the speaker gains not simply (and possibly not even) knowledge, but a mark of "privilege." This is specifically the privilege of holding the highest position among those observers whom the writer has dispatched and delegated, whose "points of view...can be easily reduced to the enunciator's," and from whom the writer is the single recipient of their perfectly (and yet artificially) retranscribed "paperwork."<sup>52</sup> As Latour contends, in Einstein's book this process occurs at the cost of the delegated observers' independence. In 'going to work' for the enunciator, the observers forfeit their rights to have a "personality." As with principles in liberal economics, the imbalances between actors generates an imperilled, possibly untenable situation in which either the enunciator can shift in or out of the now unequal frames of reference (relativism), or the delegated observers work for the enunciator only, who "cannot be betrayed by anyone" (relativity). It is in this way, Latour asserts (and by virtue of Einstein's mobilisation of the Lorentz transformations to so shift in and shift out of reference frames<sup>53</sup>), that the enunciator him or herself will always be a third or supplementary actor-observer. He or she will be an omniscient presence who controls and claims privilege over and from others, without the legitimating force of an independent, ordinary scientific principle, but

rather by means of the operationality of the Lorentz transformations (whose operationalised processes, as such, remain unquestioned, unproblematised). This remains the case notwithstanding that Einstein's narration "focuses the reader's attention upon those very operations" of shifting in and out. His ablation of "space" from this narrative, which he will "entirely shun" as a "vague word," is suggestive of the transferral of the Lorentz transformations into the non-specialist, narrational world of organisation: a world whose space is only ever imaginable as such (there is no real, material depth on the page!).

### **Latour and Bergson: Allies Out of Joint?**

While Latour does not explicitly declare the influence of other scholars (except perhaps that of Greimas), Val Dusek astutely notices the resemblance between Latour's reading of Einstein and Henri Bergson's critique of another aspect of relativity theory. Bergson's criticisms have been widely dismissed, history using similar objections to those which have been brought against Latour's interlocution with Einstein.<sup>54</sup> Bergson is ordinarily said to have completely misunderstood the conceptual basis of time dilation and the twin paradox<sup>55</sup> inasmuch as his formulation, like Latour's, introduces the possibility of a third agent. In Bergson's interpretation, that agent assumes the form of "unitary time." As Dusek points out, where Latour claims that in Einsteinian special relativity there is a third observer who must superimpose the "paperwork" of those two who are sent to collect and retranscribe it, Bergson

makes a similar move in claiming that there is a unitary time subsuming the relative times of the two observers in Einstein. Sometimes, as in Latour's account, this is the time of the third observer subsuming [that of] the other two. Latour and his critics, as well as his physicist defender David Mermin (...) confuse the number of physical observers needed in special relativity with the philosophical question of whether in thinking about some topic we are also thinking about ourselves thinking about it. The third observer is not one of the observers in the physical system, but is this self-conscious theorist or reader thinking about the other two physical observers.<sup>56</sup>

It is notable that while Dusek makes the clear point that Latour (*and* his critics *and* his followers) confuse an issue of theoretical physics with a philosophical

question, we may wonder what this means. Can we not say that this philosophical question does emerge out of the text as a result simply of its having been read? Dusek's interpretation suggests that what emerges is precisely a heightened awareness—perhaps even a species of proprioception—about ourselves as the operations of the narrative compel us to accept its theoretical structures, in what Latour will call an “infra-physics” of human and nonhuman.<sup>57</sup> However, for Dusek, it is simply not necessary for readers to consider the function performed by the scientific narrator in the communication of physical theories. His argument is in this regard not greatly different from that of Sokal and Bricmont, except that the former is better able to explicate and sympathise with Latour's philosophical question than the latter pair. But why is this question irrelevant? Or better, yet, how is it so? It is difficult to say why the emergence of such a philosophical question, as an autonomous thing, should be insignificant when it is naturally suggested by the text's tendency to focus “the reader's attentions on [such] operations,” so that the theorist-narrator is frequently an object of the reader's attention. More than that, though, further consideration of the question might show that it is just as likely *not to be a philosophical question at all*. Perhaps it is primarily rhetorical, or relates to the foundational question of the degree to which the findings of a physicist's investigations can be expressed in non-specialist language. In gaining this heightened awareness of the enunciator's (and of our own) indispensability in integrating the various framing operations involved in Einstein's explication of the theory, we do not simply learn more about Einstein's pedagogical skills. Such an interaction with theory, we discover, is of a piece with the theory's verifiability, durability, and meaningfulness as knowledge that is readable or knowable.

Understood like this, Dusek's appraisal of Latour seems to concur with Harman's reading wherein Latour can be said to be concerned to define actants as agents from which other independent entities must emerge “at any level.” And although Dusek's comparison of Latour to Bergson would seem to do little to vindicate Latour's arguments, or to inoculate him against further charges of misreading the physics, this pairing or doubling may offer a way for us to further clarify Latour's interlocution with physics. With Dusek, we can understand Latour's “serious error” not as “one which comes from an apparent confusion between the concept of ‘frame of reference’ in physics and that of ‘actor’ in

semiotics,” but as his justifiable devalorisation of the assignment of privilege to the enunciator-physicist among other actants, a privilege he continually critiques through his writing. Since Latour nowhere explicitly claims the reference frame concept is weak because it secretes the significative traces of a subject-enunciator, it remains open to Latour’s readers to interpret his criticism of Einstein as though he has not made a basic mistake with respect to physical theory. My own reading of Latour’s point is that the problem in Einstein’s narrative explication concerns the paradoxical closeness and disconnectedness of the physicist (*qua* enunciator) to and from the operability of the theory. However there is, if we think differently about Latour’s reading, another difficulty that Einstein’s text generates. Accepting Dusek’s point, we can say that what emerges from the text’s creation of an observing enunciator—what is supplemented—is *not* a suspension of reality through story, or the creation of a fictional (narrativised) universe in which we must ignore the origin of the enunciator’s singular omniscience. Instead what emerges is only the veracity of a theory (itself an actant), which has been discovered by the physicist (whose elocution of it functions thus as a kind of proof). If this is so, we remain faced with the difficulty of explaining how such an emergence, such a miracle, may have taken place. It is, after all, this very notion that nature could be wholly known and *reduced* in this way that Einstein himself described as the “eternally *incomprehensible* miracle.”<sup>58</sup>

This very specific difficulty takes us to a larger problem that might only be partially explained by Latour in his interlocution with Einstein. Latour’s analysis historicizes what he regards as the errors of relativity physicists and looks to the more recently adopted practices of quantum mechanics, in which he argues we can see the reintroduction of “independent and active observers, so active indeed that they influenced what they observe.”<sup>59</sup> However, this seems not to shed much light on the broader question of what a physicist should do given the possibility that the “eternally incomprehensible miracle” in which humans reduce the *physis* to *logos* will remain just that. On this issue, I think Stengers’ discussion of the neutrino may advance the dialogue between scientists and those working in the humanities. Stengers imagines

the creation of the “psychosocial” physicist whose practice would require her to consider, and whose practice would make possible, at the same time and coherently, these two apparently contradictory positions: that the neutrino is as old

as the period in which its existence was first demonstrated, that is, produced, in our laboratories, and that it dates back to the origins of the universe. It was both constructed and defined as an ingredient in all weak nuclear interactions and, as such, is an integral part of our cosmological models. Consequently, it can serve as the subject of propositions that make it a product of our understanding and others that make it a participant in a cosmic history that is said to have led to the appearance of beings capable of constructing such understanding.<sup>60</sup>

As Stengers suggests, for the new physicist these two time frames—these “two apparently contradictory positions”—must be conjoined by the ‘emergence’ in “cosmic history” of an actant (a “subject”) about which we can (correlatively) make two propositions. The first of these would turn the scientific object into a “product” of our *human* “cosmological models,” while the second would turn the same object into a “participant” in a *nonhuman* “cosmic history,” into an actant that finds itself in *methexis* with all that by which it may be said to be constituted.

More broadly, as Jimena Canales points out, the Bergsonian critique of relativity (a moderated form of which Latour may be seen to adopt) brings into relief the various distinctions that are drawn between “human and nonhuman time.” These are distinctions which themselves form a “subset of the broad divisions between man and animal and human and non-human” which is explored by, for instance, Giorgio Agamben.<sup>61</sup> But what role exactly might time play in this scheme? How might we interrogate temporality in relation to actants, or *as an actant*? If, with Latour, we have denuded the privilege afforded to surfaces and depths, the “stale dualisms,” and the notion that there is a “basic stuff,” can we similarly speak of ‘time’ as an irreducible actant? If so, is time the kind of actant that may be modified by other actants—could it be altered by the mood or ‘being’ of its observing subject, for instance? Would physical explanations of time also be burdened by the work of an omniscient and singular enunciator and their loyal representants? Moreover, is it possible to modify the *efficacy* of time *as* an actant (what Latour might call its “strength” or its “durability,” but which we might want to describe, simply, as its ‘durationality’)? It is in answer to these questions that we might turn to Bergson.

### What time do we mean when we speak of time?

It seems unnecessary to speak of the impossibility of altering the procession or the arrow of time; yet, we may still say that time ‘flies when we’re having fun’ or that it ‘drags’ when there is no such fun to be had. In ways that we understand but may find difficult to measure according to the standards of science, then, time can and does offer emergent alterations—different senses of its fluxions and durations—at some levels.<sup>62</sup> But, in this Husserlian sense of conscious awareness, can we apply the synecdochal words ‘surface’ and ‘depth’ to time? In one sense, Latour’s work suggests the primacy of temporal events and the individuality of objects not as physical substances but as both relational events and as actors. For (as is maintained by most object-oriented ontologists), these irreducible materials that constitute our universe, these actants, are, if not themselves completely definable simply as *events*,<sup>63</sup> nevertheless inextricable from the temporal ‘eventuality’ that constitutes them as things. As Latour notes, “everything happens only once, and at once place. If there are identities between actants, this is because they have been constructed at great expense.”<sup>64</sup> Entities or objects that are not only materially and physically deep, then, but are temporally ‘long’ and ‘short’ in relation to our present, seem just as apposite to any thorough description of the work of Latour and actor-network theory.

Of course, in another sense, the notion that time may have surfaces and depths of a material nature is confirmed not only by the so-called ‘deep time’ observable in the fields of stratigraphy (the study of rock stratification in geology) or in geochronological physics,<sup>65</sup> but also by the sense in which, to paraphrase Gayatri Spivak, we give time ‘flesh’ (a surface) both in our thinking about and our perceptions of it.<sup>66</sup> Like material surfaces and depths, time seems very often to be ‘given flesh’ (the surface of our bodies)—that is, to be theorised by philosophers, phenomenologists, and others—within a dualistic schema, constituting, in most cases, a kind of dialectic of (1) ‘surface-time’ and (2) ‘deep-time.’ Spivak herself divides time into (1) capital-t “Time,” which is constitutive of the “real laws of motion,” and (2) the word “timing,” which is constitutive by the “sequential process [of] events happening to and around many lives.”<sup>67</sup> Likewise, Deleuze and Guattari begin to think of time as divisible as between (1) the “Aeon” and (2) the “Chronos.” As well, they treat it in terms of (1) a *virtuality* of real but usually past, events which are remembered in image memories, and (2) an *actuality* of events

that take place simply by virtue of, or which is always already backstaged by, “the field of duration.”<sup>68</sup> Deleuze’s abiding concern with time and duration emerged from his own readings of Bergson, and particularly his interest in the latter’s ‘differential’ and ‘concrete duration’ models of time by which, as Merleau-Ponty notes, we understand ourselves to be “always dealing with the same tension between one *durée* and another *durée* which frames it from the outside.”<sup>69</sup> That is, we are always dealing with (1) a surface-level *durée* and (2) a larger, enframing *durée* which is also constitutive of a blindness of time.

Bergson’s phenomenology of time, then—one that began as an alternative reading of Einstein’s special relativity<sup>70</sup>—has been given ‘new flesh’ in the late twentieth century by Deleuze, Latour, and others. This is especially apparent in Stengers’ formulation of the ‘psychosocial physicist’ in which both old and new are fully and productively apprehended, as adumbrated above. As we may wonder, however, is such new flesh the product of developments in the philosophy of time? Is it a Stengersian “product” of hard-won identificatory methods? Or, have the conditions in which we come to know time (through the duration of “cosmic history:” an elapsing of time itself) changed in some relevant or determinative way over which we have had no verifiable influence? In any case, the “malaise of *le bergsonisme*” has (much to Sokal and Bricomont’s chagrin), continued to expand and proliferate, notwithstanding the infamy of Bergson’s “mistake” in respect of time-dilation and the twin paradox within physics.<sup>71</sup> As both Dusek and Canales assert, Bergson’s so-called “mistake” (a single statement in his book *Durée et simultanéité*) is neither exclusively his own, nor a *simple* mistake. Rather, it was “part of a much larger argument that had been forgotten”<sup>72</sup> and which had sought to modify one of the “scenes” (as Latour calls them) given to explain relativity theory, known as the twin paradox. Relativity theory posited that two twins, one travelling in space at approximately light-speed and the other remaining on earth, would, when they met (their clocks and calendars showing different times to reflect their different timeframes) notice that time had elapsed *differently* for each of them. According to the theory, and due to time dilation, the earthbound twin would have aged quite rapidly whereas time would have slowed down for the travelling twin, causing him to age very little. While it is rarely acknowledged, Bergson *had* indicated his acceptance that under most circumstances the twins’ times would differ as the theory held.<sup>73</sup> However, Bergson also contended that,

under certain very strict circumstances,<sup>74</sup> the traveller's clock would "present a retardation when it finds the real clock, upon its return," that is, that where the twins' situations were truly "identical," the traveller's clock would "mark the same time as the other."<sup>75</sup> It is this contention, argues Canales, that caused Bergson's ideas about time to be discredited.

While, as Dusek sharply notes, and as Sokal and Bricmont vaguely concede, physicists still offer "mutually incompatible" solutions to the twin paradox,<sup>76</sup> the diacritical variance between Einstein's and Bergson's positions is to be found in Bergson's identification of a difference between the twins' *senses* and *expressions* of time. While this is a notion that can be closely related to the twins' individually differing *experiences* of time, it is not simply a psychological notion, but is based on the relative differences in 'motion' that are firstly experienced and then secondly expressed, in terms of differing events by the twins. As Canales points out, Bergson saw how something seemingly insignificant to the physicist—such as the traveller's memory of having been in motion—would be enough to disrupt the validity of that twin's time measurement, as such traces of unique experience would be apparent in one way or another to the final reviewer or 'triallyer' of these times. Here, we see that Bergson's argument corresponds with Latour's position on Einstein's delegated observers: where one of the dispatched has a privileged point of view, the result is relativism. But Bergson seems to take this argument further than Latour. For Bergson, in a contest to determine which of the twins' times would be acceptable as 'valid,' the relative 'weaknesses' of each of the twins' objective accounts of their times would need to be determined. We can imagine each account to be supplemented by significations revealing, for instance, who of the twins had journeyed into space, and who had not. As in the case of Latour's theory of actants, the differences between these accounts would then need to be determined through a "negotiation" of these differences in a trial. This trial, or this negotiation would be (for Bergson) not simply based on the preciseness of the theory advanced by the physicist. It would also be comprised of the political, social and philosophical factors at play in the situation at hand—factors that might be overlooked within the theoretical texts and frameworks developed and reviewed by the physicist triallyer(s).<sup>77</sup>

In Canales' historicisation of Bergson's argument, she compares Bergson's hypotheses to Henry More's refutation of Descartes' theory of motion. Here,

Canales makes clear the extent to which unpredictable marks may show up ‘on the surface’ of a theory when it is applied, at both the textual (semantic-theoretical) or experimental (trial) level. If Bergson has anything to offer us, it is the idea that those marks which are revealed through critical assessments of the operations of the theory (with attention being paid to its narrational terms and operations) may determine or reveal those small differences between theory and socio-political reality, *logos* and *physis*, surface and depth that are irrelevant, undetected, or inapprehensible in the theories and models of physics. As Canales points out, in More’s rebuttal of Descartes’ theory of motion, it was the moving representant’s ‘flushed face’ that served to reveal such a small difference. Where one of two twins had been travelling or running (the other having remained stationary), the travelling twin would bear a mark that betrayed that travel (for example: the flushed face).

### **Conclusion**

It might seem irrelevant and “philosophical” to argue that physicists and critics of social science should need to consider the emergence of such marks, such actants, at the ‘surface’ of science. However, it is their neglect in these disciplines of such traces, and of the wider body of knowledge that the few examples mentioned above represents, that allows the “community of...fabricators to forget the avatars of...fabrication and to celebrate [the] existence” of their fabrications as things in themselves.<sup>78</sup> It is in such traces of production as these, moreover, that we may find certain evidence about the nature of the practices of physics itself: about the problematics of translations from trial to text, from nature to language, from deep to shallow, and so on. By considering this problem we may come to see how the historical reluctance of relativity theorists to accept the instability of delegated agents and of nonhuman frames of reference has functioned mostly to sustain and preserve the explicability and reductivity of its own enunciations.

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- <sup>1</sup> On the “human sciences” generally see Wilhelm Dilthey, *Introduction to the Human Sciences*, eds. Rudolf A. Makkreel and Frithjof Rodi (New Jersey: Princeton University Press, 1989), esp. Book Six; also see Algirdas-Julien Greimas, *Structural Semantics*, ed. Ronald Schleiffer (London: University of Nebraska Press 1966), esp. xiii-xv.
- <sup>2</sup> Here I use the term “humanist” in a broad sense and as it has recently been deployed in the special issue of *Dædalus*: ed. Phyllis S. Bendell, “What Humanists Do,” *Dædalus* 143, no. 1 (2014): *passim*.
- <sup>3</sup> On the general distinction between metaphysics and physics, see Brigette Falkenburg, *Particle Physics: A Critical Account of Subatomic Reality* (Berlin: Springer, 2007), 6.
- <sup>4</sup> For a comprehensive review of the recent work in speculative and in object-oriented philosophy (“OOO”), see “Object Oriented Philosophy,” (Chapter 7) in Graham Harman, *Prince of Networks: Bruno Latour and Metaphysics* (Melbourne: re.press, 2009), 151-228.
- <sup>5</sup> On this dialectic generally, see *Nature and Logos: A Whiteheadian Key to Merleau-Ponty’s Fundamental Thought* (Albany: State University Of New York Press, 2011), esp. the chapter on Bergson (and Schelling) at 123-153. On Parmenides’ separation of *physis* from *logos*, see Vincent Vycinas, “Disintegration of Physis-is-Logos,” in *Greatness and Philosophy* (The Hague: Martinus Nijhof, 1966), 25-30.
- <sup>6</sup> See Isabelle Stengers, “The Neutrino’s Paradoxical Mode of Existence” (Chapter 2) in *Cosmopolitics I*, trans. Robert Bononno (Minneapolis: University of Minnesota Press, 2010), 14-27.
- <sup>7</sup> On actor-network theory broadly, see Bruno Latour, *Reassembling the Social: an Introduction to Actor-Network-Theory* (Oxford: Oxford University Press, 2005), esp. 10-11; and the website, the “Actor Network Resource,” maintained by John Law, at <http://www.lancaster.ac.uk/fass/centres/css/ant/antres.htm>
- <sup>8</sup> This is how, in a different context, Slavoj Žižek characterises Alan Watts. See Žižek, *Less Than Nothing: Hegel and the Shadow of Dialectical Materialism* (New York: Verso, 2012), 739.
- <sup>9</sup> On Watts generally see, Peter J. Columbus and Donadrian L. Rice, eds. *Alan Watts—Here and Now: Contributions to Psychology, Philosophy and Religion* (Albany: State university of New York Press, 2012); Monica Furlong, *Genuine Fake: A Biography of Alan Watts* (London: Heinemann, 1986).
- <sup>10</sup> Alan Watts, “The Nature of Consciousness,” unpublished radio lecture. Text of the lecture is available at <http://www.aurapiercing.com/WattsNatureOfConsciousness.pdf>, see 3-4.
- <sup>11</sup> As Kaiser notes, physicists in the ‘40s and ‘50s were “[t]orn from their pre-war routines and thrust into projects of immediate, worldly significance” such that “physicists’ day-to-day activities in 1945 bore little resemblance to those of 1925.” Following a “quantum revival,” however, there was restoration of “philosophical engagement with quantum theory,” which “had once seemed inseparable from working on quantum theory itself.” As Kaiser continues, “Those few physicists who continued to wrestle with the seemingly outlandish features of quantum mechanics found their activity shoved ever more sharply to the margins.” See David Kaiser, *How The Hippies Saved Physics: Science, Counterculture, and The Quantum Revival* (New York: W.W. Norton & Company, 2011), xiii-xiv. For a more condensed, but at times even more thoroughgoing, examination of the “new roles of physicist within a broadly political sphere,” see David Kaiser, “The Postwar Suburbanization of American Physics,” *American Quarterly* 56, no. 4 (2004): 851-888, 853.
- <sup>12</sup> However, for some, the developing models of supersymmetry predict that there could be more than one Higgs boson. See, for instance, the phenomenological discussion of Higgs bosons in relation to the so-called Next-to-Minimal Supersymmetric Standard Model (NMSSM) in Sophie King, et. al., “Natural NMSSM Higgs bosons,” *Nuclear Physics B* 870, no. 2 (2013): 323-352). On the postulation that new “fermions, like charginos/neutralinos” exists that are “heavier than the Higgs field,” see Gregory Moreau, “Constraining extra fermion(s) from the Higgs boson data,” *Physical Review D* 87 (2013): 1 and n. 1.
- <sup>13</sup> Here I refer to Foucault’s understanding of science and knowledge as laid out in *The Archaeology of Knowledge*, trans. Alan Sheridan (New York: Routledge, 1991 [1969]), esp. Chapter 6: “Science and Knowledge,” 186-187. I also refer to Thomas Kuhn’s notion of “paradigm shifts” in scientific history as expressed in his *The Structure of Scientific Revolutions* (Chicago: University of Chicago Press, 1962), esp. 10-11 (and on Kuhn’s discussion of physical optics, see 10-14).
- <sup>14</sup> See [http://www.nobelprizes.org/nobel\\_prizes/physics/](http://www.nobelprizes.org/nobel_prizes/physics/)
- <sup>15</sup> Stengers, *Cosmopolitics I*, 22.
- <sup>16</sup> Nicolas Mendoza, “Not So Fast: Cosmopolitics and the Higgs Boson, Will Media Reports on the Higgs Boson announcement influence the way “modern people” treat all other people?” *Al Jazeera*, 27 July 2012.
- <sup>17</sup> *Ibid.*
- <sup>18</sup> Bruno Latour, *Petite réflexion sur le culte moderne des dieux faitiches* (Le Plessis-Robinson: Synthélabo, “Les Empêcheurs de penser en rond,” 1996), 99, quoted and translated as such in Stengers, *Cosmopolitics I*, 23. I note that in the English translation edition of the book, the line is translated as follows: “The fascinated spectators “attribute an autonomy to the image” that it does not possess.” See Latour, *On the Modern Cult of the Factish Gods*, trans. Catherine Porter and Heather MacLean (Durham: Duke University Press, 2010), 8.

<sup>19</sup> Latour, *Modern Cult of the Factish Gods*, *passim*.

<sup>20</sup> As Eugene Sloane has already suggested, if it were not so awkward a term, we could perhaps say “substancist” here. As Sloane writes: the “best refutation of anti-materialist (or better still if it were not so awkward, anti-substancist) is language itself—whether English, Latin or Greek.” Eugene Sloane, *Words and Their Ways: A Primer of Philology and Philosophy* (Maryland: The Owl Press, 1955), 34.

<sup>21</sup> I should note that Latour’s use of the term “actant” is not his neologism; genealogically, Algirdas Julian Greimas first introduced the term (at least in the context of narrative theory); specifically in his examination of “actants and predicates,” and then in “Actantial categories,” in his 1966 work, *Structural Semantics: An Attempt at a Method*, trans. Daniele McDowell, Ronald Schleifer and Aland Velie (Lincoln: University of Nebraska Press, 1966), 146-48.

<sup>22</sup> Aristotle, *Categories and De Interpretatione*, trans. John Lloyd Ackrill (Oxford: Oxford University Press, 1963), 9 (3b10), 12 (4a21).

<sup>23</sup> Harman, *Prince of Networks*, 14.

<sup>24</sup> *Ibid.*, 19.

<sup>25</sup> *Ibid.*, 158 (point 4).

<sup>26</sup> Bruno Latour, *The Pasteurization of France*, trans. Alan Sheridan and John Law (Cambridge: Harvard University Press, 1984), 156.

<sup>27</sup> One could say that this is also an announcement of a “finitude of knowledge” insofar as knowledge is interlinked or coextensive with depth.

<sup>28</sup> See for instance Jens-Uwe Peters, Jérôme Hert, et. al., “Can we discover pharmacological promiscuity early in the drugs process?” *Drug Discovery Today* 17, no. 7-8 (2012): 325-335; Jens-Uwe Peters, Patrick Schnider, et. al., “Pharmacological promiscuity: dependence on compound properties and target specificity in a set of recent Roche compounds,” *ChemMedChem* 4, no. 4 (2009): 680 – 686; Andrew L. Hopkins, “Drug discovery: predicting promiscuity,” *Nature* 462 (2009): 167-168; and cf. Biochemist David Nichols’ claim that the term more commonly used today to describe the activity of such compounds is “rich pharmacology”: David E. Nichols, “LSD Neuroscience,” April 19, 2013 at *Psychedelic Science 2013* (conference of the Multidisciplinary Association of Psychedelic Studies): <http://www.youtube.com/watch?v=LbUGRcuA16E>

<sup>29</sup> Hopkins, “Drug discovery: predicting promiscuity,” 167.

<sup>30</sup> Latour, *Pasteurization of France*, 191.

<sup>31</sup> *Ibid.*, 198 (3.2.3, 3.2.4), 201 (3.3.6).

<sup>32</sup> *Ibid.*, 160.

<sup>33</sup> Harman, *Prince of Networks*, 66.

<sup>34</sup> I am not so certain as Harman that Latour’s theory of actants can be implacably distinguished from theories of performativity (such as Butler’s) on the basis that “one can hardly imagine the Judith Butlers acknowledging the ‘performativity’ of an inanimate objects as well as of human actors” (66). Rather, I emphasise Latour’s openness to laboratory experiments and to “trial[s]” as places and methods in which the performativity of inanimate objects is discovered. He does not think of “trial(s)” only as places in which inanimate objects are themselves given the character of *human actors*. As Latour suggests, “The ‘things’ behind the scientific texts are thus similar to the heroes of the stories we saw at the end of Chapter 1: they are all defined by their *performances*.” Latour, *Science in Action* (Cambridge: Massachusetts: Harvard University Press, 1987), 89. (Emphasis Latour’s.)

<sup>35</sup> Harman, *Prince of Networks*, 66.

<sup>36</sup> Latour, *Pasteurization of France*, 184-5.

<sup>37</sup> Here my usage of “optic” follows from that of Steven Best and Douglas Kellner, who use the term interchangeably with perspective to describe the circumscribed vantage points adopted in the analysis of any specific phenomenon or phenomena. See Best and Kellner, *Postmodern Theory: Cultural Interrogations* (New York: The Guilford Press, 1991), 265.

<sup>38</sup> For a detailed comparison of *mimesis* and *methexis*, see Tulio Murhano, “Mimesis versus Methexis” (Chapter 6) in *Therapeutic Discourse and Socratic Dialogue* (Wisconsin: University of Wisconsin Press, 1986), 135-49.

<sup>39</sup> Latour uses the term ‘underwritten’ to denote the layering of different human and nonhuman narrators in scientific texts whose activity, together, may constitute experimental proofs for particular physical laws: that is, the “set of inscriptions that establish the credibility of the ones used in the text to establish the reference of narration.” Latour, “A Relativistic Account of Einstein’s Relativity,” *Social Studies of Science* 18, no. 3 (1988): 3-44, 13.

<sup>40</sup> For a fascinating analysis of the neutrino’s double life as a thing that exists both “in itself” and “for us,” see Stengers, *Cosmopolitics I*, 14-27.

<sup>41</sup> Latour, *Pasteurization of France*, 192.

<sup>42</sup> Stengers, *Cosmopolitics I*, 22.

<sup>43</sup> *Ibid.*

<sup>44</sup> Harman, *Prince of Networks*, 14.

- <sup>45</sup> See Étienne Souriau, *Les Deux Cent Mille Situations Dramatiques* (Paris: Flammarion Editeur, 1950).
- <sup>46</sup> Latour, "A Relativistic Account of Einstein's Relativity," 3-5.
- <sup>47</sup> Alan Sokal and Jean Bricmont, *Intellectual Impostures: Postmodern philosophers' abuse of science* (London: Profile Books, 1998), 118.
- <sup>48</sup> *Ibid.*, 119. It should also be noted that these authors dismiss Latour on a strict reading of his own aims. They claim that Latour fails to succeed in offering an "indication that relativity theory itself could be said to be social" or that it may be viewed as "social through and through." But Latour does not really suggest that this is his own aim; rather he quite clearly articulates that this is a "bold claim of the programme [of social science]" and a "programme for future field studies"?. See Latour, "A Relativistic Account," 3.
- <sup>49</sup> Latour, *Pasteurization of France*, 162, 201.
- <sup>50</sup> Latour, "A Relativistic Account," 20.
- <sup>51</sup> Albert Einstein, *Relativity: The Special and the General Theory* (London: Methuen, 1920), 26.
- <sup>52</sup> Latour, "A Relativistic Account," 15, 18.
- <sup>53</sup> *Ibid.*, see 18-20. Sokal and Bricmont criticise Latour's adumbration of the Lorentz Transformation, noting that he miscopies parts of the formulas. It is of course possible that this is a typographical error of the typesetter or publisher, although there is no evidence either way. Sokal and Bricmont, *Intellectual Impostures*, 118, n. 154.
- <sup>54</sup> Val Dusek, "Clarity, Charity and Criticism, Wit, Wisdom and Worldliness: Avoiding Intellectual Impositions," *Metascience* 9, no. 3 (2000), 358-366.
- <sup>55</sup> See n. 74, below.
- <sup>56</sup> Dusek, "Avoiding Intellectual Impositions," 362.
- <sup>57</sup> Latour, "A Relativistic Account," 20.
- <sup>58</sup> Quoted in Walter Isaacson, *Einstein: His Life and Universe* (New York: Simon & Schuster, 2007), 628, n. 46. (Emphasis mine).
- <sup>59</sup> Latour, "A Relativistic Account," 36.
- <sup>60</sup> Stengers, *Cosmopolitics I*, 20-21.
- <sup>61</sup> Canales, "Einstein, Bergson, and the Experiment that Failed," 1184, n. 10. Canales refers not only to Latour but also to Giorgio Agamben as thinkers who have distinguished between man and animal, human and nonhuman; and science and society, respectively. (See Giorgio Agamben, "Mysterium Disjunctionis," in *The Open: Man and Animal* (Stanford: Stanford UP, 2004), *passim*).
- <sup>62</sup> Psychopathological studies on 'lived time' generally affirm that this 'implicit' dimension of time exceeds or overreaches the experience of metrical time. Further, it has been shown that sometimes, for children at least, even the ideas of past and future do not stand out as such from this "pre-reflective existence." See for example Thomas Fuchs, "Temporality and psychopathology," *Phenomenological Cognitive Science* 12 (2013): 75-104, esp. 77.
- <sup>63</sup> Latour, *Pasteurization of France*, 162.
- <sup>64</sup> *Ibid.*
- <sup>65</sup> For a detailed consideration of the historical and sociological hermeneutics of these historical sciences, see Brian McGowran, "On Biostratigraphy and Biogeohistory" (Chapter 8) in *Biostratigraphy: Microfossils and Geological Time* (Oxford: Oxford University Press, 2005), 346-396.
- <sup>66</sup> As Gayatri Spivak notes in the opening of her essay on time, law and history: "Time is a word to which we give flesh in various ways." See Gayatri Chakravorty Spivak, "Time and Timing: Law and History," in John Bender and David E. Wellbery, eds., *Chronotypes: The Construction of Time* (California: Stanford University Press, 1991), 99.
- <sup>67</sup> Spivak, "Time and Timing," 99.
- <sup>68</sup> See Elizabeth Grosz, *Time Travels: Feminism, Nature, Power* (Durham: Duke University Press, 2005), 101.
- <sup>69</sup> Maurice Merleau-Ponty, *Éloge de la Philosophie*, (Paris: Gallimard, 1960), 297-298, quoted in Roger McLure, *The Philosophy of Time: Time Before Times* (London: Routledge, 2005), 11.
- <sup>70</sup> This was an interpretation defended by Merleau-Ponty and others: see Canales, "Einstein, Bergson, and the Experiment that Failed," 1169.
- <sup>71</sup> Canales' discussion of "Bergson's error" is lucid: "Einstein, Bergson, and the Experiment that Failed," 1171-1173. Also see Dusek, "Avoiding Intellectual Impositions," 361-363 and (Sokal and Bricmont's response) 381-382.
- <sup>72</sup> Canales, "Einstein, Bergson, and the Experiment that Failed," 1171. Also see Niels Viggo Hansen, "Spacetime and Becoming: Overcoming the Contradiction Between Special Relativity and the Passage of Time," in *Physics and Whitehead: Quantum, Process and Experience*, Timothy E. Eastman and Hank Keeton, eds. (New York: State University of New York Press, 2003) 136-163, esp. 144-146.
- <sup>73</sup> Canales, "Einstein, Bergson, and the Experiment that Failed," 1171.

<sup>74</sup> Canales notes that in Bergson's model not even acceleration (essential to Einstein's theory) is thought to have differed between the twins. What is more, Bergson clearly states in the second edition of *Durée et simultanéité* that "the slowing down of clocks by their displacement is, rightfully, as real as the shrinkage of objects in terms of distance." Henri Bergson, "Durée et simultanéité: a propos de la théorie d'Einstein," *Mélanges* (Paris: Presses Universitaires de France, 1972 [1922]), 238, quoted in Canales, "Einstein, Bergson, and the Experiment that Failed," 1171.

<sup>75</sup> Ibid.

<sup>76</sup> See Leslie Marder, *Time and the Space Traveller* (Philadelphia: University of Pennsylvania Press, 1971); Paul J. Nahin, *Time Machines: Time Travel in Physics, Metaphysics and Science Fiction* (New York: Springer-Verlag, 1998): 465-66.

<sup>77</sup> As Canales argues: "Whose time would prevail back on earth would depend on how their disagreement was negotiated—not only scientifically, but psychologically, socially, politically, and philosophically." Canales, "Einstein, Bergson, and the Experiment that Failed," 1173.

<sup>78</sup> Stengers, *Cosmopolitics I*, 26.