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Causes as Powers: BOOK SYMPOSIUM on Stephen Mumford and Rani Lill Anjum, *Getting Causes from Powers*

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BOOK SYMPOSIUM

Causes as Powers

Stephen Mumford and Rani Lill Anjum, *Getting Causes from Powers*
(Oxford: Oxford University Press, 2011), 272 pp, £35 hardcover.

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Jennifer McKitrick:

   Mumford and Anjum's *Getting Causes from Powers* is an ambitious and original contribution to the literature on causation, a welcome departure from Humean approaches which reductively analyze causation in terms of regularities or counterfactual conditionals. The authors develop an account of causation as the exercising of powers, a view they call "causal dispositionalism." This critique of *Getting Causes from Powers* is organized around its central heuristic—the vector model of causation. On this model, vectors represent the exercising of powers, those that are operating upon a quality space. A quality space is a background against which events can occur, where two or more general properties are considered as possible for instantiation. A central line represents a starting point of a causal process, and vectors represent the powers in play. A vector is apt for representing a power because it has intensity and a direction, indicated by its length and the property term at which it points (24). A resultant vector R is also

depicted, indicating the extent to which all of the powers in play collectively dispose toward one of the properties in the quality space. A threshold may also be depicted, representing a point on the quality space that may be of particular pragmatic interest, the passing of which would count as disposing toward an effect in question. Mumford and Anjum make the bold claim that *all* things can be represented by vectors (45–46). This claim is supported by the following theses: everything has properties; properties are clusters of powers; powers have intensity and direction; vectors represent intensity and direction. Even granting these theses, there is still much that the vectors do not represent. I discuss three things that are not represented by the vector model, in increasing order of significance for the account generally.

First, vectors do not represent particular objects, the things that have properties. While a vector diagram may show that an intense power to heat and a moderate power to cool collectively tend towards warmth, it leaves us in the dark as to what particulars have these powers. As Mumford and Anjum acknowledge, "Properties do not… float around freely in the world. They are properties of things" (1). One might argue, on the contrary, that vectors can in fact represent particulars for the following reason: particulars are bundles of properties, properties are bundles of powers, and powers can be represented by vectors. But even if Mumford and Anjum advocate a bundle-theory of particulars, the vector model does not represent the bundling, so it does not indicate which powers are bundled together constituting properties, nor which properties are bundled together constituting particulars. Perhaps one can give an account of causation without mentioning particulars. But it is not clear that one can represent "all things" without representing particulars.

Secondly, the vector model does not represent effects or events. This strikes me as especially problematic, since the model is supposed to be a model of causation, and as Mumford and Anjum acknowledge, "token causal truths are factive" (15). "*a* is the cause of *b*" is not true if *b* does not occur. A picture of causation that is silent as to whether any particular effect occurred is an incomplete picture. The resultant R is not the effect, only the extent to which the total cause disposes toward an effect. It does not show what is caused, only what is disposed to be caused (26). On Mumford and Anjum's view, R disposes towards the effect, but does not necessitate it: "we should never say more than that a causal situation overall disposed towards a certain outcome. Even the resultant vectors can represent nothing more than a tendency toward an effect" (175). So, R crossing the threshold is consistent with the effect not occurring. If, in order to be a cause, something must have an effect, everything represented in a vector diagrams is consistent with no causation happening. So, it is not clear why we should think that the vector model is a model of causation at all.

Mumford and Anjum consider this objection and deal with it in the following way. Causation occurs whenever powers operate. Even if the resultant power disposes toward passing a threshold but fails to do so, some causation has still occurred: be it a change that is short of the threshold or no change at all (74). They argue that "there can be cases of causation where nothing is outwardly happening" (29). Where this is no change, no event occurs, and the effect of the powers at work is an equilibrium. They offer as examples two books leaning against each other, a magnet clinging to a refrigerator, a ball making a depression in a cush-

ion, and a tug-of-war contest at a stalemate. These are all convincing examples of powers balancing out, causing an "uneventful" effect. However, just as any vector diagram only represents a tendency toward an effect, a zero resultant vector represents only a tendency toward equilibrium, and, by parity of reasoning, should not be taken to indicate that equilibrium is actually achieved in the situation being modeled. Mumford and Anjum admit, "the vector model does not show what actually happened" (74). Consequently, the vector model does not depict effects, be they events or nonevents.

Here, Mumford and Anjum claim that causation is happening whenever powers are exercising, even if an effect threshold is not met. However, when making the case for the simultaneity of cause and effect, they are less inclined to recognize causation that can fall short of achieving its effect. In response to Hume's claim that the rolling of ball *a* preceded and caused the rolling of ball *b*, they claim "It would be absurd to say that the causing, or any part of it, was occurring prior to this impact" because "we could have stopped the ball at any point along the one-meter roll it took before the impact and the causation would not have occurred" (108). Likewise, in the case of a decision to raise one's hand preceding and causing a rising of one's hand, they argue: "Any decision prior to the raising cannot be the cause of the raising because of the possibility of a change of mind or forgetfulness" (206). This is confusing, since, in other cases, especially in the arguments against necessity, the possibility of interference is not taken to undermine a causal claim. Firing a gun at someone is said to be capable of causing their death (151), even though it is possible that something could have blocked the bullet. Similarly, "As well as having the power to cause death… arsenic should also be thought of as having the power to cause any part of the whole process that ends in death" (168).

A third feature of the world that the vector model does not represent is dormant power. Vectors represent only the powers that are exercising or operating (38). A dormant power is one that is not exercising itself, not producing its manifestation. Mumford and Anjum acknowledge the possibility of dormant powers: "One crucial mark of a disposition is that it can exist unmanifested" (4). Something can be disposed to be F without actually being F. More strongly, they claim that if a property is a disposition, it must be possible for it to fail to manifest; if something is necessarily F, it is not the case that it is disposed to be F (177).

Before I consider that point further, I first need to consider, What is a manifestation on Mumford and Anjum's view? The text is somewhat unclear on this point. One might think that the manifestation of a power is the instantiation of the property, which, symbolically, it is pointing toward on the vector diagram. This is suggested when they say "multiple powers come together and produce an effect jointly. The effect is their joint manifestation" (106). Polygeny is important, since powers have mutual manifestation partners (12) and might produce different results in different situations. Powers are not "always able to do what they would have done had they been acting alone or in a different context" (88). When a property is dispositional, "there are a certain limited number of outcomes, out of all those that are merely possible, that would be the manifestation of the power if exercised" (210). While the number of possible manifestations is limited, it is clear from this context that they are not limited to just one. For example, the power of a fire can contribute to pleasurable warmth, a painful burn, melt-

ing a candle, or boiling water. However, Mumford and Anjum also claim that each disposition has a single type of manifestation, and this determines the identity of that disposition (5). Consequently, we cannot "have the same power with different manifestations in different contexts" (224). One power "always makes the same type of contribution to any context" (224). As represented on the vector model, the same power "must have the same direction" (224).

I am not sure how to square all of these passages, and doing so is important for understanding what it means to say that a power can fail to manifest. It might mean that a power and its mutual manifestation partners fail to cross a certain threshold we are interested in, or that it is part of a situation with a resultant vector of zero: it is a partial cause of an equilibrium situation. The vector model has no problem representing such powers. However, there is another sense of "manifestation" whereby if a power fails to manifest, it is not exercising, and it makes no contribution to the causal situation whatsoever. What I am calling a "dormant power" has no intensity, it does not move the causal situation in any direction, and it has no effect on the resultant vector. Consequently, it cannot be represented by a vector and does not appear on a vector diagram. If there are dormant powers of this type, they are one of the "things" that are not represented by vectors.

There is some evidence in the text to indicate that Mumford and Anjum think that there are such dormant powers. In the tug-of-war example, "where the two teams pick up the rope and merely hold it, in readiness for action, but without actually pulling it" there is no power being exercised, there is no causation happening, and so no vectors appear in the quality space representing that situation (30). But presumably, the teams have the power to pull the rope; they are just not exercising it at the moment. Mumford and Anjum's defense of simultaneity also requires dormant powers. They discuss a purported counterexample to the simultaneity of cause and effect in which someone has a genetic predisposition to a disease, but does not develop that disease for decades (223). But since, on their view, causation occurs when powers exercise themselves, the mere existence of a gene's power to produce a disease prior to the development of that disease is no counterexample to simultaneity of cause and effect as long as that power is not exercising. Consequently, they assert "Genes can have dormant periods when they do no work (…) As soon as [the gene] is activated, it starts to do its work" (233). Further evidence of inactive powers comes from the discussion of "lonely powers" (35). On Mumford and Anjum's view, "if there were just one power at work… it would move toward [its manifestation] on its own, unaided by any mutual manifestation partner." A lonely power is "a power that might be able to manifest itself unstimulated or spontaneously" (35). While lonely powers are theoretically possible, according to Mumford and Anjum many powers need mutual manifestation partners in order to operate. Without their partners, they do not exercise. So, they say that power that cannot operate without partners should never be represented as a solitary vector on a vector diagram (38). Only exercising powers are represented on vector diagrams, so powers that cannot exercise themselves alone cannot appear alone. But since many powers need partners in order to exercise, and since mutual manifestation partners are not always together, there must, on Mumford and Anjum's ontology, be some dormant powers that the vector model does not represent.

While these criticisms are focused on the vector model of causation, there is perhaps a deeper metaphysical point here. What is missing, from not only the model, but from the theory of causation is a story about how dormant powers become activated. Mumford and Anjum offer an account of triggering or stimulating an effect in terms of adding or removing a power from a situation to take it out of equilibrium (37). A spark can be seen as a stimulus for the flammability of the gasoline. On Mumford and Anjum's picture, the spark merely provided a salient power to an already present collection of powers, and together, they jointly passed a threshold, resulting in the fire. On their view, the power of the spark is ontologically on a par with the powers of the gasoline and the oxygen, and "stimulus" is merely a pragmatic designation of one of the contributing powers. They claim that powers are not stimulated as much as they are released or unleashed (37).

This "unleash" metaphor suggests that, prior to triggering, a power is trying to push forward, but is held back. The only thing that could hold it back, on Mumford and Anjum's view, would be another power. On a vector model, this "leashed" power should be represented by an exercising power with a countervailing power pointing in the opposite direction. When a power is unleashed, the countervailing power is removed from the causal situation, and the power is free to move the situation in the direction that it points. But this model of power activation only works for powers that are already exercising. It does not tell us how the truly dormant power, the one that has no representation on the vector model, gets activated.

Given their commitment to the existence of unmanifesting, nonexercising dispositions, Mumford and Anjum's account of causation is incomplete. It is an account of active, exercising powers coming together to possibly produce an effect. The fact that nonexercising powers do not appear on the vector diagrams is symptomatic of the fact that they are not part of Mumford and Anjum's causal story. Perhaps the unmanifested powers are inert and irrelevant, and the whole causal story can be told with the powers that are already active. But then it would be otiose to posit them, and perverse to call them powers. However, if dormant powers can become active and consequently become causes, and if we lack an adequate account of how that happens, there is more that needs to be said about getting causes from powers.

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Anna Marmodoro:

Mumford and Anjum's original and stimulating book is about a "novel and positive account of causation" which they call "causal dispositionalism." They take causal dispositionalism to be irreducible (4), and in this sense a version of causal primitivism. They tip their hands at the outset thus:

> We will simply assume that the world is a world containing real powers, and our job instead is to show what the theory of causation would look like given that assumption (4).

Hence, the title "Getting Causes from Powers." Mumford and Anjum have at least three ways to describe their theory of causation. On one version of the account, which I shall refer to as the *co-workers Model*, Mumford and Anjum claim that "causation happens when powers *do their work*" (30, my emphasis). The work of a power is "*producing* its own manifestation" (8, my emphasis). So causation happens when a power produces its manifestation. But if a power and its manifestation are related as producer and product, the manifestation of a power is something numerically different from the power itself, and it is something the power is in fact *causally* related to.

Confirmation that Mumford and Anjum think of the manifestation of a power as something numerically different from the power itself comes from their explanation that "the manifestation of a power will … be itself a *further power* or cluster of powers" (5, my emphasis). The reader might now wonder whether this new power is the manifestation of the original power *as well as* its causal effect, or is the manifestation of the original power but distinct from that effect. The way Mumford and Anjum describe their view allows either reading. For example when they write that: "effects are brought about by powers manifesting themselves" (7), they seem to allow that the causal effect results from, but is not identical to, the manifestation of the original power. On the other hand, they write: "the manifestation can be thought of as something produced by the two partners working together" (34). So here it seems that manifestation and causal effect are the same thing.

If the manifestation of the original power is different from the power's causal effect, we need to know more about what the relation between a manifesting power and its effect is. If the new power is the manifestation of the original power *as well as* the effect of causation, then is the same effect the manifestation of (at least) two different powers? But how could this be possible, since the manifestation is what defines a power? Mumford and Anjum hold that "the manifestation type *determines the identity* of the disposition" (5, my emphasis). But in some cases, the partner powers will not be of the same type, in which case their manifestation could not be the common effect. How could two different types of power have the same type of manifestation, and thus, the same definition? If this were the case, how could we then tell the two powers apart? (See e.g., Lowe's arguments in Marmodoro 2010, 8, 26).

As already briefly mentioned in the preceding quotations from the book, Mumford and Anjum hold that powers have manifestation partners; in their terminology, powers "work together" to produce their manifestation. In answer to the question: "What makes powers work together?" (100), they tell us that working together does not amount to interacting: "The powers do not need to interact, as we may grant that [given two heaters in a room] the action of one heater has no effect on the action of the other" although the current temperature in the room is the product of both heaters' action. So in what way do powers work together? What underpins their "togetherness"? Mumford and Anjum reply that: "The rough idea is that the powers [work together when they] are working *on the same subject of change*" (100, my emphasis). But what does "working on a subject of change" mean, when this is supposed to explain the relation between the partner powers? Do *any* two (or more) powers concurrently manifesting on a subject of change count as partner powers? Is the temporal and/or local overlapping of

their manifestation the only connection between them? The nature of this opera-
tion "on the same subject of change" is left unexplained. Additionally, how is the
powers' "working on" the subject related to the manifestation of the powers and/
or to the change of the subject?

By way of elucidation of their idea of co-working powers, Mumford and An-
jum add: "What counts is that there is a *localized effect* to which each [power]
makes a contribution" (100, my emphasis). But which metaphysical principles do
Mumford and Anjum appeal to, in order to "localize" the effect? This will de-
termine which powers are working together, so how do we individuate local-
ized *effects* independently of their causes? Additionally, are sameness of subject
of change and localized effect two somewhat equivalent ways of accounting for
what unites co-working powers? Or is one way intended to elucidate the other?
But if so, how?

One key feature of the co-workers model is that the union of the two (or more)
powers producing a certain manifestation is to be found externally from the pow-
ers themselves, in the "subject of change" and/or (see questions above) the "loca-
tion" of their effect. The other key feature is that the manifestation is a "product"
of the co-working powers, that is, something external to and numerically differ-
ent from the powers themselves. In developing their account of causation, Mum-
ford and Anjum state elsewhere that "There is a plurality of ways in which pow-
ers *compose* to produce an effect" (86, my emphasis). They describe the relation
between a new power and its component powers as being like the relation be-
tween a statue and its clay (43). I shall refer to it as the *ingredients Model*. The re-
sulting picture is that on the co-workers model, powers *produce* their effects; on
the ingredients model, they *make up* their effects. It is clear that there is a different
metaphysics in play in the two models.

How do powers *compose* to make up their effects? Mumford and Anjum note
that there are cases of linear composition of powers, as well as cases of nonlinear
composition:

> A linear system is one in which the extent of the output is directly pro-
> portional to the extent of the input, such that if we plotted the func-
> tion on a graph, it would give us a straight line. With addition as the
> mode of composition, we would get a straight line because the out-
> put would always increase proportionally to the input. Linear com-
> position of powers is exemplified by Martin's Two Triangles model.
> If we look at wealth as a cause of happiness, however, it is plausible
> that the relationship is not linear… The extent of the output (the resul-
> tant) is not proportional to the extent of the inputs (the components)
> (89–90).[1]

Speaking generally, Mumford and Anjum's claim is that a power manifests itself
when, by composing *holistically* with other powers, it makes up a new power. But
the examples Mumford and Anjum use to illustrate linear and nonlinear compo-
sition, respectively, are problematic. Regarding the latter example, one can see
how my wealth and my inheritance are my riches, but it is not clear how they

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1. Note that here and elsewhere the examples are about substances, not powers. Mumford and Anjum
   leave unexplained the details of how such examples illustrate the case of powers.

are literally my happiness. The problem with the latter example is that Mumford and Anjum take the addition of wealth to wealth to be a mental state (happiness). This categorical transition cannot be glossed under nonlinear composition. On the other hand, when Mumford and Anjum lean on C. B. Martin's example to illustrate linear composition as well as their general point about holistic composition, they run into other difficulties. In Martin's (2007, 51) words, the example goes like this:

> You should not think of disposition partners jointly causing the manifestation. Instead, the coming together of the disposition partners is the mutual manifestation; the partnering and their manifestation are identical. This partnering-manifestation identity is seen most clearly in cases such as the following. You have two triangle-shaped slips of papers that, when placed together appropriately, form a square. It is not the partnering of the triangles that *causes* the manifestation of the square, but rather the partnering *is* the manifestation (my emphasis).

By adopting Martin's example as an illustration their own position, Mumford and Anjum reveal a possible ambiguity in the co-workers "production" model they explicitly endorse in other parts of the book. What Martin says in the quote above is that all there is to the manifestation of a power is the power's getting together with its manifestation partner: once together, the powers themselves *are* their manifestation. But, it may also be case that the manifestation is categorically different from the powers. Mumford and Anjum would probably welcome this result, subsuming both *being* the manifestation and *producing* the manifestation under a constitution relation, where the two partners *constitute* the manifestation (linearly, and nonlinearly). We see this when Mumford and Anjum offer one of their own examples in addition to Martin's example: the case of sodium and chlorine. When the two substances are combined into a composite, their powers compose *holistically*, and produce a new power, saltiness. But this does not show anything about how the powers of sodium and chlorine jointly cause their manifestation, which is making the food they are added to salty. Mumford and Anjum add that "the powers of sodium chloride are *completely different* from those of sodium and chlorine separately" (103-4, my emphasis). But then on Mumford's and Anjum's account, the manifestation relation will not serve as a more fundamental relation, explanatory of all the other relations that puzzle metaphysicians, but rather, manifestation will carry with it all the generalities and problems that these metaphysical relations suffer from.

Let us now consider a third example that Mumford and Anjum offer in an unpublished manuscript: the pandas example. The female has the power to produce fertile eggs, the male has the power to produce sperm; jointly they have the power to generate offspring, which one might say is the result of the holistic composition of their individual powers. But how this holistically composed power comes to be by the mere addition of the female's to the male's powers is not explained. Even this example, in conclusion, does not deliver the explanation we are looking for in Mumford's and Anjum's position. There is still a gap between the co-workers and the ingredients models.

As we saw above, on Mumford's and Anjum's ingredients model, the manifestation of two or more substances' powers consists in the *replacement* of the original powers with a new one. This new power is real but un-manifested (until it gets together with its own manifestation partner, and produces a further power etc.,). But power ontologies which posit that the manifestation of a power is the emergence of a new power face the challenge that all there is or can be in the world is potential, and that change is simply a transition from one potential state of the world to another such state. This is a problem sometimes referred to as the "Always packing, never travelling" problem.[2] David Armstrong (1997, 80), following C. B. Martin, formulates the problem thus:

> Given purely dispositionalist accounts of properties, particulars would seem to be always re-packing their bags as they change properties, yet never taking a journey from potency to act.

All there is to such an ontology is potentiality; such an ontology in other words is populated only by powers waiting to get manifested. In answer to the "Always packing, never travelling" argument, Mumford and Anjum introduce what I shall refer to as the *Passing Around model*. They (5–6) present it thus:

> Rather than attempt a defensive strategy, however, and fight off Armstrong's attack, our approach is to turn the tables. On reflection, the idea of causation as a passing around of powers, especially for a pandispositionalist, starts to look extremely attractive (Mumford 2009). Some examples will illustrate this. You come in from the cold and sit by the fire. You sit by the fire because it is hot, which for the pandispositionalist means that it has the power to warm your body. Causation occurs when the fire warms your body, changing it from cold to hot. Armstrong retorts that such causation, for pandispositionalism, consists in the mere passing around of powers. In the present case, that would mean that *the heat of the fire, which consisted in it having the power to warm some other object, has been passed on to you. But that sounds quite right*. (my emphasis)

The idea that causation happens because of the passing around or transmission of properties can be traced back to an ancient Greek conception known in the literature as the contagion model of causation.[3] Aristotle too talked of the transmission of the "form" of the agent's power onto the patient's power (cf. *Physics* 202a9-11). But, as I have argued elsewhere in press,[4] contrary to the traditional understanding of the contagion model, even for Aristotle this is a figurative way of speaking. The transmission of powerfulness is a way of describing what is brought about by causation, *as if* the patient received the powerfulness of the agent. Nothing is actually transferred from the agent to the patient; what takes

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2. It is Molnar (2003, 173) who called it the "Always packing, never travelling" argument.

3. For an account of the model in ancient thought with particular reference to Aristotle, see e.g. Scaltsas (1989). The contagion model was also revived in early modern philosophy; see for reference e.g. O'Neill (1993, 44).

4. Marmodoro (2007, 2013a, 2013b, unpublished)

place is not the transmission of anything, but change, which is the *explanandum* rather than the *explanans*.

The difficulty with the position advocated by Mumford and Anjum is that even if one takes it to successfully explain the transfer of energy between objects, for example, heat, it does not explain cases where the causal effect also involves qualitative change.[5] For example, the broken vase that received the hammer's blow has not become more powerful in the way the body near the fire has become hotter; rather, the vase shattered. "Passing around force" does not describe being in pieces, by contrast with "passing around heat" which describes being hot. We cannot charge this difference to the nonlinearity of the powers' composition; the difference requires metaphysical explanation.

Mumford and Anjum's book leaves important metaphysical questions still to be answered. This is part of the value of the book, and in that, it focuses one's mind to consider the detail of the relations existing at this fundamental level of reality and seek clarity to reach understanding. In developing a fuller version of Martin's account of causation, Mumford and Anjum bring in metaphysical tools to strengthen it and to supplement it in original ways. It is clear that Mumford and Anjum's account of causation in terms of powers enriches the current debates both on power ontology and causation in many interesting ways, to which full justice cannot be done here. To mention one of the most stimulating ideas in the book, Mumford and Anjum propose to model causes as vectors (19ff.); this is an original approach whose merits would deserve a separate discussion. The book also engages interestingly with the special modality that characterizes powers, something "in between" pure necessity and pure contingency (175). One more dimension of the book which deserves attention is Mumford's and Anjum's exploration of how their theory of causation could make a difference to our understanding of perception (195ff.) and even to biological explanation (214ff.). How the authors will develop these ideas further in their future work is something I very much look forward to.

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Authors' reply: **Stephen Mumford and Rani Lill Anjum**

Getting Causes from Powers offers an account of causation that we think contrasts radically with the orthodoxies of the Humean analysis. As is well known, Hume believes that we form our idea of causation from four more basic others: constant conjunction, temporal priority, contiguity and necessity, though he takes the last of these to be illegitimate. We think the jury is still out on contiguity, in the light of some interpretations of quantum entanglement, but we reject all the other three. Our starting point is a metaphysics of powers, and we argue that if you are serious about powers you should see that causation involves neither necessity, temporal priority nor constant conjunction. We argue that causation is a single, unified, and continuous event or process rather than a relation between distinct and discrete events, that causes and effects are simultaneous and

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5. See Marmodoro, "Aristotelian Powers at work: Reciprocity without symmetry in causation," forthcoming.

that causes tend towards their effects without necessitating them. We are grateful to Jennifer McKitrick and Anna Marmodoro for their comments. Both are in general sympathetic to the powers approach and their criticisms are taken in that spirit. We accept that the ideas would benefit from further development, which we hope either ourselves or others will provide in due course.

Jennifer McKitrick considers whether all things can be truly represented as vectors and produces a list of things she thinks cannot. She points to objects, effects/ events, and dormant powers. She then also takes us to task because we have not explained the place of dormant powers in our theory adequately, though it certainly looks like we are committed to them. In particular, McKitrick points out that we have no account of how dormant powers get activated.

First: the omissions. Could the world be nothing more than powers represented as vectors? The statement that "All things are vectors" is actually a quotation from Whitehead (1929, 309), which we do not explore in any great detail, though we do quote it with a degree of approval. Might it be true? Objects could be a problem. They are not powers, but bearers of powers. One response might be to say that objects are just bundles of properties; and properties are just bundles of powers. If that is the case then objects would be constructed from powers and although powers tend to travel around together in bundles, we do not need an irreducible ontological category of object. The bundling itself need not be some additional relation: might there be a bundling power at work here? Whitehead himself probably had something even more radical in mind, however. In process metaphysics, it is the processes that are basic. Properties and particulars are both constructions from those, and one thing we hope the book shows is that a powers ontology should be understood as closer to a process metaphysics than usually recognized. In that case, omitting objects from the picture might be no bad thing.

Before we dive too much into murky metaphysical waters, however, we ought really to declare that the Whitehead quotation was intended primarily in support of pandispositionalism. All properties are causally powerful, hence vector-like. The Eleatic reality test tells us that to be real is to be powerful, but it seems entirely tenable to say that entities such as objects pass the test in virtue of their powerful properties even if they are not reducible to them. Perhaps stated this way McKitrick would find the view more credible.

But there is a more serious omission: the vector model does not represent the effects of causation. It shows us only the causes and not what they eventually produce. So we are modeling causes as vectors rather than modeling causation. We accept this, but defend our reasons for doing so. The key is the rejection of causal necessitarianism. The collocation of powers represented in the vector diagram tend, and no more than tend, toward an effect. We certainly could not, therefore, have a model for causation in which the effect was represented as following without further ado from the cause. McKitrick is correct that "everything represented in a vector diagram is consistent with no causation happening." Yes, but what it shows is what will tend to happen, what is disposed to be, without there being a guarantee. This is the dispositional modality in practice: the modality that we argue (chapter 8) is found in all natural causal processes. We need not despair of representing effects, however. If causation results in a change, then we have new properties instantiated, which for us are new powers, to be represented

as new vectors in a new diagram. What is an effect relative to one causal process can be a cause relative to another. If you want to depict the history of the world in caused events, therefore, we suggest you line up the vector diagrams in their temporal sequence.

McKitrick has an additional worry here. What are we really saying about the cases in which an effect fails to occur, and how does that square with our claim that causation occurs whenever powers are exercising? Can causation fall short of achieving its effect? Suppose partnered powers begin manifesting in a process that could result in an effect E, such as sugar being wholly dissolved in liquid or a billiard ball heading toward a collision with an object ball. If we interrupt these processes before completion, the cause will not have had "that" effect, E. We have not had the complete dissolution, nor the collision; but *something* has been produced. Maybe half of the possible dissolving has occurred, and the billiard ball has traveled some distance. But that certainly is a change, and certainly a caused one. Indeed, we claim that even where no change has occurred, for instance where powers perfectly counterbalance in equilibrium, then it is a case of causation.

McKitrick then asks us what is a manifestation? Is it just the exercise of the power? That would be confusing because we seem to allow that powers can have different manifestations when working with different mutual manifestation partners. But then we also allow that the manifestation determines the identity of the power so must always be the same. Anna Marmodoro picks up on the same issue. Given that the manifestation type determines the power, how can we speak of two different powers jointly producing the same manifestation? That would entail that the two powers were actually identical, contrary to assumption.

We try to reconcile these seemingly contrary demands in the same way Molnar (2003, 194–196) does. It is clear that a third element is needed.

We follow Molnar in saying that the manifestation of a particular power should not be understood as the final effect that is produced polygenically, but as a contribution toward the effect that the whole set of powers causes. (The only exception to this is the largely theoretical case where we have a lonely power, operating in isolation.) He is then able to claim that the same power makes exactly the same kind of contribution to any effect of which it is a part of the cause. The identity of each power is still given by its manifestation type, but that manifestation can contribute pleiotropically to many different types of overall effect. We take this account from Molnar's discussion of polygeny and pleiotropy, to which we would refer the reader.

McKitrick's final complaint is that we do not represent dormant powers. More than that, we have no theory of how they come to be triggered if they are dormant. And it seems that we indeed accept the existence of dormant powers. We do not deny this.

In defense, we say that our theory of causation is complete insofar as it can include all cases of causation. Causation on this view occurs when powers do their work. The vector model is suitable for representing such causal processes. That there are also powers that are dormant, does not render the theory of causation incomplete, nor does it show that the vector model is unsuitable for the purpose at hand. When a power is not doing its work, it is not part of the causal story, so it is not something we should be trying to include. When it is doing its work, it is indeed causally involved, and it can be represented in the vector model.

Our account offers at least some story of how a dormant power might become activated, as McKitrick allows, by the adding or removing of a further active power. This is a causal story and one in which we have assumed that at least some causal processes are already up and running, affecting each other. But to offer an account of how a first ever dormant power could spring to life and come to be activated may well be beyond the scope of our book. It sounds after all like a case of creation *ex nihilo*, which is a mystery for us all.

Anna Marmodoro also pushes the issue of how powers are activated and identifies ambiguity in our theory between the *co-workers* model and the *ingredients* model. She then challenges the ancient contagion model of causation, of which she takes our causal dispositionalism to be an instance.

Marmodoro thinks she has identified an ambiguity. In some places, we suggest that effects are things brought about by (hence distinct from) powers manifesting themselves. Elsewhere we talk of the manifestation as the sum of (identical with) the partnered powers. It is the latter view that we would drop from our account *of causation*. It comes from p. 34 where we were initially presenting C B Martin's account of mutual manifestation partnerships, an account that we subsequently improve upon. More on this shortly.

Other concerns are raised, however. What does it mean for the powers to be partnered? We say it means that they are working on the same subject of change, such as when two heaters are warming a room. But what is that? Is the overlap of the manifestation the only connection between the partnered powers? And how do we explicate the localization of this overlap?

While admitting that such an account could be developed in more detail, we think that it is a defensible package of claims. Sometimes powers might act on the same object. A single thing might be both drilled and cooled at the same time. The drilling and cooling powers are acting together in the sense that they operate on the same object to produce in it a complex change that neither could have produced alone. And two partners could be partnered though they never meet. Someone's nervous breakdown might be caused both by their mother and a work colleague, each contributing to stress at different times and without ever meeting. But we need not limit the action only to being directed upon objects. Some might operate jointly on a region, as in the case of the two spatially separated heaters. And that local region might in some cases be very large. Consider that motions of astral bodies such as comets, whose movements are dictated by gravitational fields spreading over vast distances and exerted by multiple bodies. Given that causation can range from the very microscopic to very macroscopic, there is no reason to limit how local a localized effect should be.

Marmodoro then points to a tension between two different accounts. In places, it seems we subscribe to the co-workers model, in which powers *produce* their effects. In other places, we seem to prefer an ingredients model, where powers *make-up* their effect. She notes that two different metaphysical principles are in play. She is right. The latter ingredients model comes from our discussion of how component powers constitute resultant powers. Our response is that they indeed make them up, that is, they constitute them in the sort of way the clay constitutes the statue. But this issue of the relation between component and resultant powers is distinct from the issue of how powers produce their effects and rightly requires a different principle. Composition of causes is a different matter from that of any

subsequent causal production by those resultant, composed powers. In composing to form a resultant power, we are still talking about the powers themselves, whereas in talking about causation we are talking about how those powers, or how that resultant power produces its effect (and as we are causal dispositionalists, as McKitrick notes, we cannot straightforwardly infer from a resultant vector to what is actually produced because the resultant only tends towards an effect).

Marmodoro pushes further on the question of composition of powers, testing our accounts of both linear and nonlinear composition. In the first place, she says (in a footnote) that the examples we cite in a quotation concern substances rather than properties, and it is unclear how we would extend Martin's account accordingly. And in the case of the nonlinear effect of wealth upon happiness, how could someone's wealth literally become their happiness.

This is where it is significant that while we adopt Martin's mutual manifestation model, we revise it in many respects. We do not accept his understanding of how it works, nor what it means for causation. He uses the model to replace the notion of causation, for example, which we do not. We do not think that the partnered powers are identical with the effect, which Martin does. As we understand it, Martin indeed has an ingredients model in place of a notion of causation. We reject Martin's version of mutual manifestation precisely because there are many features of causation this view could not explain. Again, an ingredients model might work for the composition of resultant powers from their components, but it does not work as an account of powers bringing about an effect. Usually effects will take time to develop, through a process that may be genuinely transformative. Effects are not just the aggregate of their causes. It seems as if Martin is trying to eliminate causation in favor of mere mereological composition of powers, which is wrong.

In the example of ours that Marmodoro discusses, we would defend the view that being wealthy and being happy are indeed properties, powerful ones, that are attributable to persons. And given that we reject the ingredients model, one's wealth does not *become* one's happiness. So there is no categorical transition, as is alleged. Rather, wealth has a power to affect happiness though in a nonlinear way. Being twice as wealthy does not necessarily dispose toward twice as much happiness.

We hope we have now sufficiently distinguished the co-workers model for the production of effects from the ingredients model for the composition of causes. There is a further account that Marmodoro attributes to us, however: a contagion model of causation. We say that causation is a passing round of powers, but surely powers are not literally transmitted from the cause to the effect.

In the book, we leave open the exact way in which powers are passed around. To an extent that would depend on one's other metaphysical commitments. Suppose you are a trope theorist, for instance. Tropes are nontransferable, we believe, so in no strong sense are they transmitted. But "passing on" can have different meanings. We need not think of it as being like playing pass the parcel or passing round a cigarette. But there is good sense in the idea of passing on a virus, passing on momentum, and, better still, passing on an idea or message where no actual matter is transferred. Such a view might indeed suit better the mild kind of process ontology that can be found between the lines of *Getting Causes from Powers*. But we cannot develop that thought here.

We are given one last challenge in relation to this idea. Perhaps momentum can be passed between distinct substances where this is merely a passing on of energy. There are many transfer theories of causation that would accept this. But our account does not explain qualitative change. We agree that there are many cases of causation where the powers received by the effect are not the same as those possessed by the cause. The broken vase has a power to cut residing in the sharpness of its pieces, but the hammer that produced the breakage did not have that power. It is not always the same power that is passed on in causation; but it is some power. And if our broad notion of *passing on* were to be accepted, we think it can apply also in this case. The powers of the cause, for instance of the hammer, produce a change in the object affected. Given that the change is a change in the properties of the thing affected, and properties are powers, then it seems reasonable to understand this as a case of new powers being given to the effect by the cause.

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