THE NEW MECHANICAL PHILOSOPHY

STUART GLENNAN

Reviewed by Carl F. Craver

The New Mechanical Philosophy
Stuart Glennan
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The New Mechanical Philosophy is Stuart Glennan's most comprehensive treatment of the philosophical worldview he championed well before his audacious title had a recognizable referent. Subsequently, philosophical interest in mechanisms and mechanistic explanation has exploded, in part through Glennan's efforts, and his knowledgeable and charitable condensation of that literature should be essential reading for would-be mechanists and critics.

His bold title misleadingly conjures the idea of a unified movement of mechanists when, in fact, those working under this banner have pursued diverse interests and have undertaken different, sometimes incompatible, commitments in the service of those different interests. Unlike Glennan, many self-labelled mechanists focus primarily on scientific discovery (Bechtel and Richardson [1993]; Thagard [2000]; Darden [2006]; Craver and Darden [2013]), modelling (Bechtel and Abrahamsen [2013]), and explanation (Salmon [1984]; Craver [2007]; Kaplan [2010]). Because these philosophers have tended to focus on scientific practices, they have also tended to remain silent on issues of metaphysics and ontology whenever possible. Glennan aims to fill that void. His New Mechanical Philosophy, capitalized for grandeur, is presented as an ontological world-view, a vision of how the diverse things in our world (electrons to economies) 'hang together' (p. 16).

His opening chapters review recent work on what mechanisms are and about how scientists represent mechanisms in models. Glennan cautiously tiptoes around familiar landmines. His 'minimal' definition of mechanism in Chapter 2 (p. 17), for example, avoids unnecessary squabbles about whether mechanisms must work from start to finish or whether they must be 'regular' (see Machamer *et al.* [2000]; Craver and Tabery [2017]). In his treatment of models in Chapter 3, he is at pains to deny the frequent and false charge that mechanists abhor abstraction and idealization. His list of 'types of mechanisms' in Chapter 5 includes stochastic mechanisms, dynamical systems, singular processes, modular and non-modular mechanisms, self-organizing mechanisms, topological structures (such as small world networks), and mechanisms that have been designed, evolved, or selected. One might worry that Glennan's efforts to avoid criticism have drained the concept of content. I don't think that's true, but his analyses would have more bite had he considered some contrast classes rather than leaving this task to critics who typically wield a double-edged sword: unless the concept of mechanism rules out their favourite, presumed counter-example (for example, self-organizing mechanisms or topological structures), it is vacuous.

On reflection, the controversial heart of Glennan's mechanical philosophy has nothing to do with mechanisms *per se*. Rather, it is nominalism: the world, he asserts, is fundamentally particular (p. 3); causal production is singular (p. 150); mechanisms, properties, and 'causal powers', are 'heterogeneous and local' (p. 8); individuals cluster in kinds only because they can be represented as similar to one another (p. 8). Nominalism figures most prominently in his treatment of natural kinds (Chapters 3 and 4) and of causation (Chapter 6 and 7).

His 'model-first' theory of natural kinds in Chapter 3 holds that 'entities are of the same kind when the same model can be used to represent them' (p. 88). A model, following Giere ([2004]), is a representation someone applies to a target for a purpose. A useful model resembles its target, where resemblance is a form of objective similarity that stands as the 'truth-maker for the claims that a set of particulars can be represented by a common model' (p. 95). By requiring so little of models and embracing so permissive a notion of similarity, it will turn out that any two things similar to the same representation to any degree form a kind (the American flag, beta sheets, and corn rows for example). One wonders why Glennan preserves the construct of a 'natural kind' if, in the end, it is only an honorific for 'things similar to one another somehow'.

Glennan's most interesting metaphysical theses are reserved for the topic of causation. His current analysis retains central features of his now-classic ([1996]) paper, but he has elaborated and reworked it significantly. He opens by distinguishing causal production (a singular, intrinsic relation between events that involves 'biff' or 'oomph') from causal relevance (a comparative, counterfactual notion that involves difference-making). In his view, production is metaphysically fundamental: event *c* causes event *e* if and only if 'there exists a mechanism by which *c* contributes to the production of *e*' (p. 156). Mechanisms make claims about singular production true. General claims about production, in turn, are claims about aggregations of singular causings. Singular causation is primary, he argues, because whether a given event causes another should not depend upon what happens at other times and places (p. 163).

Glennan contrasts his view of production with Woodward's ([2003]) counterfactual theory. On Woodward's view, singular causal claims are made true by what would have happened in response to non-actual interventions (that is, in non-actual possible worlds). Following Bogen ([2005], [2008]), Glennan holds that counterfactual claims about what would have happened in response to non-actual interventions are made true by what produces what in the actual world. Glennan is less clear about how a comparative counterfactual claim about how things would go in non-actual circumstances can be made true by how things go in an actual mechanism. Critics will note that counterfactual comparison is contrastive and that nothing in the actual world fixes the appropriate contrast. In a similar vein, it is difficult to see how Glennan will construct a notion of causal relevance out of a singular, actualist view of production. He hints that the answer is to be found by abstracting from the actual mechanism to reveal just the relevant properties. But one can just as easily abstract away to irrelevant properties of mechanistic

components. Glennan, it would appear, needs an additional sorting procedure to tell which abstract features of productive events are the relevant ones.

Chapter 7 contains Glennan's most sustained defence of his view against the charge that it regresses: *A* causes *B* just in case there's a mechanism between them; mechanisms are organized causings; those causings are mechanisms; and so on. Glennan quickly dismisses the idea that this is circular (Craver [2007]), noting that activities at one mechanistic level are different from the activities in its underlying mechanism. However, he acknowledges that he needs a story about how this chain of mechanisms within mechanisms ends. Is the world 'mechanisms all the way down'? Does it bottom out in fundamental causings (that is, producings that aren't mechanistically grounded)? Or might there be no fundamental causation at all, leaving 'production' as an empty shadow of non-causal laws? Glennan rejects these options and opts instead for a fourth way (see Kuhlmann and Glennan [2014]). He acknowledges that aspects of quantum mechanics foil the 'classical' division of the world into distinct, causally interacting objects, but he appeals to facts about quantum decoherence to explain how approximately 'classical' objects emerge from quantum effects. Philosophers of physics will no doubt opine on whether this response dispatches all their concerns about the status of causation in quantum mechanics and about whether it provides a satisfactory way to ground the ontological putative distinctness required for productive causal interactions at higher levels.

Leaving aside concerns about quantum causation, Glennan has a special burden to explain how production at one level can made true by a mechanism with productive gaps (for example, mechanisms involving double prevention). In the *lac* operon mechanism, for example, a molecule inhibits an inhibitor and thereby allows a protein to be produced. The molecule productively interacts with the inhibitor, but the inhibitor consequently fails to interact productively with the DNA. In that case, the claim that the molecule is productively related to the protein is underwritten by a productively non-continuous, lower-level mechanism (Woodward [2002]). Glennan addresses this apparent problem by claiming that we can 'black box' the *lac* operon mechanism and 'treat it as' a productive whole. But talk of 'black boxing' and 'treating as' sounds out of place if we are doing ontologically serious metaphysics about how things (rather than thoughts about things) hang together.

Glennan closes his book with a chapter on explanation. Two curious features stand out: First, the chapter provides a general theory of explanation, including causal and non-causal explanations, without describing what is distinctive about mechanistic explanation. All explanations are explanatory, in his view, because they articulate 'constraints' on 'spaces'. There are, he notes, 'many kinds' of space: 'space-time itself, physical spaces like bowls or race-car tracks, social spaces, phenotypic spaces, or state spaces of all descriptions' (p. 237). One begins to wonder why we need such a theory of explanation and what this theory plausibly rules out. For example, evidence constrains the space of possible mechanisms for a phenomenon, but not all evidence is explanatory. Lesion studies localize functions without explaining them. One can locate an object in spacetime, or identify it as a mammal, without understanding it in the slightest. Glennan says so little about what constraints are, what spaces are, and about how it is explanatory to constrain spaces that friends and foes alike will struggle to charitably reconstruct the view. Second curiosity: Glennan's admirably ecumenical tendencies lead him to embrace unification as an explanatory virtue (sometimes). This stance would be more intelligible had he not made nominalism the heart of his mechanical philosophy. If what happens at other times and places is irrelevant to what happens here and now in Chapter 6, why should an explanation that describes what happens at other times and places be illuminating about what happens here and now in Chapter 8? Is it perhaps because the more unified description covers more phenomena? If so, why should an explanation that covers more phenomena be a better of explanation of any particular phenomenon? More generally, how does Glennan's constraint-based theory of explanation fit with his nominalist metaphysics?

Before closing, I should mention a feature of the book that will influence how much one enjoys it. Most contributors to the new mechanical philosophy over the last three decades ground their view in detailed and often sophisticated examples of real scientific practice. Glennan breaks with this science-heavy tradition and uses examples closer to everyday life—for example, cooking a steak, going to dance class, and shooting a wild boar. The most meticulously described scientific example in the book, the transmission of contagion in maternity wards, will strain some readers' tolerance for (distressing) details without revealing much of the practice of building, justifying, or applying causal knowledge. In general, the choice of examples will make the book accessible to philosophers who like simple, unadorned examples, but (judging from the reactions in our reading group) it might be off-putting to philosophers who yearn for closer contact with real science.

Be that as it may, there is plenty of material in this book to provoke arguments on diverse topics of central relevance to the elaboration of the mechanistic worldview in philosophy and science. The book is essential reading for anyone hoping to engage with contemporary mechanistic philosophy, for or against. It provides a helpful introduction to many of the key concepts, and it stakes out provocative claims that will no doubt fuel productive philosophical discussion of mechanisms for years to come.

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References

Bechtel, W. and Abrahamsen, A. [2013]: 'Roles of Diagrams in Computational Modeling of Mechanisms', in M. Knauff (*ed.*), *Proceedings of the 35th Annual Conference of the Cognitive Science Society*, Austin, TX: Cognitive Science Society, pp. 1839–44.

Bechtel, W. and Richardson, R. C. [1993]: *Discovering Complexity: Decomposition and Localization as Strategies in Scientific Research*, Cambridge, MA: MIT Press.

Bogen, J. [2005]: 'Regularities and Causality; Generalizations and Causal Explanations', in C. F. Craver and L. Darden (*eds*), *In Search of Mechanisms: Discoveries across the Life Sciences*, Chicago: University of Chicago Press, pp. 397–420.

Bogen, J. [2008]: 'Causally Productive Activities', *Studies in History and Philosophy of Science*, **39**, pp. 112–23.

Craver, C. [2007]: *Explaining the Brain: Mechanisms and the Mosaic Unity of Neuroscience*, Oxford: Clarendon Press.

Craver, C. F. and Tabery, J. [2017]: 'Mechanisms in Science', in E. N. Zalta (*ed.*), *The Stanford Encyclopedia of Philosophy.*

Craver, C. F. and Darden, L. [2013]: *In Search of Mechanisms: Discoveries across the Life Sciences*, Chicago: University of Chicago Press.

Darden, L. [2006]: *Reasoning in Biological Discoveries: Mechanism, Interfield Relations, and Anomaly Resolution*, Cambridge: Cambridge University Press.

Giere, R. [2004]: 'How Models Are Used to Represent Reality', *Philosophy of Science*, **71**, pp. 742–52.

Glennan, S. [1996]: 'Mechanisms and the Nature of Causation', *Erkenntnis*, **44**, pp. 49–71.

Kuhlmann, M. and Glennan, S. [2014]: 'On the Relation between Quantum Mechanical and Neo-mechanistic Ontologies and Explanatory Strategies', *European Journal for Philosophy of Science*, **4**, pp. 337–59.

Machamer, P. K., Darden, L. and Craver, C. F. [2000]: [MDC], 'Thinking about Mechanisms', *Philosophy of Science*, **67**, pp. 1–25.

Salmon, W. C. [1984]: *Scientific Explanation and the Causal Structure of the World*, Princeton, NJ: Princeton University Press.

Thagard, P. [2000]: *How Scientists Explain Disease*, Princeton, NJ: Princeton University Press.

Woodward, J. [2002]: 'What Is a Mechanism? A Counterfactual Account', *Philosophy of Science*, **69**, pp. S366–77.

Woodward, J. [2003]: *Making Things Happen: A Theory of Causal Explanation*, Oxford: Oxford University Press.