



## Physics and the manifest image of time

Craig Callender: *What makes time special?* Oxford: Oxford University Press, xx+336pp, \$45.00 HB

M. Joshua Mozersky<sup>1</sup>

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*What Makes Time Special* is an ambitious, thought-provoking, and original investigation into the nature of time that deftly combines scientific and philosophical breadth and depth. The starting point is the incompatibility between time as it is commonly thought to be, “manifest time,” and time as revealed by science, “physical time” (2). Many philosophers and scientists have been struck by this conflict but, argues Callender, none has managed to offer a plausible account of how we come to have the manifest image of time, given its stark contrast with physical reality. If a fundamental and pervasive part of the world differs greatly from our ordinary and natural understanding of it, one wonders how the common picture could become so instinctive and ingrained. Accordingly, “reconciling manifest and scientific time is our goal” (30), though Callender is “not looking to vindicate manifest time but only to explain why creatures like us might employ that notion” (49).

Manifest time constitutes a diverse and variegated image, so Callender focuses on three features that are central to it and distinguish it from its scientific alternative: “that the present is special, that time flows, [and] that the past is fundamentally different from the future” (2).

The most famous scientific challenge to manifest time comes from Einstein’s theory of Relativity, in particular the frame-dependence of simultaneity. Any attempt to single out the present as special will run into the unenviable task of demonstrating which frame of reference is the objectively correct one, since each has a distinct “now.” This is seemingly impossible for it would entail that some observers will feel the effects of events that *objectively* have not happened yet. Accordingly, the best way forward is simply to accept what Relativity tells us: that the universe consists of a space–time whose geometry does not allow for the definition of a universal present, universal flow, or a universal past–future division. Callender points out that while it is possible to construct definitions in Minkowski space–time that capture some of the manifest image, they are invariably *local*; no

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✉ M. Joshua Mozersky  
mozersky@queensu.ca

<sup>1</sup> Department of Philosophy, Queen’s University, Kingston, Canada

such structure can be “spread” across all of space in a relativistically invariant manner, so none will justify the physical reality of manifest time (56-7), which applies globally.

Many thinkers argue that Relativity too tightly binds space and time together, thereby “spatializing” time (119). Callender does a nice job of dispelling this notion, arguing that the differences between time and space remain in modern physics. First, Relativity contains an invariant distinction between timelike and spacelike vectors (124). Secondly, time, unlike space, is one-dimensional (126-130). Thirdly, objects can move freely in space, but not in time (130-2). Fourthly, there are asymmetries in the temporal dimension that do not exist in the spatial dimensions, for example entropy and causation (132-3). Finally, natural kinds are restricted to entities that retain their identity through time (133-5).

Callender wonders why time has the five features that distinguish it from space. After all, there appears to be no logical connection between them: Why should, for example, asymmetry and natural kinds align along the same dimension? Why, in other words, do the features of time not “fragment”? Callender’s answer draws on the *best system theory* of natural laws. A system of laws must balance two, often competing, virtues: informativeness and simplicity, the goal being to explain as much as possible on the basis of as little as possible. According to the best system theory, the laws of nature are what is common to all the systems that best perform this balancing act (140). Callender’s proposal is that the temporal dimension is the one in which our best theories tell the most informative story. Time is the “great informer” (142).

Here is an example to give the idea (144): Imagine physics is deterministic, so that full information at one temporal location entails a complete description of any of the others. Such a theory is maximally informative and, therefore, lacks a reason to be deterministic in other dimensions. Now consider time travel: If closed timelike curves are possible, then there could be surfaces that surround time travel regions within which particles interact with backward time traveling versions of themselves. The problem is that the particle’s entry and exit trajectories are compatible with indefinitely many interior interactions, so allowing travel in time will introduce uninformative complications into our theories. Accordingly, time is the direction in which travel is constrained (147). Next, consider that since laws of nature operate on natural kinds, the most informative laws will be the ones that have persisting kinds in as few dimensions as is needed, (148-9), and asymmetries such as the second law of thermodynamics are sufficiently informative without applying across spatial dimensions (148). In short, according to the best system theory of laws, the simplest way to maximize informativeness is to unite the features of time in a single dimension. There is no need to appeal to the three properties of manifest time.

Many philosophers have argued that *experience* provides us with reason to believe in an objective “now,” perhaps emergent from a tenseless microphysics. Callender addresses arguments from experience by investigating empirical work on human temporal cognition. As he demonstrates, there is a tremendous amount of natural variability in judgements of both simultaneity and temporal order. Not only do people differ in which events they experience as co-occurring, but the perceived order of events can be flipped by altering background conditions. Under the sensory

barrage of everyday life, human beings, even in close contact, are certain to experientially bind different sets of events together as present: “It’s not so clear that our conscious experience has a single temporal resolution” (203). Given this, it becomes difficult to maintain that there is any common content to the manifest notion of “now.”

We should instead, argues Callender, think of ourselves as equipped with a “simultaneity window,” within which there is variability as to which events will be tied together. Given the high speeds at which perceptual signals—light, sound, etc.—travel relative to changes in our local environment, and the comparatively short simultaneity window, it stands to reason that we will not ordinarily detect the differences between our various experiential “nows.” Accordingly, we “won’t typically notice that our local [spatiotemporal] ‘patches’ aren’t global” and we end up with “strong reasons for regarding the present as objective” (221).

So, experience fails to provide grounds for belief in the special present of manifest time. What about our experience of temporal passage: Why does that occur? Callender again offers a rich, empirically detailed story, but in outline it appeals to three basic phenomena, all compatible with physical time: (1) succession; (2) agency; and (3) physical asymmetries.

First, consider that “timelike curves possess an invariant temporal order” (234), so that events in our environment occur in objective succession. Accordingly, any organism equipped with a perceptual system that is sensitive to environmental signals, as well as some kind of memory register, will have the rudimentary ability to keep track of changes in the environment, such as motion, by experiencing one state while remembering an earlier one (232).

Secondly, though our perceptual detectors and memory allow us to update our experience to keep pace with changes around us, more is required, argues Callender, for the experience of temporal passage: namely, an enduring *self*. A stream of changing memories will not suffice unless it includes something that ties the experiences together since memory updating is compatible with the absence of any felt connection between mental states. The enduring self, however, provides the requisite bond. This self is not a metaphysical entity but, rather, a *narrative* creation (251) that unifies experiences. It is natural to conceive of this character as crawling up a worldline, but we can easily reverse that and imagine the sequence of events moving past the self: “once you have the ego moving you in effect have time moving too” (254).

Thirdly, this agent, the narrative self, is immersed in various physical asymmetries: Causes precede effects, knowledge of the past is more readily available than that of the future, and so on. This gives us the sense that the future is open and indeterminate, in comparison with the past, which is fixed and settled. For instance, since causes precede effects, we can do something now to influence the future, but not the past, though we feel more uncertain about the former than the latter. According to Callender, “these asymmetries are ultimately responsible for the past/future asymmetry” (259).

So, in sum: We update our perceptual experience in the shadow of recent, distinct ones; a constructed self provides coherence to this sequence of experiences, and all of this is done in a world that is causally and epistemically asymmetric. Add it up,

and we naturally take time itself to be flowing past an objective now, from the unsettled future toward the settled past, despite the fact that the world does not contain any such process.

The book ends with a meta-philosophical discussion that is interesting and worth contemplating. Though Callender is intimately familiar with twentieth century analytic philosophy of time, he considers it to be of dubious value, largely because it has detached itself from detailed scientific investigations into the subject (290). As physicists and cognitive scientists have conducted detailed, empirically grounded studies of time, analytic philosophers have remained aloof, focusing on such issues as the semantic analysis of tensed predicates and the concept of *existence* (e.g., whether our language ontologically commits us to the non-present).

I agree that the philosophy of time should work within the light of the science of time. However, I think that there is a role for formal semantics even in scientifically informed philosophy. I bring this up because Callender concedes that his book “has not discharged its alleged obligation to explain the temporal phenomena purged of ‘tensed’ concepts” (302) because he has “not *shown* that such a cleansing could be done” (303). Now, one may think that this is simply fine: Just ignore the philosophy and get on with the science.

But Callender is deeply engaged with philosophy, clearly interested in its proper pursuit and alignment with the best empirical studies. He does not want to ignore it. Indeed, he thinks philosophy has a distinct contribution to make: “to provide meta scientific perspectives that open doors to new possibilities for science” (311).

What has this to do with semantic analysis? Well, consider that we might be at least a bit disturbed should it turn out that, despite the fact that our best physics tells us that the world is a tenseless four-dimensional manifold, we are simply incapable of making such a story coherent to ourselves without reliance on tensed concepts that privilege the present and treat the past and future asymmetrically. After all, how can a tenseless worldview be fully convincing if the attempt to grasp it invariably contradicts it? One of the tasks of analytic philosophy of time is to address this very question, and indeed, I think Callender’s book contains the tools to perform the cleansing he mentions. After all, if he is right, as I think he is, that the correct semantic analysis of temporal indexicals, such as “now” or “present,” is entirely tenseless (186-9), then we have grounds for the conclusion that there is no way of making sense of distinctly tensed content.

Here is why. Suppose that a sentence such as “x is now” expresses a tensed proposition: *Present(x)*. Tomorrow, when x is no longer present, we express that fact with a distinct, tensed proposition: *Not-Present(x)*. Taken together, we have just contradicted ourselves. So, if temporal predicates are monadic, i.e., one-place, then change becomes impossible to model coherently. However, suppose we alter the logical form of the predicate by introducing a second parameter, so “x is now” is analyzed as “x is present relative to t,” or *Simultaneous(x, t)*, and “x is no longer now” is analyzed as “x is not present relative to t\*,” or *Not-Simultaneous(x, t\*)*. Everything is now free of contradiction, the only cost being that our model of the world contains tenseless *relations* that take past, present, or future times as the values of temporal variables. This, I argue, gives us reason to reject the claim that there is distinctly tensed *content*, even if temporal indexicals are ineliminable

because they allow us to relate ourselves to particular times. If this is right, then the suggestion that our scientific theories may be inexpressible without tensed language loses force since such language is only coherent if understood in tenseless terms.

Hence, I think that the attention paid by the philosophy of time to such things as formal semantics is not entirely misplaced. Our language models our reality, so it is important to get the language right if we are not to be misled by it into a faulty metaphysical picture. This is not to insist that reflection on the nature of language alone can tell us what the world is like. Still, such reflection can shed light by placing limits on what models are permissible.

I will close by noting one aspect of Callender's approach that may strike some as disconcerting: his reliance on the best theory account of laws, in which the nature of time is determined by what makes our theories most informative and simple. The reason this may cause some worry is that it makes time's nature "relative to a standard," which is a view that is "*knee deep* in relativism" (154). After all, another system—say one put forth by alien scientists—could be the best for them, and so equally support commitment to a temporal dimension distinct from ours. Callender is not discouraged here, noting that it may very well be possible that, for example, there is "a time for particle physics and a [different] time for gravitational physics" (154), so alternative ways of conceiving of time might be scientifically well grounded. The concern, I think, is that since the universe spent many years evolving prior to the arrival of cognitive beings, it presumably had spatiotemporal and causal structure long before any stories about laws, informative or otherwise, could arise. If so, then it would seem impossible for the nature of time and causation themselves to be relative to those stories, unless we adopt a Kantian position in which the empirical structure of the world is determined by our cognitive architecture. The Kantian view would, however, render it impossible to explain our own existence in the same terms as the rest of the physical world: If space–time and causation derive their structure from *us*, then we cannot explain ourselves in the same terms employed by our physics. This is, in some sense, to take human beings outside the natural order and render the explanation of our own nature mysterious. Hence, I think we must place limits on the relativism here and consider the best theory account to furnish an *epistemic* standard of theory justification, while insisting that the spatiotemporal–causal order itself is independent of our theories. I should note that I see this as perfectly compatible with Callender's conclusions about the nature of time, but I think the distinction deserves emphasis.

Without question, I am extremely enthusiastic about Callender's book. It is bursting at the seams with insight and ingenuity. It is written with great clarity and flow, traversing complex, advanced material with the ease of a true master. *What Makes Time Special?* is a seminal contribution to the field, comparable to classics such as D. H. Mellor's *Real Time* and Paul Horwich's *Asymmetries in Time*. It is an engaging and exciting piece of scientific philosophy that will stand the test of time. Anyone interested in the issues it addresses should read it.