WHAT MAKES TIME SPECIAL?

CRAIG CALLENDER

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Craig Callender
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'Time is a big invisible thing that will kill you' (p. 1). I cannot think of a more striking opening sentence to a work of philosophy in recent times—or at any time, for that matter. What follows is a comprehensive tour of philosophy of time from Callender's perspective, written with great insight, as well as wit and flair. The book is not without its puzzles, however, and the purpose of this review is to guide philosophically sophisticated readers around obstacles to at least some of its insights.

The opening sentence quoted above begins Chapter 1, 'The Problem of Time'. The problem is that there are two distinct pictures or images of time that vie for our allegiance. One is manifest (common sense, ordinary, folk) time, characterized by an objective and global *now* or present, by a dynamic aspect that Callender calls 'flow', and by a sharp asymmetry between past and future. But there is also physical time, lightly described in this chapter but explored at length in Chapters 2–5. The most salient feature of physical time is, in Callender's view, that it lacks the three features that are constitutive of manifest time, leaving us with a version of Eddington's famous 'two tables' problem[1]:

> Unlike Eddington's problem, however, the present problem is much harder and more pressing. It is harder because physics succeeds in building explanatory and predictive theories of the world without appealing to the features of manifest time and also without providing any obvious counterparts. It is more urgent because manifest time, unlike the manifest table, occupies a deep and central place in our lives. We can't afford to dismiss either 'image' of time. To understand our place in the universe, a reconciliation is badly needed. (p. 26)

Callender brusquely indicates the difficulty of this reconciliation project by pointing out that 'our best science of time suggests that manifest time is more or less rubbish' (p. 2). This initial gulf does not bode well for ultimate rapprochement.

Callender's way of setting up his problem in Chapter 1 is reminiscent of the clash of manifest and scientific images described in the classic essay of Wilfrid Sellars, 'Philosophy and the Scientific Image of Man' ([1963]). Sellars thought that the philosopher should 'fuse [the two images] into one vision' ([1963], p. 4). Readers may then be led to expect the book to contain copious, subtle metaphysical juggling to bridge the divide. A reader with such expectations is apt to find the rest of Callender's book frustrating or confusing. If readers wish to prepare for what is to come, I suggest that they make a brief detour and read next Chapters 13 and 14, the final two chapters of the book.

Chapter 13 explains why one will not find much of current standard metaphysics of time in the book. Callender thinks that the dispute between A-theorists and B-theorists is a muddle of issues, not usually distinguished from, though in fact independent of, one another. Even if these knots could be untied, it would help us little: 'neither position tells us much that is specific about time' (p. 292).

The war between presentists and various varieties of non-presentism is in an even a worse position because these views impose irrelevance on themselves. By focusing exclusively on ontological issues, on existence, the various sides ensure that no empirical result about the nature of time could be relevant to the controversy. Analytic metaphysics 'bought itself permanent immunity from the threats of science by making philosophy of time about the one property guaranteed to generate no inconsistency with science: naked existence itself' (p. 296). Philosophers may happily carry on this discussion, but it is guaranteed to tell us nothing about the nature of time.

Another important component of Callender's outlook is to be found at the end of the next and final chapter, Chapter 14. He (p. 312) quotes the redoubtable computer scientist Scott Aaronson ([2016]):

> [...] whenever it's been possible to make definite progress on ancient philosophical problems, such progress has almost always involved a [kind of] 'bait-and-switch'. In other words: one replaces an unanswerable philosophical riddle Q by a 'merely' scientific or mathematical question Q′, which captures part of what people have wanted to know when they've asked Q. Then, with luck, one solves Q′ [...] this process of 'breaking off' answerable parts of unanswerable riddles, then trying to answer those parts, is the closest thing to philosophical progress that there is.

Readers will notice (or will have noticed, if they read the book in the printed order) that whenever Callender sidles up to a big philosophical Q, like 'does time flow?', he tends to dismiss (and quite rightly, in my view) the standard philosophical (pseudo-)answers, and then he steams off into a forest of scientific Q′s like 'why do we believe that time flows?'. This, is far as I can see, is the shape of Callender's project of reconciliation. Readers will cheer or long for the 'real' discussion depending on their meta-philosophical attitude towards Aaronson's bait-and-switch.

Now to resume... Chapters 2 through 5 of *What Makes Time Special* (henceforth, WMTS) focus on time in physics. First Callender presents Newton–Cartan spacetime (a mathematically sophisticated version of Newtonian or neo-Newtonian spacetime), in which 'all three ingredients singled out in the Introduction as crucial to the manifest image are lacking. There is no distinguished now, nor any notion of flow, and even a past/future asymmetry is not needed' (p. 40).

Then Callender turns to general relativity. Skipping over an extended presentation of the special theory of relativity makes a great deal of sense in that Minkowski spacetime is one particularly simple example of a general relativistic spacetime, but the general theory is mathematically deep. It is just not possible to give a self-contained presentation of general relativity within the confines of a book like WMTS, and many readers will find the going

rather hard, if not impossible, at this point. My advice: make what you can of it and soldier on. There will be less technical and more rewarding parts to come.

In fact, there is much more even in this chapter, but I will discuss only the point relevant to the main thread of the book. Callender presents several features of the manifest present (p. 50). He then describes various attempts to define a relativistic notion of the present, and he shows, for each, that they lack one or more of the manifest features. He dismisses them all. In fact, he presents the reader with what he calls an informal dilemma: 'the better a structure represents manifest time, the "less" relativistic it is; the "more" relativistic it is, the worse it represents manifest time' (p. 31).

There is at the very least a tension between Callender's call for reconciliation of manifest with physical time and the way that he enforces this dilemma. Reconciliation requires give-and-take. If one requires that *all* the manifest characteristics of, say, the present apply to its relativistic successor concept, then there will be no reconciliation. But if there is nothing like a present or passage in relativistic spacetimes (leaving for another occasion the vexed questions of what the manifest present or passage are and how like them scientific successor concepts must be), then there is no time in them, and they do not deserve to be called space*times*. But since they *are* spacetimes, I suggest that we should be less restrictive than Callender in our search for these physical successor concepts.

One way people hope to regain lost time is to split a four-dimensional manifold into a (3+1)-dimensional structure. To be sure, there are legitimate reasons for physicists to make this split if they want to formulate and to solve initial value problems. But Callender in Chapter 3 ('Tearing Spacetime Asunder') is concerned with metaphysicians who want to find or re-create manifest time in the relativistic setting. In particular, they want to find a global hyper-surface that 'bisects the universe [...] is global and non-intersecting' (p. 50). Such structures can in fact be found in some causally well-behaved spacetimes. Even unique such structures can be found, though their construction often involves sophisticated averaging techniques (p. 75). Callender asks what connection there is between these structures and manifest times, but this is a rhetorical question. There is no connection, in his view, that would make a metaphysician happy.

I think Callender makes his case here, but what should one infer from it? He reaches for a broad conclusion:

> Are there structures in relativity that satisfy the twin demands of (a) corresponding to manifest time and (b) being relativistically invariant? Although one lacks a general proof, the answer seems to be No.

Leaving aside for a moment the vagueness of the term 'corresponding', I suggest that one can infer from his arguments that one cannot find in relativistic spacetimes, even globally hyperbolic spacetimes with optimal matter distribution, some unique (achronal) global hyper-surface that plays the same role as the hyper-surface of absolutely simultaneous events does in manifest time. But now leaning on the vagueness of the term 'corresponding', I suggest that one look seriously at *local* structures that might have or be able to reproduce some of the features of manifest time. Of course, this will not give us back manifest time in all its pre-relativistic glory, but it may give us back enough to get by with around here.

In Chapter 4, 'Quantum Becoming', Callender gives a quick review of non-relativistic quantum mechanics, the EPR argument, Bell's inequality, and the experimental results showing that quantum mechanics correctly predicts violations of the Bell inequality. Then he addresses two ways in which quantum mechanics might be thought to rehabilitate some aspects of manifest time.

First, can quantum entanglement be employed to distinguish some sort of absolute simultaneity? Probably not, he thinks, primarily because one cannot use entanglement to send information/signals at superluminal speeds and so establish a frame-independent simultaneity. But even in interpretations of quantum mechanics that require a

distinguished hyperplane of simultaneity (his example is Bohm's interpretation) the distinguished simultaneity is empirically inaccessible. It will be no help to traditional metaphysicians.

Second, can quantum collapse distinguish the fixed past from an open future? Again probably not, first of all because whether a system is in a superposition or an eigenstate is basis-dependent, whereas whatever 'fixed' and 'open' mean, the application of these concepts should not be basis-dependent. And, secondly, the relation between being in a definite state at some time and that state's having a probability of less than one at an earlier time is much less straightforward than usually supposed. To buttress his case, Callender cites an insightful and elegant discussion of fatalism by Jordan Howard Sobel ([1998], Chapter 1). I agree with Callender that were it better known, there would be much less confused argumentation concerning the 'open' future.

There are many proposals for reconciling quantum mechanics and general relativity.[2] The different treatment of time in the two theories is a well-known impediment to their unification, and Callender discusses in Chapter 5 two quantum gravity programmes that treat time quite differently. Our conception of physical time, then, might develop in either direction, though no quantum gravity programme at present can claim to be a consensus view. Callender sees these two programmes, I think, as representing two distinct, extreme possibilities for physical time.

The first programme is causal set theory, and it gives us 'The Best of Times'. The world consists of an expanding set of events, but the key point (for compatibility with relativity) is that these events are only partially ordered. Callender then points out that for pairs of events that are spacelike separated (as that notion is captured in this theory), there is no fact of the matter as to which is earlier, doing some violence to our manifest conception of (complete) time order. But what else is to be expected?

The second programme, giving us 'The Worst of Times', is canonical quantum gravity, which seems at first blush to give us no time at all. The normal quantization of general relativity yields the Wheeler–DeWitt equation, which sets the time evolution of the universe to zero. Heroic and ingenious methods, briefly outlined by Callender, are employed to find a physical time that is 'emergent' from what is thought to be a universe that basically lacks time. There have been limited successes to date, and there may (or may not) be more to come.

As Callender points out, if you think that time does not exist or is some sort of illusion, there is a quantum gravity programme for you. If you are convinced that time is a fundamental element of reality, then there is also a quantum gravity programme for you. Since there is no consensus in the field, it is unclear what one should infer from them now about (physical) time, but of course one should watch that space.

Suppose that, as Callender says, modern physics shows that manifest time, from the perspective of physical time, is 'rubbish'. If one cannot find the marks of manifest time in relativistic spacetimes, then what, if anything, distinguishes physical time from physical space in its four dimensions? This Q takes up Chapters 6–8 of WMTS.

In Chapter 6 Callender discusses four differences between time and the (usually) three other dimensions of spacetime. The most important of these differences in his view (and by common consent, I think) is the distinction enforced by the signature of the metric, which divides the four dimensions of a manifold into three of one sign and one of another. From the metric one can derive the light-cone (or conformal) structure in a spacetime and distinguish space-like, light-like, and time-like directions. These are just words or names, of course, but Callender notes earlier in WMTS that according to the clock hypothesis (p. 47), ideal clocks measure proper time along time-like worldlines. For my money this connection welds the time-like to time.

One might add that there is a pre-relativistic clock hypothesis that Callender points to (p. 35). Since real clocks approximate ideal clocks, here is a mode of continuity between manifest and physical time that Callender ignores. If

clocks measure the passing of time, they do so in relativistic spacetimes as well as classical.

In Chapter 7 Callender proposes a new difference between time and space. Adopting the best system account of laws, he argues that 'the temporal direction is that direction on the manifold of events in which our best theories can tell the strongest, most informative "stories"' (p. 120). Less metaphorically, the temporal direction is the direction in which systems that have solved initial value problems evolve. In Chapter 8 he discusses some odd cases in which the initial value problems can be solved on surfaces that are not at all, or are not purely, space-like (and so evolution is not at all, or is not strictly, space-like). Many technical Q's flow from the main Q.

Chapters 9 through 12 provide speculative explanations as to how creatures like us—the product of evolution, the subjects of cognitive psychology, inhabitants of relativistic spacetime—might come to possess the manifest view of time. Chapter 9 asks the philosophical Q: do we experience the present? Straightaway, Callender deftly undermines two affirmative philosophical arguments that we do, a temporal version of the knowledge argument and the appeal to direct experience. The former can be disposed of by a sophisticated understanding of the way indexicals like 'now' function (Section 9.3), while the latter founders on its lack of appreciation of the limitations of Givenness (Section 9.2). As Callender remarks (and I do hope his readers pay attention), 'Experience is trouble for the detenser only if one reads the (tensed) theory into the data' (p. 183). Then follows a survey of the experimental Q's that tend to show that what we experience subjectively as present is constructed in complex ways from streams of incoming sensory information. Then in Chapter 10 Callender argues that the representational asymmetry,[3] of which I am sceptical, leads us (or perhaps tricks us) to join or stitch these subjective presents into a larger 'objective' present.

Callender addresses the alleged dynamic side of the present, the flow of time (or, as I prefer to call it, the *passage* of time), in Chapter 11. His basic (or, at least, his final) claim in this chapter appears immodest: 'By any reasonable standard of theory choice it [the theory of passage developed in this chapter] is a better theory of passage than any currently offered in metaphysics' (p. 263). But as we have seen, in Chapter 13 Callender dismisses current metaphysical theories of time as completely empty. From that perspective, he claims in this chapter to clear a bar set very low.

But, invoking his standard operating procedure, Callender moves from the philosophical Q to the empirical Q': why do we believe that time passes? To this end Callender introduces a simple (or toy) model of an information gathering and utilizing system (or IGUS). Its original equipment is a set of perceptual registers that update at a fixed short time interval, a schema that 'creates a representation of the world' (p. 233) and two processing units, U and C. In the course of a long and richly detailed discussion, Callender proposes that IGUS must be able to abstract a linear structure from its collection of memories (p. 246), to develop a concept of an enduring self (Section 11.6), to decentre temporally (Section 11.8), and to have a sense of agency (Section 11.9). With these elements in place, Callender thinks that IGUS is more-or-less equipped to develop a theory like our theory of manifest time. It seems to me, then, that a characterization that Callender offers at the beginning of the chapter accurately describes what it does: 'While physical time does not itself flow, we can explain why creatures like us embedded in a world like this one would nevertheless claim that it does' (p. 227).

I would like to suggest that one important element is omitted from Callender's list of IGUS's requirements. IGUS's initial sensory buffer, P_0, is updated periodically and its contents passed down to a chain of other buffers in turn. That is, P_0 receives one image after another; it receives images successively. To one who thinks that succession is the key or essential feature of passage, this says that IGUS operates in a world in which time, in fact, passes (see Savitt [2002]). If time did not pass in this sense and IGUS's buffers never updated, then I fail to see how IGUS would develop a theory of passage. But once it is fully conceptually equipped, it does (or it may) register the passing of time in its environment. How it comes to embellish this fact with the fanciful theoretical trappings of the manifest

picture of time may be an important chapter in cognitive psychology, but that story may not tell us much, or even anything at all, about passage itself.

Chapter 12 considers the temporal value asymmetry. We have many different attitudes towards the past and the future. We fear future pains but not past pains. Callender again argues that tensed metaphysics is no more able to rationalize such differences than de-tensed metaphysics is, but in this area we seem to be still in need of more Q's to replace the old Q.

In sum, Callender has written a survey of issues in philosophy of time from a broadly naturalistic perspective. It is rich in detail and argument. Even though this account of the book has been lengthy, I have only scratched its surface. Anyone interested in understanding time will be rewarded by further digging.

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References

Aaronson, S. [2016]: 'The Ghost in the Quantum Turing Machine' in S. B. Cooper and A. Hodges (*eds*), *The Once and Future Turing: Computing and the World*, Cambridge: Cambridge University Press, pp. 193–296.

Eddington, A. [1929]: The Nature of the Physical World, New York: Macmillian Company.

Savitt, S. F. [2002]: 'On Absolute Becoming and the Myth of Passage' in C. Callender (*ed.*), *Time, Reality, and Experience*, Cambridge: Cambridge University Press.

Rovelli, C. [unpublished]: 'Quantum Gravity: Past, Present, and Future'.

Sellars, W. [1963]: *Science, Perception and Reality,* New York, The Humanities Press.

Sobel, J. H. [1998}]: Puzzeles for the Will, Toronto: University of Toronto Press.

Notes

[1] See (Eddington [1929], Introduction).

[2] For a list of seventeen programmes in the area, see (Rovelli [unpublished]).

[3] 'Representational Asymmetry: we think, speak, and act in ways that treat the egocentric temporal categories as objective, but we do not think, speak, and act in ways that treat the egocentric spatial categories as objective' (p. 209).