

Chapter 7

Capacities, Explanation and the Possibility of Disunity

(Originally published in *International Studies in the Philosophy of Science* 17(2): 179–190, 2003)

Preview

Nancy Cartwright argues that so-called capacities, not universal laws of nature, best explain the often complex way events actually unfold. On this view, science would represent a world that is fundamentally ‘dappled’, or disunified, and not, as orthodoxy would perhaps have it, a world unified by universal laws of nature. I argue, first, that the problem Cartwright raises for laws of nature seems to arise for capacities too, so why reject laws of nature? Second, that insofar as there is a problem, it concerns the role of counterfactuals in explanation; I then briefly propose a simple model of counterfactual explanation. Finally, I investigate how a sophisticated version of the regularity theory of laws of nature (that of Ramsey-Lewis) can be neutral between the empirical hypotheses that the world is unified, and that the world is disunified.

Chapter 7

Capacities, Explanation and the Possibility of Disunity

I. Introduction.

Various writers, with Nancy Cartwright one of the most prominent, advocate that in order to understand scientific practice, and what science tells us about the world, we ought to forget about universal laws of nature (especially as conceived by the regularity theory) and begin to focus our attention on the notion of capacities. It is capacities, not laws of nature, that explain what happens: '[L]aws in the sense of claims about what regularly happens are not our most basic kind of scientific knowledge. More basic is knowledge about capacities [...].' (Cartwright, 1999, p. 77).¹ Cartwright also believes the world is, as she says, 'dappled', that is, that there is no simple set of universal laws governing how things in the world behave, but only a disunified and gappy motley of capacities, set in fortuitous or controlled set-ups ('nomological machines'), that give rise to certain patterns of activity: '[N]ot much of what happens in nature is regular and orderly [...]. The world is after all deeply dappled.' (Cartwright, 1999, p. 59).²

One might have reasons for disagreeing with Cartwright about whether the world is actually fundamentally 'dappled' in this sense, but it is a possibility one must acknowledge for it is of course not an *a priori* matter whether the world is unified or disunified. It is something only empirical science can tell us about. It is, as Cartwright demonstrates, a live empirical question whether the world is unified or not, so we would be ill-advised to adopt a view of science that would *a priori*

exclude one or the other of these possibilities. The best conception of science would be able to accommodate both possibilities. Therefore I shall take it to be a presupposition of the debate about unity that our view of science must not rule out either of those possibilities *a priori*—mere armchair reasoning cannot help us decide whether the world is in fact fundamentally unified or disunified.

Even if one disagrees with Cartwright about whether the world is fundamentally unified or disunified, one could and should agree that, though there is some regularity in the world, there is also a lot of irregularity in the often complex way events appear to unfold. Otherwise discovering laws of nature would be a lot easier than it actually is. We thus have to distinguish two theses concerning disunity: the ontological thesis that the world is fundamentally disunified, no matter how it appears to us. And the phenomenological thesis that the world appears disunified, no matter how it fundamentally is. Part of the question we are facing is therefore whether universal laws or Cartwright's capacities are best suited to explain what, at a more superficial, phenomenological level, happens in these more or less irregular ways. That is, which fundamental thesis explains phenomenological disunity?

Cartwright claims (in most of her works, but primarily in *The Dappled World* (1999)) that our evidence (concerning the phenomenologically dappled world, as well as the practices of science) points in the direction of the fundamentally disunified world, and that discrete capacities, not universal laws of nature, best allow us to make sense of this evidence.

I think it is important to take the possibility of fundamental disunity seriously; just as it would be important to take the possibility of fundamental unity seriously, if belief in disunity had been

orthodoxy. But I want to argue against the view that, in order to take the possibility of disunity seriously, we must adopt an ontology of capacities in the way suggested by Cartwright.

My argument is that, if the evidence of disunity points to a problem for the view that universal laws of nature are fundamental, then it also points to a problem for the view that capacities are fundamental, so why reject laws of nature in favour of capacities?³ And then I argue that the claim that there is such a problem rests on the *further* claim that there is a problem about how counterfactuals appear in explanations of what happens, and I briefly propose a simple model of such explanation. Finally, I investigate a sophisticated version of the much derided regularity view of laws of nature (viz. that of Ramsey-Lewis) that appears well suited to make sense of both the possibility of fundamental unity and the possibility of fundamental disunity.

II. Capacities vs. Laws of Nature

I begin by discussing some of Cartwright's core arguments to the effect that universal laws of nature are ill suited to account for phenomenological disunity, and I critically assess the claim that Cartwrightian capacities are better suited.

Problems about laws of nature

Here is an argument that has been central to many of Cartwright's writings. At a superficial level, as I noted above, the world seems 'dappled' in the sense that there are not many 'clean', sustained regularities in the world. But our fundamental (deterministic) laws of nature are of the form: all *F*s are *G*s, and so it follows from them that, in so far as there are *F*s, there *are* regularities in the world. Therefore, our laws of nature are not true of the world.

A defender of the law that all *F*s are *G*s should agree that often *F*s come along that are not *G*s, but the defender could add that this is because conditions were not favourable due to various interfering factors. Therefore we should acknowledge that laws of nature come with *ceteris paribus* clauses (CP clauses), such that, *all else being equal*, all *F*s are in fact *G*s. Cartwright's major objection to this proposal is that it makes the laws of nature true in favourable conditions, but not elsewhere; so they are not true in those complex, unfavourable real-life conditions where we need them to explain what happens (Cartwright, 1983, Essays 2, 3; 1999, p. 24).

As Cartwright notes, the defender of the law that all *F*s are *G*s, *ceteris paribus*, may counter this by observing that laws support counterfactuals such that, for any particular *F* which is not in fact *G*, if conditions were favourable, then it would be *G*. This is a way of insisting that the law could go into explaining what happens, even where conditions are not favourable, and where the law is therefore not instantiated (of course, the defender may have other options, but this is what Cartwright focuses on and it seems an obvious way to avoid the problem that laws of nature are mostly not explanatory).

Cartwright has grave doubts about the role of counterfactuals. Counterfactuals account for how laws can be true, even though there is a scarcity of regularities; but, if one is a regularity theorist about laws, what then becomes of the regularities that were supposed to provide evidence for the laws in the first place? (Cartwright, 1999, p. 144–5). In addition to that problem, it seems that counterfactuals do not give the right kind of explanation of what happens. Where we have complex, unfavourable conditions we do not just want to say that, were conditions otherwise, then a certain other event (*F*s being *G*) would obtain. Rather we want to explain how the law that all *F*s are *G*s contributes to the events that *actually* unfold (Cartwright, 1989, p. 176–7). These misgivings can be

formulated in various ways. As we shall see, my focus will primarily be on an early, and comparatively moderate, formulation, from *How the Laws of Physics Lie*: ‘Clearly this counterfactual bears on our explanation. But we have no model of explanation that shows how. [...] We think the counterfactual is important; but we have no account of how it works.’ (Cartwright, 1983, p. 69).⁴

Cartwright’s thesis is now that if we believe that capacities rather than universal laws of nature are fundamental, then the above kinds of problems will not arise. The picture of the fundamentally disunified world of capacities is roughly this: knowledge of capacities is knowledge of what things *tend* to do (of their Aristotelian ‘natures’). Reliable regularities—of the sort described by laws of nature—come about when capacities are harnessed appropriately, and capacities are what explain why those regularities come about. Finally, though we may think that capacities ‘try’ to do their stuff outside those contexts where they are harnessed, we really have little knowledge about those contexts, in particular, for all we know, most of what happens in nature may be governed by no laws at all (Cartwright, 1999, Ch. 1–4).⁵

However else one might argue for the capacities view, the claim must now be that the capacities view is not marred by the same problems as the universal laws of nature view. That is, capacities cannot have pretensions to the same kind of universality as laws of nature; it must not create problems if they turn out to involve CP clauses, and they cannot rely on counterfactuals for their ability to explain what happens. If they do have these problems, then capacities are just as bad or as good at dealing with phenomenological disunity as are laws of nature.

Capacities as dispositions

A core point in Cartwright's defence of capacities is the insight that if a certain capacity is to be explanatory in the world's actual complex conditions and explanatory of the world's various composite events, then the manifestations of the capacity cannot be linked exclusively to a very narrow set of possible manifestations or a very narrow set of favourable conditions. Capacities must therefore be able to manifest themselves in many ways in many types of conditions. Cartwright makes this point forthrightly (in a discussion about how scientific invention is possible):

Much of modern scientific theory is about capacities, capacities which can have endless manifestations of endless different varieties [...] Similarly charged particles repel each other, opposite charges attract; what that can amount to in terms of motions and location of the particles is limited only by our imagination. (Cartwright, 1999, p. 64)

This could seem to be at odds with the natural view that talk of capacities is just talk of dispositions. Dispositions do not normally allow endless manifestations (this point is important, as we shall see below). Though Cartwright does claim that the two notions differ (Cartwright, 1999, p. 59), she does also acknowledge that capacities may be like the highly generic (or multi-track) dispositions discussed by Ryle (1999, p. 64), so I will adopt the terminology of dispositions from now on.⁶ I now want to raise a series of problems for this view, given that these dispositions must have 'endless' manifestations to play the role assigned to them.

Problems for Cartwrightian dispositions

A main reason why we need dispositions, then, is that we want to explain the relative contribution of different causes to singular complex events. We saw that counterfactuals supported by laws may have problems capturing the idea that, for example, a particular force, among other forces, contributes to such an event to a certain degree. That is, we need a way of capturing that a force may, in Cartwright's words, 'try' to manifest itself in a variety of conditions; that it has a certain tendency to manifest itself (Cartwright, 1999, p. 28–29, 66; Cartwright, 1989, p. 177). Cartwright's claim is that dispositions can capture this idea:⁷ their possible manifestations are 'endless' so, in a given situation, a disposition is capable of manifesting itself only to a certain degree.⁸

Notice firstly, that we cannot take Cartwright's insistence that dispositions have 'endless' manifestations too literally. If there is really no end to the ways in which a disposition can manifest itself, then it is a *vacuous* disposition, i.e. something's disposition to do precisely what it does and nothing else, whatever it does (See Forbes, 1984, p. 230). Such a disposition is vacuous because ascribing it to something will not tell us anything at all; there is no way to distinguish it from other dispositions that the thing may have, or from the thing having no disposition at all.

Hence, if talk of dispositions is to be significant at all, there must be ways to set limits to the kinds of manifestations that go with a particular disposition. Importantly, this requirement applies to Cartwright's account in two stages: first, to the 'full' or defining manifestations of a disposition when no other forces are at work, and, second, to the 'incremental' manifestations of the disposition when it 'tries' to manifest itself when other interfering forces are at work. Without setting a limit to the kinds of ways a disposition can have a tendency to try to manifest itself, the ascription of such tendencies will be vacuous in the sense described above: without such limits *anything* could count as the disposition trying to manifest itself.

One can set these limits by specifying types of characteristic manifestations and the favourable conditions in which something's manifestations are manifestations of a particular disposition.⁹ But if we have to specify favourable conditions, then it seems we must accept that dispositions support counterfactuals about what would happen if these conditions were to obtain, and presumably these counterfactuals are then potentially at service to explain what happens outside those conditions.

This leaves Cartwright with an unattractive choice. On the one hand, if dispositions are held to be explanatory outside the favourable conditions specified for manifesting and trying to manifest themselves, then they are so in virtue of the counterfactuals they support; but if this is accepted, then it seems unreasonable to persist in denying that the counterfactuals supported by universal laws of nature can be explanatory. Here, a dispositionalist may try to resist by insisting that dispositions have an all-important wider explanatory range because they can explain the contribution of dispositions that are manifested merely *partially*, in contrast to the full manifestation of laws of nature. This is a valid point in favour of pursuing the dispositionalist strategy, but it is irrelevant to the issue at hand that concerns what happens when favourable conditions—for full *or* for partial manifestation—do *not* obtain (see also fn 7). The crucial issue is that partial, incremental manifestation of dispositions also must be understood to occur in favourable conditions, just as is required for full manifestation of a disposition, otherwise they are vacuous. But then the problem of what happens outside those conditions must be addressed. If the answer is that dispositions also can explain outside the conditions (in virtue of counterfactuals), then the same must be possible for laws of nature. That is, then there is no obstacle to allowing laws of nature being explanatory in the unfavourable conditions for that law (so they can explain in conditions that some disposition counts as favourable for partial manifestation). But then, by parity of reasoning, the initial reason for

pursuing a kind of dispositionalism immediately falls away. This objection therefore raises serious questions for dispositionalism while taking seriously what dispositionalists take to be a main advantage of their account: that dispositions can partially manifest themselves.

On the other hand, if dispositions are held *not* to be explanatory outside their favourable conditions for manifesting and trying to manifest themselves (perhaps because of scepticism about the explanatory role of counterfactuals), then the world would be very dappled indeed: every situation that is not covered by the favourable conditions for some disposition would only be explainable by positing a new, *ad hoc*-ish, disposition designed to cover precisely that situation. If we have no way of saying that it was an 'old' disposition trying to manifest itself in a new situation, then we must say that it is a new disposition. Moreover, if we are prepared to set aside the possibility that the world is one big disposition, this view of dispositions would make it *a priori* knowable that the world is fundamentally disunified. If I know that the world is fundamentally dispositional and that the counterfactuals supported by dispositions (and laws) cannot explain, then I know that the world *must* be disunified to some extent. But this goes against what I at the beginning argued must be a presupposition of the debate, viz. that it is not knowable from the armchair whether the world is unified or not.¹⁰

There might be another way to view the problem concerning how we can explain what happens in unfavourable conditions. Perhaps we should rather say that when a disposition is required in a new situation, our conception of an old disposition is *altered* such that this disposition is seen as more inclusive, covering the new situation too. But this way lies *global* dispositionalism: the view that the world is one huge disposition that does what it does. Not only is this a vacuous disposition, it also seems to leave us with exactly the same picture of the world as the regularity view of laws of

nature: if we want to do science we have to discover and systematise regularities. Whether these regularities are the manifestations of a huge disposition or not seems irrelevant.¹¹

So a dispositionalist must tread a perilous path: if dispositions have literally endless manifestations, then they are vacuous; if they are too prolific we get *a priori* disunity; if too inclusive we get irrelevant global dispositionalism.

Prima facie, there seems to be two possible ways to try to avoid these dangers: (i) accept that multi-track dispositions support counterfactuals, and that counterfactuals can be explanatory. This option would leave it an empirically decidable matter how unified the world is, but it would also allow us to re-instate universal laws of nature as explanatory. Or (ii) accept that multi-track dispositions support counterfactuals, but deny that counterfactuals can be explanatory. This option would still prevent universal laws of nature from playing their role, and it would leave us with the perhaps more acceptable *a priori* knowable conditional that if science is explanatory, then science represents a very disunified world. It would not be ruled out *a priori* that the world is fundamentally unified, but it would be ruled out that science could explain such a unified world.

The crucial issue concerns whether counterfactuals can explain

Given Cartwright's scepticism with regard to universal laws of nature, it would appear she ought to take option (ii). This means that her position hangs on the claim that counterfactuals are explanatorily *idle*.¹²

Straight off, something seems amiss in Cartwright's attack on the notion that counterfactuals can explain what happens. A counterfactual supported by the law that all *As* are *Cs*, *ceteris paribus*, can

be this: if it were that x is A , and the CP clause is satisfied, then x would be C . Cartwright's claim is that this counterfactual tells us nothing about a composite situation where x is A and something prevents the CP clause from being satisfied, and where x is not C . It would be easy to interpret this claim in terms of the notion that in the composite situations the truth of the counterfactual is undermined because we have the antecedent of the counterfactual (plus something else), and the negation of its consequent. But this should have no bearing on the truth of the counterfactual because one cannot strengthen the antecedents of counterfactuals. The mere observation that the world is complex doesn't therefore in itself create any problems for the notion that counterfactuals can explain what happens. We just need to locate the role of these true counterfactuals in explanation. Therefore it seems to me that what remains of Cartwright's arguments is the early, more modest point I mentioned above, viz. that we do not as yet have a model of explanation that shows how counterfactuals explain (Cartwright, 1983, p. 69). The observation about the semantics of counterfactuals suggests how we should begin thinking about such a model, for it shows, I think, that one should not have too high expectations of the role that counterfactuals have in explanation. We cannot expect counterfactuals to have direct explanatory relevance for what in fact happens; they must in some way have a more indirect explanatory relevance. I now turn to a discussion of this issue.

III. Counterfactuals in explanation

We need to understand how counterfactuals can enter explanations of singular composite events, such as an object a with charge e and mass m taking a certain trajectory. The purpose of this section is therefore to briefly provide a more positive answer to Cartwright's question concerning the explanation of how laws like Coulomb's law and the law of gravitation each can contribute to how

complex events unfold. In metaphorical terms, the question concerns how hard various forces ‘try’ to manifest themselves in a particular situation.¹³

This ‘trying’-conception of the explanatory task seems to suggest that the explanation in question is a species of contrastive explanation (Lewis, 1986, Lipton, 1993). If we want to know what the relative contributions of various forces were in a taking trajectory t we can ask like this: why did the composite force cause a to take trajectory t , rather than t' ? The answer can be that a took that trajectory because, given the charge and mass of a , the force due to electricity was of this magnitude and the force due to gravitation of that magnitude; if the magnitudes of the forces had been different in certain ways it would have taken the trajectory t' .¹⁴ Such an answer indirectly informs us how ‘hard’ the different forces were ‘trying’ to manifest themselves in that particular situation by informing us how events would unfold, had the magnitudes of the forces been different. We get information about the forces at play in the actually occurring case by being able to systematically pair causal accounts of the actual and the counterfactual events. In general, the contrastive why-question is this: why did the (possibly composite) cause C have the effect E , rather than E' ? And the explanation will typically include information to the effect that had it been that C' occurred, then it would have been that E' occurred. Notice that on this conception, the contrastive *explanandum* is not why E occurred rather than not occurred at all. There is no reason to think that an answer to that question would inform us about the relative contribution about the involved forces. Instead, the question concerns the contrast between E and E' , and thereby focuses on something about the way that E occurred, given it occurred. If the contrast concerns, not why E occurred at all, but why it occurred in a certain way, it becomes plausible to draw on facts about how things would be if it had occurred in a different way. This is important because it serves to ward off the objection that since it is E we wish to explain, information about other, counterfactual,

events like E' is not going to be useful. This objection is justified if we had wished to explain why E occurred at all, but not if we wish to explain why the *explanandum*-event occurred as E and not as E' .

So our question is: what role do the counterfactuals supported by laws (or dispositions) play in such contrastive explanations? Coulomb's law and the law of gravitation support ranges of counterfactuals, depending on the values of the various variables (e.g., were the mass of a to increase to m' the force due to gravitation would increase accordingly) (Cf. also Woodward, 1993, p. 253ff). These counterfactuals ground our answer to the contrastive question concerning the relative contributions of the forces: we can say that those particular forces, due to gravitation and electricity, explain why a took the trajectory t rather than t' because, if the charge and mass of a had been different in certain ways, then the forces due to gravitation and electricity would be of such-and-such magnitudes. In general, then, counterfactuals ground answers to our distinctive contrastive questions by providing systematic information about how different causes would influence how events unfold. We learn how various causes contribute to what happens by learning what would systematically happen, were things relevantly different. Counterfactuals do thus give indirect information about the way things actually happen, but if they nevertheless give the information we are seeking, then this ought to be unobjectionable.

We can illustrate this conception of explanation via a re-appraisal of the story according to which we can explain the composite case by explaining how the two forces add vectorially to give the resultant force. What the counterfactuals supported by each of the two laws give us is the opportunity to add other relevant vectors, e.g., vectors that reflect that the mass and thereby gravitational force has increased. Such vector diagrams provide a way of illustrating that had things

been otherwise, then events would unfold in other ways. We can make as many vector diagrams as there are pairs of counterfactuals, and they demonstrate the contributions of the various forces and thereby explain the contrast in question. Cartwright's original objection to the vector addition story is that 'the component forces are not there, in any but a metaphorical sense, to be added; and the laws that say that they are there must also be given a metaphorical reading' (Cartwright, 1983, p. 59) and that 'the force of size Gmm'/r^2 and the force of size qq'/r^2 are not real occurrent forces' (Cartwright, 1983, p. 60). But once we have construed the story according to our conception of contrastive explanation we can see that this objection is misguided. The counterfactuals supported by laws can go into contrastive explanations even though unfavourable conditions ensures that the forces they describe are not actually occurring in the way described by any law taken alone.

If it is agreed that such contrastive explanations can in fact provide the explanations we were after, then it seems unreasonable to keep complaining that the represented forces can't explain anything if they are not actually occurring in the way described by any law taken alone. Such a complaint is only justified if there remains some explanatory task that can't be discharged without that kind of actual presence of forces. But in the light of the above model it is difficult to see what that task should be. This kind of complaint thus just seems to beg the question against the view that the counterfactuals supported by laws can explain. The complainer needs to provide an argument that we need such presence of forces, but why increase the demands on the *explanans* if the *explanandum* is already accounted for?¹⁵

I claimed that of the problems Cartwright raises the most pressing seems to be the problem of how counterfactuals can explain what happens. But given the above conception of contrastive explanation, there does not seem to be anything problematic in how counterfactuals can be

explanatory because the counterfactuals help explain what Cartwright was after, viz. the contributions of various forces in composite cases. The consequence is that it is not possible to support the dispositionalist view by denying that counterfactuals can go into explaining what happens, and, further, that the main complaint about universal laws of nature is gone.

IV. The regularity theory of laws of nature and the possibility of fundamental disunity

I began by observing that our view of science had better not leave it an *a priori* decidable matter whether the world is fundamentally unified or disunified. We saw that commitment to Cartwrightian dispositions may bring us into conflict with this observation. Also, since I have proposed a way to understand how counterfactuals can go into explaining what happens, Cartwright's attack on universal laws of nature can be refuted. One could think that this leaves us with the unwelcome result that if we adopt a dispositional view, then we *must* say that the world is disunified, and that if we adopt a laws of nature view, then we *must* say that the world is unified (since laws are universal). However, I think that an appropriately sophisticated version of the regularity theory of laws of nature is well suited to make room for reasonable conceptions of both the possibility that the world is fundamentally unified and the possibility that it is fundamentally disunified, whatever the truth may turn out to be (there may be other notions of laws of nature, e.g., a necessitation notion, which are also well suited for disunity; I focus on regularity views because Cartwright is an empiricist who wants to distinguish her position from the normal empiricist regularity view of laws of nature).

The version of the regularity theory I have in mind is the theory suggested by Ramsey and developed by Lewis: A regularity *R* is a law of nature iff *R* is either an axiom, or a theorem, in (each of) the best system(-s), that is, the explanatorily strongest and most simple deductive system(-s) of

regularities, given all regularities in a world, at all times, everywhere (Lewis, 1973, p. 72–77). If a regularity is not an axiom or a theorem in the best system, then it is an accidental regularity.

There are three initial comments to make on this theory: firstly, the fact that it relies on simplicity and strength does not need to imply that it is a subjective matter which system is best: as Lewis notes, it might very well be that the best system wins by a very wide margin, such that there is no real scope for subjective factors to play a role in selection of alternatives (Lewis, 1994, p. 479).

Secondly, it would be implausible if we needed to be omniscient of all regularities at all times and places in order to know a law of nature. But this is not what the theory says; on the contrary, it leaves room for the very natural view that science is developing, and that we may know some laws, but that what we believe are the laws may change as more regularities come in to find their place inside or outside the system (Lewis, 1973, p. 74. This addresses the ‘serious scepticism’ about something like the Ramsey-Lewis view, mentioned by Cartwright and Dupré (1988, p. 522)).

Thirdly, it may be that irreducibly probabilistic laws can be accounted for too. Add to simplicity and strength the criterion that the best system should be the one that *fits* the history of the world best: the best system needs to get the final frequencies right too (*modulo* negotiation on matters of simplicity and strength) (Lewis, 1994).

Here is how Lewis describes the interplay between the notions of simplicity and strength:

The virtues of simplicity and strength tend to conflict. Simplicity without strength can be had from pure logic, strength without simplicity from (the deductive closure of) an almanac. [...] What we value in a deductive system is a properly balanced

combination of simplicity and strength—as much of both as truth and our way of balancing will permit (Lewis, 1973, p. 73).

This indicates well how the Ramsey-Lewis theory could deal with both the possibility that the world is fundamentally unified, and the possibility that it isn't. If the best system is much more like an almanac than pure logic—if it is a patchwork of phenomenological laws for a multitude of forces—then it represents a fundamentally disunified, 'almanac' world. If, in contrast, the best system is much more like pure logic than an almanac—if it is a relatively seamless net of few universal laws for very few forces—then it represents a very unified world.¹⁶

We saw that one of the worries Cartwright has about counterfactuals is that they obscure the fact that there are *too few* actual regularities to justify holding a regularity theory of laws of nature. Because of the complex way events unfold, laws of nature rest, not on actual regularities, but on counterfactual regularities, according to Cartwright. What Cartwright have in mind must be that there are too few clean, sustained, univocal regularities to lend credibility to a regularity theory. In the context of the Ramsey-Lewis theory this objection carries little weight: it might very well be that in the best system, once all regularities—whether sustained or short-lived—are taken into consideration, the regularities that are laws are mainly some of the many single instance regularities (some of which were manifested in a laboratory just once, say). I don't see why it couldn't even be that considerations of simplicity and strength dictate that some actually uninstantiated regularity is a law of nature. What drives this theory of laws of nature is not which regularities are most regular, so to speak, but which regularities occur in the best system.¹⁷

How well would an ‘almanac’ world capture what Cartwright originally had in mind with the notion of the ‘dappled’ world? As well as it can, given our discussions of Cartwright’s notion of dispositions and of the role that counterfactuals after all have in explanation. The almanac world may be like the dappled world in the sense that there are not a few, simple, physical laws at the bottom of the pile; there may instead be very many high-level laws. But it will be unlike the dappled world in the sense that nothing prevents a given high-level law from being explanatory in a host of different situations, also outside the *ceteris paribus* conditions it comes with—there will always be a possibility of what Cartwright calls ‘cross-wise’ reduction (Cartwright, 1999, p. 25).

It may be that orthodoxy now is that the world is fundamentally unified. We are hoping to find the few basic physical laws that underpin it all. If Cartwright is right, then this is a pipe dream. My point is that we can put this in the terms of the Ramsey-Lewis theory, it may be that, as more regularities come in, we may discover that there is no very simple, very neat set of fundamental laws. And this is a possibility we can account for without adopting an ontology of dispositions.¹⁸

References

- ARMSTRONG, D. (1983) *What is a Law of Nature?* (Cambridge, Cambridge University Press).
- BEEBEE, H. (2000) The non-governing conception of laws of nature, *Philosophy and Phenomenological Research*, LXI, pp. 571–94.
- CARTWRIGHT, N. (1983), *How the Laws of Physics Lie*, (Oxford, Clarendon Press).
- . (1989) *Nature’s Capacities and their Measurement*, (Oxford, Clarendon Press).
- . (1999) *The Dappled World*, (Cambridge, Cambridge University Press).
- CARTWRIGHT, N & DUPRÉ, J. (1988) Probability and causality: Why Hume and indeterminism doesn’t mix, *Nous*, 22, pp. 521–36.

- EELLS, E. (1995) Cartwright on probabilistic causality: Types, tokens and capacities, *Philosophy and Phenomenological Research*, 55, pp. 169–175.
- FORBES, G. (1984) Scepticism and semantic knowledge, *Proceedings of the Aristotelian Society*, LXXXIV.
- FORSTER, M. R. (1988) Unification, explanation and the composition of causes in Newtonian mechanics, *Studies in History and Philosophy of Science A*, 19, pp. 55–101.
- GALISON, P. AND STUMP, D. J. (eds.) (1996) *The Disunity of Science: Boundaries, Context and Power*, (Stanford, Stanford University Press).
- GLENNAN, S. S. (1997) Capacities, universality, and singularity, *Philosophy of Science*, 64, pp. 605–626.
- HÜTTEMAN, A. (1998) Laws and dispositions, *Philosophy of Science*, 65, pp. 121–135.
- LEWIS, D. (1973) *Counterfactuals*, (Oxford, Blackwell).
- . (1986) Causal explanation, in: *Philosophical Papers*, Vol II, (Oxford: Oxford University Press).
- . (1994) Humean supervenience debugged, *Mind*, 103, pp. 473–490.
- LIPTON, P. (1993) Contrastive explanation, in: David-Hillel Ruben (Ed.), *Explanation*, (Oxford, Oxford University Press).
- . (1999) All else being equal, *Philosophy*, 74, pp. 155–168.
- LOEWER, B. (1996) Humean supervenience, *Philosophical Topics*, 24, pp. 101–127.
- MORRISON, M. (1995) Capacities, tendencies and the problem of singular causes, *Philosophy and Phenomenological Research*, 55, pp. 163–168.
- MUMFORD, S. (1998) *Dispositions*, (Oxford, Clarendon Press).
- . (2000) Review of *The Dappled World*, *Philosophy*, 75, pp. 613–16.

SPURRETT, D. (2001) Cartwright on laws and composition, *International Studies in the Philosophy of Science*, 15, pp. 253–258.

WOODWARD, J. (1983) A theory of singular causal explanation, in: D.-H. Ruben (Ed.) *Explanation*, (Oxford, Oxford University Press).

¹ For other kinds of dispositionalists, see Mumford, 1998, Lipton, 1999.

² For an overview of the debate about disunity see Galison and Stump, 1996.

³ Some writers propose that Cartwright's talk of capacities is not, in the end, distinguishable from talk of laws of nature, or that it cannot be made sense of without being essentially about laws of nature (see Morrison, 1995, Eells, 1995, Glennan, 1997). I make the related but different claim that Cartwright's objections to laws of nature backfire on the notion of capacities.

⁴ Here we must notice a complication. Some people hold that *ceteris paribus* laws (CP laws) do not support counterfactuals (e.g., Lipton, 1999, p. 157). Clearly, if it is a law that all *F*s are *G*s, *ceteris paribus*, then it may often not be true that if *x* were *F*, then *x* would be *G* since the CP clause may not be satisfied. But, equally clearly, the CP law does support another counterfactual: if *x* were *F* and the CP clause were satisfied, then *x* would be *G*. And all we need to say is that if the CP law is to be explanatory outside the conditions described in the CP clause, then it is those counterfactuals that had better be explanatory. And we must construe Cartwright's misgivings as pertaining to the latter claim (which seems fair since she believes that all laws are CP laws, and that laws support counterfactuals). The fact that the next *Fx* we find is not *G* does not detract from the truth of the counterfactual that if it were *F* and if the CP clause were satisfied, then it would be *G*.

⁵ We should briefly notice a further worry that Cartwright has, this time about the specification of the CP clauses for practical, experimental purposes. The worry is that when we devise an experiment where conditions are meant to be favourable for the law to be manifest itself, then there are too many potential interfering factors that need to be controlled. We need some way of dividing all these factors into the relevant factors and the irrelevant ones. Cartwright's claim is that the regularity theorist of laws of nature has not got the resources to do this (Cartwright, 1999, Ch. 4,

§3-4); and that the only way to begin dividing the factors relies on a ‘robust sense’ of what will impede and what will facilitate the capacities we are interested in revealing in the experiment, that is, relies on a robust sense of the capacity in question (Cartwright, 1999, p. 87).

⁶ This is also noticed by Mumford 2000, p. 615. Moreover, when Cartwright explicates what capacities are, she comes close to giving the standard definition of dispositions: ‘First, [...] we assign [capacities] not to substances but rather to collections or configurations of properties, or to structures’ (Cartwright, 1999, p. 81). That is, capacities are second-order properties, just like dispositions. ‘Second [...], what appears on the surface is a result of the complex interaction of [capacities]. We [don’t] expect that the [capacities] that are fundamental for physics will exhibit themselves directly in the regular or typical behaviour of observable phenomena’ (ibid.). A plausible interpretation of this is that capacities come with a notion of favourable conditions, just as dispositions do. ‘Third, [...] we [don’t] identify [capacities] with essences. [W]hen we associate a principle of change with a given structure, we expect that association to be permanent, to last as long as the structure is what it is’ (ibid.). On a plausible reading, this says that capacities are multiply realisable, i.e. they can be the second-order properties of having (potentially varying) first-order properties, just as dispositions are multiply realisable.

⁷ This view receives support in Hütteman, 1998. He distinguishes between discontinuously manifestable dispositions (DMDs) (e.g., fragility) and continuously manifestable dispositions (CMDs) (e.g., solubility) where we can see the latter as the dispositions that in Cartwright’s terms ‘try’ to manifest themselves, even when the manifestation conditions are not satisfied. The claim is that CMDs help us explain what happens when the manifestation conditions do not obtain. This seems wrong to me: if the disposition is manifesting itself continuously, then it is manifesting itself *simpliciter*, and then its manifestation conditions must be obtaining; notice that this is how things

are for DMDs too. But then the distinction between DMDs and CMDs does not help giving us an account of what happens when the manifestation conditions do *not* obtain.

⁸ In the literature about dispositions it is often noted that dispositions are useful because they persist even though they are not manifested. So if laws are really basically dispositional, then things can possess dispositions even though their CP clauses are not satisfied. But it seems to me that Cartwright is right to insist that we need an account of how such unmanifested dispositions can go into explaining composite events when the CP clause is not satisfied. It is not enough to say that they persist, we must also say how they influence events even though the conditions for their manifestation are not satisfied.

⁹ Perhaps it is too strong to say that we must *specify* favourable conditions since often we can ascribe dispositional properties without having an explicit grasp of favourable conditions. What this shows, however, is just that when we ascribe dispositional properties we rely on an implicit grasp of favourable conditions (this is why we don't withdraw our judgement that someone is brave simply because she failed to act bravely on an occasion when both her legs are broken). Notice that, if dispositions come with CP clauses, then it is not convincing to argue, as Cartwright does (see fn 5), that we can only specify the favourable conditions for an experiment by relying on a robust sense of the disposition in question: one cannot rely on a robust sense of a disposition unless one has *already* grasped the CP clause.

¹⁰ There may be 'sure-fire' dispositions that manifest themselves whenever their triggering conditions are satisfied, but for which all conditions are favourable. Then we would not need counterfactuals to explain what happens when favourable conditions do not obtain, since they always obtain. It will be an empirical matter how many dispositions are sure-fire, so it will not be *a priori* that the world is fundamentally disunified. My response is to set aside the existence of sure-fire dispositions, since it is a presupposition of the entire Cartwright-debate that favourable

conditions often do not obtain. Given this presupposition, it will be *a priori* whether the world is disunified or not.

¹¹ These points are consistent with the idea when one operates with dispositions on one's scientific explanations, then part of one's job is to try to *discover* their typical manifestations and the conditions that are favourable for their manifestation. This of course leaves it a possibility that the dispositions may really be different from what we thought (and not capturable by the descriptions we use to pick them out), and that really the same disposition allows, e.g., a larger range of manifestations. This seems plausible, and compatible with Cartwright's modern empiricist position. All my argument needs to go through is that, if we are meaningfully to talk of dispositions in our scientific explanations, then we must agree that we could never discover that there are no limits to these manifestations – otherwise we would get vacuous dispositions (thanks to Johanna Seibt for raising this issue).

¹² Notice that what is up for discussion is *how* counterfactuals can be explanatory. Since it is common ground *that* laws support counterfactuals we do not have to commit ourselves to a particular view of counterfactuals: this is a debate about whether counterfactuals can be explanatory, not about what the best analysis of counterfactuals are, or what their truth-makers may be.

¹³ For the terminology of 'trying', see Cartwright, 1999, p. 66. For discussion of explanation in composite cases see also Spurrett, 1991, and Forster, 1988.

¹⁴ For something close to this conception of why-questions, see Woodward's notion of what-if-things-had-been-different questions (1993, p. 252).

¹⁵ For the issue about begging the question against regularity theories of laws of nature, see Lewis, 1994, p. 478. A full defence of such a 'non-governing' conception of laws of nature is in Beebe 2000. For more on regularity theories and Lewis see the next section.

¹⁶ This observation is also nicely made by Beebe 2000, p. 575; Beebe also gives a clear presentation, and defence, of the Ramsey-Lewis theory, including an account of how Ramsey-Lewis laws supports counterfactuals (thus answering Armstrong's misgivings on this point (Armstrong, 1983, p. 68ff.)). See also Loewer, 1996.

¹⁷ Notice how we can employ the Ramsey-Lewis theory to address Cartwright's worry that the regularity theory does not have the resources to specify the relevant factors that come with the CP clauses. The Ramsey-Lewis theory has more resources than just regularities, viz. simplicity, strength and fit. And those are resources that seem apt to divide interfering factors into relevant and irrelevant ones.

¹⁸ I wish to thank Uffe Juul Jensen, Steen Brock, Johanna Seibt and Jan Faye for stimulating discussions and comments on earlier drafts. Thanks also to referees of this journal for very helpful comments. I am responsible for all remaining flaws.