

New work in metaphysics of science

Anna Marmodoro (ed.): The metaphysics of powers: Their grounding and their manifestations. New York: Routledge, 2010, viii+196pp, £90.00 HB

Helen Beebe and Nigel Sabbarton-Leary (eds): The semantics and metaphysics of natural kinds. New York: Routledge, 2010, vii+242pp, £28.00 PB

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Metaphysics of science is currently a flourishing field of philosophical research touching issues both in metaphysics and in philosophy of science.¹ From the perspective of early twentieth-century philosophy of science, this is a rather surprising development. For as is well known, logical empiricists tended to banish metaphysical questions. Thus, the issue of realism versus anti-realism (or idealism) was classified as a pseudo-problem by Rudolf Carnap in the late 1920s and Ernest Nagel some 30 years later called it a “conflict over preferred modes of speech.” A major step towards the rehabilitation of metaphysical questions within philosophy of science and analytical philosophy in general was the development that led to the debate about scientific realism in the 1970s. It seemed to Putnam and others that, without taking into account that scientific terms refer to real entities, philosophy of science is unable to explain how theories can be compared trans-theoretically. At the same time, metaphysical or ontological questions became respectable again in areas such as philosophy of language, which ultimately led to what is now called analytical metaphysics (see Loux and Zimmerman 2003). During this period, philosophical problems that were formerly treated as pertaining exclusively the *language* of science were transformed into problems about metaphysical issues. Thus, for instance, theories of laws of nature in the 1950s aimed to define the characteristics of laws of nature entirely in terms of the syntactic structure of law statements. From the late 1970s on the question was what it is in the world that

¹ In the sequel, I will refer to Anna Marmodoro’s volume by (P) (for Powers) and to Helen Beebe and Nigel Sabbarton-Leary’s volume by (K) (for Kinds). (P) and (K) are the first two volumes in the new series “Routledge Studies in Metaphysics.”

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corresponds to law statements and whether it is reasonable to assume *sui generis* nomic facts.

Currently, the expression “metaphysics of science” is used both in a wide and in a narrow sense. In the wide sense, metaphysics of science concerns any vaguely metaphysical theme that is connected with the sciences, including for instance the interpretation of theories of space–time or quantum mechanics. It covers much of the same ground as what has once been called “philosophy of nature” (*Naturphilosophie*). In a more narrow sense, metaphysics of science is focussed on questions concerning laws of nature, natural kinds, causation, etc. (cf. Wilson, 192). The topics of the two volumes under review fall squarely within the scope of the narrow conception of metaphysics of science. Before I turn to the contributions themselves, let me mention two controversial issues in metaphysics of science as well as the resulting dividing lines that shape the argumentative landscape in this field.

The most important dividing line concerns the issue of Humeanism versus non-Humeanism. Humeans accept the claim that there are no necessary connections in nature between entities that are wholly distinct. Non-Humeans deny this. Humeans like David Lewis believe, for instance, that the apparent modal connection between dispositions and their manifestations can be reduced to categorical properties and laws. Furthermore, laws are conceived of as regularities that can be ultimately reduced to the Humean mosaic. By contrast, non-Humeans typically accept dispositions as real (i.e., irreducible to the Humean mosaic) properties and embrace the relevant modal implications.

A second dividing line concerns a methodological issue. What is the role the results of science or the scientific practice are going to play as possible evidence for metaphysical claims? While there are some who argue that the only evidential source for metaphysical claims is science (Ladyman and Ross 2007) others, like Lewis, almost never appeal to scientific findings in order to establish their claims.

It seems there are no clear correlations between the four options due to the two dividing lines. Some non-Humeans appeal to scientific practice and argue for the existence of dispositions or capacities on this basis (cf. Cartwright 1989), while others appeal to intuitions concerning so-called quidditism (Bird 2007, 70–80). On the other side, Humeans may tend to appeal less to science and its findings but even David Lewis would have—it seems—accepted a consistent successor of quantum mechanics as potential evidence for or against metaphysical claims (Lewis 1986, xi).

Volume (P), edited by Anna Marmodoro, focuses on debates relating to the notion of power. Powers (or dispositions—I will use these terms synonymously) are a central topic in debates in the metaphysics of science. Famously, Hume searched in vain for evidence for powers, which in turn motivated his denial of necessary connections. A further explanation for the centrality of issues concerning powers may start by pointing to the fact that while non-Humeans accept necessary connections in nature, the claim that there are *metaphysically* necessary connections in nature faces its own problems. For instance, causes may be thought to somehow necessitate their effects but this relation cannot be one of metaphysical necessity because there are potential interfering factors. Perhaps powers provide solace in this case. The relation that obtains between a power and its manifestation is exactly what

the non-Humean should be studying in order to understand the nature of the necessary connections in nature.

Volume (P) contains a number of contributions that are concerned with the very nature of dispositions. Even though most contributors agree on a realist reading of dispositions (i.e., they reject the idea that dispositional predicates can be fully explicated by virtue of conditional analyses), many aspects of dispositions remain controversial. One of the issues raised in some of the papers is the nature of the manifestations of powers or dispositions.

Jennifer McKittrick (P, 74) probably captures the standard view when she characterises the concept of a manifestation (i) as “minimally, that of an event—either an event-type or a particular event which occurs at a particular place and time” and (ii) often considered as being caused, triggered or brought about and thus conceived as an effect. This standard view can be challenged. Brian Ellis, for instance, assumes that causal powers “are properties that are displayed in causal processes” (P, 133). Conceiving manifestations as processes rather than events is, perhaps, not a major deviation depending on one’s conceptions of event and process. However, there are more significant disagreements.

Stephen Mumford follows Molnar in identifying manifestations with contributions. These manifestations as contributions are not the effects or events considered by the standard view, but rather something in between the disposition and its manifestation in the traditional sense. The rationale behind this terminological shift is the following: Dispositions are identified by their manifestations. But the effects that the dispositions contribute to are varied, since often many dispositions contribute to one effect. As a consequence, the dispositions cannot be identified by their effects, but should rather be identified by their contributions (which are modelled on component forces; see also Mumford and Anjum 2011, chapter 2). As McKittrick points out, these contributions are not intermediate *events* between, say the triggering of a disposition and the ultimate effect, but rather an additionally postulated entity of its own kind—in order to deal with the problem of effects being due to more than one disposition.

Still another notion of manifestation is discussed by Toby Handfield. According to Handfield (P, 106), a manifestation of a disposition does not involve only the effect (end state), but also a causal process that leads to this effect. It is important to take these causal processes into consideration because what is constitutive of a particular disposition, Handfield argues, is not only the end state or effect but also the process of bringing it about. If the same effect is brought about by a different process, it seems plausible to speak of a different disposition. Handfield’s processes, which *bring about* the manifestation (conceived in the traditional sense), need to be distinguished from Ellis’s processes, which *are identical* with the manifestation in the traditional sense. Furthermore, Handfield’s causal processes should not be conflated with Molnar’s or Mumford’s contributions. Even though both are intermediaries between the triggering and the effect, Handfield’s processes are intermediate *effects*, whereas contributions are theoretical entities postulated to account for the fact that typically more than one disposition is involved in bringing about an effect (whether or not it is an end state or an intermediate effect).

A second issue discussed in (P) is whether the manifestation, in the sense of the effect or end state, is brought about by necessity. It is important to note that this claim is not entailed by dispositional essentialism. Dispositional essentialism points out that it is part of the essence of certain kinds of objects or properties to have certain dispositions. As Markus Schrenk (P, 173) explains, it is a *further* issue whether these dispositions will display their manifestations (effects) by necessity provided they have been triggered. Some dispositional essentialists, like Ellis and Alexander Bird, have also embraced the necessity claim. Schrenk argues that the very same arguments that point to the shortcomings of reductive analyses of dispositions can be used against the claim that dispositions—if triggered—bring about their manifestations or effects by necessity. Antidotes interfere with the bringing about of the manifestation, *even though* the disposition has been triggered. They are therefore counterexamples to the claim that a property is dispositional iff had the stimulus been present, the manifestation would have occurred. At the same time, Schrenk (P, 174) notes, these are counterexamples to the logically stronger claim that it is metaphysically necessary that if the disposition is triggered the manifestation occurs. While I think this is not an argument against dispositional essentialism, it is convincing against the claim that manifestations are brought about with metaphysical necessity—a claim that has been made by some essentialists. Mumford and Anjum (P, 147ff) too claim that dispositions do not necessitate their manifestations and defend it against some objections.

If the relation between the disposition and the trigger on the one hand and the manifestation on the other hand is not one of metaphysical necessity, what is it? This is a crucial question for non-Humeans to answer. It concerns the very core of the disagreement with the Humeans, and thus non-Humeans need to spell out what they have in mind here.

One option is to postulate a *sui generis* relation. This is the approach taken both by Bird and by Mumford and Anjum. The latter identify causes with dispositions and go on to claim: “Causes do not necessitate their effects: they produce them but in an irreducibly dispositional way.” While this sounds like a description of a problem rather than a solution, Mumford and Anjum go a long way in specifying the characteristics of this “irreducibly dispositional way” of bringing about effects in terms of a vector model.

A third topic discussed in (P) is the relation between dispositions and causation. It is sometimes held that “disposition” is an inherently causal notion. Nevertheless, the exact relation between dispositions and causes remains a contested issue. There are many options how to spell out the relation. First, *dispositions* might be considered to be the cause of the manifestations (cf. Mumford and Anjum). Second, the trigger might be taken to be the cause (cf. Bird). Third, the causes might be identified with interfering factors into those processes that systems are disposed to display (cf. Hüttemann 2013). There are further options. Thus, it might be argued that causation needs to be spelled out in terms of regularities or in terms of counterfactual dependence, but that it is dispositions that ground either the regularities or the counterfactual dependencies.

In (P), two of the foregoing options are defended. Mumford and Anjum hold the view that causes are dispositions. Dispositions “bring about” their effects. So how

does that work? Mumford and Anjum represent causes as vectors that can add up. An effect occurs when the different causes/dispositions accumulate to a certain threshold value. They illustrate how this account can deal with negative causation and how it accommodates the fact that causes do not necessitate their effects. Nevertheless, certain questions remain open. What exactly is the status of the threshold? Mumford and Anjum hold that “it is not a real thing at all” (P, 146). But if it is not a real thing, what is it that determines whether the effect occurs or not? Another question concerns the assumption that all powers can be represented as vectors (made explicit in Mumford and Anjum 2011, 46). Physics describes only some quantities that play a role in causation as vectors (e.g. forces), but other entities in terms of scalars, two-dimensional tensors, etc. It seems that the account needs some adjustment here. Bird starts with a view he calls the simple dispositional analysis of causation: “A causes B when A is the stimulus of some disposition and B is the corresponding manifestation.” This account allows drawing a distinction between cause and condition: not all of the conditions necessary for the occurrence of an effect count as a cause, only the stimulus of a disposition. Bird discusses one problem that arises from cases of trumping pre-emption. In these cases, there are two dispositions with the same kind of manifestation. Both stimuli occur, so does the manifestation. The problem is to determine which stimulus was the cause. In the end, Bird (P, 164) embraces the claim that the relation between the disposition and the stimulus on the one hand and the manifestation on the other hand is ontologically basic and cannot be spelt out, for example, in terms of counterfactuals. At this point, some readers might feel that something more needs to be said about this relation and about its modal character in particular.

Finally, there is the much-discussed topic of pan-dispositionalism. The Introduction by Marmodoro and the paper by Kristina Engelhard give nice surveys of the issues involved. With respect to categorical and dispositional properties, there are monists and their rivals. Monists either claim that there are only categorical properties (categoricalism) or that there are only dispositional properties (pan-dispositionalism). The papers in (P) are mainly concerned with the question whether pan-dispositionalism is a tenable view. Several regress arguments have been mounted to show that this is not the case.

The pan-dispositionalist may hold that the manifestation event consists in acquiring a dispositional property. According to a well-known objection “particulars would seem to be always re-packing their bags as they change their properties, yet never taking a journey from potency to act” (Armstrong quoted by McKittrick in P, 75). However, it is not clear how the objection works. If the claim is that nothing ever becomes actual on a pan-dispositionalist account, then the claim seems to be false. Having a disposition is something actual. According to McKittrick, the regress should be reconstructed as implying that if no disposition ever becomes manifest, dispositions will not be (neither directly nor indirectly) observable. This, she notes (P, 79), might pose a serious objection to pan-dispositionalism. According to another version of the regress argument due to E J Lowe, the identity of a power is (partly) fixed by its manifestation type. If manifestation types turn out to be powers, we are led into an infinite regress. It thus seems that the identity of a power cannot be fixed. Against this argument, it might be maintained that in the actual world each

power is related in a unique way to other powers, such that the identity of each power can be defined in terms of its unique place in the relational structure constituted by all the powers in this world (cf. Lowe P, 15). Lowe, however, rejects this move, because criteria of identity need to be applicable in every possible world, and there is no a priori reason that the power structure in every possible world contains the required asymmetries (P, 18).

That seems to leave us with the option to accept that there are both categorical and dispositional properties. Why should that be a problematic view? From the Humean/Empiricist perspective, the original problem with dispositions was that they could not be directly observed. Only the manifestations were considered to be observable. The problem of how to understand dispositional properties was then considered as a special case of the interpretation of theoretical terms. More recently, the observability issue is no longer considered to be an obstacle for a realist reading of theoretical terms in general, and there is no reason why it should provide a problem for dispositional properties. Today's opposition to the acceptance of dispositional properties as real has to do with the modal relation that seems to obtain between the disposition and the stimulus on the one hand and the manifestation on the other hand. Even if the relation is not one of metaphysical necessity, the reality of dispositions seems to imply that some kind of necessary relation seems to obtain. It is this modal issue that drives Humeans towards categorical monism.

Non-Humeans are often driven into dispositional monism. They argue that the very notion of a categorical property is problematic. According to their reasoning, the identity of a property is constituted by its causal profile. If there were properties that could not be individuated in terms of their causal profile, we could not know about them. Two such properties could be swapped without us being able to realise this (this is the so-called problem of quidditism). However, two questions may be raised at this point. First, how do we know that this is not actually the case? Second, could not there be other reasons for assuming the existence of properties over and above their causal profile. Ellis, for instance, argues (P, 137) that powers need to act from somewhere and thus presuppose locations. Locations are not themselves located anywhere and are thus no powers. While this particular argument might be objectionable, there is no reason why similar arguments to the effect that particular dispositions or dispositions in general presuppose the existence of particular categorical properties should not work. Monism of whatever kind is not inevitable.

The volume (K), edited by Helen Beebe and Nigel Sabbarton-Leary, raises another important issue for non-Humeans: the question of how we can come to know that necessary connections obtain. In pre-Kripkean times, it was generally accepted that necessary connections if at all can only be known a priori. The importance of Kripke's work on proper names and natural kind terms in particular consists in opening up the prospect that there might be a posteriori knowledge of necessary connections. Paradigm cases are "Water is H₂O" and "Gold is the element with the atomic number 79." In these cases, we have a rigid designator on the left-hand side of the identity statement because the natural kind terms function like proper names. Likewise, we have a rigid designator on the right-hand side because the terms in question pick out the essence of water or gold. Because we have rigid designators on each side of the identity statement the identity claim, if

true, is true with metaphysical necessity. It is, however, an a posteriori matter to figure out the essence of water or gold. The notion of an essence, it seems, can thus be made plausible within a metaphysics of science. Furthermore, if laws of nature are conceived as statements that describe the dispositional essences of properties or objects as a consequence, it seems plausible that laws are both metaphysically necessary and a posteriori. However, while Kripke certainly provides a useful analogy for dispositional essentialists, there are a number of obstacles that make it doubtful whether this analogy is of great help.

One issue is raised in a paper by Joseph LaPorte. LaPorte does not put into doubt that theoretical identity statements are true. He does, however, question whether they are in general a posteriori. Rather than describing discoveries, LaPorte holds, they may state stipulations. It was a stipulative decision to no longer use the word “fish” as applying to whales. Similarly, “Water is H_2O ” may be regarded as a stipulation rather than as describing a discovery. LaPorte points to the fact that natural kind terms were often used vaguely before being *precisified* by science. Which precisification is chosen is ultimately a matter of a decision. It might well have happened that deuterium oxide was counted as non-water (K, 107). Both Bird (K, 125) and Robin Hendry (K, 149–50) have challenged this claim. Both argue that there is less room for conceptual choice than LaPorte suggests. This discussion is largely about referential stability across theory change and about the interpretation of historical episodes.

Beebe and Sabbarton-Leary try to establish the general point that theoretical identities can only be analysed as metaphysically necessary statements a posteriori if certain conditions are met. For a statement like “Water is H_2O ” to be metaphysically necessary and a posteriori, at least the following has to be the case:

- (1) Even if water has an essence, it has to be established that “water” works like a proper name, rather than as a description such as “drinkable liquid typically found in rivers.” In the latter case, “water” would refer to XYZ on twin earth. So the metaphysical necessity of a theoretical identity statement can only be established if it is shown that the left-hand term works like a proper name.
- (2) It has to be established that the natural kind term on the left is not introduced as a stipulative definition (this is the same point as the one discussed by LaPorte and others) (K, 151).

Beebe and Sabbarton-Leary argue that if dispositional essentialists like Ellis do not explicitly show that these conditions are met, they are not entitled to rely on the Kripkean analysis of theoretical identities. The upshot is that while Kripke’s analysis is useful in pointing to the conceptual possibility of statements that are metaphysically necessary and a posteriori, much work needs to be done to provide actual examples of such statements and to establish that laws of nature are among them.

Jessica Wilson presents an abductive argument for the existence of necessary connections. She starts from the observation that many (Humeans and non-Humeans alike) accept constitutional necessities like “Water is H_2O ” or “Anything that is an

electron is electrically charged” (K, 197). She then argues that the non-Humean can provide a better explanation for why we should accept that such statements are necessarily true. The non-Humean in contrast to the Humean can appeal to the modal stability of causal profiles, that is, to the claim that, for instance, water and H₂O share their causal profile across possible worlds. The Humean does not accept that (some or all) properties are individuated in terms of their causal profile because that would presuppose necessary connections between the property and its causal profile. The claim then is that the non-Humean can give a better explanation of a fact accepted by both the Humean and the non-Humean (K, 206–7).

That leaves us with the general question what options there are for arguing for the claim that necessary connections obtain in nature—besides a priori reasoning and Kripke-style analyses of theoretical identities. Abductive arguments, as we have just seen, might be such an option. More particularly, there might be also abductive arguments from scientific practice. Some authors like Armstrong (1983, 104) have argued that the success of certain explanatory or inductive scientific practices can best be explained in terms of necessary connections that obtain in nature. This line of argument might be promising (For a recent critique of such arguments, see Beebe 2011.).

To conclude, the two volumes under review contain very stimulating papers by some of the main contributors to the flourishing field of metaphysics of science. While the shortcomings of Humean metaphysics have already been widely discussed, these volumes show how much work there is to be done by non-Humeans in order to provide convincing alternatives to Humeanism.

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