

personhood, which is the only chapter to step explicitly outside the boundaries of Western analytic philosophy, invites us to think of the Buddhist themes of human flourishing and the unfolding of the person as central to any science which, like psychology, aims to give a full understanding of human nature, its limits and potential.

As is inevitable, not every reader's interests and preferences will be fully satisfied by the *Companion's* contents. One significant omission, especially given the interdisciplinary focus of many of the volume's chapters, is that of language and language-science, which receive scant attention in the *Companion*, despite the important ongoing interaction between linguistics and psychology, and the philosophical issues that arise therein. Another minor criticism concerns the inconsistent policy on including 'further readings' in addition to chapter bibliographies. Where present, these are a great tool for navigating often-complex literatures, and it is unclear why they do not follow every entry. Similarly, cross-referencing within the volume, which is exemplary in, for instance, Aare Laakso's chapter on Development and Learning, is less adequate in other entries, where the careful drawing-out of connections among topics would be helpful for students not already familiar with the landscape.

Overall, though, the *Companion* is a terrific resource for serious students of philosophy and psychology, and for researchers pursuing interdisciplinary themes. While the impeccable quality of the scholarship behind each individual entry means that the *Companion* is well suited as a reference collection, to be consulted when needed, the effort of reading the complete volume will be amply rewarded with a fascinating insight into past and future developments in philosophical psychology.

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S. HARTMANN, C. HOEFER & L. BOVENS, eds. 2008. *Nancy Cartwright's Philosophy of Science*. London: Routledge.

Nancy Cartwright is no doubt one of the most productive and influential philosophers of science nowadays. This collection of essays provides an excellent commentary on several facets of her work. The book is divided in three parts. Part I is named "Models and Representations". The title of Part II is "Causes and Capacities" and the title of Part III is "Antifundamentalism and the disunity of Science". In fact, the division aptly reflects the three major themes in Cartwright's work in the 20th century. Part I deals with the issue of representation and in particular with the question of how models may — to a certain extent, and for certain purposes — represent the world. Part II deals with several different discussions going on in the literature about the way in which the explanatory force of "causes" in causal explanations depends on something beyond what can be captured by the mathematical structure of models or equations used to describe phenomena. Part III deals with a perennial issue, whether science is ultimately committed to what Cartwright calls "cross-wise reductionism"— a view that Cartwright labels as fundamentalism.

Perhaps the best place to start getting a grip on her philosophy of science is with the antifundamentalist stance. Thus, I shall start reviewing the book starting with the section on which the book closes. Fundamentalism, as Hofer characterizes it in “For Fundamentalism” (chapter 13) is that there are truths expressible in mathematical language, laws of nature, and that physics has been getting closer and closer throughout the history of physics to these laws. Hofer, as well as two other contributors to this section, Esfeld (chapter 14) and Falkenburg (chapter 15), dispute Cartwright’s antifundamentalism in different ways. Hofer provides a strong defence of our belief on true universal and fundamental laws. Esfeld thinks that quantum theory can serve as a guide for understanding the sort of wholism he sees Cartwright aims to unravel. Falkenburg in turn attacks Cartwright’s claim that the measurement problem in quantum physics is not a real problem. The rejection of fundamentalism in physics leads to a denial of the measurement problem, and argue that such position is untenable. In her reply to the authors Cartwright repeats one basic point that can be put as follows. Why should we expect that unitary Hamiltonians are privileged sort of representations?

The ultimate reason for such a view is the framing of the problem of measurement as a semantic question. But why not to try to locate the problem elsewhere? Cartwright thinks that the problem can be located “in technology”. If we take seriously this point of departure, the thesis that the measurement problem is an artifact of mathematics follows. It follows also a more general argument for antifundamentalism. To the extent that locating the problem of measurement in technology involves questioning the claim that epistemological problems have to be framed as semantic questions, then we can make the move, as Cartwright’s does, to claiming that our mathematical representations might well have excess structure, to which we should avoid the temptation of attributing physical significance, and use as basis for induction. Cartwright considers that mathematical equations are guides for truth only if we have good specific reasons to believe that how they represent specific processes in specific circumstances is right. And how can we know this? It is here that Cartwright’s answer leaps out of the usual empirical tradition and claims that we can and should interpret the equations as statements of capacities.

Of course, as an argument for antifundamentalism the argument is casuistic. You might want to think that this only shows the argument is no good or might want to think that it leads us to try to understand how casuistic arguments can and should be at the center of the stage in the philosophy of science. What is a fact is that Cartwright claims that the hypothetico-deductive method is no guide to the truth. But what is the alternative project? Mauricio Suarez (chapter 7) thinks that the key to this alternative project is experimental realism. Margaret Morrison (chapter 4) thinks that going beyond the hypothetico-deductive method requires understanding the role of models as mediators between theory and the world. Paul Teller (chapter 5) reflects on how one can reconcile Arthur Fine’s “homely line” that scientific investigations as well as “homely truths” have to be accepted as a point of departure of what is “true” with Cartwright’s claim that what science delivers are caricatures and simulacra. These three contributions point in very different directions, to some extent consonant and to

some extent opposed to Cartwright's work. All share, however, the recognition of the importance of questions about representation and abstraction that have been ignored by traditional philosophy of science.

How these discussions relate to the casuistics that is at the bottom of Cartwright proposal is an interesting question. Two contributors pick up this question in very different ways. One is Alfred Nordmann (chapter 16), and the other is Daniela Bailer-Jones (chapter 1). Nordmann takes seriously the metaphor of the "theatre of Physics" and studies the importance of an "impersonal reader" for understanding the way in which Cartwright "dresses up" theories as statements of facts. Bailer-Jones sees clearly that the general issue behind several of the discussions and proposals of Cartwright is "what to do with scientific practice in philosophy of science". And as she sees it, if Cartwright's project is to be taken seriously, we have to discuss the question of the particular philosophical status of arguments from scientific practice. She thinks one crucial thread here is the problem of how we chose and weight our case studies.

This diagnostic naturally leads to potential accusations that Cartwright is overstating her case on the basis of a few case studies. But practices are not mere "cases studies". If one takes in consideration the normative dimension of practices, and understand these norms as norms relevant for deciding about the goodness of an argument Cartwright position does not look so hopeless.

Bailer-Jones also discusses another issue —the question of abstraction— that I think is crucial to understanding Cartwright's philosophy of science. The question of what is abstraction is crucially related to the sort of philosophical explanation of the role of generality that science looks for. I think is no coincidence that the two other contributors that do discuss the issue of abstraction (Nordmann and Giere), also share with Bailer-Jones the recognition that the study of scientific practice and methodology is crucial for Cartwright, and that a diagnostic about this connection leads to different views about ontology (and metaphysics).

In his contribution Ronald Giere provides a quite interesting comparative account of his own approach and Cartwright's. Giere thinks models are abstract in two ways: one in the sense that they are not physically realized, as numerical relationships, for example; and two, in that they are not fully specified, as for example the forces in Newton's theory. This account of abstraction (different from the one elaborated by Cartwright) leads to a way of understanding scientific representations that is at odds with Cartwright's attempt to distinguish "representational" and "interpretive" models. This account of abstraction allows Giere to argue that contrary to what Cartwright thinks, scientific principles like the principle of relativity or the principle of natural selection, do not describe capacities, but instead "causal structure". Giere's discussion shows very clearly how much of Cartwright's philosophy of science depends on her account of abstraction and that such account has to appeal to non-actualizable things, and thus reject laws understood as mere regularities.

Such are some of the themes that interestingly weave back and forth across the contributions in this book, tying the sections one to the other. Mention should also be made of several other interesting contributions.

In the first part, in addition to the articles by Bailer-Jones, Morrison and Teller that we have already mentioned, there is an article by Ulrich Gähde where he discusses similarities and differences between Cartwright's approach and the structuralist framework. In the second part, in addition to the paper by Giere and Suarez already mentioned, there are articles by Stathis Psillos, James Woodward, Iain Martel, Julian Reiss and Christoph Schmidt-Petri. Psillos rehearses a series of criticisms of Cartwright's metaphysics and in particular argues for difficulties associated with the characterization of capacities. Woodward sketches his attempt to give a modularity account of causality, and, Cartwright's criticisms of it — which ultimately derive from her oft repeated preference for what Woodward labels 'causal diversity'. Iain Martel presents a model for EPR and uses it to argue against Cartwright's understanding of causality and her argument against the Causal Markov Condition. All of these articles criticize different aspects of Cartwright's theory of causality, and in particular her reliance on the concept of capacity. Schmidt-Petri argues that Cartwright's appeal to Mill's "tendencies" is questionable. Reiss explores the relevance of the concept of capacity for the social sciences and provides interesting insights into the related concept of *ceteris paribus* laws (in Cartwright's sense).

It struck me that so many contributions directly or indirectly are related to the discussion about the extent to which (or the sense in which) Quantum Theory is a fundamental theory. In Morrison contribution, for example, her criticism that Cartwright tends to downplay the role of representational models is really a question about the fundamentality of Quantum Theory and the extent to which it makes sense to say that we can have representational models that are *ad hoc* from the perspective of the theory. Her claim that interpretive models have a representational role that can be understood only as secondary (an opinion also shared by Giere) relies on a detailed discussion of the way the theory of Quantum mechanics can be said to provide a representation of the behavior of electron pairs. In a similar vein, Bailer-Jones questions the claim that we can assign both quantum and classical descriptions to the same system, and Falkenburg provides an interpretation of Cartwright's view that aims to locate Cartwright ascription of quantum and classical descriptions in postmeasurement situations. Similarly, Iain Martel claims, "the true metaphysical lessons from quantum mechanics concern the ontological structure of the world, not the causal structure". Such "true metaphysical lessons" rely on a certain way of locating the quantum state in the process of measurement and assume that quantum theory has representational capacities that Cartwright has from the beginning rejected.

Let me finish up by expressing a thought suggested by seeing the role played by quantum physics in this book, which is that maybe projects like the one suggested by Reiss, that is, ones that do not depend on inferences guided by the mathematical structure of theories, seem to suggest promising future research and a tighter fit among different themes in Cartwright's philosophy of science.

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