The metaphysical status of natural laws: A critique of Stephen Mumford's Nomological Antirealism[1]

O estatuto metafísico das leis naturais: uma crítica ao Antirrealismo Nomológico de Stephen Mumford

Bruno Borge[2]
Universidad de Buenos Aires

Abstract

The issues of laws of nature and the modality underlying natural regularity have often been treated as one. Metaphysical analysis shows, however, that only those positions that assume an ontological commitment to laws of nature can be considered within Nomological Realism (NR). Mumford (2004) proposes an alternative to NR compatible with the modal commitments commonly associated with realist positions. In this view, the weight of modality is not set on laws but on properties — understood in terms of powers and propensities. A Realist Lawlessness (RL), according to his own nomenclature. In this paper I aim to show, first, that Mumford's arguments against NR do not justify its rejection. Second, I argue that the dispositional metaphysic of RL leads at least to the same problems as NR.

Keywords: laws of nature, scientific laws, Nomological Realism, Stephen Mumford.

Resumo

As questões das leis da natureza e da modalidade subjacente à regularidade natural muitas vezes têm sido tratadas como uma só. No entanto, a análise metafísica mostra que só as posições que assumem um compromisso ontológico com as leis da natureza podem ser consideradas dentro do Realismo Nomológico (RN). Mumford (2004) propõe uma alternativa ao RN compatível com os compromissos modais comumente associados a posições realistas. Neste ponto de vista, o peso da modalidade não está posto nas leis, mas sim em propriedades entendidas em termos de poderes e propensões. De acordo

com sua própria nomenclatura, trata-se de um Realismo sem Leis (RSL). Neste trabalho pretende-se mostrar, em primeiro lugar, que os argumentos de Mumford contra o RN não justificam a sua rejeição e, em segundo lugar, defende-se que a metafísica disposicional do RSL leva, pelo menos, aos mesmos problemas que o RN.

Palavras-chave: leis da natureza, leis científicas, Realismo Nomológico, Stephen Mumford.

Introduction

The issue of natural laws has been a topic of deep interest to modern science and, of course, to the philosophy that had it as its object of inquiry. However, systematic analyses of its metaphysical implications are relatively recent. Even in the context of the Scientific Realism/Antirealism debate, the status of the laws of nature was discussed mostly as a lateral issue. The earliest approaches[3] tended to prioritize a logico-syntactic analysis and to focus on the possibility of making a distinction between authentic laws and mere accidentally true generalizations. However, a treatment of the distinction's metaphysical background was often avoided, or just taken for granted as a simple dispute between humeans and necessitarians. While that can be seen as the result of the influence of Logical Empiricism — whose reluctance to consider metaphysical issues is well-known — even in more recent disputes the notions of 'scientific law' (a true, universal statement that describes some real regularity in the world) and 'natural law' (something other than the mere regularity as being the truth-maker of that statement) are often confused or treated as one.

The contemporary debate, however, takes a more complex form. No one seriously doubts that there are regularities in the world. No one seriously calls into question that if there is a statement that adequately describes one of those regularities in the past, present and future (a statement that will be universal and true), it deserves to be called 'law'. The sticking point is to determine by virtue of *what* that statement would be true, i.e. whether there is indeed an objective substratum that makes the regularity necessary, and not merely a happy coincidence. Some (I honestly think that it's much more complicated than it seems to know exactly how many) found in natural laws that substratum: laws are not mere projections of our creativity but *something* in nature, things we discover as supporting the objective necessity of regularities, i.e. as its explanatory and ontological principle. Those who believe this advocate for Nomological Realism (NR). It should be noted, however, that postulating necessary connections between phenomena is not sufficient to support NR: it should be maintained that it is the laws of nature and no other thing in the world what gives ontological support to that necessity. That is why both humeans and anti-humeans can coexist under the shelter of Nomological Antirealism (NA). Stephen Mumford devotes his *Laws in Nature* (2004) to illustrate this point, to show, in short, that to deny that laws exist does not imply embracing a metaphysics of mere constant conjunctions, where necessity should be taken as a habit of our minds mistaken for a principle. Mumford's proposal intends to make clear that laws are only one possible candidate to explain regularities and the necessitation relations that constitute them. They are not the one and only candidate, and by no means the best. They are in fact a bad candidate, and his main argument sup-

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[3] See for example Chisholm (1946), Goodman (1947), and Hempel and Oppenheim (1948).

porting that point is what he calls the Central Dilemma: laws are internal to their instances or they are external to them; but it turns out that if we consider them to be either internal or external to their instances, we cannot give an account of how they govern their instances, so the possibility of considering them as the basis of regularity would be closed. But there is more: taking them to be external to their instances leads us to *quidditism* regarding the nature of properties. Mumford's own proposal is to take laws out of the picture and endorse a metaphysics of powers and propensities: they are able to play the role of laws being immune to the Central Dilemma and the charges of quidditism, a Realist Lawlessness (RL), as he likes to call his own position.

The primary aim of this work is critical: in "Natural laws as a metaphysical issue", I offer a brief overview of the debate between nomological realists and anti-realists, reviewing some philosophical positions that exemplify both sides. I give an account, specifically, of the general guidelines of Humeanism — as the basis of all the alternatives that fall within NA— ("*One little thing and then another*") and the realist proposals of Brian Ellis and David Armstrong ("Nomological Realism: essences and universals"). This sets the scene to present, in the third section ("Mumford vs. Nomological Realism"), the fundamental aspects of the Central Dilemma and its main consequences regarding the rejection of NR. In addition, I try to discuss this argument in order to show that its effectiveness depends on certain notions of *governing role* and *natural law* that the nomological realist could resist to accept ("The Central Dilemma"). I also present a further problem Mumford associates with NR: quidditism ("Quidditism"). In "Powers in nature: Realist Lawlessness and the problem of quidditism", I try to establish that the alternative metaphysics proposed by Mumford — i.e. RL — entails at least the same difficulties that led to the rejection of laws. Finally, the last section includes the conclusions and final comments of this work.

Natural laws as a metaphysical issue

The well-known distinction between scientific laws and accidental generalizations largely monopolized early discussions around laws. Despite the multiple inflections the discussion had, the point then was to give conceptual support to the intuitive distinction between necessary correlations of properties (e.g. the correlation between 'being a metal' and 'being expansible with heat') and factually constant but contingent correlations (e.g. between 'being a player for the Chicago Bulls' and 'being taller than 150 centimeters'). However, the elucidation of the nature of that necessity was rather a secondary topic, while the main interest were the semantic, syntactic and logical considerations that intended to provide a set of sufficient conditions for a statement to be considered a law. Conversely, the discussion between nomological realists and antirealists is today, in its basis, metaphysical. There are many ways to sketch out a map of this debate, and since the following subsections will give an account of the position of some of its main actors, now I will just give a purely conceptual picture of the matter. Although offering this picture is not one of the aims of this work, as far as I know a pure conceptual map of the debate around laws has not been given in the related literature.

Imagine three small possible worlds, call them M_0, M_1 and M_2. M_0 is composed of a handful of individuals and properties such that the former instantiate the latter; say, individuals a, b and c, and properties F and G. Also suppose that all of them (individuals and properties) are observable. In this world it is always true that 'Fa', 'Fb', 'Ga' and 'Gb'. M_1 and M_2 are identical to M_0 in all the aspects

described so far[4], however, while in M_0 it is just a bare fact that all Fs are Gs, in M_1 all Fs are Gs *necessarily*. One might think that the difference really is that in M_0 we are going to find, at some point, an individual which is F and no-G, thus showing us that the regularity was in fact contingent. But that is not the case in our example; M_0 is such that in its whole history all Fs are Gs, always and without exception. I think anyone can get some interesting information about her own philosophical affiliation wondering whether there is really a difference between M_0 and M_1 or they are in fact the same world. And even wondering whether that question should be considered as a meaningful one in the first place. However, despite containing necessary connections, M_1 is not yet a world of laws. Then M_2 has the same distribution of necessary relations as M_2, but includes an extra feature: natural laws that support such necessity. So the basic question is: What is it to *be* a law? For some (e.g. Armstrong) laws are second order universals instantiated as relations between first order universals (in this case, F and G), while for others (e.g. Ellis) they are essential properties of natural kinds. Note that M_0, M_1 and M_2 are empirically equivalent worlds; no internal or external observer would notice any difference in them as systems of entities considered synchronously, or in respect of their development over time. However, if their metaphysical differences are accepted, these are three ontologically distinct worlds. Although the metaphysical question about natural laws has many variations that cannot possibly be captured in this brief picture, it can be said that for Humean NA our world is like M_0, for the defenders of RL it is like M_1, and for nomological realists our world is some version of M_2. In other words, the defender of RL rejects the metaphysical picture of M_0 and M_2, since she believes that the former lacks any philosophical motivation and the latter is refuted by the Central Dilemma. Nevertheless, before we get to that point, I will briefly review the positions against which Mumford runs his argument, so it is time to include some proper names.

One little thing and then another

A scientific realist who defends a strictly humean metaphysics would be a rare find nowadays. Yet, nowadays nobody seems to be sure about what is, strictly speaking, a humean metaphysics. The picture, for those who tend to fall under that label, seems to be this: the world is constituted by discrete events, each of them is self-containing and both ontologically and causally independent of the rest. Here is an analogy that may be illustrative: the world is like a mosaic whose pieces are those discrete and causally inert events, where each piece is what it is in itself, independently of the rest. Many of them are arranged in regular relations of similarity and spatial contiguity, but outside them there is no necessary relation connecting them. That is our world, *one little thing and then another* (Lewis, 1986, p. ix). The analogy is appropriate in an additional respect: the independence of each of the parts does not imply that there are no regularities; on the contrary, with enough dedication we can find many complex patterns in the distribution of the pieces. We can realize that every red piece is adjacent to a hexagonal one, or that each group of similar black pieces is followed by a number of green pieces determinable by some function, etc. The point is that none of these regularities identified by empirical inquiry is determined by an internal necessity (one piece implying another)

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[4] The ontological configuration of these strange worlds only intends to eliminate any element that might deflect attention from the point that I intend to establish; however, the same argument can be applied to our real world and the corresponding equivalent possible worlds.

or external necessity (the system as a whole implying some distribution). Proposals along these lines are usually grouped under the name of 'regularity theories'. Although sometimes regularism is presented as a theory of laws (Psillos, 2002, p. 137), it is actually a theory about regularities or constant conjunctions in nature. In other words, according to the foregoing metaphysical considerations about laws, the regularity theory of laws falls, despite its name, within NA.

Mumford's reservations about regularism (mainly focused on its most developed version, defended by Lewis) are based on a motivational level. Its acceptance lies in the adoption of a certain metaphysical picture; if that picture is accepted, then the theory follows (Mumford, 2004, p. 49). The problem of regularism then lies in the Humean metaphysics that sustains it, but in turn the criticism of that kind of metaphysics may not be logical or conceptual. The position is consistent, and it cannot be refuted by appealing to intuitions such as the distinction between true laws and accidental generalizations, given that such intuitions are not, from the beginning, intuitions the regularist has. Mumford's point is to note that an ontology of discrete and causally inert units lacking any necessary connection "is not an attractive metaphysic and also that there has been no compelling reason […] for why we must accept it" (Mumford, 2004, p. 30).

The former, undoubtedly, is not a conclusive argument against Humean NA. Maybe it is not even a good argument. However, this is not the focus of this paper, so it will be better to continue our exploration of the controversy around natural laws.

Nomological Realism: essences and universals

Mumford believes that Brian Ellis believes that laws exist, but they are internal to their instances, more precisely, they are the essential properties of natural kinds[5]. In Ellis's own words:

> […] all the laws of nature, from the most general (for example, the conservation laws and the global structural principles) to the more specific (for example, laws defining the structures of molecules of various kinds, or specific laws of chemical interaction) derive from the essential properties of the object and events that constitute it, and must hold in any world of the same natural kind as ours (Ellis, 2001, p. 4).

The quote is somewhat controversial, but is understood by Mumford as claiming that, given that the world has a hierarchical structure of natural classes, the essential and constitutive role properties play with respect to those classes is what gives rise to necessitation relations between properties. Two options arise here in order to elucidate the true metaphysical commitment of essentialism: the laws are reducible to those properties or are some kind of entity supervening upon the class structure that those properties define. But whether we understand laws as mere aggregates of essential properties or as supervening upon them, a simple question, according to Mumford, is enough to devastate the argument: how can something rule over that to which it is reducible or upon which supervenes?

Another alternative is then to adopt the externalist conception of laws defended by Dretske (1977), Tooley (1977) and Armstrong (1983) (hereafter DTA).

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[5] Despite that, Ellis has denied to be realist about laws or to take them as having a *determining role* in nature. Reviewing Mumford's book he said: "I did occasionally speak of laws of nature as 'governing' various ranges of phenomena. This was a loose talk, for which I apologise." And he adds: "[L]aws of nature are not things in the world, but are general propositions descriptive of the kinds of natural necessities that exist in it. […] [T]hey are not items that should occur in anyone's ontology" (Ellis *et al.*, 2006, p. 438).

The DTA theory maintains that laws are a type of second order universal. In this metaphysical picture properties are understood as actually instantiated universals that maintain necessitation relations; these necessitation relations *are* the laws. If having the property F implies having the property G, it is because F and G are bound in a certain relation of necessity N, such that N(F,G). This is a metaphysic of instantiated universals, so it has an Aristotelian flavor: there would not be universals F or G if there were no entities in the world in which F and G are instantiated, as there would not be a necessitation relation N (i.e. the law) if there were no instances in which actually F makes G necessary[6]. It is precisely at this point where Mumford finds the first weakness of the DTA theory: immanence is a (in the best of cases, limited) way of supervenience. The real existence of a law depends on (i.e. derives from, or is determined by) the actual instantiation of a causal sequence between two universals whose real existence depends on (i.e. derives from, or is determined by) the actual instantiation of those properties in the world. So again we must ask how it is possible that something can govern something else if it depends on this thing to exist. A second weakness is the fact that the relation N is *sui generis*, almost a *deus ex machina* that puts in the properties the necessity that they cannot provide to themselves. In some sense, this does not seem to be far from an *ad hoc* hypothesis to justify the nomological structure of the world.

So, according to Mumford, the essentialist theory of laws and the DTA fail to provide an account of how laws govern their instances. Let's look at this point more closely.

Mumford vs. Nomological Realism

The Central Dilemma

The discussion about the metaphysical status of natural laws has often been a topic of interest among scientific realists and antirealists. This is due mainly to the fact that, although scientific realism and realism about laws are logically independent theses, those who endorse Scientific Realism often show sympathy for some form of NR[7]. In other words: those who believe that atoms or molecules exist tend to believe that certain things *necessarily* happen to them in some given circumstances. The problem then lies in determining the place where the weight of that necessity has to rest. Nomological realists choose to put it in laws of nature, assuming that observable regularities are ontologically based on them. Therefore they assume those laws are part of the metaphysical furniture of the world. Besides his specific criticism of the various forms that this commitment has taken, Mumford rejects it based on his Central Dilemma: laws of nature are internal to the events they govern or are external to them. If they are internal to (i.e., if they consist of, or are reducible to) their instances, it is not possible to explain how laws govern them. If they are external, it is also impossible to provide a characterization of laws as fully independent entities that play a governing role over their instances. In order to consider the relevance of the argument two basic assumptions must be accepted:

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[6] This story does not apply to Tooley, for whom universals should be understood in a platonic sense. Since it is the most developed position, I will follow Mumford in taking Armstrong's theory of laws as the paradigm of DTA.
[7] The central thesis of Scientific Realism is the claim that unobservable entities postulated by our best scientific theories exist. It is possible to hold that view without committing oneself to an objective necessity of the type required to support NR. Moreover, it would be possible to sustain NR restricting it to the observable world, that is, without committing oneself to the type of entities that are the object of the scientific realist belief.

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(a) Laws must be understood as an 'addition of being'.
(b) Laws must govern their instances.

The first implies that anyone who decides to be realist about laws must commit himself to the fact that laws have some kind of ontological thickness, must believe that they are *things* in the world, an ontological category *per se*. The second assumption implies that the governing role over their instances is required as a constitutive feature of both the laws themselves and the feasibility of a metaphysic that postulates them. This means that both assumptions also work normatively as a criterion of acceptability for any theory of natural laws. Mumford explains that if "govern" is theoretically uncomfortable to us, we could replace it by any expression that denotes certain *determining* role for laws, so that the world would be very different if they were not in it (Mumford, 2004, p. 145). However, laws cannot play that role, whether we consider them external or internal to their instances: if we want to escape from Hume and keep objective modality, NR is not a good option. The proposal, then, is a metaphysics of properties understood as clusters of powers and/or dispositions, capable, according to Mumford, of explaining their necessitation relations without falling prey to the Central Dilemma[8].

Those are Stephen Mumford's reasons. Let's face the problems in order: laws can be understood as internal to their instances in two senses: as constituted by them or as supervening upon them. In either case this characterization of laws violates the second criterion of acceptability that had been imposed on NR: laws do not govern their instances because "[i]t is highly implausible to suppose that laws could govern something upon which they are supervenient" (Mumford, 2004, p. 103). Many of the theoretical details of Ellis's philosophical position about natural kinds are called into question throughout *Laws in Nature* — including the very notion of essential property —, yet the complaint that it fails to give an account of the governing/determining role of laws is the only one that directly affects his proposal as a form of NR. The problem here is: what does 'govern' exactly mean in this context? Alternatively, in a more relaxed version, what is it that is meant with 'determining role'?

I do not think I can answer those questions here in the right way. To be honest, I am not sure that Mumford himself can. But let me tell some stories instead. I once had an electric stove, actually a very simple device. Searching in the Internet I could learn that my stove's thermostat was constituted by metal pieces with different coefficients of thermal expansion, so it was the stove's temperature itself that modified those parts by switching an on/off device. The thermostat was not identical to the stove, but it was certainly part of the stove, which did not work without the thermostat, which, on the other hand, did not work without the stove. The point is that in some interesting sense of 'govern' the thermostat *governed* the temperature of the stove, even if it functionally depended on it. While it is clear that this qualifies as a determining role, one would think that the analogy is weak because the way in which laws depend on their instances is not the same way in which a thermostat depends on the device on which it is installed. So I will tell other stories. Many philosophers make their living defending the idea that mental processes are epiphenomena of cerebral events, that they supervene upon them; yet many of these philosophers would argue that in an interesting sense mental phenomena 'govern' some brain events. The rules governing the use of our language

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[8] The presentation and discussion of this alternative will be the subject of section "Powers in nature: Realist Lawlessness and the problem of quidditism".

depend — are determined by or derived from — our linguistic practices, yet these practices are 'governed' by those rules and they play a 'determining role' in the way we communicate. Something similar may be said of laws, in the usual legal sense. Jerry Fodor once wrote: "[…] anyone can play the natural language game; the problem is that nobody ever wins" (Fodor, 2000). I do not pretend to say anything interesting about how language works or about the human mind — or even about my electric stove —, but simply to note that if the possibility that supervening entities have some significant role for those entities upon which they supervene is going to be objected, much more than a simple diagnosis of implausibility has to be done. That is not an acceptable argument. Indeed it is not even an argument, and if it were, here is an answer that is also acceptable: that the supervenience of natural laws is a very implausible assumption seems to me a very implausible assumption.

We turn now to the externalist conception of laws. The first objection to it argued that it cannot give an adequate account of the governing role laws must have over their instances, because being second order universals immanent to their instantiations in specific relations makes them ontologically dependent on those instantiations, some kind of supervening entity. Carefully considered, this is a curious objection: the problem of the externalist conception of laws is that its laws are not properly external, so it is not really an externalist conception of laws. Therefore, it turns out to be vulnerable to the same arguments that make internalist conceptions implausible.

The spirit of this objection seems to be in fact a challenge: to give an account of laws as a separate instance, completely transcendent to the events that fall under its coverage, but that nonetheless allows explaining how laws can play a governing role over them without implying any prior ontological relation. However, I do not think that is the real objection, nor that the real problem is how to understand the external nature of laws or its governing role. To be honest, I do not even think that laws are the real problem here: the problem is not that the requirements imposed on them are impossible to fulfill, the problem is that these requirements were not there to be met. Mumford did not open the doors of *the laws* to convince us that they are inconvenient, or even that those doors are a real obstacle; he opened them just to close them. Thus, the road to a metaphysics of powers and propensities appears as a natural movement.

Quidditism

However, according to Mumford there is an even more pressing problem for the DTA theory that stems from its postulation of metaphysically contingent laws. For Armstrong, the laws are necessary in a nomological sense, i.e. they are themselves a necessary connection between two universals that occurs in the real world. However, that relation does not have to be replicated in every possible world, so there are some possible worlds containing necessitation relations between universals that are different from those that exist in the actual world. It follows that something being a law is different from that being a metaphysically necessary fact. In other words, there is a sharp distinction between *nomological necessity* and *metaphysical necessity*. What is wrong with this conception? The problem is that it implicitly assumes categoricalism about properties. A property F that in the actual world causes necessarily the property G could not do so in, say, M_4, and cause instead Z. That property could actually not *do* in M_4 anything of what it *does* in this world and still be the same property F; i.e. the identity of a property is independent of its causal role or causal profile. It depends then on something else; but that is all we can say: what makes F to be the property that it is is a 'something', a *quidditas*

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which underlies its causal role. So for Mumford the third reason which makes the externalist conception of laws undesirable is that it implies quidditism regarding properties. Quidditism states that the essence of a property is given independently of its theoretical/causal roles, so the real essences of categorical properties — i.e. their quidditas — are condemned to remain hidden from empirical inquiry.

One might ask what is so wrong with quidditism, why do not just happily admit it within NR. After all, what is the harm of one more epicycle to an already highly speculative metaphysics?[9] To begin with, there are a number of obvious concerns about quidditism (of course, besides being an old fashioned metaphysics): first, it has some counterintuitive consequences — for example, there could be infinitely many possible worlds which were identical in their observable and unobservable parts, but each could have a completely different set of fundamental properties. Second, even if admissible in a broader philosophical context, it does not seem to be a convenient move in an account of laws. It's expectable that one wants to say that the nature of a property is not completely independent of the relationships it maintains with other properties and hence not completely independent of the type of laws that property will be involved in, which is the case if quidditism is true. Third, doctrines on laws are usually related to naturalism, but if the ultimate nature of properties is inaccessible by any means to empirical inquiry, it turns out that naturalism is false if quidditism is true. I believe those are sufficient reasons, so I join Mumford in his rejection of quidditism. Nevertheless, it should be noted that is enough for the purposes of this paper that he believes so. My aim is to show that RL implies quidditism as much as NR does, so it should also be rejected *according to Mumford's own standards*.

As we saw, the Central Dilemma intended to show that both the internal and the external forms of NR fail to account for the governing role of laws. Nevertheless, that point depends on a questionable and unclear notion of *governing* role. But as far I can see, the problem with laws has never been other than quidditism, because I suspect that the problem for Mumford has been quidditism from the beginning. The essential properties of Ellis or the categorical properties of NR support modality at the expense of assuming that they directly or indirectly depend on an objective and inaccessible substrate that has a non-relational character. Mumford considers it unacceptable, and I think he is right. However, as I hope to show in the next section, his RL cannot do better as long as it also implies a form of quidditism.

Powers in nature: Realist Lawlessness and the problem of quidditism

If the preceding considerations are correct, the Central Dilemma fails to establish a compelling reason to reject NR. However, it could be argued that as long as NR still implies quidditism, a metaphysics of powers and propensities may be preferable given that it does not imply that undesirable thesis. That is how Mumford presents powers: they are capable of doing all the work laws do without falling prey to the Central Dilemma nor implying quidditism. But is this really the case? A property, Mumford argues, is merely (i.e. is constituted by) a cluster of powers and propensities. The identity of a property is not independent of its causal profile, instead this identity is the sum total of its causal propensities (whatever it can do) and nothing else, so there is no dissociation between some intangible essence and a set of propensities that, at least in principle, can be empirically assessed.

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[9] I am indebted to an anonymous reviewer of this journal who called my attention to this point.

If the causal profile of a property were to be modified, we would not be looking at the same property. The identity of a property is determined by extension, by the powers that constitute it. There are some common concerns about proposals of this kind. One might ask whether the cluster of powers should be described using disjunctions or conjunctions; also, whether it is reasonable to think that a property ceases to be the property that it is if it loses one or some of its powers, or if it gains a new one. In any case those are not problems only for RL — if they are problems at all —, but for any other form of dispositionalism, so it will be better to ignore them and move on[10]. However, properties are powers and to move on involves asking at least what a power is. This problem is not new; it goes back to the logical positivists. Dispositions were introduced precisely because some properties are never actualized and therefore are never empirically accessible (see Carnap, 1928, 1936-1937). So we have some clues: first, a power is not a mere potentiality, but it is itself in some sense *actual*. It is plausible to think, we are told, that a broken glass was breakable before actually breaking. Another clue: the relation between a power and its manifestation would not be merely analytical, that is to say what is being defended here is not just a metaphysics that consists of instructions on how to add the suffix "able" to some known terms of our language to form words like "breakable" or "bendable". Returning to the broken glass, the propensity or power (I admit sometimes I cannot see the difference) was real and was present in the glass before its manifestation, it was in a certain way *actual*.

We now know more about what power is not, but our question remains unanswered: *where does* the identity of a power rest? Mumford seems to do not intend to answer it directly, so we should try an alternative. The identity of a power cannot be in the property that the power constitutes, as that property is *something more* than its powers; if so, we would just be falling into quidditism. But could each power contain in itself the principle of its own identity? Considering more carefully the very notion of power, some curious consequences arise. For example, a property would contain in itself infinite powers. Mumford's own example says that a sphere with a 5 cm diameter would have the power to pass through a 6 cm round hole, and of course through a 7 cm round hole, and so on. But let's stick to the issue of identity. A power does — or would do — certain things in certain circumstances. It has, say, some *Factual Implications* (FI), manifested or not. In fact some of them will never come to be manifested, but this does not matter, as they are real in the sense that the fragility of a glass that will never break is also real. So given that the identity of a power cannot rest on the property of which it is part — because it's precisely the other way around: the identity of a property lies in the powers of which it's constituted —, it rests on the set of its FI or on something else. The latter is inadmissible; if the identity of power is determined by something other than the whole of its FI, it could be possible to find two powers with the same FI — which is to say, two powers that *can* do exactly the same things —, but that still are two different powers. And then there could be two different properties with exactly the same causal profile, which is not only inconsistent with the above, but with the basic purpose of this theory. Then, the nature of a power can only be determined by its FI: what a power *is*, is just what it *can do*.

However, it cannot be just that. Let's present the argument as we should: the nature of a power is exhausted by (i.e. it is, in the extensional sense) the set of its FI, or it is something else, but ontologically dependent on those FI, i.e. some kind of entity supervening upon a set of not actualized dispositions. The first horn of

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[10] For the treatment of this and other problems associated with powers see Handfield (2009), Ellis (2010) and Groff and Greco (2013).

this dilemma could not be the case; if the nature of a power were exhausted in its FI, then we would go back to the empty notion of potentiality — which Mumford explicitly rejects — and it would not make sense to say that a power has some kind of actuality when is not manifested. In sum, Mumford's philosophical position would be reduced to assertions like "objects fall when one pushes them". The only way out of this problem is to understand FI as an addition of being, but that would be a quite strange metaphysics. The fragility of a glass should be understood extensionally as the set of its FI, i.e. as the set of those possible times in which, under the right circumstances, the glass would break. But supposing that there is a glass that stays in one piece forever, in what sense are the FI that constitute its fragility real? They could not be real in the sense that manifestations are, as manifestations are events that occur in space and time. Non-actualized FI must have a different kind of existence, what is often called *subsistence* in the context of discussions around non-existing entities[11]. This supposes a serious multiplication of entities since each power is reduced to an infinite number of subsistent FI, and just a little of them (or maybe none of them) will turn out to be real manifestations of the power. And if this doesn't seem worrying enough, there is another major concern to be faced: In what sense could it be said that the FI that constitute fragility are *present* in the glass? Objects are constituted by properties, properties by powers, and powers by subsistent FI, but how could this be? How could an existing power be constituted by non-existing events? This seems to be a dead-end.

Mumford's own solution to this problem is to say that powers are neither directed towards their FI nor to their particular manifestations; powers are powers *for* the instantiation of a property, i.e. a universal: "[P]owers are directed towards the properties rather than the particular instantiations of those properties at particular times and places, […] the universal is what a power is a power *for...*" (Mumford, 2004, p. 194). This implies some obvious complications. Firstly, properties were defined as clusters of powers and dispositions, but now with universals coming to the rescue powers seems to depend on properties. As soon as a power can stay uninstantiated forever, its corresponding universal must be real (independently of its instantiations) for the power to exist; without its corresponding property a power cannot be a power *for* that property. What started as a metaphysic of immanent powers and propensities is now becoming a theory of transcendent universals.

Certainly that is serious enough, but for sure that's not the most worrying point concerning the solution proposed by Mumford. The problem to be faced now is in fact implicit in that solution: powers could not be reduced to their FI, instead powers are directed towards universals. So we must ask again: what is a power? A power cannot be just what it *does*; if it could be reduced to its manifestations it would be impossible to explain how two powers that are not manifested are in fact two different powers. It would be exactly the same thing to be breakable as to be flammable, under the assumption that both dispositions will never be actualized: as soon as they are non-actualized powers, they would be identical unless they are somehow directed to their FI. But on the other hand, a power cannot be what it *can do*; it could not be, as we saw, reduced to its FI. A power is just *something* directed towards a universal; but because its manifestations are not necessary, the universal can exist uninstantiated, so the only difference between two distinct unmanifested powers is that they are somehow *pointing towards* two different universals. So powers are neither the universals themselves nor their instances, they're just *something* directed towards universals. Nothing in the causal profile of a power — i.e. in the

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[11] See, for example, Russell (1905) and Quine (1953).

things that it does or can do — is constitutive of its identity, instead it's determined by a mysterious relation that is not participation or instantiation, but some kind of *orientation* towards a universal[12]. Apart from that relation and independently of their causal role, powers are just that: something, an essence, a quidditas. Thus this metaphysic of powers and propensities implies precisely the problem it was designed to address, and if NR was rejected because it implies quiddtism, RL should be abandoned for the same reason.

Conclusion

There are many ways to talk about laws of nature, and most of them are just informal or figurative ways to talk about other important philosophical problems such as modality, causation, regularities, explanation, scientific realism, etc. One could have a realist attitude towards all those issues and still not be a nomological realist. Facing questions such as 'are there necessary connections in nature?', 'are there nomological foundations for scientific explanation?' or 'are there regular causal patterns in the world?' many philosophers — and that includes me — would answer: 'of course there are!', but this is not enough to support NR; in order to do so one has to believe that laws are things in the world. Humeans defend an irrefutable but unappealing metaphysic; on the other hand, the so-called internalist conception of laws is in fact a theory about essential properties and natural classes, and its discourse about laws is — if one believes Ellis — nothing more than a loose talk. The metaphysical discussion around laws is thus a dialogue between Mumford and the defenders of the DTA — they are nomological realists since they *do* believe that laws are things in the world. Mumford's major point against them is that laws, as they conceive them, are mere supervening entities and then cannot govern their instances. This objection is based, as I showed, both on an imprecise notion of 'governing role' and an unjustified charge of implausibility.

So the real problem is quidditism. And that's because, ultimately, Mumford's main concern is to give a convincing metaphysical picture of the modality of our world. He believes that modality has to be an immanent feature of objects. That's why he rejects regularist theories for being unappealing. That's also the reason for his rejection of natural laws: the modal character of relations between phenomena cannot be added *from outside*, since being modally related to other properties has to be a constitutive feature of what it is to be a property. Nonetheless, without the 'N' relation Armstrong's properties are not very different from the tides in the Humean mosaic. But he has to pay the price of putting the weight of modality on the shoulders of powers, and that is: the ontological dependence of powers on universals and quidditism. So there are no powers without universals, and the identity of a power is not determined by its relations to other powers; it has nothing to do with its causal profile, but it's fixed by a mysterious non-causal relation in which it's *directed towards* a universal.

From the beginning, the aim of this work was not to solve this problem but to show it. Anyway, I do not want to finish without giving any clue about what I believe is the way out of this problem. Despite thinking that Mumford's dispositionalism entails quidditism — just like NR does —, I believe its main motivation — i.e.

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[12] Even if the nature of the relation could be somehow clarified, it should be noted that this relation cannot be itself causal. For a body to be heatable is to be constituted by a power that is directed to the universal 'heat'. The causal profile of that power is determined by the things it can cause (e.g. heat other bodies) or that can cause its manifestation (e.g. exposure to heat), but the relation it maintains with the universal is not one of them, it is not itself a causal relation, so it is not part of the causal profile of the power but its metaphysical foundation.

to give an account of immanent natural modality — is right. I also believe that not every form of dispositionalism necessarily entails quidditism.

It seems that if one is not willing to believe in laws as things in the world, one should accept the existence of powers as things in the world. But why should one do so? Why does one have to think of the basic ontological constituents as *things*? In recent years, defenders of Ontic Structural Realism (OSR) have been trying to show that objects can be thought of in purely structural terms and that it is possible to develop a metaphysic that assigns ontological priority to relations over individuals. If the modal nature of the structures postulated by OSR could be explained in terms of powers and dispositions — as Esfeld (2009) has suggested —, we may retrace our steps to find a solution to the problem about the identity of powers. According to Mumford, the identity of a power is determined by a relation between the power and a universal, but why can we not start thinking that the power is *itself* that relation? It may look strange at the beginning, but it is coherent with the idea that an unmanifested power is in itself *nothing* but the possibility of the instantiation of a property, some kind of 'place holder' for the manifestation of a universal. Even I cannot think of this possibility as a definitive solution yet, and much more has to be done in order to consider it that way. But I believe that a structuralist metaphysics, such as the one proposed by OSR, is a promising way to solve a handful of interesting philosophical problems. A lot of hard work needs to be done, but this is always great news for philosophers.

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