SAVING THE SCIENTIFIC PHENOMENA: WHAT POWERS CAN AND CANNOT DO

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Abstract

Recent metaphysics of science has been fuelled significantly by an interest in causal powers or dispositions. A number of authors have made realism about dispositions central to their projects in the epistemology of science, suggesting that the existence of irreducible powers is a commitment entailed by taking scientific practice seriously. This paper strikes a cautionary note with respect to the two most common arguments for this view, concerning the putative requirement of dispositional properties in the contexts of scientific explanation and scientific abstraction. I contend that neither argument is successful, but that nevertheless, realism about powers better accords with an arguably scientistic consideration of property identity, thus affirming the importance of dispositions to the epistemology of science.

1. Dispositions, Laws, and Scientific Practice

Causal powers or dispositions are familiar in philosophy from discussions of the metaphysics of properties, but increasingly, recent philosophy of science has found room for the concept in discussions of scientific knowledge. This shared fascination is no accident, for the concept is often implicated in discussions of the idea of laws of nature, and the topic of laws is one that is shared between metaphysics (where the subject matter is often laws in general) and the philosophy of science (where the subject matter is often specific laws). The metaphysician wonders whether there is anything in the world that answers to the description 'law of nature', and the philosopher of science wonders whether there is anything in common between the mathematical expressions and other generalizations about parameters, properties, and behaviours of certain kinds of entities and processes that merits a unified treatment. In both cases, a philosophical question is posed regarding whether there are things in the world that are properly called laws, to which all the things called laws in scientific practice (that is, law statements) might apply. It is in grappling with this question that the concept of dispositions naturally arises, as something that might explain why the sorts of phenomenal regularities that many associate with laws are found in nature.

Even more recent discussions have presented further motivation for the concept of dispositions in observations to the effect that many law statements do not appear to describe regularities at all, strictly speaking. That is, many law statements appear to describe regularities

that break down when the conditions under which they are typically found do not apply. Arguably, some law statements in fundamental physics are about strict regularities (consider the originally intended scope of Newton's second law of motion, $F = ma$), whereas others are understood to be more tightly constrained to particular circumstances ('water boils at 100 °C' is true only so long as water is at sea level, does not contain significant concentrations of solutes, and various other conditions are met). Some have thus sought to explicate the concept of law by appealing to metaphysical facts underlying fickle regularities: facts that might explain why there are regularities, where they occur, and why they break down elsewhere. These deeper metaphysical facts putatively concern dispositions possessed by things in the world, which may then figure in explanations of why these things behave in certain ways under certain conditions, and why they do not when conditions are varied in certain ways. This is, of course, an ancient idea, but one that has come to prominence again in the form of a number of modern interpretations.[1]

My aim in this chapter is to focus on some recent arguments for the reality of dispositions that have arisen in the context of these sorts of philosophical considerations. More specifically, I will focus on arguments based on considerations of certain aspects of scientific *practice*. In recent decades, a number of authors have claimed that realism about causal powers or dispositions (and with respect to more or less synonymous notions such as capacities, propensities, and tendencies) follows from a careful study of specific activities performed by working scientists. What is striking about these arguments is that unlike the more widespread considerations just mentioned, they are not part and parcel of the project of grappling with the idea of laws of nature. Rather, and intriguingly, dispositional realism is here viewed as a commitment that is entailed or strongly suggested by the ways in which scientific knowledge is employed by scientists in the course of scientific, as opposed to philosophical work. The commitment to dispositions is described as a consequence of taking scientific practice seriously. In the remainder of this chapter, I will consider the idea that taking science seriously requires us to be dispositional realists, and I will argue that while this is not the case, a similarly motivated consideration may yet provide a compelling reason to be a realist about dispositions after all.

In section 2, I offer a clarification of what it means to be a realist about dispositions, which will serve as an essential probative tool in the analysis to follow. In section 3, I consider the general argumentative strategy suggested by recent authors for producing dispositional realism from an examination of scientific practice. Next, in sections 4 and 5, I consider the two main

[1] For some notable examples, see Cartwright 1989, Ellis 2001, and Bird 2007. There are further motivations in the literature. Chakravartty 2007, for example, argues that dispositions furnish a powerful unificatory framework for the conceptual foundations of scientific realism.

exemplifications of this strategy – an argument from scientific explanation, and an argument from scientific abstraction – respectively. In both cases I will argue that the inference to dispositional realism is, in fact, independent of the science adduced, and is instead a function of some substantive philosophical commitments, such as views regarding what sort of balance is most appropriate between ontological commitment one the one hand, and explanatory power on the other. In section 6, I will sketch a case for why, nonetheless, a scientistic consideration of the nature of property identity points in the direction of dispositional realism after all, and I will conclude in section 7 with some brief thoughts on the nature of the dialectic between dispositional realists and antirealists.

To begin, then, what is a causal power or disposition, and what does it mean to be a realist about them?

2. Dispositional Realism: Two Contrasts

I will use the modern term 'disposition' henceforth as a proxy for the various terms that are commonly used in more or less synonymous ways in this context, including 'capacity', 'propensity', and 'tendency'. To be fair, some authors in the literature distinguish these terms in subtle ways, but these fine-grained distinctions are immaterial for present purposes, and I will ignore them here. This benign neglect is licensed by the shared connotation of all of these terms, which is my primary focus presently: all of these terms have the common connotation of a *causal power*, commonly associated with Aristotle and scholastic philosophy more broadly, and in various ways opposed by the new mechanism of seventeenth and eighteenth century natural philosophy. Having gestured vaguely in the direction of Aristotelianism and scholasticism, however, it is still somewhat unclear what it means to be a realist about dispositions today. This ambiguity, I believe, has its source in the fact that the concept of a disposition is commonly described in two different ways, by means of two different contrasts, and these two contrasts and the modes of description that flow from them are not equivalent. Thus, at the risk of being tediously conscientious, let me describe these contrasts with some care, if only for the sake of clarity.

Dispositions, or dispositional properties, are often introduced by means of a contrast with so-called "categorical" properties. The difference is usually explicated in terms of how these respective properties are described. Dispositions are described in terms of what happens to things under certain conditions, and categorical properties are described without reference to any happenings or conditions. Canonical examples of dispositions are thus properties like fragility and solubility, which are described in terms of what happens to certain things when they are treated

roughly and placed in solvents, respectively. On the other hand, categorical properties are described in terms of static features of things, such as their dimensions (for example, length and volume), their shapes (square, cylindrical), and configurations or arrangements (such as molecular structure). So here we have one common contrast in the context of dispositions, and one may, of course, if one is so inclined, interpret this distinction as marking an ontological difference between two different kinds of properties.

Interestingly, however, the distinction between the dispositional and the categorical has no implications for the issue of realism about dispositions *all by itself*, because even if one is content to talk about dispositional properties, it is possible to give this talk a purely linguistic (as opposed to ontological) interpretation. An excellent exemplar of this approach is J. L. Mackie (1973, chapter 4), who held that dispositional ascription is merely a style of property description. That is to say, it does not make reference to a separate ontological category of properties. Rather, all dispositional descriptions are co-extensive with categorical descriptions; for example, 'soluble', a predicate naming a putatively dispositional property, actually labels a given molecular structure, where 'molecular structure' is a predicate naming a categorical property. On Mackie's view, only categorical properties are real, but one can describe them in different ways. One may employ both categorical and dispositional descriptions, but this by itself does not reveal anything about ontology *per se*. It reveals only a distinction regarding predicates. Therefore, a linguistic acceptance of dispositional predicates must be distinguished from an ontological acceptance of dispositional properties, and this leads me to a second contrast.

A second way in which dispositions may be characterized is by means of a contrast with so-called "occurrent" properties. The term 'occurrent' is used in different ways, reflecting different connotations, but as I will use it here, an occurrent property is one that genuinely exists, and thus, anyone who accepts this contrast is thereby an antirealist about dispositions. On such a view, dispositional ascription is merely elliptical for reference to categorical properties, and as I have described it, this is precisely Mackie's view. Conversely, realists regard dispositions as genuinely occurrent properties. That is, they deny the contention that the terms 'dispositional' and 'occurrent' are mutually exclusive labels. For the realist, it follows that the use of dispositional predicates is not merely a linguistic device; rather, it has genuine ontological significance. Unlike the contrast between the dispositional and the categorical, which can be interpreted in different ways – either as indicating the existence of two different ontological categories of property, or as indicating merely a distinction between two different kinds of predicates – the contrast between the dispositional and the occurrent represents an unambiguously ontological claim. Whereas the first contrast may be

accepted by both realists and antirealists about dispositions, *modulo* different interpretations of dispositional language, the second contrast is accepted by the dispositional antirealist only.

I have belaboured the point about these two different contrasts with respect to dispositional ascription because, as we shall see, a number of recent arguments for the reality of dispositions have not paid sufficient attention to it. As a consequence, or so I will maintain, the force of these arguments is not what their proponents contend. With this suggestion in mind, let us turn now to the idea of a scientific practice-based argument for dispositional realism.

3. Arguments for Dispositional Realism

Arguments typically adduced in favour of dispositional realism are well known from a number of longstanding disputes in metaphysics. They appeal to the idea that one's ability to explain certain facts about the world is significantly enhanced by adding dispositions to one's ontology, and that having this explanatory power is a good thing – an epistemological virtue. For example, why do objects (including here the referents of both count nouns and mass nouns) behave in law-like or regular ways in similar circumstances? Answer: they are disposed to do so, in virtue of their dispositional properties; these causal powers thus explanatorily ground law-like regularities. The idea that having such explanations is epistemologically virtuous, however, is demonstrably contestable. Indeed, historically, empiricists have contested it. On the commonly invoked Humean view (to pick a broad theme out of many more specific variations), there is no *want* or *need* of an explanation of law-like regularities. In response to a request for an explanation of this sort, one should simply accept that there is really nothing to be said. Perhaps there is no *want* of an explanation because there are no necessary connections between distinct existences (as per Hume). Perhaps there is no *need* of an explanation because the putative *explanans* – involving the concept of a disposition – is too mysterious or occult to function as an illuminating explanation.

These historically celebrated arguments between dispositional realists and antirealists are well established, and my own considered view is that they have reached an impasse. I will not argue for this assertion here, but mention it simply to distinguish these arguments from the ones I will focus on presently. Interestingly, arguments from recent philosophy of science for the reality of dispositions take a somewhat different form than the traditional metaphysical arguments. These more recent arguments are generally presented, either explicitly or implicitly, as *transcendental* arguments.[2] Recall the general form of an argument of this type, which proceeds from two premises

[2] For a more detailed diagnosis along these lines, see Clarke 2010.

to a conclusion. The first premise, P_1, is typically a claim that is uncontroversial, readily accepted, or perhaps even undeniable. The second premise, P_2, is the claim that in order that P_1 be possible or conceivable, some other more controversial claim, Q, must be true. The conclusion, then, is Q. The arguments that I am interested in here, based on considerations of scientific practice, exemplify the general form of a transcendental argument in just the way one might expect: P_1 is typically an uncontroversial claim about how scientific knowledge is used, or how some activity is performed in scientific practice; P_2 is the claim that in order for it to be possible that we do these things, there must be dispositions. The conclusion, then, is dispositional realism.

These arguments from scientific practice come in two families, and I will consider them in turn.[3] The first comprises arguments regarding dispositional ascription in the context of scientific explanation, and the second comprises arguments regarding the use and nature of abstractions in scientific practice. If either one of these arguments could establish an ontological commitment to dispositions, it would succeed where traditional arguments have failed, to break what would seem to be an apparent deadlock in the dispute between dispositional realists and antirealists. Let us turn to this possibility now.

4. Arguments from Scientific Explanation

The first argument from scientific practice turns on how dispositions are often invoked in the course of scientific explanation. Two varieties of this argument have emerged, the first of which I will call the Dispositional Regress argument; though expressed by a number of authors, it finds especially forceful exposition in the work of Brian Ellis (2001). The basic idea is that we often appeal to dispositions in giving scientific explanations, which is clearly a central feature of scientific practice. And though one may think that one can discharge these appeals to dispositions by means of further explanations citing categorical properties instead, this simply leads to appeals to yet further explanatory dispositions. Consequently and ultimately, the appeal to dispositions cannot be discharged.

Perhaps the most transparent way to see how this argument works is to consider an example. Here is one that Ellis (2001, pp. 15-16) himself uses: one might hope to explain an empirical fact regarding, say, the brittleness of a particular crystal, in terms of its internal planar structure – a categorical property. But this does not explain why the crystal is brittle, one might

[3] Williams forthcoming identifies 'the argument from science' more specifically with an argument for ungrounded dispositions based on descriptions of elementary particles in physics. My own phrasing here is intended more generically, to cover arguments of a more general form.

reasonably contend, unless one adds to the description the fact that the crystal is *disposed* to crack along certain of these internal planes: namely, the cleavage planes. Of course, one might hope to dissolve this talk of dispositions into talk of the lesser electromagnetic bonding forces between the cleavage planes in comparison to other planes in the internal structure of the crystal, where the determinate values of these forces are conceived as categorical properties. But again, one might contend, this does not explain anything by itself, unless one adds some information about the dispositions of attraction that hold between charged particles… As Ellis (2001, p. 116) puts it: 'there never seems to be any point at which causal powers can just drop out of the account'. Thus, in the absence of an appeal to dispositions, one would not be able to explain the phenomenon of brittleness.

The Dispositional Regress argument is seductive, but on reflection, it is incapable of doing the work for which it is intended. Let us grant for the sake of argument that there are scientific-explanatory contexts in which dispositional ascription is indispensable. Even granting this substantive claim, closer scrutiny reveals that the transcendental argument for dispositional realism here has no force, because, as one may recall, the dispositional sceptic is at liberty to use dispositional language where it is convenient. On the sceptic's view, the use of dispositional language commits the user of such language, at best, to an acceptance of dispositional predicates, not dispositional properties. If one is determined to do so, dispositional description can always be taken as elliptical for categorical description, whether one knows the relevant categorical description or not. As a result, the Dispositional Regress argument is ineffective as an argument for dispositional realism. It attempts to promote an ontological acceptance of dispositions as a necessary condition for scientific explanation, but instead, the best it can do is establish the necessity of a *linguistic* acceptance of dispositional predicates.

A second argument for dispositional realism arising from considerations of scientific explanation is due to Nancy Cartwright (2009). I will call it the Dispositional Exercise argument, and it begins with the observation that certain kinds of "composite" phenomena are often explained in terms of the "exercise" of dispositions whose associated manifestations are not realized. The relevant senses of 'composite' and 'exercise' here are, again, most easily illuminated by means of an example. Here is one that Cartwright (2009, pp. 151-155) herself uses: imagine two negatively charged particles whose gravitational attraction is exactly balanced by their Coulomb repulsion. Here we have a composite phenomenon, combining both gravitational and electrostatic forces. In this case, one might reasonably say that both the disposition for attraction associated with the gravitational force and the disposition for repulsion associated with the electrostatic force are

exercised, even though, as a consequence of the fact that the two forces are equal and opposite, there is no manifest motion.

This idea that dispositions can be exercised (that is, in some sense activated) in the absence of a corresponding manifestation (the manifestations generally associated with the dispositions ascribed in the current example are resulting motions) is intriguing. Cartwright maintains that if one does not appeal to the notion of dispositions exercising without manifesting, one simply cannot explain what is going on in composite phenomena such as that described in the example of the two particles. It would be a bizarre thing to suggest, for example, that both motions typically associated with the relevant dispositions – a movement together as a result of the attraction and a movement apart as a result of the repulsion – are actually *manifested*, given that there is no actual movement. And thus, so the argument goes, in order to explain what is happening in such cases, one must appeal to the existence of dispositions, which are the only sorts of properties capable of producing this interesting behaviour of exercising without manifesting.

Just as in the case of the Dispositional Regress argument, there is something alluring about the Dispositional Exercise argument. On reflection, however, it too is revealed as ineffective. There is no question that for a dispositional realist, the description of the case of the two particles just given may seem entirely natural. On closer scrutiny, however, it seems undeniable that this description simply begs the question against the dispositional antirealist. After all, no such sceptic would be tempted even to say that both motions are manifested, because no such sceptic would agree that there are dispositions here to be manifested in the first place! That is to say, the explanatory context in which one cites dispositions exercising in the absence of their characteristic manifestations does not even arise for the antirealist. Such a person is content with a Humean description of the phenomena: there are no dispositions, or exercisings, or manifestings; there is only one state of affairs followed by another. When there is a net force, there is a motion. When there is no net force, there is no motion. That, for the Humean, is the end of the story – there is simply nothing more to be said by way of explanation.

No doubt, in both the case of the Dispositional Exercise argument and that of the Disposition Regress argument, there is more that could be said. Dispositional realists will complain that the antirealist responses I have sketched above are unsatisfactory, for they antecedently regard dispositional antirealism as an unsatisfactory position. My point in discussing the Dispositional Exercise and Regress arguments here, however, is simply to note that they do not establish any further grounds for belief in dispositional properties than the traditional arguments they are intended to supplement. I will return to this moral shortly.

5. Arguments from Scientific Abstraction

Let us now turn to a second family of scientific practice-based arguments for the reality of dispositions: what I earlier referred to as arguments from scientific abstraction. The term 'abstraction' has the same connotation here as that found in much contemporary literature on scientific modelling. The basic idea is that to abstract is to extract certain features of a target system of interest in the world, and build only these features into a model of that system, ignoring others that may be relevant to its behaviour. What is interesting about this notion of abstraction in the present context is how some philosophers of science have derived from it an argument for dispositional realism. Once again, it is a transcendental argument. It suggests that the efficacy of abstraction in scientific practice would be inconceivable, if in fact there were no dispositions.

The first instance of this argument from abstraction is due to Roy Bhaskar (1975), but it has been developed significantly by others since. Bhaskar maintained that scientists commonly generate knowledge of causal laws under "closed" (for example, laboratory) conditions, in order effectively to shield the systems under study from potentially interfering factors, so that they can study causal relationships between a few isolated parameters. In other words, they abstract from the world. The very worth of this activity requires, however, that what scientists learn under closed conditions be exportable to the world more generally. Bhaskar offers little indication of how an ontological commitment to dispositions would help to explain how or why causal knowledge generated in the laboratory is exportable, however. Two decades later, echoing similar insights by Cartwright, Andreas Hütteman (1998) argued that physical laws are generally abstract and thus only describe behaviours of isolated systems. It is common scientific practice nonetheless, he noted, to apply such laws to non-isolated systems, and it would be impossible to explain this practice unless both sorts of systems have dispositions. The key notion here is that of "application"; one cannot explain how abstract laws are applicable to non-abstract conditions without assuming that these laws make reference to dispositions. Once again, however, one might ask: why is that?

There would appear to be two serious difficulties with the idea that the existence of dispositions makes such exportation or application possible. The first is that often such exportation and application *is not* possible. Consider a simple example. The fact that one might dissolve a teaspoon of salt in a glass of water in the laboratory does not entail that one will be able to apply successfully the lawful relations discovered there in other contexts. Whether this knowledge can be applied successfully elsewhere depends on whether the conditions elsewhere are sufficiently

similar to the conditions one finds in the laboratory. Since generally, dispositions are only manifested (or exercised, for that matter) in certain conditions, there is nothing about a dispositional ontology that guarantees the general applicability of abstract laws, and thus, invoking an ontology of dispositions does not provide any obvious answer to the question of how or why abstraction is a successful scientific practice.

The second difficulty with the idea that dispositions are somehow required to account for the efficacy of abstraction is that even in cases where real-world settings *are* sufficiently similar to closed laboratory settings, it is hardly obvious that an assumption that there are dispositions present is necessary to account for the success of the relevant abstractions. Presumably, for the dispositional antirealist, the presence of categorical properties could serve exactly the same end. Whether one regards the term 'solubility' as labelling an occurrent disposition or simply a given molecular structure – either way – the problem of induction is the same! That is to say, the question of whether external conditions are sufficiently similar to the conditions under which scientific knowledge is formulated is one that must be answered in either case. Imagine that under laboratory conditions one discovers that salt dissolves; in some other circumstances, it will also dissolve, and in yet others, it will not. Whether the properties involved are dispositional has no bearing on the inductive challenge of working out which circumstances are which.

Cartwright (2009) suggests that the ability to plan our endeavours, make predictions, manipulate phenomena, and consequently, to make good policy decisions of great importance to ourselves and our environment, depends on the presupposition that we have knowledge of occurrent dispositions. As we have just noted, however, there is nothing here to suggest that one could not do all of these things if there were only categorical properties instead. Indeed, Gilbert Ryle (1949) made a similar point sixty years ago when he described dispositional ascriptions as "inference tickets", because their function, he said, is simply to indicate that we are licensed to make certain inferences about what will happen to things with certain categorical properties in a variety of circumstances. Scientific abstraction, it seems, provides no telling argument for the reality of dispositions.

6. An Argument from Coherence: Property Identity

Where does this leave us? I have argued that considerations of scientific practice do not suggest that we must or should invoke dispositions in the world in order to make sense of phenomena like explanation or the use of abstractions. I have suggested instead that it is only in

virtue of the philosophical intuitions one invokes in interpreting these scientific practices that one is able to determine how to read their ontological significance. This is not the last word, however. Even though I suspect that, ultimately, at the level of fundamental intuitions, there may be an irresolvable impasse between the dispositional realist and antirealist in connection with the usual metaphysical arguments for and against dispositions, I believe that there is one previously under-appreciated sense in which the realist about dispositions has a surprising advantage.

As a philosopher of science, one might be forgiven for taking an interest in the question of what properties of scientific interest are, precisely. This is ultimately a question about the natures of these properties, or their identity. What is it that makes electric charge the property that it is? What is it that makes the fitness of an allele the property that it is? One answer to this sort of question, proposed by a number of authors (though differing somewhat in the details), is that what makes a property the property that it is, are the dispositions it confers on the things that have it.[4] On this view, it is dispositions that constitute property identity; one may thus call it a dispositional essentialist view of property identity. If entities having negative charge are disposed to repel other entities with negative charge, and to attract entities with positive charge, then these dispositions are part of the nature of charge – they constitute (in part, since negative charge is also associated with other dispositions) the identity of charge.

Clearly, the dispositional antirealist cannot approve of the idea of dispositional essentialism, the most obvious reason being its appeal to dispositions in the service of ontology. Additionally, there may be further concern here regarding the fact that dispositional essentialism has the consequence that laws of nature are strongly necessary, since if one were to imagine different laws, then, given dispositional essentialism, these different laws could not concern the same properties.[5] For example, given that the attraction of positive charges is one of the dispositions conferred by negative charge, and that this disposition is part of what it is to *be* negative charge, it follows that laws concerning such attractive behaviours by entities with negative charge are metaphysically necessary – they are laws in all possible worlds in which there is negative charge. This conflicts with a common philosophical intuition that laws such as those concerning the behaviours of objects with negative charge might have been different – that there are possible worlds in which charged objects behave in slightly or radically different ways than in the actual world. If one has this intuition, the dispositional essentialist view will seem unacceptable thereby.

[4] For example, see Shoemaker 1980, Swoyer 1982, and Chakravartty 2007, chapter 5.
[5] I say 'strongly necessary' here to distinguish the metaphysical necessity intended from weaker forms of "nomic necessity" associated with laws by Dretske 1977, Tooley 1977, and Armstrong 1983.

It is here that the dispositional realist can employ dispositional essentialism to good effect in her dispute with the dispositional antirealist. If one rejects dispositional essentialism, how is one to understand the identities of properties instead? The rival, dispositional antirealist view is that what makes a property the property that it is, is something primitive: a "quiddity". In other words, negative charge is something that is ultimately unknowable – its identity is primitive; there is nothing more that can be said about it. (For simplicity's sake, I will leave aside here the so-called "double aspect" view according to which property identity is a function of both dispositions and quiddity.) This appeal to quiddities accommodates the intuition of some philosophers that one and the same property might have figured in different laws of nature, but in so doing, it has the consequence that *any* nomic profile *at all* is compatible with the identity of a given property: for any given nomic profile, there is a possible world in which any given property has it. Once one detaches the identity of a property from the dispositions it confers, it follows that there is a possible world in which it has any causal profile one might imagine, so long as its quiddity remains the same.

Conceived as a purely metaphysical issue, I am not convinced that there are any non-question begging ways to resolve this dispute between the dispositional essentialist and the dispositional antirealist about property identity. Very quickly one finds oneself mired in fundamentally opposed intuitions concerning what is more or less ontologically reasonable or satisfying, with little hope of progress. Qua philosopher or metaphysician of science, however, it seems that there *is* a promising way forward here, because from a scientistic perspective, the rejection of dispositional essentialism and the adoption of quiddities seems a bizarre way to make sense of our ordinary talk of properties, let alone property talk in the scientific domain. This, I think, leaves the dispositional antirealist in a very uncomfortable position. She may persist in claiming that what makes a property the property that it is, is something primitive. But is it not the very aim of the sciences to tell us about what the natural world is like? This, I will now contend, generates a kind of pragmatic incoherence on the part of the dispositional antirealist in the context of the sciences.

Dispositional antirealism is the default *empiricist* position in this area of the philosophy of science, and the empiricist typically champions empirical science as the paradigm or exemplary form of inquiry into the nature of the world. In considering the question of property identity, however, as we have seen, the dispositional antirealist is driven to claim that the natures of properties investigated by the sciences are entirely unempirical! This seems an obviously jarring combination of views. In order to avoid this apparently incoherent combination, one might think that the dispositional antirealist should simply avoid the trap of invoking quiddities, and instead

say nothing at all about property identity. That is, one might think that the dispositional antirealist should refrain from saying anything at all about what makes negative charge the property that it is. But this sort of quietism also seems deeply anti-scientistic. It does not sit well with the idea of championing an empirical approach to understanding nature either. So once again, incoherence threatens.

What if instead of invoking quiddities or remaining silent, the dispositional antirealist were to grant that fixing the identities of properties in terms of the dispositions they confer is the most empirically satisfying account of property identity, but maintain that this sort of dispositional ascription must be understood in a deflationary manner – that is, in merely linguistic terms, as I suggested one might do earlier? But this is no good either, because what would dispositional ascription here be elliptical *for*? If it is elliptical for quiddities, then one is back where one started. On the other hand, if dispositional ascription is merely an inference ticket, this would make the natures of properties in the world a function of human inferential practices, which surely sounds too much like idealism for any contemporary philosopher of science to accept.

Once the question of property identity has been raised, I cannot see a way forward for the dispositional antirealist in the context of the sciences. Conversely, if what makes properties like charge or the fitness of an allele the properties that they are has something to do with their causal powers or dispositions, then the natures of properties of scientific interest are things that can be investigated by the sciences after all. This, it seems, is the only means by which the empiricist-minded philosopher of science can avoid pragmatic incoherence: by accepting the very reality of dispositions that she has traditionally denied.

7. The Dialectic of Dispositions

I began this chapter by noting how some recent work in the philosophy of science has invoked dispositions in the course of interpreting scientific knowledge. Most commonly these appeals are intertwined with the project of explicating the concept of laws of nature, but a distinct vein of argument presents a putative requirement for dispositional realism in connection with certain scientific practices. I have attempted to show that contrary to such thinking, scientific practice does not, by itself, serve as the basis for an argument favouring an ontological commitment to dispositions. It is simply a mistake, I believe, to think that one can derive such fine-grained ontology from the use of dispositional ascription in scientific explanation and in the context of scientific abstraction. This is not to say, however, that one should not make such commitments.

Indeed, though I have made no attempt to argue for it here, I believe that this case study of dispositions in scientific practice is indicative of a more general moral: by itself, scientific practice does not yield *any* ontology *at all* unless one is willing to adopt some philosophical lenses through which to interpret its outputs. Just as practices of scientific explanation and abstraction underdetermine the choice between realism and antirealism about dispositions, scientific practice in general underdetermines ontology more generally.

Longstanding, traditional arguments between dispositional realists and empiricists who reject the reality of dispositions have, I think, run their course, and fundamental disagreements stemming from clashes of deep-seated intuition are unlikely to be resolved. These intuitions inform considerations of what sorts of entities (like dispositions) are acceptable candidates for ontological theorizing, and whether the explanatory power they may contribute to philosophical analysis justifies their admission. I submit that the only real hope of progress here resides in the demonstration of some self-undermining incoherence on the part of one side or the other. I have sketched one such demonstration: the natural deference paid by empiricists to the sciences as the paradigm of inquiry into the natural world undermines their natural antipathy towards the notion of a disposition. This contention is infused with irony: the traditional empiricist worry is that dispositions are mysterious or occult, but in the context of property identity, it appears that one must value dispositions for being empirically accessible instead. It is in this way that a scientistic principle – the regard for empirical investigation as a gold standard for claims about the world – comes to undermine dispositional antirealism in the scientific domain. Thus it seems that powers can do some valuable work in saving the scientific phenomena after all.

The underdetermination of ontology by science generally, and the pragmatic incoherence of the rejection of an ontology of dispositions by empiricist sceptics in particular, takes philosophical discussions of these issues beyond the traditional dialectic between dispositional realists and antirealists. Previously, faced with the traditional dialectic, many philosophers were apt to question whether those interested in the study of *scientific* knowledge should engage in theorizing about dispositions at all. For after all, one might contend that metaphysical issues concerning philosophical concepts that are not referenced explicitly in descriptions comprising scientific law statements are not subjects of genuine concern to the philosopher of science. In light of the underdetermination of ontology by science, however, this ban on the metaphysics of science is hopeless if we are to understand what scientific knowledge is knowledge *of*. And if I am correct in my contention that there is a form of pragmatic incoherence that is inherent to the rejection of

dispositions by empiricist philosophers of science, it would seem that a modicum of metaphysical theorizing about the nature and role of dispositions in this context is unavoidable.

Among those who have always known that these and other issues in the metaphysics of science are central to a thorough philosophical consideration of scientific knowledge, there have always been healthy debates concerning precisely *which* metaphysic (at the relevant extra-scientific level of discourse) is most defensible. The conclusions of this paper, if sound, open up to scrutiny a new set of issues with significant import for this discussion. Debates between those attracted to and repelled by realism about dispositions have traditionally focused on the explanatory power of the concept: whether it has any at all; and if so, the extent of this power. I have argued that although careful considerations of scientific practice do not take us beyond traditional clashes of intuition in these regards, careful considerations of our accounts of the aims and scope of scientific knowledge may yield progress nonetheless. A commitment to dispositional realism here does not represent the sort of gain in dubious explanatory power that one may enjoy simply in return for ontological profligacy. Rather, it represents an ontological commitment that is maximally consistent with a view of the sciences according to which they are our best hopes for learning whatever contingent truths about the natural world as may be within our grasp.

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