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REVIEW

MAURO DORATO
Time and Reality: Spacetime Physics and the Objectivity of Temporal Becoming

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Craig Callender
Department of Philosophy, Logic and Scientific Method
The London School of Economics

Since the discovery of Minkowski spacetime many have felt that special relativity conflicts with the conception of time found in ordinary thought and language, namely, the tensed theory of time. The tensed theory claims that it is an objective feature of the world that events are continually changing with respect to the monadic properties of being past, present, and future. Can we reconcile this temporal flux with the relativity of simultaneity? Thinkers such as Einstein and Godel grappled with this interesting question, and it has been a semi-regular topic in the philosophical literature for half a century. To my knowledge, Dorato's work is the first book-length examination of this issue.

The first section is an exposition of different theories of time. Depending on which events we consider real (present, past, and/or some future), it is possible to formulate three different tensed theories in addition to the tenseless theory that claims that all events are real. The second section presents a particular way of understanding the idea of events 'coming into existence' when present. The remainder of the book is a study of how tenses fare in relativistic spacetimes, except for the last chapter, which is an interesting discussion of cosmic time. The main conclusion is that although relativity is compatible with tenses, relativity plus the notorious Bell inequalities make the existence of tenses unlikely. Hope is held out, however, that cosmology may provide a way of resurrecting temporal becoming.

This book has its ups and downs. Perhaps the best section is the discussion of the semantic and ontological formulations of the debate about tenses. Dorato should be applauded for placing the debate squarely within the realm of ontology. In this reviewer's opinion, for far too long the literature surrounding tenses has focused on whether or not tensed statements, such as 'thank goodness my headache is over', have tenseless truth conditions. To philosophers reluctant to make ontological commitments this way, this tired semantic analysis is orthogonal to the real (interesting) issue: that is, is there reason to

believe in a genuine ontological asymmetry between the present and future? By concentrating on the possible mind-independent facts that would give future-tensed statements truth values, Dorato significantly improves the discussion of this issue.

This virtue comes with a price, however. Since McTaggart, it is quite difficult to formulate an *ontological* asymmetry between the present and future in the manner tensers desire, especially if one holds that existence is a trivial property. Dorato proposes to characterize the notion of 'coming into existence' in terms of a second-order property of 'becoming determinate'. The world does not become from nothing on this view, rather it becomes determinate. An event-type is determinate with respect to the past just in case it possesses exactly the same attributes in all physically possible worlds sharing the same past (p. 108). Since 'is determinate for' is a second-order relation between events, events can be determinate for one event but not another. Events can therefore be determinate for later ones but indeterminate for earlier ones. This network of second-order determinacy relations among events gives substance to the picture of an ontologically 'fuzzy' future made determinate by the present.

I doubt that many tensers will recognize their theories in this reconstruction. Definitive of the usual tensed theory is the notion that (in McTaggart's terminology) 'A-properties' of being past, present and future are irreducible monadic properties of events. On Dorato's analysis, however, there are no A-properties, only second-order relations between events. Most tensers, I suspect, would consider this nothing more than a poor man's (that is, tenseless theorist's) explication of tenses. Dorato's 'deflated' tenses are certainly a far cry from what the original tensers had in mind. For instance, note that physical *determinism* implies *determinateness*, and thus on Dorato's analysis, the tenseless view. Surely no tenser would agree that her thesis depends on the *manner* in which physical systems evolve—the thesis is supposed to be about which physical systems exist. The question for Dorato's analysis, as always with deflationary theses, is whether the deflated item is similar enough to the original to be worth having. Although I am no fan of tenses anyway, I wonder what purposes deflated tenses are supposed to serve.

It is a bit surprising that Dorato pays so little attention to C.D. Broad's theory. Broad provided objective referents for tenses by asserting that 'fresh slices' of existence are continually being added to history. His innovation lay in his response to the objection that this changing demands a second-order time. He insisted that temporal becoming is a *sui generis* process not defined by reference to time. So far as I can see, this is a perfectly consistent formulation of tenses. Against it Dorato complains that the change in A-properties is not similar to the change of ordinary properties, since the latter is change with respect to time whereas the former is not (p. 121). But that is no objection, it's

the theory. Admittedly Broad's manoeuvre is somewhat unsatisfying, but are tenses really being done a favour by deflating them rather than treating them as primitives?

On the traditional interpretation of tenses, only present (or present and past) events are real. If present events are all those events simultaneous with the present one, and all and only those events are the real ones, then the relativity of simultaneity poses a problem: existence itself must be relativized to frame. This *may* not be a contradiction, but it is certainly a queer position to hold. Deflated tenses don't share this problem, however. By interpreting tenses as relations among events on a 4-manifold and not as genuine changes in existence, Dorato (and H. Stein before him) removes the apparent contradiction and is able to investigate the idea of relativistic becoming. Putnam and others are said to be wrong in claiming tenses to be inconsistent with relativity, but this doesn't seem fair since the participants in the debate do not share a univocal sense of tenses.

One unfortunate omission from the discussion is the possibility of interpreting special relativity along the lines suggested by J.S. Bell. The idea is to eliminate the Lorentzian metric structure of spacetime by looking at the effects of relative motion on measuring devices, that is, at time dilation and Fitzgerald contraction. This move allows one to interpret relativity as a 'phenomenal' theory, naturally suggested by observation but not fundamentally true; that is, becoming picks out a priviledged frame. So understood, relativity is perfectly compatible with tenses (however interpreted). Dorato accuses a similar move of being *ad hoc* (p. 190). I disagree. *If* there is independent reason to believe in tenses *and* relativity traditionally construed conflicts with them, then that seems a well-motivated reason to prefer Bell's interpretation. Since this option undermines the whole debate—and it may be pressed on us from problems with quantum mechanics anyway—it is regrettable Dorato (and the literature) misses it.

Despite defending tenses from relativity, Dorato withdraws his support for them due to difficulties posed by quantum mechanics. On his tensed theory, spacelike related events must be considered indeterminate to each other. Dorato then worries that the Bell inequalities prove that some spacelike related events are determinate, for example, distant subsystems possess definite spins. He also worries that the tenseless view implies there are no quantum indeterminacies. However, because there exist non-local hidden variable interpretations that have this consequence anyway, he finds the first worry more serious and concludes against tenses. This section needs more development. If the crux of the issue is quantum mechanics' relationship with relativity, there can be no sidestepping the delicate issue of the compatibility of the two theories. After all, if the two are inconsistent with each other, one shouldn't draw lessons for the philosophy of time from their combination. Whether one

opts for instantaneous collapses or non-local mechanisms, quantum theory *seems* to pick out a preferred foliation of spacetime, contrary to relativity. Dorato can't afford to ignore this. If, for instance, the problems with quantum mechanics force us to adopt Bell's interpretation of relativity, then the whole conflict between relativity and tenses disappears. Drawn by the neat consequence for determinacy, Dorato wants to include nonlocality in his discussion without considering the larger issues. But because these issues are relevant, he cannot afford to be so selective.

The concluding chapter suggests the possibility of using cosmic time, the time used in cosmology, as a way of defining his tenses. Cosmic time enables one to define an objective series of moments along which the world could successively become determinate. A problem with this is that cosmic time depends on a special global matter distribution, and it is counterintuitive to think of time as depending for its existence on the initial distribution of matter. In contrast to Godel, this fact doesn't upset Dorato, who endorses positing tenses if a cosmic time is available. Still, since cosmic time is only definable via elaborate averaging procedures over the matter distribution and is not at all the sort of thing to which we have access, one again wonders what the purpose of these deflated tenses would be. The passing of cosmic time is not the passing of time tensers seek to describe.

By focusing on my disagreements with the main argument I have not done justice to the many positive aspects of this fine book. Particularly impressive are Dorato's novel take on the view that only the here-now exists, his objections to Stein's theory, and above all, his careful exposition of the various theories of time. The solid exposition makes this book a valuable resource for anyone interested in time. Regrettably, quite poor editing will bother some readers. But the book is worth reading. Dorato's knowledge of the literature on time is encyclopaedic, and the book is absolutely packed with argument. Even if the reader does not agree with the main one, I suspect that most philosophers will come away having learned a good deal.