Beyond or Above? The Adynamical Explanation Meets Ontological Contextuality without a Fundamental Level

Book Review of "Beyond the Dynamical Universe: Unifying Block Universe Physics, and Time as Experienced" by Michael Silberstein, W.M. Stuckey and Timothy McDewitt. Oxford: Oxford University Press, 2018, 448 pp., ISBN: 9780198807087. £55 $75 (hbk).

Physics is at an impasse: there is little consensus on how to solve the problems of quantum mechanics and general relativity, and on how to unify these theories. In this book a philosopher (Michael Silberstein), a physicist (W.M. Stuckey) and a mathematician (Timothy McDevitt) identify the source of this deadlock in the dynamical point of view (the Newtonian schema), our natural way of understanding physical phenomena in terms of initial conditions and laws of nature. According to the authors (SSM) instead one should embrace an adynamical, spatiotemporal perspective, in which the behavior of an object is explained by 'initial' and 'final' boundary conditions together with a global constraint. That is, the flowers of Mrs Daisy's flowerbed being dead will not be explained, like in the Newtonian schema, by mentioning the law of gravity and by specifying that someone let a bowling ball go down the hill in the flowers direction. Rather, in the adynamical schema one specifies the initial state of the ball on the hill, the final state of the ball on the flowers, together with the Lagrangian connecting the two extrema. SSM maintain that only by adopting this schema *all* the current problems of quantum mechanics, general relativity, and quantum gravity will be finally solvable. Moreover, also a solution of the problem of consciousness will be in reach.

The book has three parts: Part I provides a general overview of the book's aim and strategy; the second part elaborates on how SSM's framework makes the 'old' problems disappear and improves on the solutions of the 'new' ones; while Part III is devoted to making sense of the experience of time and more generally the problem of consciousness. The book is extremely dense and there is a lot more to say; however in these notes I will focus on Part II (the core of the book), leaving Part III (on the perception of time) to another commentator.

What's exactly is SSM's view? It has three distinct ingredients: the block universe; the adynamical schema; and contextual antireductionism (my term). While the first is not controversial, the other two are the core of SSM's "Kuhnian revolution" (p. 17). In Chapter 2 SSM motivate the block universe view on the basis of the theory of special relativity, reviewing the standard arguments. Then in Chapter 3 they combine this view with the adynamical schema to solve the outstanding problems of general relativity. These problems (the flatness problem, the uniformity of the microwave background radiation, and low entropy initial state) all postulate a very special initial condition that cries for explanation. Theories (like inflationary cosmology) have been proposed to

overcome this, but according to SSM they fail, as this kind of problem is an artifact to the Newtonian schema, in which one explains using initial conditions (special or not). Only adopting an adynamical perspective these problems will evaporate.

More complex is the discussion of quantum theory in Chapter 4, where the third ingredient seems to play a crucial role. The problems of quantum mechanics are well knows: Is the wavefunction real? Does it collapse? How can one solve the measurement problem? What about nonlocality? SSM discuss and evaluate the various interpretations of quantum theory and dismiss them one after the other. First, Everettian mechanics, being committed to configuration space realism (the view according to which physical space is high dimensional), is implausible. Instead, one should solve the measurement problem by denying that the wavefunction is real (their approach is ψ-epistemic). Then, Bohmian mechanics and the GRW theory, being nonlocal, are in contrast with relativity. Nonlocality is in tension with relativity *only* from a dynamical point of view when thinking about influence *traveling from here to there*. Instead, SSM urge us to adopt the adynamical picture paired with a contextually defined ontology. SSM identify the ontology of quantum theory as given by "4D spacetimesource elements" (p. 153), i.e. spatiotemporal events that can be regarded as 'sources' of 'signals' in the dynamical picture but that here are simply one of the extrema of the 'process. ' These elements do not have any intrinsic property but their properties "are obtained from its classical spacetime context" (p. 155), hence spatiotemporal ontological contextuality. Feynman path integrals express the global adymanical constraints between these extrema: they generate the empirically adequate experimental distributions. From this, they extend their view to quantum field theory in Chapter 5: since their ontology is of spatiotemporal events, the idea is to develop a discrete theory, suitably modifying lattice quantum field theory and reading the Lagrangian at face value, i.e. adynamically. It turns out that in this theory (and presumably also in 'regular' quantum mechanics) the "graphical counterparts [of the fundamental equation] end up with links connecting non-neighboring points on the corresponding spacetime manifold M of classical physics, so called disordered locality" (p. 222) which results "from a variation on the old idea of direct particle interaction [of e.g. Wheeler Feynman] […] whereby the naïve notion of a mediating quantum field is eliminated" (p. 254). SSM then move on to their view of quantum gravity, in which they wish to use classical mechanics to give the curved spacetime and quantum mechanics to give the distribution of 'matter,' bypassing quantization altogether. SSM maintain that their different approach to unification allows them to explain the origin of the cosmological constant, while di sordered locality applied to mass may allow them to account for dark matter.

The book is fascinating: who doesn't like provocative ideas? Who doesn't want physical and mathematical competency without philosophical naiveté? However, I

walked out a little disappointed: the view is too sketchy, too radical, and too accommodating.

First, there are so many things that need clarification. To mention only a few: What are exactly 'spatiotemporalsource elements'? How is disordered locality different from 'old fashioned' locality? What does it mean that objects are 'contextually defined'? Is their view, truly ψ-epistemic? One may think that I am asking too much: I should not expect SSM to figure *everything* out. However, I'm not asking for (perhaps unnecessary) technical details but rather for more clarity about what the view is. This leads to my second worry: it is difficult to see the role of the various assumptions in solving the various problems. For instance, I dubbed their view contextual antireductionism because objects should not be thought as composed of smaller entities, but as contextually defined at the al macroscopic level. SSM think that reductionism is intrinsically connected with the dynamical picture, but I do not see why. Moreover, objects could be adynamically *and* contextually defined at the *microscopic* level, thus without denying reductionism: this microscopic spatiotemporalsource element is contextually defined by this other one in the sense that they are connected *via* this Feynman path integral. Thus, their view is too radical than needed as this 'reductionist' reformulation would still have the same advantages they ascribe to the original view. One possible rejoinder is to claim that some form of antireductionism is needed to explain consciousness. It may well be that this is the lesson to be learned. However, I will be ready to accept it only after all the other (less radical) alternatives have been ruled out, and I do not think they have been. This is my third, and most important, criticism: I am not sold that the adynamical picture is *truly* explanatory. Philosophers of science have proposed objective accounts of explanation, but they all recognize there's a strong sense in which explanation is 'explanation for us,' and any account should capture our intuition that explanation is fundamentally dynamical. This is connected with causation: intuitively, we explain an event because we find its causes; causes happen before their effects and 'bring them about.' An empiricist will be skeptical of causation, like presumably SSM. However, as is well known, one can dispense of causation and propose models of explanations in which laws of nature and unification of phenomena play an important role. Should I think of SSM's adynamical view in this sense? Or should I connect their view with the distinction between constructive and principle theories, proposed by Einstein (1919)? According to Einstein, principle theories (like thermodynamics) are formulated in terms of principles that systematize the phenomena; so that one has explained an even if it follows from the principles. In contrast, in a constructive theory (as kinetic theory) a phenomenon is explained when it fits into the 'mechanical' model of the theory. Should I understand SSM's view as a principle theory? (But if so, which are the principles?) In this sense, they 'merely' systematize the phenomena rather than explaining them. As it is, their view seems too cheap to me: all our questions, which are mostly about initial conditions, will go away if

we think that we do not need to explain initial conditions at all. If so, why do I see a mystery there, anyway? Why am I still unsatisfied? Be that as it may, even in the dynamical view, it is not true that the Newtonian schema is doomed to fail by definition because all initial conditions cry for explanation. In fact one could argue that phenomenon has been explained if it follows from the laws *regardless* of its initial conditions. In contrast, (most of) the cases mentioned in the book as mysteries for the dynamical view are not like this: they cry for an explanation because they can account for the phenomenon *only* by postulating a very special initial condition (e.g. the low entropy initial state). However, a satisfactory response can be given without going adynamical but remaining within a dynamical picture by providing a theory in which the special state actually arises from 'typical' states instead. Be that as it may, I think that a chapter on scientific explanation, in which their approach is compared and contrasted with these and other ideas, to make the case for the adynamical view as *genuinely* explanatory is missing from the book and should have made their case much more compelling.

To conclude, the book is extremely thought provoking and interesting, proposing a perspective I am not sold with, but that I still think is worth exploring.

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