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Where the Real Power Lies: a Reply to Bird

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1. The powers project

Alexander Bird has launched a blistering attack on the project of putting powers to work outside a narrow context of fundamental properties (Bird 2016 and henceforth BO). To give a flavour:

For example, several provide dispositional accounts of some phenomenon from which it is fallaciously inferred that they have thereby shown the value of the powers ontology. (BO, p. 344)

For those who see a broader role for an ontology of powers, that metaphysics can be applied to give illuminating accounts of many phenomena of philosophical interest, including causation, representation, action, free will and liberty. I have argued that this is just moonshine. (BO, p. 379)

An attack of this kind could be particularly damaging. Work on fundamental powers is, after all, only a small part of the powers project. Many have attempted powers-based accounts of the sort of macrophenomena Bird mentions (Molnar 2003, ch. 12, Mumford 2004, Borghini and Williams 2008, Mumford and Anjum 2011, Groff 2013, Lowe 2013, Hüttemann 2013, Vetter 2015, Anjum and Mumford 2018). From the language Bird employs ('moonshine') it is clear that he thinks all these applications, and thus a substantial majority of the literature on powers, are misconceived and worthless. My own work with Rani Lill Anjum (Mumford and Anjum 2011) comes under particular fire. Many would take it as an important part of the argument for any kind of powers metaphysics that it can explain a range of phenomena such as causation, modality, laws, free will, and so on. Friends of powers believe that they can use a similar argument to the one that Lewis (1986) deploys for the plurality of worlds. It is not that there are direct arguments for other worlds but we should accept them on the basis of their explanatory value. Not everyone endorses this as an honest method in metaphysics (Bueno and Shalkowski 2015). We can at least say, though, that Bird's view, if correct, would prevent any such parallel move on behalf of a powers ontology. This newly

antagonistic stance has been expressed elsewhere besides (Bird 2018) but Vetter (2018) dealt adequately with that set of arguments so I shall make no further comment on them here.

Should we be concerned, then, that a formidable former friend of our fledgling metaphysics has turned his back on non-fundamental powers? I argue not since the case he offers consists primarily of red herrings, false dichotomies, straw men, cheap shots and, that old conjuror's trick, diversion. The result hides the strength of the powers metaphysics. It is important, then, that we untangle Bird's rhetorical web lest it lead trusting readers astray.

2. What are powers?

The first mistake might be an honest one. Nevertheless, it is the most serious error Bird commits since it immediately sells the reader a diversion. It occurs early, when he considers what powers are (BO, section 2.2). He acknowledges that there is no clear agreement on this matter but states his view that 'a power is a property that is dispositional in nature' (BO, p. 345). And what does that mean? 'Most advocates of the powers ontology agree with one or both of the following', he says: that a power (a) is an ontic property with a dispositional essence or (b) is an ontic property whose identity is given by its dispositional role. He concludes from this that all are agreed that the very same power could not have a different dispositional or causal role, which he calls Modal Fixity: powers are modally fixed properties.

I accept that the modal role of powers is fixed. However, it is wrong to reduce powers down to this one feature. It already does powers a great disservice. Bird's approach to the topic may seem innocuous but is far from it. The 'is' deployed in both (a) and (b) is presumably, and ought really to be, the 'is' of predication rather than the 'is' of identity. Bird does not specify either way. Glossing over that matter obscures the important point that modal fixity is not all that there is to being a power, and allows Bird to proceed with the rest of his arguments as if it is. Granted, not everyone agrees about all that powers are but the most obvious omission in Bird's considerations is that powers are productive of their manifestations. This is the very reason they are called powers: they are powerful.

I understand why Bird misses this. His own limited preoccupation (Bird 2007) has been to show the connection between powers and laws, for which powers' modal fixity is indeed crucial. But it is wrong to narrow powers down to a single aspect of them and then criticise

any powers-based theory of some phenomenon on the basis that these eviscerated powers offer little by way of explanation. This is especially conspicuous when it comes to causation. Bird thinks that both Humeanism and Armstrong's nomological realism can explain just as much as a powers-based theory of causation. He would think that if he has overlooked the productive nature of powers. Humeans deny there is any such thing as production, while Armstrong has laws of nature do all the heavy lifting, so there is a genuine difference between these theories on the matter of causation. Of course, many Humeans profess not even to understand what powers theorists mean by causal production, over and above constant conjunction or counterfactual dependence, and then will not be able to see that a powers-based theory is offering them more than, say, a Lewisian view. That's where we differ. My suspicion is that vestiges of Humeanism have always persisted in Bird's work, even when he made use of a notion of power. Note, for instance, how he prefers to articulate modal claims in terms of possible worlds.

3. Bird's fundamentalism and a false dichotomy

A focus on too narrow a notion of power is not all that has gone wrong. A major difference between us (Mumford and Anjum) and Bird is that Bird thinks that 'all the (intrinsic) facts about a world supervene on the instantiation of all the fundamental properties' (BO, p. 358). We are not persuaded of this.

We accept an 'ontic' notion of property, with Bird, in which a property is a real entity rather than just the intension of any old predicate (BO, p. 344). This is not what divides us. And Bird commits to naturalism, where the ontic notion of properties is sparse, permitting only 'those [properties] that would be mentioned in a correct complete science' (BO, p. 344). We can accept that too. Bird seems to think that we do not but that is because we differ over what a correct complete science might look like.

Having laid out these assumptions, Bird then attempts to foist upon us a false dichotomy:

Their liberal conception of properties threatens to be inconsistent with their commitment to Pandispositionalism . . . For many non-sparse properties are clearly not dispositional at all, for instance, the

property of being either identical to the number two or taller than the Eiffel tower or made of fossilized dinosaur bone' (BO, p. 344n).

What is false about this dichotomy is that Bird presents the reader with a simple choice between his extremely sparse, fundamental-only properties and, effectively, 'anything goes': what I would call a superabundance of properties. Clearly there is plenty of ground between allowing only fundamental properties and superabundance. A macro-property such as sphericity is manifestly not of the same sort as being identical to the number 2, or being taller than the Eiffel tower. There are very good reasons to rule out both of those as genuine properties: the first is an artifice of an identity statement, while the second mentions a particular. Most theories of properties would disqualify those instantly. Nor would we allow disjunctive dispositions, as Bird suggests we might (BO, p. 351). Indeed, the whole of Bird's section 4 is a red herring. No one argues for the unrestricted view that any old conjunction of powers is also a power, nor that a disjunction of powers is a power (BO, p. 359). If we are to defend macro-powers, it will not be that way.

This sleight of hand on Bird's part quietly equates naturalism with fundamentalism. They are not the same and nor does the former entail the latter. It is a perfectly acceptable view that there should be naturalistic constraints on what count as real, ontic properties even if they are more than just the fundamental properties. Non-fundamental properties might indeed be mentioned in a correct completed science since no compelling evidence demonstrates that the completed science will contain reference only to fundamental properties, nor even that all its properties will supervene on the fundamental ones. There has for some time been evidence of emergence in nature (now conveniently gathered by [Gibb, Hendry and Lancaster 2019](#)), which Bird ignores. In a development of Aristotle's original account (*Metaphysics* 1045a 8-10), we can understand emergence as occurring where a whole has a power that is not the same as any of the powers of the parts, nor their mere aggregation, and results from the interaction and alteration of its parts. Supervenience can fail here if the emergent power is produced, but without being necessitated, by the parts' interaction ([Anjum and Mumford 2017](#), pp. 99-101). Such non-reducible macro-powers can be entirely natural, ontic properties that are apt to figure in scientific theories.

To allow that there are more properties than the fundamental ones, therefore, does not mean acceptance of the absurd candidates for

property-hood that Bird wrongly introduces into the discussion. Here is a straw man if ever there was one. Clearly there is space for a view of properties that is to an extent sparse – rejecting their superabundance – but without being as restricted as the fundamentalist asserts.

4. What is wrong with macro-powers?

The primary reason I find for why Bird thinks there are no useful powers-based accounts of macro-phenomena such as causation and agency is that he believes there are no macro-powers that could be at work in these phenomena ('... [W]e lack a reason to think that there are any powers at a macro level' (BO, p. 363)). But his arguments for this are weak and only appear credible after he has set up the straw man of superabundance and persuaded us to accept a notion of power that is solely about modal fixity. Even then, he still has to rely on an illegitimate shifting of the burden of proof.

Although Bird denies, and for his conclusion must deny, that there are macro-powers, his direct argument for this rests on mounting a case against pandispositionalism, occupying the whole of his section 3. Pandispositionalism is the view that all properties, micro and macro, are powers, and is refuted with just one counterexample. But this refutation is not what he needs to sustain the primary claim of his paper: 'that the ontology of powers, even if successful as an account of fundamental natural properties, does not provide the insight claimed as regards the aforementioned non-fundamental phenomena' (BO, p. 341). The powers view does not need pandispositionalism. It only requires that there are some macro-powers. So Bird has played a cheap trick here: first denying that there are any macro-powers at all, a view which is refuted by the existence of just one macro-power, and then diverting the reader's attention onto a very different contention that could be refuted by one macro-property that is not a power. It is a classic bait and switch. You don't prove your claim that no macro-properties are powers by arguing against a view that all macro-properties are powers. While I confess that I am a pandispositionalist, we can have that debate elsewhere since it is perfectly possible that there be a useful powers-based theory of causation if just some, but not all, macro-properties are powers.

Why can't there be macro-powers, then? This is the real question. Bird insists that ontic macro-properties are not powers in the required sense of having modal fixity. Why not? The example of sphericity

which we have given previously (Mumford and Anjum 2011, pp. 3, 4) is glibly dismissed out of hand in the following: '[T]he sphericity example is just too simple to be readily extendible to more complex properties' (BO, p. 355). This will not do. Whether the same account is extendible to other properties is, of course, a further matter, but saying so does not refute the claim that sphericity itself has modal fixity. And given that it is a macro-property, which is hard to deny, then we have an apparent case showing that something more than his Fundamental Powers Thesis (FundPT) is true. *Prima facie*, anything that is spherical must be disposed to roll in a straight line down an inclined plane, be disposed to make a circular impression when pressed into soft sand, be disposed to feel smooth in the hand, and so on. If a property does not have these dispositions, it is not sphericity.

I am aware of some arguments for why this causal-dispositional role for sphericity is not fixed and, given the importance of the point, it is worth acknowledging them. One view is that the laws of nature are contingent so there must be some worlds in which sphericity plays a different causal role. But I reject this view for reasons given by Black (2000). I do not see a sense in which something that does not have the causal role of sphericity really is spherical any more. One might accept quiddities or primitive property essences, though I, like many powers theorists, reject them. I am going to say a little more about this issue in the next section. Another challenge would be to say that not all spherical things have the disposition to roll in a straight line down an inclined plane because, if you consider a soap bubble, it sticks to the inclined plane rather than rolls down it. (This putative counterexample was put to me by E. J. Lowe.) But this is to misconceive the dispositional nature of a causal role. The causal role is not about what things actually do in the occurrent sense. Something's causal role is about what it is disposed to do. Even the soap bubble is disposed to roll down the inclined plane. It doesn't do so because it has a countervailing power of stickiness. Were the bubble to stop being sticky, then we assume its disposition to roll will be able to manifest itself. A third kind of argument challenges whether sphericity has the causal role on the ground that a soft sphere would not roll down a slope at all but would collapse as soon as it is released (Unger 2006, p. 269). This is a poor argument. Of course, anything that loses its sphericity when, for instance, it collapses, loses the causal role of sphericity. But whenever it has that shape, it has that dispositional-causal role. This review of the arguments may be cursory but it is still more than Bird provides, even though his whole case would seem to rest on the

point. If the modal role of sphericity is fixed, there is at least one macro-power in the sense Bird requires.

Instead of engaging with this kind of case, where there is a plausible macro-power, Bird instead produces a long list of alleged properties that he says do not have a fixed causal role: being metallic, aromatic, heterocyclic, covalent, homodesmic, leukopenic, being a transition element, 'the property of being a dinosaur', being a manus, being pericardial. 'Science is full of references to properties that are not at all dispositional' (BO, p. 355), he concludes. This is a mixed bunch, whose diversity might be justified if his opponents really were superabundantists and prepared to defend pandispositionalism even here. I suspect any such opponent is merely imagined.

Freed of superabundantism, we should question whether some of the items in the above list are genuine properties at all. Being a dinosaur is not a property: it is an attribution of kind-membership and, as [Lowe \(2006, p. 26\)](#) shows, kinds are not the same as properties. Bird unintentionally reveals why: being a kind is not a One running through Many (BO, p. 356). At least in some cases, kind-membership is about common ancestry. Kind membership is a complete red herring here, which Bird looks reasonable in introducing only because he has already wrongly implied that we are superabundantists about properties.

Similarly, 'properties' that concern the relationships between entities, such as we find in structural arrangements, need not bother us since the pandispositionalism that we hold is a thesis about properties (that they are powers or clusters of powers). It is not a claim about relations, nor is it a claim about so-called relational properties since there need be no relational properties in addition to properties and relations ([Armstrong 1978](#), pp. 78-80).

Other examples Bird gives are clearly determinables, for example, aromaticity. It is no surprise if there is not a single set of powers that characterises all aromatic compounds since that is an indeterminate type. A single power or set of powers would only come with determinacy. Any powers that accompany aromaticity will be as indeterminate as aromaticity itself. By this, I do not mean that there is such a thing as an indeterminate power: rather, it is indeterminate what determinate power something will have when it is aromatic. Compare being coloured, which similarly is indeterminate with respect to which particular determinate colour power is involved. [Armstrong \(1978, p. 117\)](#) has the right intuition here, that the real ontic properties will be determinates rather than determinables.

Let us not sidestep all of Bird's examples, though. Suppose we accept being leukopenic and being covalent as naturalistic-enough properties. Can a case be made for these having modal fixity?

First, being leukopenic. There are recognised symptoms that tend to accompany this condition. Leukopenics are at greater risk of infection, for instance, due to a lower number of leukocytes in their blood. The condition has effects on the person concerned and on measuring devices that are used to detect it. Why think that the causal-modal role of leukopenia could change and it still be leukopenia? Could leukopenia and epilepsy, for instance, change their causal roles, and hence their symptoms and effects on measuring devices, but leukopenia still be leukopenia and epilepsy still be epilepsy? I don't see that they could. Clearly the case hangs on the answers to these questions and nothing Bird has offered compels us to doubt the modal fixity of the property.

The covalence of a bond is also detectable. It affects those things bonded. A covalent bond is made and can be broken in certain ways that would not break other types of bond (for example, by hydrolysis). It is not merely that the bond is composed in a certain way, but being composed in that way makes a difference to the way something is disposed. Could something be covalent without being so disposed, or be so disposed without being covalent? These are simple questions that Bird avoids asking.

There is a general consideration that weighs in favour of these properties having their modal role fixed. Such properties having modal fixity would explain why they are useful within science, in our explanatory and predictive practices. If they weren't modally fixed, why would science invoke them? Bird seems to concede that there is an argument to this effect (BO, p. 351) and I do not see how one could possibly maintain that science invokes a certain property because it is useful in explanation and prediction while rejecting the view that its modal role was fixed. A property would be predictively useless to science were its modal role not at least fixed in our world. That a property such as covalence is useful to science is thus *prima facie* evidence that it does have a fixed dispositional-causal role. Of course, science has other purposes besides, such as classification, for which determinables and common ancestry can be considerations, so there is space for categories and natural kinds as well as properties.

5. The Taylor interpretation

Henry Taylor, in discussion, has offered the following possible interpretation of Bird (leaning on Bird 2007). Perhaps one should say that the necessity of laws follows from essence, since Bird accepts much of Brian Ellis's (2001) dispositional essentialism. For example, the essence of an electron includes being negatively charged. However, matters are different with cases such as sphericity, Taylor suggests. The essence of sphericity is given by its geometrical definition, not its causal powers, as anyone who contemplates the Platonic forms will know. To be a sphere is to be a three-dimensional shape with every point on the outside equidistant from the centre and this is nothing to do with modal fixity.

Such a view does not get Bird off the hook, however. In BO, Bird's claim concerns modal fixity specifically. What is at issue is whether the causal-modal role of sphericity is fixed and, for the reasons given above, powers theorists say that it is. The argument that matters is that nothing can be spherical (with those exact geometrical properties, if that's how you put it) and lack the modal-causal role of sphericity.

A stubborn opponent might allege, regardless, that the laws of nature could be different such that something spherical, as determined geometrically, has a different causal role from the one it has in our world. In that case, sphericity does not have a modal role fixed in all possible worlds.

The friend of powers need not despair, however. There are two types of response, naturalistic and metaphysical. For powers to be scientifically useful requires only that they have a fixed causal role for us, or in all the worlds with the same laws as us. That is all that naturalism is entitled to demand. Bird alleges that there are no useful powers-based accounts of causation, agency and so on and it is hard to see how this is undermined if there are other worlds with different sets of laws from ours since they are not the world with which our science deals.

We could, nevertheless, go toe-to-toe over the metaphysics, if we needed to. The friend of powers would insist that the property of sphericity in any world is the property that plays the spherical causal role. Platonists might prefer to go with the geometrical definition. Powers theorists won't. For us, it is absurd to suggest that something could be spherical geometrically but be disposed to leave a square impression in sand instead of a circular one, to feel pointed in the hand instead of smooth, and not to roll down an inclined plane. That's

what our opponents have to say but we think these consequences only expose the incredibility of their view. Humeans think the causal role and geometry could come apart; we don't.

6. Causation

Bird's attack on a powers-based theory of causation is particularly egregious. In his section 6, he argues that (1) the Mumford-Anjum powers theory of causation boils down to causation being vector-like, (2) being vector-like boils down to causes having a direction and intensity and (3) insofar as there is any truth in this, other theories of causation account for it just as well (BO, pp. 364-5). This is shoddy treatment of an opposing view since even a hasty reading of Mumford and Anjum (2011) would show that (1) and (2) are clear misdirections.

On (1), the idea that causation can be usefully modelled using vector diagrams instead of neuron diagrams is just one chapter out of ten in the book. Why should a whole powers-based theory of causation get reduced to this one feature, which actually concerns representation rather than metaphysics? The full theory, in the book as a whole, says that: causation can be understood as a passing around of powers; causation involves a non-necessitarian but still non-Humean production involving a *sui generis* modality; higher-level powers can be emergent and not reducible to their component powers; causation is directly knowable proprioceptively through ourselves as causal agents; and there are new accounts of prevention, causation by absence, non-transitivity and the logic of causal claims. There are many aspects of the theory that Bird simply ignores or only mentions in passing without further engagement.

To make matters worse, in (2) Bird then reduces the idea that causes can be represented as vectors to them having direction and intensity, so that he can claim in (3) that rival theories also allow this. There is more in a vector model than direction and intensity. Vector models show: how causes are complex, in a way that neuron diagrams don't, treating an effect as a mutual manifestation of multiple powers; how no cause alone is sufficient for an effect; that effects can be threshold phenomena; and how an effect might be that nothing happens – the absence of an event. In general, it is bad philosophical practice to attack an opponent's entire position based on one out of their ten chapters, and then reduce the argument of that chapter down to two features out of many.

Why might Bird have done this? One possibility is that he thinks he has a knock-down argument against causes being vectors. They don't add so they can't literally be vectors (BO, p. 370). But if the set up in (1) and (2) is just for this pay-off, it isn't worth it. For a start, we ourselves make it clear that powers can compose in non-additive ways since we allow compositional pluralism. Bird uses our refinement of the account as if he has discovered a new objection against it. At BO (pp. 369-70), he even uses our own examples supposedly against us: the nonlinear chocolate-eating example and antipathetic composition (repeating reasoning already presented in Mumford and Anjum (2011, pp. 88-92)).

We claim that vector models are a useful representative tool for complex cases of causation, as compared to neuron models. Others have seen their advantages too. There are documented uses of vector diagrams in NHS patient consultations (Low 2017). We never claimed that the vectors in our models are exactly the same as vectors in classical physics. Objecting that our vector model fails (and consequently so too does our whole theory of causation) because our vectors are not exactly mathematical vectors is as ridiculous as saying that neuron diagrams are useless because their neurons can't transmit electrical impulses, which real neurons do, and Lewis's theory of causation is thereby defeated.

7. Agency

Powers theorists have claimed that powers can produce helpful theories for a range of phenomena. But, says Bird, all one needs to invoke in these theories are 'mere dispositions' rather than modally fixed powers. Given that a mere disposition is something a Humean can accept, in Bird's account, then we might think of it as only a regularity or a tendency for something to happen but with no real power behind it. Furthermore, he declares 'There is no reasonable way in which the modal fixity of powers could be made relevant to such debates' (BO, p. 377). I will finish, then, by outlining why accounts based upon modally fixed powers will indeed fare better than those based on what Bird thinks of as mere dispositions. It is precisely because friends of powers believe we can explain something with real powers that we could not explain otherwise that they think we should take powers seriously.

Would 'mere dispositions' really suffice for an adequate theory of agency? No. We want our intentions to be genuinely productive of our actions. Would agents be really empowered at all if willing to raise

one's arm could have the effect of raising one's leg instead, or some other consequence? No. Further, it's absurd to suggest that intentions could have different causal roles in other worlds, as Bird seems to imply (BO, p. 377). Intentions and actions are more integrated than that (Mumford and Anjum 2011, pp. 204-7). So the case can be made that an agent has to have modally fixed powers instead of mere dispositions as a precondition for qualifying as an agent. With only a Humean mere disposition, my wish can play no productive role in my decision and my decision can play no productive role in my arm raising. That means I am not a proper agent (Groff 2012).

A Humean might question what evidence there is that I have anything more than mere dispositions at my disposal. There is nothing empirical that shows I have powers rather than dispositions. But that just illustrates, as we knew all along, that it is a metaphysical difference that divides us, rather than an empirical one. For Humeans, dispositions consist in regularities: A and B being constantly conjoined, and so on. So there can be a regularity of wishing being followed by deciding, and deciding being followed by a bodily movement. But not one of these produced the other, and nor is there any guarantee that a future wishing will be followed by a deciding and a deciding be followed by a movement. The problem of inductive scepticism applies to agency too, if all we have are mere dispositions. The poor Humean 'agent' will know this: it really is a pitiable position to be in since there would be an element of uncertainty in what action will follow what intention. There are, thus, substantial differences between mere dispositions and powers for the case of agency. An action is not accidentally conjoined with a decision, on the powers view, but really produced by it.

There is only so much that can be done in a discussion note and I have endeavoured to be succinct. What I hope to have established, nevertheless, is that there are plausible-enough reasons for the minority of us who support a powers metaphysics to hold their nerve in the face of Bird's substantial, yet ultimately groundless, critique.

References

- Anjum, Rani L. and Stephen, Mumford 2017, 'Emergence and Demergence', in M. Paolini Paoletti and F. Orilia (eds) *Philosophical and Scientific Perspectives, on Downward Causation*, London: Routledge, 92–109.

- Anjum, Rani L. and Stephen, Mumford 2018, *What Tends to Be: the Philosophy of Dispositional Modality*, London: Routledge.
- Aristotle, *Metaphysics*, Lawson-Tancred H. (trans.), London: Penguin, 1998.
- Armstrong, David 1978, *A Theory of Universals*, Cambridge: Cambridge University Press.
- Black, Robert 2000, 'Against Quidditism', *Australasian Journal of Philosophy*, 78: 87–104.
- Bird, Alexander 2007, *Nature's Metaphysics*, Oxford: Oxford University Press.
- 2016, 'Overpowering: How the Powers Ontology has Overreached Itself', *Mind*, 125: 341–83.
- 2018 'Fundamental Powers, Evolved Powers, and Mental Powers', *Proceedings of the Aristotelian Society, supp.* Vol. XCII, 247–75.
- Borghini, Andrea and Neil, Williams 2008, 'A Dispositional Theory of Possibility', *Dialectica*, 62: 21–41.
- Bueno, Otavio and Scott, Shalkowski 2015, 'Modalism and Theoretical Virtues: Toward an Epistemology of Modality', *Philosophical Studies*, 172: 671–89.
- Ellis, Brian 2001, *Scientific Essentialism*, Cambridge: Cambridge University Press.
- Gibb, Sophie, Robin, Hendry and Tom, Lancaster 2019, *The Routledge Handbook of Emergence*, London: Routledge.
- Groff, Ruth 2013, 'Whose Powers? Which Agency?' in J. Greco and R. Groff (eds.), *Powers and Capacities in Philosophy: The New Aristotelianism*, London: Routledge, 207–27.
- Hüttemann, Andreas 2013, 'A Disposition-based Process-theory of Causation', in S. Mumford and M. Tugby (eds) *Metaphysics and Science*, Oxford: Oxford University Press, 101–22.
- Lewis, David 1986, *On the Plurality of Worlds*, Oxford: Blackwell.
- Low, Matthew 2017, 'A Novel Clinical Framework: The Use of Dispositions in Clinical Practice. A Person Centred Approach', *Journal of Evaluation in Clinical Practice*, 23: 1062–70.
- Lowe, E. Jonathan 2006, *The Four-Category Ontology*, Oxford: Oxford University Press.
- 2013, 'The Will as a Rational Free Power', in J. Greco and R. Groff (eds.), *Powers and Capacities in Philosophy: The New Aristotelianism*, London: Routledge, 172–85.
- Molnar, George 2003, *Powers: a Study in Metaphysics*, S. Mumford (ed.), Oxford: Oxford University Press.

- Mumford, Stephen 2004, *Laws in Nature*, London: Routledge.
- Mumford, Stephen and Rani, Anjum 2011, *Getting Causes from Powers*, Oxford: Oxford University Press.
- Unger, Peter 2006, *All the Power in the World*, Oxford: Oxford University Press.
- Vetter, Barbara 2015, *Potentiality: From Dispositions to Modality*, Oxford: Oxford University Press.
- 2018, 'Evolved Powers, Artefact Powers, and Dispositional Explanations', *Proceedings of the Aristotelian Society*, *supp.* Vol. XCII, pp. 277–97.