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Jimena Canales
The Physicist and the Philosopher: Einstein, Bergson and the debate that changed our understanding of time
Princeton and Oxford: Princeton University Press, 2015, 488 pp.
ISBN: 9780691173177

Reviewed by Chris Nunn

It's hard to imagine that any single author will ever outdo this account of the recent history of our concepts of time. The story centres on disagreements between Einstein and Bergson that came to a head at a meeting in 1922, held in Paris. Both protagonists attracted passionate supporters and detractors while ramifications of their opposing views, extending way beyond purely technical issues, remain pertinent today. Jimena Canales describes the philosophical, scientific, technical, and socio-psychological issues in meticulous, accurate (so far as I could judge), and well-written detail, showing an admirable breadth as well as depth of insight into all of these different fields and the wide cast of characters who were involved.

But what were the disagreements about and can we, nearly a century on, say anything useful on how best to resolve them? The basic problem was that Einstein felt that his new theory of general relativity said nearly all that needed to be said about the nature of time. There had been some opposition to it initially and his supporters had all the enthusiasm, along sometimes with the aggressiveness, of new converts. Bergson, while accepting the mathematical sufficiency of Einstein's theory and its probable advance on earlier proposals made by Lorenz and Poincare, thought that it did not capture the changeability and 'vitality' of the world. He considered that time as perceived by us, with its durations and simultaneities, might be more than a purely mental construct and implied an ontology not covered by relativity theory.

Early debate often revolved around the 'twin paradox' — the different rates of aging of twins with different movement histories — with Bergson initially claiming that only one of the twins should be regarded as having experienced 'real' time. This was unfortunate from his point of view as both logic and experimental findings were against him. Einstein and his supporters were soon able to claim that Bergson simply 'didn't understand' relativity theory, which in fact seems not to have been the case. It was more that he felt that any ontology of time based only on considerations to do with measuring it was likely to prove incomplete. Arguments for his view, however, were mainly rhetorical and thus easily dismissed by opponents. Alfred North Whitehead's developments of Bergsonian ideas do still have a smallish following, but are generally regarded more with puzzlement than acceptance.

Indeed Einstein is widely accepted to have been the victor in this case, in contrast to his later defeat over 'spooky action at a distance' quantum theoretical questions. The recent detection of gravity waves (subsequent to publication of this book) on top of many earlier empirical findings has set the seal, many would say, on the adequacy and validity of relativity theory. Dissenting voices remain, even about how best to deal with the relativistic 'twin paradox' (e.g. Masreliez, 2012), but they are largely ignored. General relativity is recognized to have limitations, especially in relation to quantum theory and questions about 'black holes', but is nevertheless regarded as providing a 'gold standard' ontology for time, with questions of 'time's arrow' being treated as secondary and our experience of temporality as tertiary.

Actually, time's flow and directionality were problematic for Einstein since the overall structure of general relativity is static, while his earlier interest in, and experience of, Brownian motion suggested that there might be no inherent temporal directionality to events at the microscopic level. He perforce had to adopt Bolzmann's entropic account, despite doubts about the adequacy of any purely statistical explanation of directionality. Bergson, meanwhile, continued to advocate a notion of biological, 'lived' time to which he went on attributing some objectively ontological, as opposed to purely epistemological, significance; a manoeuvre that most scientists saw as nonsensical although it found favour with some artists and even a quantum physicist (Satosi Watanabe). Debate tended to centre around analogies with cinematography, the opposing parties drawing different conclusions from it. Bertrand Russell, for instance, emphasized that a

succession of stills produced the illusion of movement and directionality, while Bergson pointed out that this illusory movement was a product of real movement in the projector. The overall impression is of messy and inconclusive argument that eventually petered out, leaving entropy as the only explanatory candidate still standing.

A penumbra of thought experiments, popularizations, extrapolations, misunderstandings, and misrepresentations accumulated around the arguments, which are of historical interest (did you know, for instance, that Einstein had apparently endorsed eugenicism in the 1920s?) but, with one exception, have little contemporary relevance. The exception was down to Charles Richet who, from work that had begun in the 1870s, concluded that the smallest time unit of consciousness is $1/12^{th}$ of a second. He went on to suggest, in the context of the Einstein/Bergson debates, that this might be a fundamental unit in some sense.

Towards the end of his life, and long after Bergson's death, Einstein apparently had second thoughts about the completeness of his ontology of time. Canales writes that: 'Yet in 1949 he stood "guilty" as charged [by Whitehead and others, building on Bergson's legacy], so he said, because deep down nobody could draw a firm distinction between the world of sensations and the world of the mind.' Earlier, when confronting Bergson, he had firmly insisted on a clear separation between subjective and objective. Ironically enough we can now begin to see how his earlier insistence on a clear separation, not his later partial acquiescence in a Bergsonian view, might possibly have provided a basis for agreement between them.

Jimena Canales rounds off her book with a look at some very recent philosophico-social developments, suggesting in the course of an elaborate argument that 'humanistic' considerations may provide a preferred frame of reference that would permit rehabilitation of Bergson's ideas. She hopes, in effect, to meld Einstein with Bergson along the lines suggested by Einstein's 'admission of guilt'. But maybe this is not the best strategy. Perhaps it would be better to first try to pin down the nature of whatever Bergson's intuitions referred to, and then see how it might relate to Einsteinian time. There are, I think, potentially fruitful avenues to explore, that relate directly to the possible ontology of consciousness, rather than going via its content or epistemology. I'd like to finish off with a brief attempt to justify this claim and to show how the original positions taken by Einstein

and Bergson may *both* have been right in that they were correctly referring to very different, but also very 'real', entities.

General relativity provides a marvellously accurate metric, describing the spatio-temporal structure of causal relationships within the universe. The 'time' that it includes, with its contrasting relative rates and its 'block universe' implications, governs these relationships which are, however, entirely classical. The pre-'measurement' world of quantum superpositions works by different rules, so the phenomenon of 'entanglement' has shown us. Einstein was entirely correct that his time is the fundamental one as far as the classical, post-'measurement', 'objective' world is concerned, while he never fully accepted implications of quantum theory for the nature of pre-'measurement' reality.

It has often been proposed that conscious mind has some intimate connection with the 'measurement' process, ranging from von Neumann's suggestion that it is the final cause of 'collapse of the wave function', through Roger Penrose's (1989) theory that it is part and parcel of a gravitationally induced collapse process, to suggestions, including my own (Nunn, 2016), that proto-consciousness may manifest along with energy eigenstates in the course of a fundamental, 'measurement'-associated symmetry-breaking. All such proposals have the advantage that they automatically explain the directionality of perceived time because quantum 'measurements' are irreversible. My own suggestion additionally entails a quality of 'duration' (albeit not specifically Richet's '$1/12^{th}$ of a second') that Bergson would probably have liked. In brief, one might reasonably suppose that, when Bergson was talking about time, he was really referring to a concept that shared its ontology with subjective experience — an ontology distinct from that of the temporal structure of the objective world to which Einstein referred. Whitehead may have realized something like this long ago, when he wrote that '[conscious] mind… is simply the intrinsic temporality of a physical event'.

Bergson's mistake was to suppose that the two ontologies are mutually exclusive and/or that his concept referred directly to the 'objective' world. No doubt the two have consequences for one another, but that's a rather different issue. We know quite a lot about how Einsteinian time affects our lives and experience, but there's a wide open field when it comes to understanding how experiential time might affect 'objective' time. One interesting possibility is that it might provide the sort of universal reference frame that Masreliez (2012), for instance, has argued is necessary for resolving general

relativity's difficulties.[2] It's always exciting to spot the possibility that a whole new field of fundamental enquiry may exist, and this book certainly does a lot towards providing a basis for opening up pastures new.

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[2] Masreliez's specific suggestion for a suitable reference frame envisages the existence of a fifth, universal 'scale dimension'. He has described the mathematics of this in detail, in a series of earlier papers. Implications of his proposal appear to sit uneasily with some astronomical findings, albeit providing plausible explanations for other observations. It's currently unclear how Bergsonian time might provide an alternative, and perhaps more 'natural', universal reference frame. My own suspicion is that it may provide what could be envisaged as a gradually evolving temporal 'temperature' for the universe.