The End of Time or Time Reborn? Henri Bergson and the Metaphysics of Time in Contemporary Cosmology

Paula Marchesini

Ph.D. Candidate in Intellectual History at the Department of Comparative Thought and Literature at the Johns Hopkins University
(Baltimore, USA)
E-mail: psouzam1@jhu.edu
ORCID: 0000-0002-6955-6600

In this paper, I evaluate the work of two contemporary cosmologists, Julian Barbour and Lee Smolin, through the lens of Henri Bergson's metaphysics of time. Barbour and Smolin center their cosmological systems on their respective philosophical conceptions of time: for Barbour, time is a human illusion that must be eradicated from cosmology; for Smolin, time must be considered a reality of the universe, a force of change that underlies our everyday observations and which not even the laws of physics can escape. Both systems, however, run into dead ends. Barbour cannot escape dealing with observed movement and change and ultimately restricts them to the human brain, where these phenomena are left unexplained; Smolin posits the need for a meta-law that would account for why temporal phenomena unfold as they do, but fails to provide such a law. As I will show, Bergson's original take on the problem of time has a lot to offer to both sides of the debate. On Barbour's side, it provides compelling arguments against the latter's eradication of time, which, if accepted, would invalidate the philosophical assumptions behind his cosmology; on Smolin's side, Bergson sidetracks the "meta-law" problem and offers a deeper understanding of time than the one presented by Smolin, putting forth a consistent philosophical theory of time which, as I will show, is missing from the latter's work. Ultimately, my aim is to illustrate, through Bergson's work, how, without the aid of philosophy, cosmology is likely to keep running into such dead ends.

Keywords: Henri Bergson, Julian Barbour, Lee Smolin, Time, Metaphysics, Contemporary Cosmology

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In 2009, Julian Barbour's article "The Nature of Time" won the first prize for a prestigious essay competition in contemporary cosmology, organized by the celebrated Foundational Questions Institute (FQXI). In the article, Barbour argues that time does not exist and that the concept of time has no place in physics. The article summarizes arguments first developed in

his 1999 book *The End of Time: The Next Revolution in Physics*. An independent scholar who takes on the fundamental questions of physics on his spare time and translates Russian scientific journals for a living, Barbour is among the most respected contemporary cosmologists. Lee Smolin, another great name of the discipline, has considered Barbour's views on the nature of time an important contribution to ongoing cosmological debates [Smolin, 2013: 169-71]. Unlike Barbour, however, Smolin argues that time must exist and that embracing its reality is the key to solving persistent problems in cosmology. Smolin's defense of the reality of time is developed in detail in *Time Reborn: From the Crisis in Physics to the Future of the Universe* (2013). While Barbour's defense of a timeless universe finds support in the work of other important cosmologists, including Einstein, Smolin's view that time is a fundamental reality of the universe has fewer adepts. The great majority of cosmologists is extremely resistant to the idea that time exists, for they consider it to entail that Einstein's theory of relativity is incorrect, and hence that our current understanding of the cosmos must be completely revised [Smolin, 2013: 74].

Although Barbour and Smolin give divergent answers to the question about the reality of time, they agree that the fundamental problems of cosmology turn on this question, as is suggested by the titles of their aforementioned books. Both argue that many if not all puzzles of contemporary cosmology can be either solved or dissolved with a correct understanding of time. For Barbour, the chasm between General Relativity and Quantum Theory only appeared due to erroneous conceptions of time [1999: 16] and the much sought after theory of everything, considered the "holy grail" of modern physics, can be obtained by means of a well thought out eradication of time [1999: 13]; for Smolin, on the other hand, if physicists can embrace the reality of time, the very need for a theory of everything will be made absurd, since it is in itself a symptom of timeless or static thinking [2013: 12-25]. Whether one sides with Barbour or Smolin, therefore, a consistent theory of time might well be the escape route in the endless search for a unified theory and thus the keystone of contemporary cosmology.

Henri Bergson (1859-1941), a major figure in modern European thought, gives comparable emphasis to the concept of time. Unlike Barbour and Smolin, however, Bergson thinks about time in the context of philosophy, particularly metaphysics, using data from the sciences to support his philosophical arguments. In this paper I will situate Bergson's ideas on time against those of Barbour and Smolin, identifying what Bergson's conception of time can add to one of the most pressing debates in contemporary cosmology. Bergson is, at first glance, more in line with Smolin than with Barbour, since, as we will see, he defends the reality of time. Bergson and Smolin, however, while they agree that time exists, have markedly different views on what it is.

Barbour and Smolin both draw heavily on Western philosophy in their books on time, yet neither makes a single reference to Bergson, arguably the most important philosopher of time working across the 19th and 20th centuries. As I will show, Bergson's original take on the problem of time has a lot to offer to both sides of the debate. On Barbour's side, it provides compelling arguments against the latter's spatialization of time, putting into question the philosophical assumptions behind the postulated unreality of time; on Smolin's side, Bergson offers a deeper understanding of time than the one presented by Smolin, putting forth a consistent philosophical theory of time which, as I will show, is missing from Smolin's work.

Bergson's Philosophy of Time

Bergson's philosophy of time is marked by the insistence that time must not be confused with space. Our habitual representations of movement and change are spatial: we understand

movement as a series of positions being occupied successively in space; we understand change as a consecutive series of fixed states, each one immediately adjacent to the next in an imagined line of time [Bergson, 1946: 18]. If this picture were accepted, however, duration would be no more than the unrolling of a series of immobile snapshots of reality. The movement and change that we observe would be lost and time would be a mere juxtaposition of immobile objects. We would then have to explain how these immobilities are set into motion, why they do not remain immobile, which for Bergson, is impossible [Bergson, 2016: 99]. Rather, we should think of movement as preceding immobility; we should grasp movement in its entirety as something indivisible and time as what is ceaselessly happening [Bergson, 1946: 14].

According to Bergson, we usually think of time in terms of space because intelligence itself seeks fixity and refuses to consider transition. When observing a moving object, we want to frame and fixate all of its individual spatial positions, rather than consider movement as it is [Bergson, 1946: 15]:

> [A]s a certain space will have been crossed, our intelligence, which seeks fixity everywhere, assumes after the event that movement has been *exactly fixed on* to that space (as though it, movement, could coincide with immobility!) and that the mobile *exists* in turn in each of the points of the line it is moving along [Bergson, 1946: 16].

Just as the intellect breaks up movement into fixed spatial positions or "virtual halts in time," it breaks up change into fixed successive states, each of them supposed to be invariable in themselves [Bergson, 1946: 12]. But, for Bergson, change is, like movement, continuous and indivisible [1946: 16]. The illusive character usually attributed to change is a consequence of this tendency of the intellect to break it down into fixed snapshots, instead of considering its fluidity as something real: "It is not the 'states', simple snapshots we have taken once again along the course of change, that are real; on the contrary, it is flux, the continuity of transition, it is change itself that is real" [Bergson, 1946: 16].

For Bergson, the history of philosophy is tainted by the confusion between time and space, which leads to a series of pseudo-problems [1946: 14]. Time and space have been treated as things of the same kind and theories of space and time have been mere counterparts: "to pass from one to the other one had only to change a single word: 'juxtaposition' was replaced by 'succession'" [Bergson, 1946: 14]. As Bergson admits, the masking of duration, the spatialization of time, can be advantageous in certain contexts, such as that of science, which is preoccupied with extracting from nature what can be repeated [1946: 13]. But science itself, if it wants to put its abstractions at the service of understanding reality as the moving changing complex that it is, must make its way back from general to particular; and, in the context of metaphysics, where we want only to understand reality as it is, we must avoid generalizations entirely and grasp duration in its flow, without stopping it, just as it is experienced [1946: 13].

As Bergson notes, the spatialized conception of time is already present in the work of the Eleatic philosophers. Zeno of Elea famously elaborated a series of paradoxes to prove that movement and change were inherently contradictory [1946: 17]. His "arrow paradox," for instance, was elaborated to prove that motion is impossible: since the arrow will always have half of the remaining distance to travel toward the target, it supposedly never reaches the target, and thus motion is impossible. Our impression that the arrow moves and reaches the target is illusive, just like all movement and change.

In Bergson's view, the main effort of philosophers and scientists since the time of the Eleatics has been to surmount these contradictions related to movement and change. But to do this, they have seeked the reality of things beyond time, "beyond what moves and what changes, and consequently outside what our senses and consciousness have perceived" [Bergson, 1946: 17]. Succession has been understood as a "co-existence which has failed to be achieved" [Bergson, 1946: 18]. Duration has been viewed as a "non-eternity" [Bergson, 1946: 18]. For Bergson these are, consciously or unconsciously, the thoughts of all philosophers and scientists: "*Not one of them has sought positive attributes in time*" [1946: 18]. This failure to embrace fluidity would have led to a lack of precision in both areas, generating systems of thought that are "too wide for reality" [Bergson, 1946: 11]. Thus, if thinkers should have any hope of understanding reality as it is, they must begin by understanding time as duration: "let us restore to movement its mobility, to change its fluidity, to time its duration" [Bergson, 1946: 17].

Time, acknowledged as duration, is thus, according to Bergson, the key to understanding reality and how we experience it. But what would this picture of time as duration look like? How can we understand time without spatializing it? Bergson offers a comprehensive theory of time as duration, to which I now turn.

Perhaps the simplest way to summarize Bergson's concept of duration is to say that it is a "virtual qualitative multiplicity." To understand this, let us first consider its converse, i.e. an "actual quantitative multiplicity," which is easier to grasp. A flock of sheep, for instance, is a good example of the latter sort of multiplicity, and one offered by Bergson in *Time and Free Will*, his first published work [1910: 76]. The sheep that constitute the flock have material existence, and therefore the flock is actual; the flock is also quantitative, because the sheep can be counted as discrete and juxtaposed units of the same kind. A flock of sheep is thus an actual quantitative multiplicity.

The feeling of pity, on the other hand, is an entirely different kind of multiplicity [Bergson, 1910: 18]. Bergson gives the following account of the feeling of pity: one begins by putting oneself in the place of others and suffering their pain; this is followed by a need to help our fellow-men and alleviate their suffering; in its lowest forms, this need to help others is based on a dread of future evils to ourselves; but if pity keeps deepening in its intensity, this fear of evils will be replaced by a desire for such evils and one will take it upon oneself to suffer what others are suffering; this willingness to suffer results in a feeling of superiority, which has a certain charm about it [1910: 18].

When one feels pity, this whole sequence of feelings is experienced indivisibly, continuously, and in full movement. The feeling of pity cannot be divided up into discrete elements that can be juxtaposed and counted, because its components all interpenetrate one another. It is a continuous intensity, as opposed to what is discrete and extended in space [Bergson, 1910: 20]. Any attempt to decompose it or halt its movement to try to understand it would result in changing it and failing to grasp it as it is; it would yield an imprecise definition of pity, an empty abstraction.

Although the feeling of pity is real, it is not material (actual); hence it is virtual, if we understand virtual as precisely that which is real but not material[1]. Additionally, it is not composed of homogeneous elements. The flock of sheep is homogeneous. We can only count the sheep because we assume they are objects of the same kind and discount the differences among individual sheep. Homogeneity is thus implicit in quantitative multiplicities. The

[1] This is the definition of "virtual" that Deleuze famously offers in interpreting Bergson's works, in *Bergsonism* [Deleuze, 1999: 96-98].

feeling of pity, on the other hand, is entirely heterogeneous. We can attempt to divide it, but each time we divide it, it changes in kind [Pearson and Mullarkey, 2002: 3]. Hence it is qualitative, rather than quantitative. The feeling of pity is, therefore, a virtual qualitative multiplicity.

Our experience of being conscious in general can be understood in the same terms, of a virtual qualitative multiplicity. As Pearson and Mullarkey point out, Bergson's aim in *Time and Free Will* is precisely to show that the way we experience our psychic states presupposes a virtual multiplicity of this sort, since our states of consciousness are continuous, indivisible, and interpenetrate one another [2002: 2]. They constitute a succession that is not an addition and does not culminate in a sum [Bergson, 1910: 79]. Bergson thus offers a way of depicting psychic events that does not dismiss their movement and interdependence:

> We can thus conceive of succession without distinction, and think of it as a mutual penetration, an interconnection and organization of elements, each one of which represents the whole, and cannot be distinguished or isolated from it except by abstract thought [Bergson, 1910: 101].

For Bergson, physical time, as duration, should be understood as a phenomenon of the same sort [PM, 2002: 1]. It requires the same "uninterrupted prolongation of a past into a present which is already blending into a future" [Bergson, 1946: 32]. The whole of the universe moves and changes much like our conscious states. The flux of the external world is as indivisible as the feeling of pity. What is material and extended is thus also continuous and "this continuity changes from moment to moment and can be conceived in terms of a whole that changes like a kaleidoscope: there is no center since everything is bound together in relations" [PM, 2002: 13].

Movement is therefore indivisible and happens "in one stroke" [Bergson, 2014, 4179]. And the same goes for change. Zeno's paradox of the arrow, along with all paradoxes related to movement and change, would arise only when one fails to understand movement and change in this way [2014: 4179]. The space that the arrow traverses is extended and a quantity, and hence divisible; but its movement is intensive and a quality [PM, 2002: 5].

For Bergson, there are no isolated material objects. Conscious beings are deeply connected to everything that surrounds them; and all things endure [Bergson, 2014: 277]. We are not merely contemplative with regards to what happens around us. The brain, which is one more object among objects, or image among images to use Bergson's vocabulary, merely receives movements from other objects and responds to them, just like everything else in the universe [PM, 2002: 15]. Perception is a part of things; it is not interior, or subjective [PM, 2002: 16]. Therefore, duration, when properly understood, bridges the gap between subject and external world: the process of movement and change in our conscious states and that of the universe are one and the same. In Bergson's picture, we do, contra Kant, have access to absolute reality, by means of intuition, which, unlike the intellect that searches for immobility, allows us to apprehend duration as it is [PM, 2002: 33].

But, for Bergson, duration has an even more radical role in the universe: it is an agent of invention and novelty: "duration means invention, the creation of forms, the continual elaboration of the absolutely new" [2014: 277]. This aspect of duration is, in Bergson's view, supported by the verifiable fact that living species evolve through time. Bergson thinks of the evolution of life as an intrinsically creative process, one that is constantly bringing about novelty and is thus unforeseeable.

Evolution is usually conceived as a mere realization of the possible: each stage of time always contains what is needed for the appearance of new living species in the next stage [PM, 2002: 21]. As time passes, existence is merely added to what was already possible. New forms of life appear as a result of rearrangements of material, or mutations, at each stage. This is a spatialized view of evolution, because it draws on the notion of change as mere mechanical rearrangement of spatial parts [PM, 2002: 21]. In this view, new species appear by mere reassemblage of materials, and adaptation happens solely through the exogenous workings of natural selection [PM, 2002: 26].

Bergson proposes a "creative evolution," conducted by duration, in which there is an "incommensurability between what goes before and what follows" [2014: 5128], and which thus renders intelligible the ruptures and discontinuities we observe in the evolution of species. For Bergson, mechanism, i.e., the view that new forms of life can be explained by preceding ones, cannot explain life [2014: 645]. Similarly, finalism, i.e. the view that there are final goals orchestrating the appearance of new living forms (for instance that eyes were made so that living beings can see), is inappropriate [2014: 645]. Both views neutralize the agency of time, with its marked characteristic of bringing about true novelty [2014: 645]. In both, all is given in advance: in mechanism, what is given is in the past, whereas in finalism, it is in the future [2014: 645]. Both preclude novelty and invention, juxtaposing all events in a pre-established and predictable sequence. They are instances of the tendency to spatialize time, which Bergson wants to overcome.

Bergson posits a vital impetus (élan vital) that struggles with matter to produce novelty [2014: 3450]. This vital impetus creates divergent lines of evolution, each finding solutions for certain problems. For instance, life requires energy; to solve this problem, the vital impetus invents photosynthesis for plants, animals that are able to eat these plants and to use the energy drawn from the sun [2014: 3450]. For Bergson, life is precisely this tendency to solve problems by means of the creation of new forms [2014: 3450]. A coherent theory of evolution requires this interplay between organic memory and new situations, and thus requires the notion, implicit in duration, of a prolongation of the past into the present [PM, 2002: 45].

Bergson acknowledges that describing life in terms of an impetus is merely to offer "an image" [2014: 3495]. The image, however, discloses that life is not of a mathematical or logical order, but "of the psychological order, and it is of the essence of the psychical to enfold a confused plurality of interpenetrating terms" [2014: 3496]. What is psychical in nature cannot be thought out spatially or fit into separate categories of understanding [PM, 2002: 2]. Duration would thus be a creative force in the universe and evolution would offer evidence for its existence.

In conclusion, Bergson shows that the tendency to spatialize closes down possibilities for thinking, while the intuition of duration opens up new avenues. If we take reality to be intrinsically stagnant and uncreative, we will be unable to explain observed movement and novelty. The question about the origin of the universe, for instance, only appears because we assume that nothingness must logically precede things. The question about how it is that order came to be, comes from our presupposition that disorder precedes order. Similarly, the question about how movement and change are possible, rests on the assumption that inertia and stability have some sort of logical priority. Anchored in his concept of duration, Bergson described a universe in which things precede nothingness, creative order precedes disorder, and movement and change precede inertia and immobility [Bergson, 1946: 62-3].

Barbour and The Unreality of Time

In the first pages of "The End of Time," Barbour describes the main aim of his cosmological treatise: to introduce a way of thinking about "instants of time" without presupposing that such instants constitute a force that flows forward ceaselessly [1999: 7]. He then suggests the following way of understanding instants of time: instants are merely "possible instantaneous arrangements of all the things in the universe" [1999: 8] or "configurations of the universe" [1999: 9]. The idea is that each possible configuration of all the things in the universe constitutes an independent instant and that instants do not flow into one another, since they are, in themselves, "perfectly static and timeless" [1999: 9]. Barbour does not deny the human impression that time flows, but claims that the reality behind such impression is a collection of timeless instants or configurations of the whole, which should be explained on entirely timeless principles.

Reality, beyond our impressions of flow, is thus a multiplicity of static, timeless instants, or "nows" [Barbour, 1999: 16]. While physicists usually assume that things travel in an invisible framework of space and time, Barbour wants to get rid of the invisible framework and keep only things and their possible configurations [1999: 16]. "Nows" are "more fundamental entities that fuse space and matter into the notion of a possible arrangement" [1999: 16]. These possible arrangements are the ultimate things of the universe: "The world does not *contain* things, it *is* things" [1999: 16].

The common-sense idea about time — i.e. that it is a ceaseless linear flow directed forward, stringing one instant to the next — is, according to Barbour, counterproductive, because it makes time into something invisible and difficult to grasp [1999: 18]. For Barbour, "Nows" are more tangible than time, since it is easier for us to agree on what an instant of time looks like than on what time is [1999: 18]. A "now," is like a "three-dimensional snapshot" [Barbour, 1999: 18], constituted of objects in definite positions. "As instants, rather than an invisible river, time becomes concrete" [Barbour, 1999: 18]. Because these separate instants can be arranged in a linear sequence, we have the experience of time passing; but this impression is a result of concrete things, not of invisible time [Barbour, 1999: 18]. The properties usually ascribed to time—that it is linear, that it can be measured or has duration, and that it has a direction—are in fact properties of concrete instants, not of an invisible force that strings instants together [Barbour, 1999: 19].

Barbour allegedly developed this way of understanding reality by means of a very simple philosophical argument: (1) we orient ourselves by objects we actually see and not by invisible space, (2) at any instant there are certain distances between all objects in the world and us, and such distances provide the only way for us to tell where we are, (3) hence, any motion we call our own is a mere change in the complete universe, (4) the reality of the universe, therefore, is that, at any instant, the objects it contains are disposed in some relative arrangement [Barbour, 1999: 68-9]. For Barbour, what we can see is all that there is: "I believe in a timeless universe for the childlike reason that time cannot be seen—the emperor has no clothes" [Barbour, 1999: 251].

Time as an absolute invisible framework was first posited by Newton, in 1687, and for Barbour, it is unfortunate that it should have remained the common-sense understanding of time up to our days [1999: 20]. Newton's time is more fundamental than things and precedes them. For Newton, an empty world would still have time [Barbour, 1999: 20]. Richard P. Feynman's definition of time, quoted by Barbour, perfectly illustrates this image: "time is what happens when nothing else does" [as cited in Barbour, 1999: 2]. Barbour suggests "an alternative arena" to space and time, which he calls "Platonia," comparing his timeless

instants to Platonic forms [1999: 44]. Platonia is the totality of all possible instantaneous configurations of things, i.e. the totality of possible timeless instants. Different instants of time are different places in Platonia [1999: 69].

History, for Barbour, is merely "the passage of the universe through a unique sequence of states" [1999: 69], but there are many possible sequences in Platonia, not just one [Barbour, 1999: 36]. Barbour admits that it is tempting to think that these unique sequences, since they imply progress from one state to another, require the existence of time [1999: 69]. For him, however, this is not the case, since "there is nothing outside the universe to time it as it goes from one place to another in Platonia — only some internal change can do that" [1999: 69]. There is no motion in Platonia. There are instants or configurations that can be "piled" in the same heap, so to speak, forming a unique path, but there is no movement or continuity from one instant to the other. Barbour gives the example of a three-body universe, in which all possible configurations, or instants, would form triangles, and in which we could come across different heaps of triangles: "With time gone, motion is gone. If you saw a jumbled heap of triangles, it would not enter your head that anything moved, or that one triangle changed into another" [Barbour, 1999: 69].

Why then do we experience motion and change? To explain this, Barbour puts forth the concept of "special Nows," or "time capsules" [1999: 30]. He defines time capsules as "any fixed pattern that creates or encodes the appearance of motion, change, or history" [1999: 30]. A straightforward example of a time capsule would be a fossil: It exists only within a particular instant, but it encodes the appearance of history, and thus suggests the existence of other particular instants [Barbour, 1999: 30]. But fossils are not the only cases of time capsules; every object that we experience as being in motion is a time capsule. When a person watches a kingfisher flying, for instance, what actually happens is that her brain *at that instant* contains a series of snapshots of the kingfisher and somehow plays the movie for her in her mind [Barbour, 1999: 266].

Barbour does not go into details about how such movies are played in the mind and merely states that this hypothesis is compatible with observations from the brain sciences that "what we seem to experience in one instant is the product of the processing of data coming from a finite span of time" [1999: 266]. What we experience as motion would thus be a collection of stills in the brain, within the instant that contains the experience. Hence, there would be no motion at all. In fact, for Barbour, there is not only one kingfisher flying across instants, but also billions of kingfishers, each one inhabiting a different timeless instant in which it is placed at different distances from surrounding objects [1999: 48]. The illusion of a single kingfisher flying across instants is a result of our abstracting and detaching all of those billions of kingfishers from their corresponding instants [1999: 49]. For Barbour, Zeno's arrow will indeed never reach the target, because "the arrow in the bow is not the arrow in the target" [1999: 49].

Hence, instead of seeing instants as belonging to time, Barbour sees time as belonging to particular instants [1999: 34]. Time capsules are precisely that: time inhabiting the instant. We only believe in time and in motion because we always experience the universe by means of time capsules [Barbour, 1999: 51]. Yesterday only seems to come before today because today contains time capsules that point to instants that we define as pertaining to "yesterday" [Barbour, 1999: 53]. My current memories are pictures of other Nows within this Now: "Each Now is separate and a world unto itself, but the richly structured Nows 'know' about one another because they literally contain one another in certain essential respects" [Barbour, 1999: 55]. By surveying things in one Now, consciousness makes itself present in other Nows [Barbour, 1999: 55].

The advantages of Barbour's view, according to him, would be to make it easier to solve persistent problems in cosmology, such as how the world was created [1999: 45], how order exists in the face of increasing entropy [1999: 25], and why General Relativity and Quantum Theory seem to be incompatible [1999: 15]. Whether or not this is the case, Barbour himself claims that his argument for the unreality of time starts from "the philosophical conviction that the only true things are complete configurations of the universe, unchanging Nows" [1999: 49]. His argument, therefore, regardless of whether or not it is useful from the point of view of physics, has a purely philosophical basis, and thus can be criticized on purely philosophical grounds. It is thus pertinent to examine how Bergson's philosophy of time, discussed in the previous section, might serve us in criticizing Barbour's central philosophical conviction.

Barbour's conviction that there are only timeless instants, which are no more than possible spatial configurations of things, is a clear instance of the spatialization of time against which Bergson vehemently argues. As we have seen, Barbour claims that time as it is experienced, as a directed flow, is too difficult to grasp, and thus that we should look at concrete instants in their immobility. But, for Bergson, this difficulty is created by intelligence, which requires immobility. The difficulty, however, should be overcome by the use of intuition, which can grasp duration as it is, in its fluidity. Barbour's claim that he does not believe in time for the childlike reason that it cannot be seen, aside from being problematic on its own (since Barbour himself believes in other things that cannot be seen, such as Platonia), also loses strength if we think of time in Bergsonian terms. For, as we have seen, Bergson understands time as a "virtual qualitative multiplicity." Being virtual, or immaterial, time cannot be seen, but that does not entail that it is not real or that it cannot be experienced in other ways. Barbour's desire to make time into something concrete and material, points to an inability to think time in its mobility and continuity, which might well hinder the prospect of solving cosmological problems that justifies his theory of time.

Barbour clearly adheres to "the fiction of the instant," which is characteristic of much of contemporary cosmology [PM, 2002: 26]. Immobile instants are fictions, because they are never observed; rather, they are intellectual abstractions from mobile reality. Barbour considers movement to be an abstraction from timeless snapshots; but if we take our experience of nature into account — and a vast majority of scientists would themselves agree that we should — then arguably snapshots should be considered abstractions from moving reality. Russell claimed that logical necessity compels us to a conception of "instants without duration" [as cited in PM, 2002: 6). Barbour's conception of change as mere reconfiguration of objects responds to the same logical necessity. But for Bergson, reality cannot be directly known by means of logic. It must be grasped by intuition, which can comprehend movement and change, intrinsic aspects of reality, for what they are.

Lastly, Barbour's concept of time capsules and his account of motion as a series of snapshots that are played in the brain are unsatisfactory. How can movies be played in the mind if there is no movement in the universe? How are we to explain the nature of this experienced movement? Bergson's point that a series of immobile snapshots is something quite different from movement is compelling. Barbour's heap of triangles, as he himself states, is just a heap, with no motion or time. Similarly, the snapshots in the brain are, arguably, just snapshots. The leap from these snapshots to a moving picture can arguably never be made, not even in the mind, and thus presents a challenge to Barbour's account of our experience of time. If Barbour cannot take the leap, then he cannot explain our impressions of movement and our experience of reality; if he somehow takes the leap, proving that there is in fact

motion in our mental representations, he will have to admit that there is some motion in the universe, even if just in brains. To explain this motion, he will face the same challenges he tried to escape by postulating timeless instants. Ultimately, Barbour's cosmology is another "Platonism of the real" [PM, 2002: 36] and it is plausible to think that Bergson would find it "too wide for reality."

Smolin and The Rebirth of Time

In *Time Reborn* (2013) Lee Smolin suggests, against Barbour, that we must bring time as a real phenomenon to the forefront of theoretical physics and cosmology. For Smolin, it is no wonder that much of modern physics posits a timeless universe [2013: 12]. This is in great part due to a scientific attitude, in vogue since Galileo, in which understanding the universe is equivalent to uncovering its timeless mathematical laws [Smolin, 2013: 13]. The scientist who works on this assumption is, from the outset, taking timelessness to be a constituting principle of the cosmos and is therefore prone to fitting it into the model presupposed. The very search for a theory of everything would be the ultimate expression of this attitude [Smolin, 2013: xxi]. Smolin criticizes this impulse harshly and blames it for the schism between General Relativity and Quantum Field Theory [Smolin, 2013: 19]. He suggests a fundamental change in attitude, proposing that the laws of physics, like everything else we observe in the physical world, are constantly evolving and, therefore, the quest for a theory of everything as it is currently pursued should be abandoned [Smolin, 2013: 123]. In his picture, everything — laws of physics included — is perpetually changing. Time is a fundamental reality that cannot be dismissed or transcended [Smolin, 2013: xxxi]. Our experience of the world, our perception of change, our feeling of being in the present, and all other human perceptions related to temporality, are thus not mere illusions.

Smolin's central philosophical argument in favor of the reality of time is based on the need to avoid what he calls "the cosmological fallacy" [2013: 97]. To commit the cosmological fallacy is to try to arrive at a law or principle that we can successfully apply to every situation of the universe as well as to the universe as a whole. The fallacy consists in thinking that there are certain principles external or prior to the universe that could explain it. It is a fallacy for two reasons. Firstly, there can be nothing external to the universe, for the universe is no more than the sum of everything it contains and nothing is left outside of it to explain it. Secondly, because even if we did arrive at an ultimate unified timeless law that would explain all physical phenomena in the universe, we would still have to answer what Smolin calls the "Why these laws?" question, which for Smolin should be answered in any acceptable cosmological paradigm [2013: 97]. In Smolin's words: "To make laws explicable, we must consider them as much a part of the world as the particles they act on… They become explicable only when they participate in the dance of change" [2013: 121]. Thus, for Smolin, laws can be either (a) timeless, external to the universe, and inexplicable, or, (b) temporal, intrinsic to the universe, and explicable.

Searching for laws of the second kind, Smolin proposes a theory in which laws themselves evolve, called "cosmological natural selection" [2013: 123]. In this picture, new universes are constantly being created from black holes and each new universe has a different set of physical laws [Smolin, 2013: 123]. Some universes have an initial set of laws that allows them to "survive" and to produce life; other universes have laws that lead them to collapse [Smolin, 2013: 123]. According to Smolin, this picture facilitates the answer to the "Why these laws?" question: our universe has these laws because these were the laws that allowed it to survive and to generate life; had the laws been different, we might not be here to try to

discover them [2013: 123]. The rationale is the same as the one we find in natural selection among biological species. Only the fittest of universes survive.

In summary, Smolin's central argument is that a universe where laws are temporal allows them to be intrinsic to the universe, rather than external to it, and explicable, rather than inexplicable. This argument resembles Bergson's appeal for precision in philosophy. Timeless laws are external to the universe and inexplicable because they are abstractions of the intellect. They do not fit reality, which is a ceaseless process of change. They result from the spatialization of time, from envisioning time as a line that is given all at once, with timeless laws "hovering above" temporal events. Smolin wants laws to reintegrate reality and partake the fluidity of the universe.

However, Smolin's theory that the laws of nature evolve and his "cosmological natural selection" have a few important drawbacks from the point of view of philosophy, which Bergson's thought helps to reveal and could help to overcome.

Firstly, the idea of a temporal law is a controversial one. Laws are arguably necessarily timeless, since they are arrived at by means of abstractions from change and movement. A law that is constantly changing is arguably not a law at all. Additionally, Smolin's laws do not exactly evolve or change through time, and thus are not as temporal as he depicts them. In Smolin's picture, different universes have different sets of laws, and each universe survives to the extent that its laws allow it to survive. But within each newborn universe, laws are unchanging. Once a universe is born with its set of laws, it is precisely this set of laws that will determine whether it will survive or not, and thus the laws themselves will not change. Over time, the universe as a whole, with all of the sub-universes that it contains, evolves through the process of natural selection. However, the laws pertaining to each universe are as timeless and immune to evolution as the currently accepted laws of physics, which Smolin criticizes, and therefore each universe would be justified in searching for its own private theory of everything. It is true that Smolin forgoes an ultimate timeless law, valid for the whole of the universe and all of its sub-parts. But he does not fully embrace change within each of the nascent universes.

It is true that Smolin's theory of cosmological natural selection indeed facilitates an answer for the "Why these laws?" question. The inhabitants of any given universe can ask the "Why these laws?" question and obtain the same answer, namely that the laws are what they are because, had they been different, their universe would have collapsed. Nevertheless, the question "Why these laws?" remains unanswered when applied to the entire set of universes that are generated, that is, to the totality of things that exist: why is it that things are configured in such a way that new universes are constantly being generated and then selected based on their laws? Why is it this way rather than another way? Why these laws or circumstances? Perhaps to answer this question Smolin would have to introduce a universal principle of evolution, a principle that would arguably be an intrinsic property of the reality of time advocated by him. However, being universal and absolute, such principle would also be external to all of the universes that evolve according to it, i.e., it would remain constant and unchanged by all else that happens. It would be timeless, i.e., unchanging and valid for all time. Smolin recognizes this dilemma, which he calls "the meta-laws dilemma" [2013: 243], but he leaves it unresolved, claiming that "the direction of 21st century cosmology will be determined by how the meta-laws dilemma is resolved" [2013: 245]. Ultimately, the temporal universe proposed by Smolin and the timeless one he argues against run into a similar dead end. Timelessness and externality are harder to escape than Smolin claims, and, unless he can answer the meta-laws dilemma without appealing to a timeless principle, he

will fail to show that the rebirth of time offers advantages over the current framework. This is where Bergson's philosophy of time might be of help.

Smolin uses spatialized notions of evolution, understanding adaptation as the result of a purely external process of natural selection. Smolin's meta-laws dilemma can perhaps be answered with the help of Bergson's account of duration and evolution as intrinsically creative processes. The fact that Smolin cannot solve the meta-laws dilemma reveals that he is still somewhat trapped in timeless thinking, for the need to solve this dilemma is in itself not very different in kind from the need for a theory of everything to which Smolin so ardently objects. Were Smolin to embrace duration and evolution as agents of invention and constitutive forces of the universe, this problem would be resolved. The "meta-law," or the ruling principle for all individual evolving universes, would be pure invention. In other words: it would be *time*. This would constitute a true rebirth of time. Perhaps Smolin, more than any other contemporary cosmologist, would be able to appreciate Bergson's definition of the vital impetus as a tendency, rather than a law. The fact that Smolin's cosmology is halted at the need for a "meta-law" that regulates evolution shows that he suffers from the usual resistance to accepting novelty, the trademark of temporality, as an intrinsic feature of the universe. He cannot fully embrace time as invention.

Conclusion

In its attempt to evade the dead end it is currently facing, contemporary cosmology keeps running into new ones. The currently accepted timeless model exemplified by Barbour's work and the temporal model proposed by Smolin both engender paradoxes that are equally hard to overcome. In the end, if one wants to choose between timelessness and temporality as they are presented in these works, one has to choose between one set of unresolved paradoxes and another.

I hope to have shown that the task of developing a new cosmology can only be undertaken as a joint effort of cosmologists and philosophers, which was my initial motivation for bringing Bergson into the discussion. Barbour's and Smolin's proposals, although plausible from the point of view of science, have serious drawbacks from the point of view of philosophy. They cannot escape the temporality and the timelessness they respectively argue against. Bergson claimed that science always operates with an "unconscious metaphysics" [Pearson & Mullarkey, 2002: 36]. It is precisely because Bergson brings this unconscious metaphysics to the foreground that his philosophy can be so useful to cosmology. It would be interesting to see what a cosmology entirely based on Bergson's philosophy would look like and whether it would avoid the issues faced by Barbour and Smolin.

I align with Karl Popper, for whom philosophy loses all interest when it is severed from its original cosmological impulse, the impulse to understand the world and our place in it [1998: 7]. The converse observation can also be made, that cosmology loses all interest and plausibility when severed from its original philosophical impulse. Cosmologists have been historically more resistant toward philosophy than philosophers to cosmology. This is exemplified in the meeting between Bergson and Einstein at the *Collège de France* in 1922, which is beautifully revived in Jimena Canales' most recent book, *The Physicist and the Philosopher*. As Canales notes, Bruno Latour and many philosophers before him have drawn attention to the fact that, while Einstein declared an unbridgeable gulf between the time of the scientist and that of the philosopher, Bergson considered Einstein's work carefully and attempted a reconciliation of both times, to which he devoted his *Duration and Simultaneity* [as cited in Canales, 2015: 357].

Our contemporary cosmologists are not philosophers. They are theoretical physicists who solve puzzles from the point of view of science and observation but who often neglect fundamental philosophical problems in structuring their theories about the universe. Barbour and Smolin offer wonderful philosophical insights in their books, but there is a larger role to be played by philosophy in cosmology, and the many problems found in their proposals, of which I have listed the ones I consider most important, support this point.

Cosmology is arguably the science that relies most heavily on philosophical theories and thus the one that holds the most potential to foster an approximation between science and philosophy. Because the concept of time is the keystone of contemporary cosmology, such an approximation seems inevitable. Without a philosophy of time as rich as Bergson's, cosmology is likely to keep running into dead ends.

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