THE REGRESS OF PURE POWERS?

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Abstract

Dispositional monism is the view that natural properties and relations are 'pure powers'. It is objected that dispositional monism involves some kind of vicious or otherwise unpalatable regress or circularity. I examine ways of making this objection precise. The most pressing interpretation is that is fails to make the identities of powers determinate. I demonstrate that this objection is in error. It does however puts certain constraints on what the structure of fundamental properties is like. I show what a satisfactory structure would be.

1   Introduction

Some ontologies take the properties of particulars to be entities in their own right, in addition to the particulars themselves. This is most clearly expressed in the view that properties are *universals* (although, arguably, the view that properties are classes of tropes also holds that properties are to be explained in terms of a distinct kind of entity). Once we take it that properties are a distinct class of entity then we may ask certain questions of such entities: What sort of nature do such entities have? Does they have essences? What determines their identity or distinctness? For although such questions are most naturally asked of particulars, they may be asked of any class of entity that finds a place in our ontology. For any genuine existent, whether a particular or a universal or something else, the questions just posed must arise.

In this essay I examine one response to these questions and one of the principal problems it faces. I shall sometimes talk of 'all properties'; but one may wish to take this as a restricted quantification. Adopting Lewis's (1986) distinction between 'abun-

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dant' and 'sparse' properties, this discussion of properties is limited to the latter, that is to the natural properties of things, for the reason that the merely abundant, non-natural properties are not any distinctive class of entity. We do not need to ascribe any basic explanatory role in our ontology to the property of being grue or to the property of being a member of the set {Donald Rumsfeld, the Eiffel tower, the power set of the natural numbers}. One may want to restrict our focus yet further, holding that some natural properties do not have corresponding universals (or sets of tropes), since they are complexes of such items. I shall not address that issue directly, but ask, insofar as there is an explanatorily basic ontological category of properties, what general characteristics do the essences or natures of such entities possess?

1.1 Dispositional essentialism

According to certain authors some such basic, natural properties are 'powers' or 'potencies' which is to say that they have essences that may be characterized dispositionally (Ellis and Lierse 1994; Heil 2003; Mumford 2004; Bird 2005b). Thus, for some property P to which this applies, there is a stimulus S and a manifestation M, such that it is essential to P that anything that possesses P thereby possesses the disposition to manifest M in response to stimulus S. For example, it may be essential to the property of being negatively charged that any object that is negatively charged attracts objects that are positively charged.

The contrasting view is that a natural property is *categorical* (Armstrong 1997, Lewis 1986: 162). A property may contingently have a dispositional character, but that is in virtue of contingent laws of nature whose holding is independent of the property itself. The same property could exist in another possible world which has some different set of natural laws, in which case the property may have some other dispositional character. So when we talk of a disposition, some categorical property or complex of categorical properties grounds the disposition.

By definition, therefore, a property cannot be both a potency and a categorical property. Charlie Martin's (Armstrong et al. 1996: 74) 'Limit View' holds that all properties have both a dispositional and a qualitative side. His distinction cannot be the same as

that under discussion here. Shape may be regarded as paradigmatically qualitative in his sense. We can certainly grasp shape concepts without associating them with dispositional characters, which is unlike concepts such as 'fragility'. Likewise we can correctly attribute shape properties to things without identifying a dispositional character that those things have. But that does not mean the properties themselves—or more importantly the underlying physical properties such as spatio-temporal separation—do not have a dispositional essence.

So far I have described two opposing approaches to the essence of some particular property: the dispositional essentialist approach and the categoricalist approach. We may regard *dispositional essentialism* as the view that *some* properties have dispositional essences—the dispositional essentialist approach is correct with respect to at least one property. (I take this quantifier, and the corresponding quantifiers in the next paragraph to range over all possible as well as actual properties, although one could restrict the quantification to the actual world alone.)

What of properties in general? One might take the view that all properties have dispositional essences—which we may call *dispositional monism*. One could take the view that all properties are categorical—*categorical monism*. Or one could take a *mixed view*, that some properties have dispositional essences and some are categorical. Dispositional essentialism is thus what dispositional monism and the mixed view have in common.

1.2 Dispositional monism

Dispositional essentialism has two principal merits: (i) Dispositional monism entails a condition for transworld identity of properties (sameness of dispositional essence), whereas a view that permits categorical properties envisages *quidditism*, i.e. primitive identity for properties. Quidditism is regarded as problematic by critics (Mumford 2004, Bird 2005b), because it permits the swapping of causal powers by properties (the properties actually filling the charge-role and the inertial-mass-role could swap those roles to yield a new possible world. There are also sceptical concerns arising from the possible duplication of causal roles (several properties could possess the same

role). (ii) Dispositional monism and the mixed view both permit an account of the laws of nature as generated by dispositional essences (Swoyer 1982, Ellis 2001, Bostock 2001, Bird 2005a) (or they obviate the need for laws, Mumford 2004). That account does not suffer from the faults of either the regularity theory (objections to Humean supervenience, failure of laws to explain their instances) and the nomic necessitation view (the identification and inference problems). It also accounts for the modal force associated with laws by identifying it with metaphysical necessity (although that raises the objection that laws are supposed to be contingent).

Although the mixed view has the advantages of (ii) it suffers from allowing some quiddities and hence the objections of (i). Being a dualism about properties, it is also disadvantaged by being less economical than the monistic views. The dispositional monist view is thus worth pursuing. In this paper I shall defend it against a criticism that has repeatedly been expressed in the literature (Campbell 1976, Swinburne 1980, Foster 1982, Robinson 1982, Blackburn 1990, Armstrong 1997, Heil 2003), that it involves some kind of pernicious regress or vicious circularity. My first task will be to give precision to the objection. Despite its popularity as an objection, it has not been expressed sufficiently clearly that advocates of dispositional monism can be confident that they know what problem is being raised and what would be required to circumvent it. Having made clear how the objection ought to be framed, I will then explain what limitations this puts on the dispositional monist position.

1.3 The regress objection

Here is the problem for dispositional monism. According to dispositional essentialism the essence of a property is to be given by some dispositional characterization in terms of stimulus and manifestation conditions. Dispositional monism holds this to be true of *all* properties, including, therefore, the properties involved in the stimulus and manifestation conditions. Thus the essence of the first property involves at least two further properties, whose essences in turn involve yet further properties, and so on. There is thus an infinite regress of properties. Or, if not, it looks as if there must be a circularity of a vicious nature, by analogy, for example, with the view that all words had

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their meaning given by explicit definitions (which entails that the chains of definitions would have to be viciously circular).

This is a rough and ready formulation of the regress/circularity objection. In what follows I consider ways of making the objection more precise or at least explicit and will show how dispositional monism can be defended in each case.

2 Unsuccessful regress arguments

In this section I consider two possible interpretations of the regress/circularity objection. I conclude that each of these may be answered fairly straightforwardly. The third, most pressing version of the objection I consider in the next section. The first interpretation is that the regress shows we could never know any power. The second is that the regress shows that powers do not have sufficient actual reality.[1]

2.1 Swinburne's epistemological argument

Richard Swinburne (1980: 316-19) offers a version of the circularity/regress argument that is epistemological in character. He concludes that if dispositional monism were correct, then we could not know what properties any thing has. Here is his argument:

> One can recognize that objects have powers only if one can recognize when such changes [the changes they are powers to produce] have occurred ... [T]o recognize that changes have occurred, one has to recognize properties. But if properties are nothing but potentialities for contributing to causal powers, we have a vicious infinite regress.

So Swinburne is not suggesting that the very idea of properties as powers is incoherent. But rather that if it were true, we could never know any properties. Yet we do know properties.

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[1] There is another concern, that dispositional monism is inconsistent. Richard Holton (1999), responding to Blackburn (1990), show this to be false.

One might think that a plausible response would be that in some cases the manifestation of some property would be in the mind of the subject.[2] For example, if colours are dispositions, then a certain experience of colour might be the manifestation of that disposition. Indeed many dispositional accounts of colour take this to be so. Swinburne anticipates this response with two related objections. First, the phenomenal state of 'being appeared to redly' has more to its nature than just its causal role, as the inverted spectrum argument shows. Secondly, what we typically observe are not the properties of our sensations but the properties of things themselves. Swinburne goes on to say that in the latter case we can see straight away that if all red objects were blue and vice versa and the causal roles of red and blue were swapped, the world would be genuinely different, even though its causal structure is unchanged. The second argument seems to be just a variant of the first, since the difference in the world after swapping red and blue and their causal roles is a difference in appearance. So just as in the inverted spectrum case, we are invited to consider worlds that are identical in their causal structure but different in phenomenal appearance.

Note first that the inverted spectrum argument, if sound, would be a direct refutation of dispositional monism, quite independently of the regress argument, and so needs to be addressed in its own right. To do so therefore takes us beyond the scope of this paper. That said, it is clear that the dispositional monist is far from being without resources to answer that problem. For it is precisely the same question as that which must be answered by a functionalist theory of mind (functionalism about the mind can be seen as an implementation of the subtheory obtained by restricting the domain of dispositional monism to the mental). Furthermore, if the argument is sound against functionalism it is sound against physicalism too. And in both cases the argument for the genuine possibility of inverted spectra from their intuitive plausibility is notoriously weak.

If we put the inverted spectrum argument on one side we can see that there is no epistemological regress problem. Let us imagine that a subject wants to know whether some object has property F, and therefore must come to know whether it manifests

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[2]This response is also considered by John Foster (1982: 70).

itself with property G, and so on, until she comes to property J. In the case of J, its manifestation is some property, K, of one of her mental states. Now K will also be dispositional, with manifestation property L, and so forth. But that latter fact is irrelevant from the epistemological point of view. If the mental property K is reliably brought about by J, then the subject's being in state K may itself be a state of knowledge (or belief that is justified) concerning the presence of property J. And there is no requirement that the subject additionally know (by detecting L) that she is in a state with property K. In general one can know without knowing that one knows (and likewise for justified belief). So simply being in K stops the regress, since the subject thereby knows about J, and thence about the preceding properties in the chain back to G and ultimately F. Such a view is consistent with a variety of claims about what K might be—a quale or phenomenal experience of some kind (understood functionally), a belief state, or a *sui generis* state of knowledge. And note that we can generalize this a little further. There may be intermediate states between J and K, so that the immediate manifestation of J is some I_1, whose manifestation is some I_2 and so forth, and where K is the manifestation of some I_n or some combination of Is. The Is might be brain states of the subject of which she is entirely ignorant. So long as the genuine mental property K is reliably related (via this chain) to J, then it is a possible candidate for a knowledge or belief state concerning J. Note therefore that J does not have to be a disposition whose *essential* manifestation is K. More generally, a property F can have effects that are not essential to it, even if they are necessarily connected; first because those effects further down the chain are not essential to F, and secondly because F can be the stimulus condition for D without that being part of F's essence—though it will be part of D's essence. (We return to the latter point below.) According to various dispositional accounts of colour, it is the case that the essential manifestation of a colour property is a mental state concerning that property. But according to the view that a colour is essentially a spectral reflectance property its manifestation will be a complex of physical properties of light and so on. Most plausibly the instantiation of the original property F will have as a consequence, via chains such as those discussed, a brain state of the subject on which, in conjunction with environmental conditions, the knowledge state K concerning F supervenes.

I conclude that although Swinburne presents his argument as an epistemological regress argument, the regress in fact plays little forceful part. *Prima facie* it looks as if we are presented with an epistemological analogue of some more ontological regress argument. Powers must have (potential) manifestations, which are themselves powers, and so forth. Even if that regress may not be vicious, there is an epistemological problem that knowledge of a power then requires knowledge of *its* manifestation, which is itself knowledge of a second power, and so requires knowledge of its manifestation, which is a third power, and so forth. An infinitely descending chain of knowledge looks more obviously wrong than an infinite chain of properties. It therefore seems as if we can only know any property if this regress ends somewhere with a property which is not a power but is something else, and colours or colour qualia seems instances of such non-power properties. But in fact the epistemological chain can end with a property which while a power is itself a state of knowledge (or other epistemic state) concerning other powers. There is no further regress since there is no requirement that to be in a state of knowledge one must know that one is in such a state (likewise for other epistemic states). Consequently the only potentially troublesome part of Swinburne's objection is the entirely independent problem of the inverted spectrum.

2.2 Not enough actuality

There is common view that powers do not have enough actual reality, or ontological content, on their own to be all there is to the properties of things in the world. In Howard Robinson's words, that view regards "a world of powers as too insubstantial to command belief" (1982: 114); he describes it as an "etiolated conception of matter."

David Armstrong (1997: 80) writes, "Can it be that everything is potency, and act is the mere shifting around of potencies? I would hesitate to say that this involves an actual contradiction. But it is a very counter-intuitive view. The late Professor A. Boyce Gibson, of Melbourne University, wittily said that the linguistic philosophers were always packing their bags for a journey they never took. Given a purely Dispositionalist account of properties, particulars would seem to be always re-packing their bags as they change their properties, yet never taking a journey from potency to act. For

'act', on this view, is no more than a different potency." This suggests a different criticism, that if everything is just potency, there isn't enough actuality in the system. Keith Campbell's (1976: 93) criticism of Boscovich's theory in *A Theory of Natural Philosophy* likewise proceeds thus, "Is it possible for anything to be constituted by nothing but causal powers?' Whatever the answer is to that question, I doubt very much whether it is possible for *everything* to be constituted by nothing but causal powers. But that seems to be the situation in Boscovich's system. When one point moves another, all that has been shifted is a power to shift powers to shift ... But powers to shift *what*?" Here is how Ellis (2002: 171) characterizes Swinburne's objection, "If all of the poperties and relations that are supposed to be real are causal powers, then their effects can only be characterized by their causal powers, and so on. So causal powers are never manifested. They just produce other causal powers in endless sequence." John Foster's (1982: 68) version of the regress is similar, "... there seem to be no physical items in terms of whose behaviour the content of the powers could be specified, and consequently, it seems that, in the last analysis, there is nothing which the powers are powers to do."

Consider the analogy with the circularity of definitions. One way of understanding that problem is that we think of definition giving meaning to a definiendum because the definiens already has meaning. Definition is a way, as it were, of *passing on* meaning, not of creating it *ab initio*. A system where all meanings were given by definitions would not have any semantic value in the system to be passed around by those definitions. What is needed is some other way of providing meaning, e.g. an ostensive definition linking a word to a thing, so that the system as a whole has some real meaning (semantic value) that can be passed on to the definienda. Similarly one might think that a dispositional statement can only represent some real state of affairs because its stimulus and manifestation conditions are at least possible real states of affairs. But if the stimulus and manifestation conditions are themselves mere powers, there seems to be insufficient reality or content in the system as a whole. What is needed is that at least some properties are non-dispositional in order to inject some content into the system. As Armstrong goes on to say, "Perhaps accepting that the purely spatiotemporal

properties are categorical will give enough categorical basis to blunt the force of this criticism."[3]

This is the form of the objection that people often express using the words of G. K. Chesterton, "We cannot all live by taking in each other's washing" ("especially in the form of pinafores ..." the quotation continues). This objection fails because it simply assumes what it sets out to show, that dispositions do not have sufficient reality to be genuine properties without the support of something else. This is particularly clear in the quotation from Ellis, which assumes that if the effect of some power is the instantiation of some other power, then that is no manifestation. How can that be unless one assumes that powers do not on their own have enough reality to constitute a genuine manifestation?

Hugh Mellor (1974: 157) once described an anti-dipositionalist prejudice thus, "Dispositions are as shameful in many eyes as pregnant spinsters used to be—ideally to be explained away, or entitled by a shotgun wedding to take the name of some decently real categorical property." It is this prejudice that is behind the objection under discussion. Thus one might think that dispositions can be admitted only in so far as they are reducible to some counterfactual. That counterfactual will mention certain antecedent and consequent states of affairs. But if dispositional monism is correct, then the properties involved in those states of affairs are themselves essentially dispositional and will need to be reduced to counterfactuals if they are to be admitted. It seems as if we we are faced either with either regress or circularity.

The clear and simple response for the dispositionalist is to deny that dispositions are respectable only if reducible to counterfactuals (or something else). The dispositional essentialist's thesis is that real properties just *are* dispositions, and are necessarily those dispositions. Thus she will reject immediately the assumption of the objection that dispositions are real only if they are really something else. Once we reject that

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[3]Likewise Campbell suggests that the dilemma could be escaped if we introduce an 'intrinsic quality' that is not some further power. That is, he proposes the mixed view as the solution. This is also Ellis's view (2002: 171). I do not believe that this in fact quite Armstrong's own understanding of the circularity/regress objection (personal communication). Armstrong's own view is closer to Swinburne's; c.f. Armstrong 2004: 138-9.

assumption, the objection falls apart. Even if it were true that dispositional statements are equivalent to counterfactual or subjunctive conditionals (which, strictly, they are not), we need not take that to show that dispositional properties inherit their reality or acceptability from those conditionals. Essentially dispositional properties may form a network, but it is not the function of the network to spread around a component of 'reality'.

Furthermore, when we compare properties understood as the dispositional essentialists do with properties understood as categorical properties, we see that there is no reason to regard the former as any less real than the latter. Why it should ever be thought that essentially dispositional properties have less reality than categorical properties. What is there to a categorical property? Robert Black (2000) characterizes Lewis's Humean fundamental qualities, which are categorical properties by another name, thus: "Just about all there is to a Humean fundamental quality is its identity with itself and its distinctness from other qualities. A Humean fundamental quality is intrinsically inert and self-contained." To be precise, we may list the essential features that can be attributed to a categorical property thus:

>   (a) it is distinct from (i.e. not identical with) other properties;
>
>   (b) it is a universal and thus can have instances;
>
>   (c) for some n it is an n-adic universal.[4]

Now consider what the features of a property are, as understood by the dispositional essentialist. All the above hold of essentially dispositional properties. What differentiates such properties is the *additional* claim that they have (essentially) a dispositional character. Thus there is more to the nature of an essentially dispositional property than there is to that of a categorical property. In which case the claim that essentially dispositional properties are lacking in reality unless reducible to or explicable in terms of a 'decently real categorical property' is in error. If anything the boot is on the other foot. The thinness of the nature of a categorical property should raise questions about *its* sufficiency for reality.

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[4]Armstrong would add: (d) it has at least one instance. This makes no difference to the ensuing discussion.

Consequently we may conclude that this form of the objection fails on two grounds. It assumes what it sets out to show, that pure powers have insufficient ontological content to be real. And they have no less ontological content than categorical properties, since the essential features attributed to the nature of a categorical property are a proper subset of those attributed to an essentially dispositional property.

The last *ad hominem* response from the dispositional monist might elicit the rejoinder from the believer in categorical properties to the effect that there is something that categorical properties are supposed to have that the essentially dispositional properties do not have, viz. primitive transworld identity—they are quiddities. The claim made by the dispositional monists is precisely that dispositional monists do not need primitive transworld identity.

This remark does little to undermine the force of the *ad hominem* response. The possession or lack of primitive transworld identity conditions or any other kind of transworld identity conditions is not relevant to the reality of some entity in the actual world—it is relevant only to the question, which is the same entity in some other world? Thus this difference between essentially dispositional and categorical properties is not enough to give a reality to the latter that it withholds from the former. After all, Lewis does not regard primitive transworld identity as necessary for the reality of particulars. Strictly his particulars have no transworld identity whatsoever. And his substitute for transworld identity, counterparts, is a qualitative theory of (pseudo-)transworld identity.

3   Regress, circularity, and identity

The focus on identity does raise what I take to be the most important version of the circularity objection, viz. that identity of dispositional character is insufficient to account for transworld identity, within a dispositional monist approach. E. J. Lowe (2006: 138) does frame the regress objection in terms of identity, but does not provide any details beyond the following (original emphasis): 'The problem' he writes, '...is that *no property can get its identity fixed*, because each property owes its identity to another, which, in turn owes its identity to another—and so on, in a way that, very plausibly, generates either a vicious infinite regress or a vicious circle.' Howard Robinson's (1982: 114-

15) version comes close to this, with a little more detail. Robinson argues from the premises (1) that every real object must possess a determinate nature, and (2) that the nature of a power is given by its manifestation, to the intermediate conclusion that the determinacy of the nature of a power depends on the determinacy of its manifestation. But this leads to regress, if the manifestation is always some new power. An infinite sequence of manifestations constitutes indeterminacy. Hence if a power is to be determinate, somewhere in the chain of manifestations we must come to one that is not itself a power.

If, as I am inclined to do, we identify 'nature' and 'essence' and note that for the dispositional essentialist, essence determines identity, then Robinson's argument is pretty well that which I present below. There may those, however, who regard nature as distinct from either identity or essence, and these may regard metaphysical indeterminacy in nature as permissible. For example, one might hold that the nature of an entity can include contingent properties. Furthermore such properties may be vague, so, for example, it is part of the nature of Hera that she has brown eyes, and likewise for others. While it may be determinate for Hera that she has brown eyes, for Minerva it may not be determinate, since her eyes have a shade on the borderline between brown and green. The same goes for an endless range of other properties that are part of the contingent natures of entities. Hence such natures may be indeterminate. But even if we restrict our attention to essential properties, the same problem arises. According to Kripke, one's species is an essential property. But the lesson of Darwinian evolution is that species boundaries are not determinate. Hence there will be creatures whose nature is not determinate. In which case Robinson's argument starts from a false premise. Those who take an epistemicist approach to vagueness will reject this conclusion. But even to those for whom indeterminate natures are permissible, the impermissibility of the indeterminacy of *identity* should be clear, thanks to Gareth Evans's (1978) argument that indeterminate identity violates Leibniz's law. Bearing in mind that for the requirement that identity be determinate is more obvious than the requirement that nature be determinate it will be more effective to present the regress argument in terms of the determinacy of identity rather than of nature.

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Let us see, therefore, how something like Lowe's argument or Robinson's may be developed to show the indeterminacy of the identity of powers. I shall follow Aristotle in taking the essence of an entity to be that whereby a thing is what it is (*Metaph.*, VII, 7). Thus we should expect the essence of a property, its dispositional character if it is an essentially dispositional property, to determine the identity of the property. According to the dispositional essentialist therefore, the essence of such a property is determined by its relations to other properties. And as we have discussed above, if one is a dispositional *monist* then those other properties also have dispositional essences. Consequently the identity of any property is determined by its relations to other properties. Hence, either there is an infinity of properties or there is circularity in this relationship of identities.

Either disjunct in this consequence of dispositional monism seems problematic. Consider the second disjunct, that the identity of a property is determined by its relationships with other properties whose identities are determined by their relationships with yet other properties, in a set of relationships which at some point returns to involve the very property we started with. The identity of that property is what this set of relationships was supposed to settle. Yet the nature of that set of relationships is dependent on identities of its relata, which *ex hypothesi* have not yet been settled.

This, I think, is the real problem of circularity that critics such as Lowe have in mind when they accuse dispositional monism of some kind of regress or circularity. Dispositional essences are relational—the essence of a property is a relation to other properties. If essences fix identity, as Aristotle says, then the identity of a property is determinate only if the properties to which its essence relates it themselves have determinate identity. And that is just what is ruled out by circularity.

The first disjunct provides little opportunity of escape. First, it is implausible that there are in fact infinitely many fundamental properties. The progressive unification of the laws of physics involves the reduction of the number of fundamental properties in the world. Secondly, the infinity of properties does little to remove the worry that the identity of any one property is not in fact determined. If one is worried that identity cannot be fixed by a circular set of relationships, then one will not regard an infinitely descending set of relationships as providing a solution. The circularity worry may be

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expressed thus. Saying that the identity of A is determined (in part) by B, can satisfy one that the identity of A is in fact determinate only to the extent that one is satisfied that B's identity is determinate. Likewise, the move from B to C will help only if C's identity is determinate. But if C's identity depends on A we cannot be satisfied that C's identity is determined, nor B's nor A's. Now consider the infinite case: C's identity depends on D, and D's on E and so forth without end, so that there is no point at which one can say 'X's identity depends on Y, and Y's identity is unproblematically determinate'. Just as in the finite but circular case, one has no reason for supposing the identity of any of the entities in question to be determinate. Infinite hierarchies need not always be looked on with suspicion. But as a rule of thumb an infinite hierarchy is benign only when its collapse into a finite structure is also benign. In this case to collapse the infinite structure we must suppose that at some point in traversing the structure, instead of being presented with new properties, we are presented with ones we have already come across. That is, the collapse of the infinite case is just the circular case, as one would expect. Thus if one thinks the circular case is troubling, the infinite case should be no relief. One way to see this is as follows: consider an attempt to fix the identity of A with a structure which turns out to be a circle with n elements, X_i being the ith element and $X_1 = A$. Thus the identity of X_i depends on that of X_{i+1} and that of X_n on A. Let us add an $(n + 1)^{th}$ element, X_{n+1} between X_n and A. Clearly that does not help matters, for although we can say that the identity of X_n is fixed by that of X_{n+1}, that only helps if the identity of X_{n+1} is fixed. And when we see that X_{n+1} has its identity fixed by A, the circularity objection bites. Adding in an element X_{n+2} will not help, nor an element X_{n+3}, and so on. Now let us consider adding in *infinitely* many elements after X_n. If we now traverse the list of dependencies starting at A, we will not reach A itself. But that hardly helps matters. The problem of the circle returning to A was not that the circularity led to some contradiction, but rather that the circularity seemed to show that our attempt to provide determinacy for the identity of A failed. And the infinite case fails to do so just as much as the finite, circular case.

3.1 The advantages of categorical monism and the mixed view

We can now see why categorical monism and the mixed view are perceived to have an advantage over dispositional monism. The matter is straightforward for categorical monism, for on that view the identity of categorical properties is primitive and so is primitively determinate. That is just what is meant by saying that they are quiddities. In the case of the mixed view many properties may well have dispositional essences. And so something like the structure of dependencies discussed above arises. The essences and so identities of some properties are dependent on those of others. But we are not required to regard such a structure as either circular or unending. This is because the structure can terminate in categorical properties. If we trace the chain of dependencies, from the essence of one essentially dispositional property to another we will eventually come across essentially dispositional properties whose manifestations or stimuli are characterized not in terms of yet further essentially dispositional properties but in categorical terms instead. Since these have their identities primitively, they serve to determine the identities of all the properties in the structure.

In the light of this, it might be asked why the believer in dispositionally essential properties does not accept the mixed view, which is the position adopted by Ellis (2002) and in a modified way by Heil (2003: 118). The principal reason is the disadvantages of quidditism mentioned above, which affect the mixed view as well as categorical monism. As it stands each view has its problems. But if the regress problem for dispositional monism can be resisted, then dispositional monism has a clear advantage. That it can be resisted I show in the next section.

4 Responding to the regress objection

I have described at some length the regress/circularity objection in the form that I take to be most pressing, in order to allow us to see what kind of response, if any, can be given by the defender of dispositional monism. Note what the objection has achieved and has not achieved. It has *not* shown that there is any inconsistency in the conjunctive claim that all properties have dispositional essences and those essences suffice to

determine the identities of those properties. Rather, it presents a challenge to the dispositional monist to show that this can be done. The argument, by referring to the circularity or infinite regress that would be involved, casts *prima facie* doubt on the ability of the dispositional monist to achieve this, while pointing out that the categorical monist and the mixed view can both meet the challenge without difficulty. I shall argue that the dispositional monist can meet the challenge, but that in so doing we see that the structure of properties and their essences must meet certain constraints.

To appreciate why dispositional monism can be defended, it is helpful to see that the challenge presented is an instance of a more general kind of problem. The dispositional monist wants the essences and hence the identities of her entities to be determined *relationally* rather than purely intrinsically (as is the case for categorical properties). In general the relational characterization of a set of entities faces the sort of challenge we have seen already. Indeed the problem is raised by Aristotle in the *Categories* where he rejects the idea that primary (and secondary) substances are relational. In effect Aristotle argues that all relations may be reduced to monadic properties of things, on the ground that a relation requires the distinctness of its relata—but that cannot be established by some further relation, since that further relation would require the distinctness of its own relata, and so on. Thus a regress ensues unless we ground these relations in monadic properties. I shall not pursue the exegetical question of whether Aristotle's argument is an analogue of the regress arguments considered above. But the position rejected certainly is an analogue of dispositional monism. Aristotle rejects the idea that all there could be to (the identity of) any *particular* is a matter of its relations to other particulars. Dispositional monism is the view that all there is to (the identity of) any property is a matter of its second-order relations to other properties. Aristotle's target is the first-order position of which dispositional monism is the second-order analogue. In dispositional monism the second-order relation in question is the relation that holds, in virtue of a property's essence, between that property and its manifestation property—which we will call the *manifestation relation*. In both cases, the thesis under discussion is this:

(S) The identity and distinctness of the elements of a set *E* of entities

supervene on the instantiations of some relation *R* (or set of relations $\{R_i\}$)

on the elements of E.

The simplest case would be that where we are permitted just a single symmetrical relation *R*. Could a set of *R*-relations on *E* suffice to determine the identities of each element of *E*? The answer is *yes*. As Randall Dipert (1997) argues, this is just a simple question in graph theory. In graph theory we deal with a set of entities (*vertices* or *nodes*) and a single two-place relation among them (each instance of which is an *edge*), which is symmetric in the case of undirected graphs. The claim S then becomes:

(S*) The identity and distinctness of the vertices of a graph can supervene

on the structure of that graph.

whether 'the structure of the graph' is just the pattern of the edges. (For the present I shall take it that we are interested in *relations between distinct entities*, so that the holding of a relation between an entity and itself is irrelevant to (S). We assume that the relation in question is irreflexive. As regards (S*), in graph-theoretic terms no vertex has a loop, although one could equally assume that the relation is reflexive and that all vertices have loops, in which case the presence of a loop add no information. For now graphs are *simple*.)

Clearly not *all* graphs can make (S*) true. Consider Fig. 1. It can be easily seen that a rotation of 180° will take all the vertices onto different vertices yet leave the structure unchanged. Consequently the structure of this graph fails to determine the identity of its vertices. A mapping whereby structure is preserved and at least some vertices are mapped onto different vertices is known as a *(non-trivial) automorphism*. What we
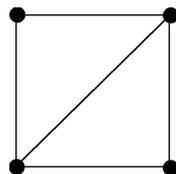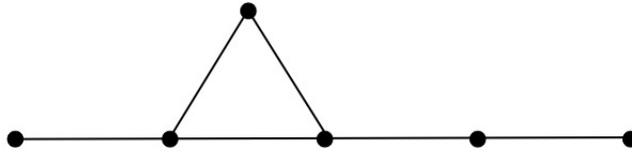

Figure 1:

Figure 2:

are looking for is a graph that has *no* non-trivial automorphisms—i.e. an *asymmetric* graph. Such a graph would have no way of swapping vertices while leaving structure unchanged. Which is to say that the structure determines the identity of the vertices— the structure itself distinguishes each vertex from every other vertex; i.e. the identity of vertices supervenes on the set of instantiations of the edge relation. Are there then any graphs that have no non-trivial automorphisms? Yes, infinitely many. The simplest, trivial case is the graph consisting of a single vertex. The next simplest asymmetric graph has six vertices, as shown in Fig. 2. (This graph is a subgraph of all asymmetric six vertex graphs.)

Dipert takes this to refute the Aristotelian claim. More generally we can see that it is possible for a set of instances of even a single symmetric relation to determine the identities of the various relata. Dipert was considering the first-order case, whether a first-order relation can determine the identity of particulars. Our case concerns whether a second-order relation (the manifestation relation) can determine the identity of first-order properties (powers). John Heil (2003: 115) argues that since powers are intrinsic to their possessors and because Dipert's world is purely relational, there cannot be a world of pure powers. But this is to confuse the first-order and the second-order cases. The pure powers view is not committed to all first-order properties being relational, i.e. it could consistently reject Dipert's view at the first-order level. Rather it asserts that the second-order analogue of Dipert's view is correct—powers may have relational essences but nonetheless be intrinsic to their possessors. If we consider the manifesta-tion relation to be a symmetric two-place relation, then our conclusion thus far would seem to be that a world of pure powers is possible, but the number of distinct pow-

ers is either one or more than five. That might appear to be an odd conclusion, but the thought that there might be just one fundamental natural property is not itself that strange. Physics shows success in reducing the number of *prima facie* fundamental laws and properties. There could be a single one. Of course that single property would be instantiated in a large number of different fundamental particulars, and it might be that different non-fundamenal properties correspond to different patterns of instantiation of the single fundamental property. The fact that there could not be two or three fundamental properties might seem rather more strange. But if we simply accept it is a mathematical consequence of the fact that the structure of the set of fundamental properties determines the identity of each, then it ought not appear objectionably strange. For we know that our intuitions about what is correct or reasonable in both physics and mathematics are not entirely reliable.

4.1 Reflexive powers and the asymmetric manifestation relation— loops and digraphs

In fact we do not yet have to conclude that there cannot be two fundamental properties, because we have not yet added all the appropriate detail to our picture. The graph-theoretic conclusion holds given the following assumptions: (i) the graph is *simple*, which is to say that it contains no loops and no more than one edge between vertices; hence the manifestation relation is irreflexive and there is at most one way it is instantiated between properties; (ii) the graph is *undirected*, which is to say that the edges have no direction; hence the relation is symmetrical; (iii) edges are defined as *pairs* of vertices, not triples, quadruples, etc.; hence the manifestation relation is a two-place relation, not a three- or four-place relation, or any *n*-ary relation for $n > 2$. Arguably all of these assumptions are false: (i) It may well be that our graph should not have multiple edges, since there will not be more than one way a property can be the essential manifestation of another. But there is no reason to exclude loops—why should not some powers be reflexive, i.e. the manifestation of an instance of *D* be another instantiation of *D* ? (For example, in a macroscopic case: the dispositional state of being magnetic, instantiated in one piece of iron, may manifest itself by inducing a state
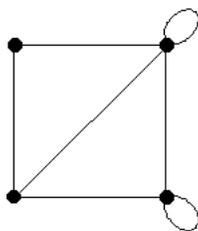
Figure 3:

of being magnetic in some other piece of iron.) (ii) Clearly the manifestation relation is not symmetric, for *M* may be the manifestation property of *D* without it being the case that *D* is the manifestation property of *M*. (iii) So far we have considered simply the relationship between a power and its manifestation. But the nature or essence of a power is often thought to be given not only by its possible manifestation but also by its stimulus. In which case we should be considering the three-place relation which holds between a power, its characteristic stimulus, and its characteristic manifestation.

We'll put aside the complication raised by (iii) for the time being. The effect of our responses to (i) and (ii) is to make it much easier to find graphs without non-trivial automorphisms. Considering (i), adding a loop to a vertex may now distinguish it from one with which it previously had a symmetrical relationship. In Fig. 3 the graph from Fig. 1, which was symmetric, is now asymmetric thanks to the addition of loops. The edges in the graphs so far considered have no direction—the graphs are *undirected* graphs. But in *directed* graphs (*digraphs*) the edges do have a direction (and are called *arcs*), corresponding to asymmetrical relations. Clearly the asymmetrical arcs (edges with direction) add another source of asymmetry in a graph, as is shown in the asymmetric digraph in Fig. 4, whose underlying undirected graph is again the symmetric graph in Fig. 1. Thus if we are consider that the fundamental properties are structured by the asymmetric, non-irreflexive relation between a power and its essential manifestation property, then we can see that there could be any number of fundamental properties, represented by the vertices on directed graphs that may contain loops.
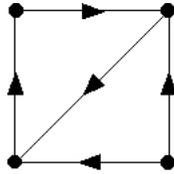
Figure 4:

We should now check that we have answered the original regress problem. In short, the problem was that since each property's identity is determined by relation with a property, it seems as if we are faced with an infinite regress or a circularity, and this seemed to raise the question of whether the identity really is determined ('determinately') thereby. One aspect of this that we have not addressed is that each property is determined by what *it does*. Since an arc represents the relation between a property and the property that characterizes what it does, that amounts to the requirement that the graph representing the properties is such that each vertex has at least one arc incident from (leading away from) it. This constraint is not a particularly onerous one, and is satisfied, for example, by Fig. 4. It can be trivially satisfied if we allow loops. As is implicit in the statement of the regress problem, a finite solution is one that has circularity—or *cycles* in the terminology of graph theory, again as in Fig. 4. However, it is worth noting that infinite graphs can lack non-trivial automorphisms and so represent the determinate identity of the properties represented by its vertices.
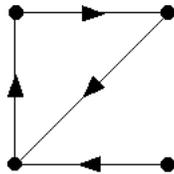

Figure 5:

4.2 Further constraints

Depending on one's view of powers one may wish to add further constraints. For example, one might think that although non-fundamental dispositions may be multi-track—having a variety of distinct kinds of manifestation—the essences of fundamental properties should be single-track dispositions. This would require that for every vertex there is at most one arc incident from it. And so combined with the previous condition, we have that each vertex has precisely one arc incident from it. Fig. 4 does not satisfy this condition but its subgraph in Fig. 5 does.

By assuming that the *whole* graph contributes to determining the identity of its vertices, we are assuming, in effect, that the identity of a power is determined not only by its manifestation property but also by any property of which *it* is the manifestation property. One might argue that this is a mistake. While the latter may be a necessary connection, it need not be *essential* to the property. What is essential to a power is what it does—not what brings it about. In that case it would not be the whole graph that contributes to the identity of any vertex but is instead only that subgraph consisting just of those vertices and arcs lying on some directed *walk* (sequence of arcs) directed away from (and including) the vertex in question. Let us call such a subgraph a 'downstream' subgraph. So the criterion for determinacy of identity for vertices on a graph is that no two vertices should have isomorphic downstream subgraphs (excluding trivial automorphisms). This criterion—call it *strong asymmetry*—is not satisfied by the graph in Fig. 6. That graph is asymmetrical overall, but has several downstream subgraphs isomorphic to the graph in Fig. 5. Indeed the latter also fails the criterion; each of the vertices in the triangular cycle has the same downstream subgraph—the cycle
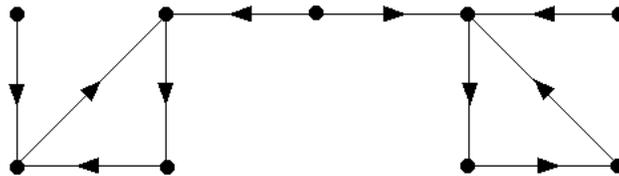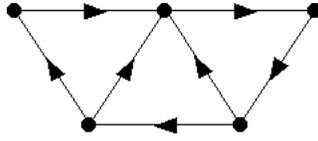

Figure 6:

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Figure 7:

itself. And so three vertices have downstream subgraphs that are isomorphic without being trivially automorphic. If a graph itself is asymmetric, a sufficient condition for strong asymmetry is that from every vertex there should be a directed walk that includes every other vertex. For if that condition is met, then the downstream subgraph for every vertex is just the whole graph, as is exemplified in Fig. 7.

Note, however, that the graph in Fig. 7 does not meet the condition imposed to ensure that powers are single-track dispositions—several vertices have more than one arc incident from them. In fact no asymmetric digraph with more than one vertex can meet both these conditions, as is easily proved. Let a digraph have n vertices. Since there is precisely one arc incident from each vertex, the digraph has n arcs. Now assume also that from every vertex there is a directed walk that includes every other vertex. This implies that every vertex must have an arc incident to it. Since there are n vertices and n arcs, that in turn implies that each vertex has precisely one arc incident to it. So we conclude that every vertex has one arc incident from it and one arc incident to it, in which case the graph is a cycle graph (an n-agon, with the arcs all having the same sense), which is clearly symmetric, unless $n = 1$. Nonetheless, the condition that from every vertex there is a directed walk that includes every other vertex is only a sufficient condition for strong asymmetry, not a necessary one. And it is possible to satisfy that condition as well as all the others discussed so far, as is witnessed by the graph in Fig. 8.

Figure 8:

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Figure 9:

4.3   Essential stimuli

I shall now turn to an issue raised above concerning the stimuli of powers. So far we have considered just the relationship between a power and its manifestation property. But dispositional essentialists think that a power is not only essentially a disposition to do something but is also essentially a disposition to do something in response to something else, the stimulus. Standard graph theory does not have the resources to capture this since its edges and arcs represent two-place relations whereas we now need to represent the three-place relation between disposition, stimulus, and manifestation. However we may adapt it by having two kinds of arc, one for the manifestation relation and another for the stimulus relation, the latter represented by a white arrow (see Fig. 9). (Note that the direction of an arrow represents ontological dependence, not causation.) To show that the two relations belong together as part of the same three-place relation, we may use arcs with different hatching. Arcs with the same hatching belong together. But this is merely a labelling device—differently hatched arcs are not different kinds of arc.

As the graphs in Fig. 10 show, it is possible to satisfy the desiderata discussed above; in particular:

(i) Each vertex has a single black-arrowed arc and a single white-arrowed arc incident from it, representing single-track dispositions with unique stimuli.

(ii) The graphs are (a) asymmetric, and (b) such that each vertex's downstream subgraph is the whole graph, and thus are strongly asymmetric. This ensures the achievement of our goal, that in a system of pure powers, each power can have its identity determined uniquely by its essential relations with other powers.
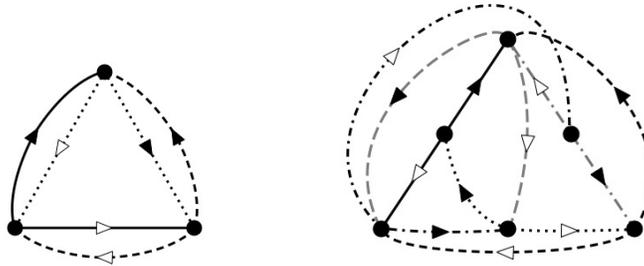
Figure 10:

(We adopted digraphs because the disposition–manifestation relation is not symmetric. But as the three vertex graph in Fig. 10 represents by a pair of vertices between which there are black-arrowed arcs in both directions, some instances of the disposition–manifestation relation are reciprocal. Such properties are what Charlie Martin calls 'reciprocal disposition partners' (Armstrong et al. 1996: 135-6), and, in non-fundamental properties, are exemplified by salt's disposition to dissolve in water and water's power to dissolve salt, or the disposition of iron to be magnetized by a magnetic field and the field's power to magnetize iron.)

5   Conclusion

All natural properties are essentially dispositional—what each property is depends on its essential relationship with its manifestation. Since the latter is a matter of instantiating a further property, we are faced with a regress of infinitely many properties or circularity. While this problem has been raised for dispositional monism by a number of authors, there has been little agreement on exactly why this regress is problematic. Holton takes Blackburn to regard the it as involving a contradiction. Swinburne's version of the problem is couched in epistemological terms, although Armstrong refers to it in his metaphysical rejection of dispositional monism. As it is, these objections are easily defeated. Lowe and Robinson come closest to what I regard as the most pressing

form of the objection, viz. that the regress raises some doubt as to whether *identity* is determinate for pure powers.

Once the objection is couched in these terms it is clearer what would be required to address the problem satisfactorily. For the dispositional monist identity of properties is dependent on something else, rather than being primitive (the latter view being quidditism). The something else is the pattern of manifestation relations. The question may be phrased then, Can the identity of pure powers supervene on the pattern of their manifestation relations? The answer is that it can.[5] If we represent the manifestation relation by edges of a graph and the powers by its vertices, that question is represented by the graph-theoretic question: Can a graph be asymmetric? This is because in an asymmetric graph, one which lacks non-trivial automorphisms, the identity of the vertices supervenes on the structure of graph, as fixed by the pattern of edges. To represent satisfactorily various metaphysical characteristics of the manifestation relation (e.g. that it is asymmetric, that it holds once between any pair of powers, that it is not irreflexive, etc.) we may put various constraints on the graph. Furthermore, we need to add to the normal graph-theoretic machinery to represent the stimulus relation also. Nonetheless, once all these constraints and additions are taken into account, it remains the case that there are graphs that represent possible structures of pure powers that have the property that the identity and distinctness of the vertices supervene on the structure of manifestation and stimulus relations. We may confidently conclude therefore that the regress objection can be answered. There may be structures of powers that are circular (or that involve infinitely many powers) but that is no obstacle to the identities of those powers being fully determined by the asymmetric pattern of those structures.[6]

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[5]The problem addressed here can be thought of as an instance of a more general one, whether identity criteria can be *impredicative*. Thus Davidson's (1969) criterion of identity for events, viz. that events are identical that have the same causes and effects (which are themselves events), has been criticized on this ground by Lowe (1989), Strawson (1976), and Quine (1985). For a revealing discussion of impredicative identity criteria in the same spirit as the above see Horsten (2006).

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