BOOK REVIEW

The Nature of Time

By Ulrich Meyer

Oxford: Oxford University Press, 2013. xii + 162 pp. £35.00

In *The Nature of Time*, Ulrich Meyer advances a modal theory of time-the time series forms 'a logical space that is occupied by sentences or propositions, rather than a geometric space that is populated by material objects or events' (3). Unlike another recent exploration of modal accounts of time (Rini and Cresswell 2012) that explicitly tries to stay metaphysically neutral, Meyer argues that his modal theory is the best metaphysical account of time.

What sorts of things are instants of time? Temporal substantivalists say they are metaphysically basic temporal points. Relationalists, on the other hand, claim that times just are some sort of relational structure–the overlap of events, for example. Modal theorists say that times 'are ways the present was, is, or will be' (2) and that 'time is a type of logical space' (3). How then to adjudicate amongst these options? According to Meyer, an adequate theory of time must (i) be able to solve the Problem of Change, that is, reconcile the possibility of change with the Indiscernability of Identicals; (ii) mesh with the role that time plays in our best physical theories of motion; and (iii) make appropriate contact with our ordinary way of talking about time, our 'folk-theory' of time. Meyer argues that satisfying these three constraints speaks in favour of a modal theory of time.

In Chapters 2 and 3, Meyer presents and critiques various versions of relationalism and substantivalism, respectively. For example, against event-relationalism Meyer argues that such views either get the cardinality of events wrong, presuppose the very times they are trying to analyse, or provide no solution to the Problem of Change. Temporal parts relationalism does better, but, argues Meyer, avoids presupposing times only by incurring a higher ontological cost than modal views. Temporal substantivalism, on the other hand, either fails to solve the Problem of Change or is ontologically extravagant. In the latter case, Meyer argues that there is no temporal counterpart of Newton's bucket of water example (designed to show the need for spatial points). Consequently, Leibniz's argument that metaphysically basic temporal points are dispensable succeeds. Meyer also notes the metaphysical oddity of temporally basic points-they would not be continuants as required of a substance, and it seems arbitrary that there are the same number of times as spatial points (which appears to be a requirement for motion on a substantivalist account).

Having dispensed with the two main competitors, Meyer sets out in the rest of the book to present and defend his own modal view of time. In Chapter 4, he quickly introduces modal logic and some corresponding tense logic systems. Meyer takes the operators P (it was the case that) and F (it will be the case that) as conceptually primitive and defines their duals H (it has always been the case that) and G (it will always be the case that) in the standard way. Next he spells out, Z, a system of tense

logic with a standard propositional base and the tense axioms Z1: $H(\varphi \rightarrow \psi) \rightarrow (H\varphi \rightarrow H\psi)$ and $G(\varphi \rightarrow \psi) \rightarrow (G\varphi \rightarrow G\psi)$; Z2: $\varphi \rightarrow HF\varphi$ and $\varphi \rightarrow GP\varphi$; and TG: If $\vdash \varphi$ then $\vdash H\varphi$ and, If $\vdash \varphi$ then $\vdash G\varphi$. Quantifiers and identity are added in Chapter 8. Though there are certainly other axioms that could be added, Meyer proposes to treat Z as the fundamental theory of the nature of time. Additional axioms would describe not the nature of time itself, but rather what is happening in time.

The remaining chapters concern expansions and defences of the basic tense logic presented in Chapter 4. In Chapter 5, Meyer argues that a modal theory of time, while hospitable to temporal propositions, does not require them. Hence, he can remain neutral on the controversial issue of whether propositions can change truth value over time.

In Chapter 6, Meyer spells out a solution to the problem of definitional incompleteness-the problem that not all temporal locutions seem expressible in terms of the P and F operators alone. First, he specifies that instants of time are maximal consistent sets of sentences of tense logic. Meyer plausibly argues that the solution is to create an extended tense logic that quantifies over these instants of time. The only temporal operators in instants of time are P and F. The extended tense logic includes names of these times and quantification over them, but no new temporal ontology. The result, Meyer argues, allows temporal primitivists to express all that is required of a theory of time, but does not expand the temporal ontology or ideology of the theory.

Chapter 7 aims to deal with some problems concerning temporal structure that arise for Meyer's account. For example, as Meyer points out, maximal consistent sets accounts of modality have been charged with not being able to provide enough sets to account for all the needed possibilities. Meyer's quick answer is that a similar problem does not plague his account since 'no one thinks that there are more than continuum many times' (67). Whether this quick response is adequate is unclear since these actual times are a subset of possible presents (which are also captured by maximal consistent sets of sentences). But there seem to be at least as many possible presents (or ersatz times) as there are possible worlds, so the problem re-emerges for capturing possible presents with no guarantee that the possible presents we can model are in fact the actual times. In general, Chapter 7 might be viewed as an acknowledgement of some of the costs associated with Meyer's view–he just bites the bullet and denies the possibility of linear recurrence or symmetric branching of time. In addition, temporal distances are always theory relative, but no less objective, he maintains.

The most significant defence of his theory, however, occurs in Chapters 9 and 10. According to Chapter 9, tense primitivists, contra popular opinion, are not committed to presentism, but instead, 'like everyone else, must endorse eternalism' (87). Given the quantified tense logic–Meyer presents in Chapter 8, the presentist thesis, (P) 'Nothing exists that is not present', is either trivial or false. He also argues that rejecting presentism would not require an analogous rejection of actualism. Hence, Meyer argues that a rejection of presentism is not a reason to reject his modal account of time. In Chapter 10, Meyer disentangles tense primitivism from any commitment to the flow of time and suggests the flow of time is nothing more than a metaphor.

In Chapters 11 and 12, Meyer tackles the Problem of Motion–which is a combination of the Problem of Change and the nature of space and time (and so makes good on his promise that tense primitivism can mesh with our best physical theories of motion). Chapter 11 lays out the standard Minkowski spacetime solution to the Problem of Motion-'treat space and time as mere facets of a four-dimensional *space-time*' (119), which sets up for his argument of Chapter 12. While appeal to Minkowski spacetime seems to require that space and time be inseparable in a way that is problematic for tense primitivism, Meyer argues that in fact a hybrid view-space substantialism and tense primitivism is compatible with the empirical evidence for Minkowski spacetime.

Chapter 13 is an elegant one-page summary of the book. The fact that Meyer can so adeptly summarize his book in one page shows the precision and elegance of his writing. In just 134 pages of text, Meyer covers significant ground with crisp, clear prose and argument. He does not shy away from the presentation of the required logic, mathematics or physics, yet does not get mired in the technical details. Meyer does an excellent job of laying out the strengths and weaknesses of the many available positions, including his own. While it is unlikely that the single chapters devoted to rejecting presentism, temporal substantivalism or relationalism will convince advocates they are wrong, Meyer has carved out a tenable and interesting modal theory of time that requires consideration.

> G.C. GODDU University of Richmond Richmond, VA 23173 ggoddu@richmond.edu

Reference

Rini, A.A. and M.J. Cresswell. 2012. *The World-Time Parallel*. Cambridge: Cambridge University Press.