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LAWS AND ESSENCES

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Abstract

Those who favour an ontology based on dispositions are thereby able to provide a dispositional essentialist account of the laws of nature. In part 1 of this paper I sketch the dispositional essentialist conception of properties and the concomitant account of laws. In part 2, I characterise various claims about the modal character of properties that fall under the heading ‘quidditism’ and which are consequences of the categoricalist view of properties, which is the alternative to the dispositional essentialist view. I argue that quidditism should be rejected. In part 3, I address a criticism of a strong dispositional essentialist view, viz. that ‘structural’ (i.e. geometrical, numerical, spatial and temporal) properties must be regarded as categorical.

1. Dispositional essentialism

Many subjunctive conditionals are true; ‘were I to place this salt in water, it would dissolve’ is one I know to be so. What makes such conditionals true is often the existence of a dispositional property. On the simple conditional view of the concept of a disposition, that link is analytic. (For example: x is soluble in water *iff* were x placed in water, x would dissolve.) But there are reasons to think that the simple conditional analysis is false – the disposition might be finkish,¹ there may be antidotes present,² more generally conditions may not be ideal.³ But even so, as Charlie Martin, who rejects the conditional analysis, admits, there is some connection between dispositions and conditionals.⁴ What exactly the relation between disposition and conditional is has been widely discussed elsewhere. Mumford’s ‘conditional conditional’

¹ Martin (1994).

² Bird (1998).

³ Mumford (1998).

⁴ Armstrong, Martin and Place (1996: 178).

account, for example, claims that the relation is such that the disposition suffices for the truth of the conditional under ideal conditions (1998: 87–91). Dispositions can still be a crucial part of what makes conditionals true, even if their existence is not sufficient for that truth.⁵ Let us now add the contentious claim that the connection between a particular dispositional property and the corresponding conditional is one that is essential to that property. This claim is contentious because a widespread view is that all natural properties are essentially categorical. The view I shall promote here is:

- (DE) Some properties are essentially dispositional and these properties include the properties that figure in the fundamental laws of nature.

When I say ‘property’ here, I mean what David Lewis signifies by ‘sparse’ property, that is a natural property, one which thus would be mentioned in some ideal complete science. (DE) says that at least all the fundamental sparse properties are essentially dispositional. (DE) leaves it open that all properties are essentially dispositional, but *prima facie* this is implausible: ‘being made of clay’, or ‘being hydrogen’ seem to be respectable properties but are not obviously dispositional. We might be able to conceive of such properties, properties of constitution, as being identical with complexes of dispositions: to be hydrogen is just to have all the dispositions that hydrogen has. But that is an issue to be addressed in full elsewhere.

(DE), the claim that fundamental sparse properties are essentially linked with characteristic subjunctive conditionals, is consistent with a denial that the instantiation of the disposition in question necessitates the truth of the corresponding conditional. What it does require is that the kind of ability that a disposition (strictly, its instantiation) has to make a conditional true in this world (when it is true) is repeated with respect to the same conditional in all other possible worlds. In another possible world the disposition might not in fact make the conditional true, but that will be because extrinsic conditions are not suitable; it will not be because in that world the disposition is irrelevant to that conditional. (Here I am talking about conditional-*types*, where the same conditional type (e.g. were x placed in y , x would dissolve) may be instantiated by different sets of individuals. The condition

⁵ For an extended discussion see Mellor (2000: 758–65).

stated in the antecedent of such conditionals is the *stimulus* and in the consequent is the *manifestation*. I symbolise this subjunctive or counterfactual conditional thus: x is placed in $y \square \rightarrow x$ (dissolves.)

This view, dispositional essentialism, contrasts with a number of traditional and more modern views about the nature of properties and laws, and their roles in explaining the truth of conditionals.^{6,7} Categoricalism I regard as the view:

(C) All properties are categorical.

Understanding the term 'categorical' can be subject to misleading connotations. One such invites the following thought. An essentially dispositional property is only sometimes there, viz. only when it is being manifested in response to the appropriate stimulus; that is, the property's instantiation is conditional on that stimulus. By contrast, a categorical property is always there, not conditionally on anything. This is a mistake. Dispositions exist and are really there whether or not they are manifesting – the fragile vase is fragile even when not being struck and being broken. The fact that the manifestation is conditional on the stimulus does not make the disposition itself conditional on the stimulus. Nor should we see categorical properties as permanently manifesting properties – manifesting their own existence. First, a genuine disposition might permanently manifest itself, perhaps even necessarily so, without that making it categorical. Secondly, a manifestation is distinct from the property itself. To say that a property manifests itself in its own existence is to state a truism that holds of every property, dispositional or categorical.

What we mean by 'categorical' must be understood in negative terms. That is, a categorical property does not confer of necessity any power or disposition. Its existence does not, essentially, require it to manifest itself in any distinctive fashion in response to an appropriate stimulus. To say that a property is categorical is to deny that it is essentially dispositional. (C) implies the negation of (DE).

⁶ Dispositional essentialism is a view first promoted in Ellis and Lierse (1994). They do not define dispositional essentialism as I have done, but it is clear nonetheless that something like weak dispositional essentialism is close to the core of their position. Ellis has since expanded on his view in Ellis (2001, 2002).

⁷ It is a solecism to confuse laws and law-statements. It is one that for the sake of convenience I shall consciously commit in what follows.

While, according to (C), the dispositional character of a property is in no case essential to that property, it is undeniable that there are properties with a dispositional character. The categoricalist regards that character as being imposed upon a property by the laws of nature. More generally the categoricalist holds:

(CL) The laws are metaphysically contingent relations among categorical properties.

Whether (CL) is entailed by (C) is unclear. One could hold that the laws of nature are metaphysically necessary, which would give categorical properties a necessary dispositional character. But this need not be equivalent to (DE) since something may have some feature necessarily without that feature being essential. However, that would leave unanswered the question of the source of the relevant metaphysical necessity – why should laws be necessary on this view?

As a matter of fact, no-one has taken this view and all those who hold (C) also hold (CL), and consequently I shall take it that categoricalism involves commitment to (CL). On a regularity view of laws, for example, a law is some sort of regularity among the instantiations of properties: all instances of the property F are instances of the property G ($\forall x(Fx \rightarrow Gx)$), or in a slightly more complex case, whenever both property S and property D are instantiated, then property M is instantiated ($\forall x((Dx \& Sx) \rightarrow Mx)$).⁸ If these are laws on the regularity view, then (according to the regularity theorist) we have explanations for the truth of subjunctive conditionals. The first law makes it true that were **a** F, then **a** would be G; the second makes it true that given that **b** is D, were **b** S, then **b** would be M. The latter also allows us to say (to a first approximation) what a disposition is, according to a regularity theorist. It is a property (such as D in the last example) that occurs in the antecedent of a law in conjunction with some other property (S), the stimulus property, where the consequent (M) in the law is the manifestation property. Regularity theorists hold that the regularities in question might not have held; in other possible worlds they do not. Hence in some other possible world, $\forall x((Dx \& Sx) \rightarrow Mx)$ need not be true. In such a world, it might be the case that, for example, $\forall x((Dx \& Gx) \rightarrow Fx)$. While in the actual world the property D bears

⁸ A sophisticated regularity theorist will not regard every such regularity as a law. Additional conditions, such as being a consequence of a system of regularities that optimises simplicity and strength, will be required. Cf. Lewis (1973: 72–7).

a special relation to the conditional ($Sx \square \rightarrow Mx$), in this other world it bears that relation not to this conditional but to a different one, ($Gx \square \rightarrow Fx$). Since the same property may in different worlds be associated with different conditionals, the relation it actually has with some conditional and hence the dispositional character it actually has are contingent. Thus regularity theorists deny dispositional essentialism.

This denial is not exclusive to regularity theorists. It is made also by their opponents, the nomic necessitarians. For David Armstrong, laws are better understood as second-order relations of nomic necessitation among universals.⁹ So the laws are not $\forall x(Fx \rightarrow Gx)$ and $\forall x((Dx \& Sx) \rightarrow Mx)$, but are $N(F, G)$ and $N((D \& S), M)$. But Armstrong does agree with the regularity theorist that these laws are contingent. In his metaphysics the relation of nomic necessitation, its name notwithstanding, might hold between certain universals in this world but not between those universals in another possible world. Thus Armstrong's understanding of dispositions is that they are properties such as D where in the world in question there is a law $N((D \& S), M)$.¹⁰ Thus in the actual world D may be associated with the conditional 'were x to be S it would become M ', but because the relation of necessitation may not hold in some other world, D will not be associated with that conditional in all worlds.

Clearly there is a deep difference between the dispositional essentialist on the one hand and both the regularity theorist and the nomic necessitarian on the other, about both the nature of laws and the nature of properties. Note that so far the dispositional essentialist has said nothing about the nature of laws. Where the anti-essentialists explain a subjunctive conditional by citing a property plus a contingent law, the essentialist cited only the property. It looks as if laws are otiose for the essentialist.¹¹ But it is better to regard them as simply supervening on the dispositional properties. Let us imagine that a simple essentialism were true, whereby the existence of the dispositional property entails the corresponding conditional, i.e. Dx entails $Sx \square \rightarrow Mx$. Let it be the case that for some a , Da . Because of this entailment, ($Sa \square \rightarrow Ma$). And now let it be that Sa ; hence we have Ma . Thus it is true that $((Da \& Sa) \rightarrow Ma)$; and generalizing gives us

⁹ Armstrong (1983). See also Dretske (1977) and Tooley (1977).

¹⁰ Armstrong (1997: 80–3).

¹¹ Mumford (2004) takes an eliminativist view of laws on roughly these grounds.

$\forall x((Dx \& Sx) \rightarrow Mx)$. So merely the existence of the property D generates what the regularity theorist takes to be a law. If we allow ourselves to think in terms of universals, then we may take the conditional-type to be really a relation among universals, 'S $\square \rightarrow$ M'. Since this relation holds by virtue of the existence of the universal D, we have that D & S 'necessitates' M (by parallel reasoning to the foregoing). By necessitates here, I mean the following: universal F necessitates universal G, when for any particular x , Fx entails Gx . We need only interpret 'necessitates' as being identical to or entailing Armstrong's 'N', to have Armstrong's law. Thus the dispositional essentialist view can be seen as generating what the regularity theorists and nomic necessitarians take to be laws. (Note that we have taken the simple case where Dx entails $Sx \square \rightarrow Mx$. As I will shortly mention, where this is not strictly true we will have a *ceteris paribus* law.)

That is not to say that advocates of contingent necessitation or of the regularity view should be happy with dispositional essentialism. The sophisticated regularity theorist will have constraints upon laws that the essentialist's view will not meet, such as the need for the law to figure in some optimal systematization of regularities. More significant for current concerns is the fact that the essentialist view makes the laws of nature necessary. In deriving the laws I assumed only the existence of the property D. Hence in any possible world in which D exists, the corresponding law exists too. And so, according to the dispositional essentialist, it is not true that there might be a world in which things are D but where there is no law (strict or *ceteris paribus*) relating D, S, and M.

The above shows that (DE) has the following consequence, partial necessitarianism about laws:

(PNL) At least some of the laws of nature are metaphysically necessary.

An ambitious dispositional essentialist may wish to go beyond partial necessitarianism to full necessitarianism:

(FNL) All the laws of nature are metaphysically necessary.

The fact that (DE) can explain some of the laws of nature inspires the thought that it might explain them all. Accepting (PNL) but not (FNL) would give us a mixed view of laws, some explained as consequences of (DE) while others are explained à la façon de Lewis or à la façon d'Armstrong. This would seem to be an untidy

metaphysic, with two classes of laws. Theorists have always sought a unified account of laws. If we accept:

- (U) Whatever it is, the true account of fundamental laws is a unified account, then a commitment to (PNL) becomes a commitment to (FNL).

As I have mentioned (p. ■■ above) simple essentialism is not generally true – although it might be true of some specific properties. I said that a property might be essentially linked with a conditional without entailing it. But if the existence of the property does not entail the conditional, it looks as if it will not entail the corresponding law either. Rather than being an objection to the dispositional essentialist account of laws, this provides the opportunity to explain non-strict laws. A property that does not entail the related conditional may nonetheless generate not a strict law but a *ceteris paribus* law. The manifestation of charge is that like charges repel and unlike attract. So it will be a (necessary) law that like charges repel. But this is a *ceteris paribus* law, for if the charged bodies have sufficient mass then the gravitational attraction will exceed the electrostatic repulsion and they will attract not repel.¹² The conditions corresponding to finks and, especially antidotes, will be those that are the *ceteris paribus* conditions in the corresponding law. Thus dispositional essentialism gives a natural account not only of strict but also of *ceteris paribus* laws.¹³

2. Quidditism

In part I above I sketched the view of laws that flows from taking properties to be essentially dispositional – a view which is articulated first by Chris Swoyer (1982) and later by Brian Ellis and Carlene Lierse (1994) and which draws on a conception of properties closely related to that advocated by Sydney Shoemaker (1980). I shall now argue that this dispositionalist view of properties has advantages over the categoricist view.

¹² This is an account of fundamental laws and one need not expect that all laws will have the form, when expressed as generalizations, $\forall x((Dx \& Sx) \rightarrow Mx)$. Laws supervening on such laws need not have such a form. The law that protons repel positrons will be a consequence of the *ceteris paribus* law considered plus the essences of protons and positrons (which in each case involves their being positively charged).

¹³ But see Drewery (2001) for the view that laws cannot be reduced to dispositional properties of individuals, as opposed to dispositions of kinds.

In part 1, I adverted to the fact that for both regularity theorists of law and nomic necessitarians, the nomic features of a universal are contingent. In other possible worlds they might be connected in other laws with universals with which they have no connection in this world. Hence the dispositional character, the causal powers and other such properties of universals are not essential to them. As David Lewis says, 'there isn't much to the intrinsic nature of a universal' (1986: 205) and as Robert Black (2000) describes Lewis's view of qualities (properties, universals),

Lewis follows Hume in denying that fundamental properties have, let alone consist of, essential causal powers. . . . 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.

If we allow one and the same universal to appear in distinct possible worlds, then, as Black notes, this Humean view of universals is akin to haecceitism about particulars. I shall regard the core of haecceitism to be the view that the transworld identity of particulars does not supervene on their qualitative features.¹⁴ Black calls haecceitism about universals 'quidditism', which he takes to be 'the acceptance of primitive identity between fundamental qualities across possible worlds.' By 'primitive' we mean an identity that is not dependent on identity of causal roles or powers more generally. (Henceforth I shall refer to the causal powers and dispositional features associated with a property as its 'powers'.¹⁵ Roughly, the powers of a property are the dispositions conferred on an object by possessing that property.) Although Black discusses quidditism with regard to Lewis's metaphysics, we should note that Armstrong is equally committed to quidditism. Whatever powers a property has it has contingently as a consequence of the contingent laws in which it is involved. There is equally little to the essential nature of a property on Armstrong's view as there is on Lewis's.

¹⁴ Where 'qualitative features' are taken to exclude properties of identity.

¹⁵ I do not call them *causal* powers for two reasons. First, I do not want to give the impression that the notion 'causal power' is to be analysed in terms of causation. If anything the relationship is the reverse. Secondly, it may turn out that causation is only a macro-level phenomenon, but that powers exist at the fundamental level. An additional point: it is implicit in this that there are no causal or other powers independent of laws/dispositions. While singularists about causation might think that a particular has its causal powers independently of law, it is difficult to see how a universal could have or confer causal powers without generating what we would naturally think of as a law.

It is useful to distinguish here various elements to quidditism. First, says Black, according to the quidditist, fundamental properties do not have essential powers. I shall liberalise this to say that such properties do not have any powers of necessity.

(QA1) For all fundamental universals F and powers X there is a world where F lacks X.

Now let us consider a world w_1 where F does have X. (QA1) tell us that there is some world where F lacks X. Because we are dealing with fundamental universals, we can say that the nearest possible world where F lacks X is one which is, in fundamental respects, just like w_1 , except in just that F lacks X. (If we were dealing with differences at a non-fundamental level, then we could not say this.) For example, in Lewis's view the nearest such world will be one where the regularity which relates F, the stimulus property of the power S, and the manifestation property M, will not hold – there will be one exception. In Armstrong's view F will not be related by contingent nomic necessitation, N, to S and M. These changes can be made leaving all other fundamental features of the world intact.

(QA2) For any world w_1 , any fundamental universal F, and any power X, where at w_1 , universal F has X, there is a world w_2 like w_1 in all fundamental respects except that the very same universal F lacks X.

If a universal can lose a power with ease, it can also gain one. Categorical properties are all essentially alike – differing only in their mutual distinctness. So if one categorical property can have a certain power, so can another, in some world. Given that in w_1 F lacks X, what is the nearest world in which F possesses X? It will be just like w_1 , except that (i) F possesses X and (ii) F loses any powers possessed in w_1 that are incompatible with F's possessing X. Thus:

(QA3) For any world w_1 , any fundamental universal F, and any power X, where at w_1 , universal F lacks X, there is a world w_2 like w_1 in all fundamental respects except (i) that very same universal F possesses X, and (ii) F does not possess any powers inconsistent with X.

(DE) states that fundamental universals do have essential powers, and hence (DE) $\Rightarrow \neg$ (QA1) (and (DE) $\Rightarrow \neg$ (QA2) and (DE) $\Rightarrow \neg$ (QA3)). Since both (DE) and (QA1) are claims about *all*

fundamental properties, the denials of both are consistent with one another – if one denies both one holds that some fundamental properties have dispositional essences and others do not. However, if as I suggested for laws, we adopt as an assumption of the debate that we should give a unified account of the metaphysics of fundamental properties (one that ascribes the same modal character to all – either all have dispositional essences or none have) then (DE) $\Leftrightarrow \neg(\text{QA1})$.

Secondly, we may adopt the analogue of the core of haecceitism as I defined it above: the transworld identity of universals does not supervene on their qualitative properties, where now ‘qualitative’ means powers.

(QB1) Two distinct worlds, w_3 and w_4 may be alike in all respects except that: (i) at w_3 , universal F has powers $\{C_1, C_2, \dots\}$; (ii) at w_4 , universal G has powers $\{C_1, C_2, \dots\}$; (iii) $F \neq G$.

(QB1) captures the idea that sameness of powers does not entail identity of universal. Strictly this is consistent with dispositional essentialism. The fact that one property has its powers necessarily is consistent with some distinct property having those same powers (also necessarily). However, just as essentialism aims to give an account of what laws are, it may also aim to account for the nature of, at least, fundamental properties. That is, not only are the powers of a property essential to that property, they are the essence of the property – they constitute what it is to be that property. Thus identity of powers entails identity of property. This view I shall call strong dispositional essentialism (SDE). The difference between (henceforth weak) essentialism and strong essentialism is captured in Black’s statement of what Lewis and Hume deny, ‘that fundamental properties have, let alone consist of, essential powers’. The denial of *having* essential powers is the denial of weak essentialism, and the denial of *consisting of* essential powers is the denial of strong essentialism. Thus (SDE) = (DE) + $\neg(\text{QB1})$ Strong essentialism makes the identity of fundamental properties require identity of powers. The further claim that strong essentialism makes over weak essentialism is pretty well what Shoemaker famously argues for in ‘Causality and Properties’ where he says,

what makes a property the property it is, what determines its identity, is its potential for contributing to the powers of things

that have it. . . if under all possible circumstances properties X and Y make the same contribution to the powers of the things that have them, X and Y are the same property (1980: 212).

In this discussion I have been careful to distinguish (QA1) and (QB1). However, as we shall see, (QA1) in fact entails (QB1), via (QA2) and (QA3). (Note, nonetheless, that because the negation of (QA1) does not entail the negation of (QB1), weak and strong essentialism are still distinct.)

Against quidditism – (QA1)

Haecceitism about individuals is discussed, and rejected, by Roderick Chisholm (1967). Chisholm considers changes to the properties of two individuals, Adam and Noah, in a sequence of possible worlds, so that at each change from one world to the next we are, it is supposed, happy to say that the change in properties does not change the identities of the individuals. We then find that in the final world Adam has all the properties Noah has in the actual world, and vice versa (including the names people call them). The transitivity of identity requires that the final world is distinct from the actual world. But Chisholm takes it to be absurd that there should be a world like this that is not the actual world. If he is right, then haecceitism is false. He draws a disjunctive conclusion, that either there are essential properties (we were wrong to assume that every change of property across worlds leaves identity intact), or transworld identity of particulars is misconceived. Since he has what he takes to be reasons for thinking that essential properties are absurd, he adopts the second disjunct. This is of course Lewis's view about particulars, which each exist only in one world but may have counterparts in others. Interestingly Lewis does not reject transworld identity for universals – and the force of Black's argument against Lewis is that Lewis cannot both be a genuine (or concrete as opposed to ersatz or mathematical) modal realist while remaining a quidditist, someone who allows for transworld identity of Humean properties. Black raises counterparts for properties as one option for Lewis (not Black's preferred option). However, this is not the only option, even for genuine modal realists. It is my view that Chisholm should have accepted that individuals have essential properties. I shall argue that we should accept that analogous view of properties, that they have essential powers.

It may be noted that Chisholm's argument is not against the core of haecceitism as I defined it – that the transworld identity of particulars does not supervene on their qualitative features. Rather it is against the following:

- (H0) Two distinct worlds, w_1 and w_2 may be alike in all respects except that: (i) at w_1 , particular **a** has qualities $F_1, F_2, F_3 \dots$ and particular **b** has qualities $G_1, G_2, G_3 \dots$;
 (ii) at w_2 , the particular **a** has qualities $G_1, G_2, G_3 \dots$ and particular **b** has qualities $F_1, F_2, F_3 \dots$;
 (iii) $\forall i \forall j (F_i \neq G_j)$

(H0) is a substantial claim. The simplest expression of haecceitism is that particulars lack essential properties. In what follows, 'properties' are limited to intrinsic properties that not all particulars have of necessity (i.e. not self-identity, not the property such that $2 + 2 = 4$, etc.). Thus:

- (H1) For any particular **a** and any property F there is a world where **a** lacks F.

which corresponds to (QA1). Just as (QA1) leads to (QA2) and (QA3), (H1) leads to:

- (H2) For any world w_1 , any particular **a**, and any property F, where at w_1 , **a** has F there is a world w_2 like w_1 in all respects except that **a** lacks X.
 (H3) For any world w_1 , any particular **a**, and any property F, where at w_1 , **a** lacks F, there is a world w_2 like w_1 in all respects except (i) that **a** is F, and (ii) **a** does not possess any properties inconsistent with X.

Put less formally, the haecceitist conception of particulars is that they are essentially all alike, differing only in that they are mutually distinct. Identity is independent of qualities in a very strong sense. Any property a particular has it could lack and any it does not have it could possess; in general any particular may possess or lack any consistent set of qualities. Is Chisholm correct in ascribing (H0) to the haecceitist? I think he is. Since all particulars are essentially alike, it is possible for one to possess all the properties of another and vice versa. Furthermore, Chisholm provides a story about how we get to (H0) via repeated applications of (H2) and (H3). Neighbouring worlds differ only as regards the lack/possession of a single quality.

As mentioned, (H2) and (H3) are the haecceitist analogues of the quidditist (QA2) and (QA3). Correspondingly, quidditism is committed to the truth of:

- (QA0) Two distinct worlds, w_1 and w_2 may be alike in all respects except that: (i) at w_1 , universal F has powers $X_1, X_2, X_3 \dots$ and universal G has powers $Y_1, Y_2, Y_3 \dots$; (ii) at w_2 , the universal F has powers $Y_1, Y_2, Y_3 \dots$ and universal G has powers $X_1, X_2, X_3 \dots$; (iii) $\forall i \forall j (F_i \neq G_j)$

This seems right. If, as Black says, the quidditist conception of properties is that they have primitive identity, identity that is completely independent of their powers, then there should be no reason why we cannot swap powers without swapping universals – or swap universals without swapping powers.

Now consider the following descriptions of worlds:

- w_a The actual world (assuming a Newtonian account of the laws of nature).
 w_b Like w_a , except there is no negative charge.
 w_c Like w_b except that:
 (i) inertial mass is not proportional to gravitational mass;
 (ii) inertial mass is proportional to charge.
 w_d Like w_c except that there is negative gravitational mass (Newton's laws of gravitation still holds, so a negative mass and a positive mass repel).
 w_e Like w_d except that the signs in Newton's law of gravitation and Coulomb's law are both changed. (Thus two positive charges attract; two positive gravitational masses repel; a positive and a negative gravitational mass attract.)

w_c is a world where charge has all the causal or nomic roles associated with gravitational mass, including proportionality with inertial mass, while gravitational mass has the causal/nomic roles of charge. We can also describe a world w_f like the actual world except that the roles of gravitational mass and inertial mass have been swapped. Consequently we can also describe a world w_g like the actual world except that the roles of charge and inertial mass have been swapped.

The worlds w_e , w_f , and w_g are analogues for properties of Chisholm's final world with every property of Adam and Noah swapped. Just as Chisholm wants to say about Noah and Adam, if

anything exists which seems to fit our description of w_e , then it is just the actual world plus a decision to swap the names 'gravitational mass' and 'charge'; similarly if anything exists which seems to fit our description of w_g , then it is just the actual world plus a decision to swap the names 'inertial mass' and 'charge'. Indeed, I think our intuitions tell us that there is something wrong about worlds w_b to w_d as well.

Just as we should reject haecceitism we should reject quidditism, which we may do by allowing both particulars and properties to have essential properties. Chisholm does not go down this road for particulars, for two reasons. First, he thinks that we would have no way of knowing what the essential properties are. Secondly, he thinks that the essentialist would be committed to the view that knowing, for example, who the bank robber is would require knowing of some x , whose essential properties are E, that x has E and x robbed the bank. But neither of these are good grounds for doubting essentialism. To the first one may make two replies. First, if we are to believe Kripke, we do know what an individual person's essential properties are (or at least include), and that is a matter of coming from some particular egg and sperm. Secondly, whether or not Kripke is right, our ignorance of which the essential properties are is not itself a strong reason for doubting the coherence of the view that says that they exist. Turning to the second problem, the issue of essential properties, in this context, is a matter of transworld identity. Presumably the detective is interested in capturing the criminal in this world, not in tracking him down in some other world. Therefore knowledge of *contingent* properties that enable the detective to pick the robber out from other *actual* people is all that is required.

Essentialism thus seems a good bet for delivering us from haecceitism about individuals. And it is equally serviceable for avoiding quidditism about properties. If inertial mass, charge and so forth are qualities that confer the powers that they do necessarily, then the descriptions of worlds w_b to w_g do not describe genuine possibilities. The Chisholmian intuitions that lead us to reject those putative possible worlds can only encourage us to reject strong quidditism.

Against quidditism – (QB1)

Assuming a uniform metaphysics of properties, rejecting (QA1) is the same as accepting weak essentialism. But weak essentialism

is compatible with (QB1). (QB1) allows that the essential properties of a property may not be enough to establish its identity – two properties may have the same essential powers.

What then might inspire us to make the transition to strong essentialism from weak quidditism? Equivalently, what reason is there to adopt the Shoemaker line about properties, that their powers establish their identity?

Consider:

(QB2) One and the same world w is such that: (i) at w , universal F has powers $\{C_1, C_2, \dots\}$; (ii) at w , universal G has powers $\{C_1, C_2, \dots\}$; (iii) $F \neq G$.

(QB2) differs from (QB1) in that whereas (QB1) contemplates distinct worlds where distinct properties have the same powers, (QB2) allows a single world to contain distinct properties with the same powers. Despite this difference, I believe that (QB2) is implied by the quidditist picture. If identity is independent of powers, why shouldn't two properties possess the same powers in the same world? Furthermore, it looks as if we can get to (QB2) by iterated applications of (QB1), in a manner similar to Chisholm's strategy. In Chisholm's original story, we considered swapping the qualities of Adam and Noah one by one. But if instead we considered just half this story, the changes that happen to Noah, so gradually Noah loses his own properties and acquires Adam's, without Adam undergoing any change, then we will end up with two particulars, Adam and Noah, in the same world with identical qualities. The same strategy applied to properties gives us (QB2). (QA1), thanks to its implications in (QA2) and (QA3), allows the loss and gain of powers quite without consideration of whether those powers are possessed by any other property. *A fortiori* (QA1) permits us to start with a world where F has powers $\{C_1, C_2, \dots\}$ whereas G does not, and for G to lose and gain powers until we end up with a world where G has powers $\{C_1, C_2, \dots\}$ without considering the existence of a distinct F with those same powers. The same argument shows how (QA1) yields worlds as described by (QB1).

(QB2) envisages two properties entering into entirely parallel causal roles and nomic relations. i.e. let F and G be properties, and let it be the case that for every other property H , it is a law that F s are H s iff it is a law that G s are H s, and so on. If this were the case, then F and G would be indistinguishable – where there seemed to be one law there would in fact be two. Applied to the

case of inertial mass, the idea is that there might be two fundamental properties that are actually responsible for its being such that if a force is applied then a corresponding acceleration would result, $mass_A$ and $mass_B$. If something accelerates with acceleration a when subjected to force F , there would be two potential explanations for this, that the entity has $mass_A$ equal in magnitude to F/a or that it has $mass_B$ equal to that magnitude. If weak quidditism were correct we would not know whether we are in such a world or not, or indeed in such a world there are many, many parallel properties, each of which is possessed by exactly one bearer.

The foregoing consequence of (QB2), adverted to by Shoemaker (1980: 215), does serious damage to our concept of property. Nonetheless, at first sight, categoricalists might be able to bite this bullet. But they should contemplate a more obviously troubling difficulty thereby created for our understanding of dispositional and theoretical terms. For example, Prior (1985: 64) suggests two ways a categoricalist might understand 'inertial mass': inertial mass = the property responsible for being such that if a force were applied then a finite acceleration would result; or, inertial mass = the property *actually* responsible for being such that if a force were applied then a finite acceleration would result. The first proposal is that 'inertial mass' stands for a definite description, while on the second 'inertial mass' is a rigid designator that picks out at a possible world precisely that property that in the *actual* world has the relevant kinematic effects. As far as I can tell, Armstrong regards the second or something like it as the appropriate understanding. Now consider a world as described where two distinct properties both do the same causal work of responding to a force with an acceleration. Then the term 'inertial mass' would fail to refer, on both glosses.

Similarly, Lewis (1970) explicates theoretical terms by elaborating on the idea of a Ramsey sentence. The Ramsey sentence of a theory $T(t_1, t_2, t_3, \dots, t_n)$, which contains the theoretical terms $t_1, t_2, t_3, \dots, t_n$, is the sentence $\exists x_1, \exists x_2, \exists x_3, \dots, \exists x_n T(x_1, x_2, x_3, \dots, x_n)$. Lewis's idea is that we regard the terms $t_1, t_2, t_3, \dots, t_n$ as referring only if the open sentence $T(x_1, x_2, x_3, \dots, x_n)$ is uniquely satisfied. If the latter is the case then the term t_i refers to the entity e_i in the unique n -tuple $\langle e_1, e_2, e_3, \dots, e_n \rangle$ that satisfies $T(x_1, x_2, x_3, \dots, x_n)$. In a world where there are parallel properties, both of which stand in the relation T to other properties, there will be failure of reference of the corresponding theoretical

terms. The possibility of failure of reference of theoretical terms is not itself a problem – we know this possibility to be actualized in some cases. What is worrying is the thought that we can never know that the possibility is not actualized for any theoretical term – we never know whether any such term refers.

It appears that Lewis later changed his mind to regard cases of multiple realisation as involving indeterminate reference.¹⁶ I am not sure what indeterminate reference is. The law of the excluded middle requires that either t refers to e or t does not refer to e . In any case we are still left in the position of never knowing whether our theoretical terms (determinately) refer. Lewis says that the original injunction to regard reference as failing in the case of multiple realisation was supposed to meet the intention of the theorist to give an implicit definition of his terms. That may be the intention of the theorist. What is clearer is that the theorist intended to refer (determinately). For if the theorist had intended to leave open the possibility of multiple realisation, the theorist would not have used a theoretical term (a referring expression) but instead would have used quantifiers (as in the Ramsey sentence). Put another way, the proper Ramsey sentence for $T(t)$ is not $\exists xT(x)$ at all but rather $\exists!xT(x)$. Lewis seems to concur, saying that we should write the postulate in such a way that the theory cannot be multiply realised. If we do that, we have no way of knowing whether our theory is true or not, since we have no way of knowing that it is not multiply realised by functionally parallel but categorically distinct properties. Lewis accepts and indeed argues for the thesis that quidditism entails Humility, where Humility is the claim that we cannot know about the fundamental properties of nature. Lewis may have been content to accept both quidditism and Humility. But *this* sceptical consequence of Humility is, I suggest, a very high price to pay for the Humean metaphysic.

We do not want our metaphysics of properties to condemn us to necessary ignorance of them. And so we should reject quidditism. Since categoricism entails quidditism (strong and weak), we should reject categoricism too. The problems concerning identity and reference raised by quidditism are immediately resolved by adopting strong dispositional essentialism, the view that the identity of properties is fixed by their essential powers.

¹⁶ Lewis, 'Ramseyan Humility'.

3. Structural properties

In this section I will consider the objection to (DE) raised by Brian Ellis (2005). This concerns geometrical, numerical, spatial, temporal properties, and other properties that I call 'structural'. The concern is that while other properties have dispositional essences, it is difficult to see that these ones do. On the other hand we cannot just ignore such properties, for they do play a part in scientific explanations. A cylinder can be made to roll down an inclined plane of less than 45 degrees but a triangular or square prism cannot. It is the shape of the cross-sections that explains such facts. The law of gravitation tells us how gravitational force depends on spatial separation. And so on. If the fundamental properties of science include such properties then, it seems, some fundamental properties are categorical.¹⁷

I will first consider whether the problem raised in part 2 against categorical properties can somehow be avoided for these properties. Here is a suggestion. The problem arises for property terms which are introduced by a description of their theoretical role. But not all properties need be introduced that way. For example, we can understand 'triangle' via a definition ('plane figure with three straight edges'). Or we can understand the same term via direct ostension of triangles. Similarly we can fix a standard of spatial displacement (distance) with a sample (a ruler or standard measure). These might be direct ways of relating to categorical properties, as contrasted with the indirect route via a role in a scientific theory or explanation.

This perspective is, however, misleading, for various reasons. First, the claims of dispositional essentialism are intended to apply only to fundamental properties. And there is no reason to suppose that properties identified in the manners described will be ones that appear in fundamental science (the ostensive definition of spatial and temporal quantities may appear to be an exception – I shall return to these). In particular we should not expect composite properties, those defined in terms of a composition of parts (such as triangle) to figure in fundamental science. Secondly, we have no guarantee that the methods under discussion (ostension and definition) will pick out genuine natural properties, fundamental or not. Let us consider a parallel case,

¹⁷ A similar point is made by Molnar (2003: 158–62).

the ostension of natural kinds of substance. We may be able to define a natural kind term (e.g., 'gold') by ostension. But a *posteriori* investigation is required to establish that we have successfully done so. If the ostended sample is not a single substance but a mixture, then we will not have defined a kind term. Furthermore, the distinction between mixtures and compounds, which is required to ground the ostension of many chemical natural kinds, is itself a product of chemical theory. Thus ostension cannot bypass theory in the definition of kind terms. Nor can it do so for property terms. One might have thought, nonetheless, that if there *is* a single kind being ostended, then one has succeeded in picking out that kind rather than some functionally parallel kind. However, it is not merely a simplification to think of ostensive definition as being a single event. There is no single sample of gold that fixes the extension of the term 'gold'. We multiply and repeatedly characterise that extension via acts of ostension. Our ability to do so depends on its being the case that most of the samples are indeed instances of the same substance. That can be confirmed by empirical investigation, and again that will depend on the employment of a relevant theory. In some cases we may find out that the samples are not all the same, as in the case of jade, and that we have not picked out a natural kind. In such cases we can find out whether we have succeeded (or failed) in characterising a kind by investigation of the structure and composition of the samples. But in the case of fundamental properties that is just what we cannot do.

Let us turn to spatial and temporal properties. These might well seem to be quantities that we can define ostensively and which appear in fundamental physical theory but do not themselves have an essentially dispositional character. Again there is no guarantee that the macro-quantities are related to fundamental micro-quantities just by 'scaling-down'. The more we discover about space and time as revealed by basic physics, the less it resembles the three more-or-less Euclidean spatial dimensions and one temporal dimension that the macro-world appears to occupy. Indeed space-time might not be a fundamental entity at all and hence measures of space and time might not be fundamental either. (Compare the temperature of a gas, which is a macro-quantity that has no corresponding micro-quantity.) Nor can we assume, therefore, even if there are fundamental spatial and temporal quantities, that these are the same as the macro-quantities. Again, it is a matter of scientific discovery whether this is so.

Consequently the terms that a fundamental theory would employ to name such quantities will be theoretical terms. Hence the problems raised for categorical properties will apply to these properties also. More generally, it is a mistake to think that we are acquainted with any natural property as it is, independently of its causal powers, since if we know about a property at all it is via its effect on its. As Marc Lange puts it,

Geometric properties, like size and shape, may initially seem too be ideal cases of properties we know in themselves. But insofar as these are *physical* properties, to be instantiated by matter in space and not merely by abstract mathematical entities, it is not obvious that our senses disclose to us these properties as such (2002: 87).

Lange's remark may also help us see why it does not help that we think we can grasp 'triangle' simply through its definition as a 'plane figure with three straight edges'. The possibility of abstract definition does not show that we have defined a property such that we can know, independently of any theory, that it is physically possible for some object to possess it.

The next question is this: can structural properties be attributed with dispositional essences, contra Ellis? One way to show that they can be would be to identify a subjunctive conditional (perhaps with a *ceteris paribus* condition) entailed by an ascription of a structural property. Hugh Mellor (1974) identifies such a conditional for the property of triangularity: x is triangular entails: if x 's corners were counted correctly, the result would be three. This claim has been challenged by Elizabeth Prior (1985), not, ultimately, successfully (in my opinion; see my 2003). But the problem with this conditional is that it seems not to provide the real essence of triangularity, since the disposition mentions the human process of counting. But if structural properties are to function in a fundamental science we do not want their essences to be anthropocentric. Sungho Choi has suggested to me that we could generalize the notion of counting corners. All we would need is a counting machine that can distinguish travelling along a geodesic from not doing so. If it did not do so at any point, then it would add one. Such a machine, travelling along a triangular path, starting at any non-apex point, would count to three on returning to its starting position. Even so, one might hope to find an essence constituted out of properties that one might expect to find in a fundamental theory. For example:

<The paths AB, BC, and AC form a triangle> entails <if a signal S travels along AB then immediately along BC, and a signal S* travels along AC, starting at the same time, then S* will reach C before S>.

The problem with this is that it is false for many non-Euclidean triangles. One possibility would be to regard 'triangle' as ambiguous, or generic, across a range of triangle-properties, each for different kinds of geometry, and each of which has a different essence of this kind.

However, we should remember that 'triangular' is unlikely itself to be a fundamental structural property, and the dispositional essentialist is thus not required to find a dispositional essence for it. It is the fundamental structural (primarily spatial and temporal) properties that have dispositional essences. Our knowledge of the nature of space and time is in a state of flux and we do not know what the role of fundamental spatial and temporal properties will be in the final theory of everything. Note that it is not *a priori* that such a theory would refer to spatial and temporal properties at all, nor, if it does, that the fundamental ones neatly mirror the role of such properties in folk physics or classical physics.

Nonetheless, we can make some prognostications that suggest that a final theory would treat all fundamental properties dispositionally. I will first mention a brief response by Stephen Mumford (2004: 188) to the current problem. The gravitational force on an object is sensitive to both the masses of it and other massy objects and its displacement from those other objects; looking at Newton's law: $F = Gm_1m_2/r^2$, the force F is a function of the masses m_1 and m_2 and also of their displacement r . That equation does not treat mass and displacement differently. In which case why should we not regard the force as a manifestation of the displacement, in which case displacement is characterised dispositionally (the displacement r between two points is the disposition whose manifestation, when masses m_1 and m_2 are located at the points, is a force between those masses with magnitude $F = Gm_1m_2/r^2$)?

While I think this is along the right lines, it needs supplementation. First, we need some explanation as to why it seems so much more natural to regard the force as a manifestation of the masses rather than of their displacement. Speaking figuratively we are inclined to think of the force as being generated by the masses,

not by the displacement. Secondly, displacement crops up not just in the law of gravitation, but also in Coulomb's law and elsewhere. Thus it would appear that we could characterise displacement dispositionally with respect to a variety of different and seemingly independent manifestations. Should we think of displacement as a multi-track disposition (one with more than one kind of manifestation)? But that would be reason to suppose that displacement is not fundamental. Or is one of these manifestations (e.g. gravitational rather than electric force) privileged over the others?

The classical conception of space-time has been that of a stage or container within which things and laws act, but which is not itself involved in the action. It is a mere *background*. As such, although terms for spatial and temporal dimensions appear in the laws, we do not regard these terms as indicating action on the part of space and time. One manifestation of this is conventionalism about space-time, à la Mach, Poincaré, Schlick, or Duhem for example. According to views of this sort, a choice of geometry and metric is conventional. We typically choose our geometry in such a way as to make the laws of physics expressible in a convenient form. The choice does not reflect some fact concerning the real structure of space and time. If a spatial property, such as the distance between two points, is in effect the result of a conventional choice, rather than a real property of a real thing, then it is difficult to regard it as being active. Certainly this view would reject Mumford's claim that structural properties could be seen as dispositional properties with characteristic manifestations, on the same footing as the property of mass. A defender of (DE) (all fundamental, natural properties are essentially dispositional) may reply at this point that conventionalism is in effect arguing that spatial properties are not really natural properties at all, being simply the product of conventional choices. Hence the apparent exceptions do not fall under the scope of (DE) after all. At the same time, the awkward fact remains that spatial and temporal terms appear in our best scientific theories. One way of reading the debate between substantialists and relativists regarding space and time is that the substantialists, being impressed by the appearance of space and time in our laws, want to elevate space and time to something unarguably real, a substance, while the relativists noting that space and time are a mere background, not an agent, want to downplay space and time, holding them to be merely relative or conventional. In effect both camps recognize a

deep tension between the presence of space and time in our laws and their role as a mere background – and both give an inadequate response, since neither fully eliminates a component of the tension.

Recently physicists such as John Baez (2001), Lee Smolin (1991), and Carlo Rovelli (1997) have advocated the view that a good physical theory should be background-free. Thus either space and time should be eliminated from our theories (although an unlikely prospect, this is not impossible). Or they should be shown not to be merely background. Either way the grounds for spatial and temporal properties and relations being exceptions to (DE) would be removed – in the first case because the properties no longer figure in fundamental science *at all*, and so are not fundamental, natural properties; and in the second case because space and time would no longer be background but fully fledged agents, capable of acting and being acted upon, and so permitting spatial and temporal properties to be understood dispositionally. General Relativity endorses the second alternative. Each space-time point is characterised by its dynamical properties, i.e. its disposition to affect the kinetic properties of an object at that point, captured in the gravitational field tensor at that point. The mass of each object is its disposition to change the curvature of space-time, that is to change the dynamical properties of each space-time point. Hence all the relevant explanatory properties in this set-up may be characterised dispositionally. And furthermore, this relationship explains why gravity is privileged over other forces in characterizing the essence of spatial relations.

4. Conclusion

In this paper I have examined in detail the prospects for explaining the nature of laws as reflecting the essences of the relevant natural properties. Those essences may be characterised dispositionally. Properties are what properties do. This contrasts with the view of, for example, Armstrong, according to which properties just are, and what they do depends on what the laws tell them to do – properties are categorical.

That properties are categorical and have no essential natures beyond being themselves involves a commitment to quidditism, a commitment shared by Lewis also. I argued that dispositional essentialism, unlike strong quidditism, does not lead to

Chisholm's paradox for properties. And if we extend essentialism by making it an account of the nature and identity of at least fundamental properties, following Shoemaker, then we can also avoid the undisprovable possibility of a parallelism about properties that would make impossible knowledge about the reference of theoretical terms.

The latter problem is a problem for a quidditist/categoricalist conception of *any* property. Hence dispositional essentialism ought to apply to all properties. This invites the objection from Ellis and others, that structural properties, such as spatial relations, are rightly considered categorical. I argued that we are not obliged to see them as such. Since the thesis I am defending is one about the fundamental properties of physics, we cannot be sure that spatial properties are categorical until we understand the role of those properties in a true fundamental theory. I have proposed that our inclination to think that spatial properties are categorical is a reflection of the fact that we treat space and time as a background for our theories. But if we ought to make our theories background free, then we ought not allow ourselves to think in such a way that permits spatial properties to be categorical. And indeed General Relativity suggests that we should not.

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