Powers, Necessitation, and Time

WESTLAND, DAVID,WILLIAM

POWERS, NECESSITATION, AND TIME

DAVID WILLIAM WESTLAND

Durham University
Department of Philosophy

Submitted for the degree of Ph.D.
2015

Abstract

In this thesis I investigate the question of whether or not dispositional properties are able to necessitate their manifestations. I provide three main discussions that reflect three aspects of my question. The first and second discussions concern different aspects of the 'problem of prevention'. This is the premise that causal interactions can be subject to interference/prevention, generally construed. A number of philosophers have argued that the problem of prevention undercuts the necessitation of lawful regularities in the context of dispositional essentialism. We can term this issue the 'necessitation issue'.

In the first discussion I examine whether or not antidotes *qua* preventative entities are metaphysically possible within the context of Alexander Bird's (2007) dispositional monism. I argue that Bird's theory raises a problem of ontological representation *re* antidotes. The line of thought in this discussion is that it is difficult for Bird to say what antidotes are and how they operate; nevertheless, in this discussion I provide a solution to my problem that stays within the confines of Bird's dispositional monism. In this section of the thesis I remain neutral on the necessitation issue, but I take myself to clarify the question of whether or not dispositional properties are able to necessitate their manifestations by criticising Bird's model of antidotes/prevention and setting out a replacement.

In the second discussion I examine Stephen Mumford and Rani Lill Anjum's (2011) anti-necessitarian strategies. Mumford and Anjum's 'causal dispositionalism' encompasses a theory of dispositional properties, antidotes, and prevention. Mumford and Anjum's causal dispositionalism is not subject to the problem of ontological representation that Bird's theory raises; nevertheless, I argue that their theory is multiply problematic. The purpose of this discussion, taken as a whole, is to show that a recent strategy for attacking the necessitarian claim of dispositional essentialism is weaker than it has appeared to a number of philosophers. In this section of the thesis I move from a neutral stance on necessitation to a defensive stance.

In the first two stages of the thesis, which concern the problem of prevention, I work with the background assumption that dispositional essentialism is a tenable position. In the third section of this thesis, however, I begin by endorsing Stephen Barker's (2013) essay *The Emperor's New Metaphysics of Powers*, which argues that the main articulations of dispositional essentialism are either internally inconsistent or otherwise disguised versions of brute modalism, where brute modalism focuses upon possible worlds as oppose to properties. In response, I develop a replacement position for dispositional essentialism that I term 'temporal essentialism'. I advance temporal essentialism as a prototype position in the properties and laws debate. It aims to provide a metaphysical explanation for lawful regularities by drawing upon the passage of time. In short, temporal essentialism is the position that it is built into a system of ontology that it dynamically adds new entities to its ontological categories and constructs states of affairs in a rule-following way.

Declaration

I confirm that no part of the material has been submitted by me for a degree in this or any other university. No material has been generated by joint work. In all cases material from the work of others has been acknowledged and quotations and paraphrases suitably indicated.

David William Westland
Durham University

Acknowledgements

Since converting to philosophy in 2008 it has been my main aspiration to study for a Ph.D. in this subject. I am pleased to say that the experience has lived up to the anticipation. I have greatly enjoyed my time at Durham University, and I feel privileged to have had the opportunity to be a part of its Department of Philosophy. In writing this thesis I am first of all indebted to my two supervisors, Jonathan Lowe and Sophie Gibb. I have benefited greatly from their expertise in metaphysics and their kind discussion. I would also like to thank my family members who have supported me during this time: my wife Michelle Westland, my parents Lynda Westland and Bill Westland, as well as other family members, such Michelle's parents, Christina Roberts and Stephen Roberts. This thesis would not have been completed without their support. In addition, I would like to thank all of my friends who have made the writing of this thesis enjoyable and memorable. I must also thank the members of staff that have helped me at various times: Robin Hendry, Simon James, Matthew Ratcliffe, and Peter Vickers. Second to last, I am deeply grateful for the AHRC doctorate scholarship that I received so as to complete this project. And last but not least, my special thanks go to Matthew Tugby, who took me on as a student after the very sad passing of Jonathan Lowe in January 2014. This thesis has greatly benefited from his patience, encouragement, and knowledge of all things dispositional. (Any remaining errors rest with the author, of course.)

Dedication

I would like to make a two-fold dedication. In the first place, I humbly dedicate this thesis to Jonathan Lowe (1950–2014), my favourite philosopher. And in the second place, I dedicate this thesis to Michelle Westland.

Table of Contents

Section Two: Anti-Necessitarian Strategies

Introduction

1

Powers, Necessitation, and Time

1.1 Abstract

In this thesis I investigate the question of whether or not dispositional properties are able to necessitate their manifestations. I provide three main discussions that reflect three aspects of my question. The first and second discussions concern different aspects of the 'problem of prevention'. This is the premise that causal interactions can be subject to interference/prevention, generally construed. A number of philosophers have argued that the problem of prevention undercuts the necessitation of lawful regularities in the context of dispositional essentialism. We can term this issue the 'necessitation issue'.

In the first discussion I examine whether or not antidotes *qua* preventative entities are metaphysically possible within the context of Alexander Bird's (2007) dispositional monism. I argue that Bird's theory raises a problem of ontological representation *re* antidotes. The line of thought in this discussion is that it is difficult for Bird to say what antidotes are and how they operate; nevertheless, in this discussion I provide a solution to my problem that stays within the confines of Bird's dispositional monism. In this section of the thesis I remain neutral on the necessitation issue, but I take myself to clarify the question of whether or not dispositional properties are able to necessitate their manifestations by criticising Bird's model of antidotes/prevention and setting out a replacement.

In the second discussion I examine Stephen Mumford and Rani Lill Anjum's (2011) anti-necessitarian strategies. Mumford and Anjum's 'causal dispositionalism' encompasses a theory of dispositional properties, antidotes, and prevention. Mumford and Anjum's causal dispositionalism is not subject to the problem of ontological representation that Bird's theory raises; nevertheless, I

argue that their theory is multiply problematic. The purpose of this discussion, taken as a whole, is to show that a recent strategy for attacking the necessitarian claim of dispositional essentialism is weaker than it has appeared to a number of philosophers. In this section of the thesis I move from a neutral stance on necessitation to a defensive stance.

In the first two stages of the thesis, which concern the problem of prevention, I work with the background assumption that dispositional essentialism is a tenable position. In the third section of this thesis, however, I begin by endorsing Stephen Barker's (2013) essay *The Emperor's New Metaphysics of Powers*, which argues that the main articulations of dispositional essentialism are either internally inconsistent or otherwise disguised versions of brute modalism, where brute modalism focuses upon possible worlds as oppose to properties. In response, I develop a replacement position for dispositional essentialism that I term 'temporal essentialism'. I advance temporal essentialism as a prototype position in the properties and laws debate. It aims to provide a metaphysical explanation for lawful regularities that draws upon the passage of time. Simply speaking, temporal essentialism is the position that it is 'built into' a system of ontology that it dynamically 'adds' new entities to its ontological categories and 'constructs' states of affairs in a rule-following way.

1.2 Introduction

In this chapter I shall introduce the reader to the thesis. I think it will be useful to: (i) outline our general topic, which is the properties and laws debate in contemporary metaphysics; (ii) set out the structure of the thesis and explain its aims and scope; and (iii) provide surveys of the different arguments that I will be making. To this end, I have divided the main body of this chapter into the following parts. In the first part, *Three positions in the properties and laws debate*, I shall draw upon Bird's (2007) demarcation of the properties and laws debate, which marks out three central positions—neo-Humeanism, the necessitation theory, and dispositional essentialism. These three central positions form the general background to our discussion. In this part of the chapter I shall also introduce the specific problem that I will be tackling in the thesis, which concerns dispositional properties and necessitation. (As we shall discuss, dispositional properties, or powers, belong to dispositional essentialism). In the second part of this chapter, *Structure and aims of the*

thesis, I shall set out the main sections of the thesis. In this part of the chapter I will be able to explain the objectives of these sections as well as the line of thought that holds them together. In the third part of this chapter, *Original contributions*, I will highlight the original contributions that this thesis is making to contemporary metaphysics. And in the fourth section of this chapter, *Chapter outlines*, I shall provide outlines of the nine chapters to follow.

1.3 Three positions in the properties and laws debate

The properties and laws debate is currently enjoying a central status in contemporary metaphysics, and it commands a high level of activity. Bird (2007, pp.1–4) provides a three-way distinction for this debate that is useful in compartmentalising the different positions that philosophers advance. He suggests that the properties and laws debate can be viewed as centering on the following associated questions.

What is the nature of properties?
What is the nature of laws?
And what is the nature of the relationship between properties and laws?

The positions that Bird distinguishes set out different answers to these questions, whilst all agreeing (roughly speaking, at least) on a realist stance towards properties and laws.

The first position is neo-Humeanism. Philosophers associated with this position include Lewis (1986), Beebee (2000), Lower (1996), and Psillos (2002). We can understand neo-Humeanism as the view that properties (and relations) are categorical entities and that laws are regularities. Categoricalism is the view that the identity of a property is independent of its physical modal role. Let us use the phrase 'physical modal role' to capture what a property does in terms of the causal interactions that it enters into and the laws that it is bound up with (adapted from Barker 2013, p.606). For example, the scientific predicate 'charge' is involved in causal interactions such as electrostatic attraction and repulsion, which are described by Coulomb's law. (At the level of quantum electrodynamics, we can think of different magnitudes of charge as different amplitudes for photon absorption and emission.) This scientific predicate is a candidate for picking out a

property, where the latter is construed as an "element of being", such as a universal or trope (Lowe 2006, pp.13–5). In the contemporary literature there is a trend towards limiting the properties that are accepted by a metaphysical theory to the 'sparse properties', i.e. to the predicates that are inventoried by current science, or, more strictly, to the predicates that are inventoried by a 'hypothetically-finalised' physics (e.g. Armstrong 1978, p.43; Ellis 2009, p.34). Categoricalism does not deny that properties have physical modal roles, but it does deny that a property's physical modal role is essential to it. A standard way of explicating categoricalism is to say that properties have quiddities. Roughly speaking, a quiddity is a ground for the identity of a property (Barker 2013, p.611). According to categoricalism, then, properties have their identities fixed by their quiddities, which stand over and above their physical modal roles. We can note that if properties are categorical in the above sense, then a property can retain its identity whilst taking on different physical modal roles. For example, whilst it is actually the case that charge is bound up with electrostatic attraction and repulsion, it could have been the case—so far as categoricalism is concerned—that charge entered into the causal interactions that we associate with Newtonian mass, as described by Newton's gravitational law.

This contingency claim for physical modal roles dovetails with the neo-Humean conception of laws as regularities. According to the naive version of this view, a law is a regularity of the form 'For all objects *x*, if *x* has property F, then *x* has property G'. So construed, laws are patterns of property instantiation that hold across space and time. By far the most widely discussed version of the neo-Humean approach to laws, however, is Lewis' (1986) best systems theory. According to this theory, laws are regularities that stand as axioms (or theorems) in the best systematisation of the world's matters of fact. The basic idea is that laws are a special kind of regularity—namely, laws are those regularities that have a prominent deductive/descriptive role with regard to patterns of property instantiation. In any case, the neo-Humean conception of laws—whether naive or sophisticated—takes laws to supervene upon the world's matters of fact, such that laws are nothing over and above the distribution of properties across objects. To see how this neo-Humean conception of laws supports the contingency claim for physical modal roles, we can note the explicit absence of 'governing entities' in Lewis' Humean supervenience (e.g. 1986, p.14). Humean supervenience is a view that Lewis advanced for the sake of philosophical discussion, in the sense that whilst it may have been open to challenges from scientific quarters, its philosophical adequacy

was (allegedly) worth defending. According to this view, all that exists are fundamental objects, such as point-like particles, and their fundamental properties and relations. With this in mind, by the term 'governing entities' we can refer to entities that necessitate—i.e. constrain or force—patterns of property instantiation (I shall have more to say on this issue below).

Firstly, then, Lewis' properties cannot be governing entities, since Lewis has not modified categoricalism in such a way that properties can necessitate. Indeed, the neo-Humean typically portrays categorical properties as 'qualities' in order to emphasise their modal inertness. But secondly, laws *qua* regularities are not governing entities, either: this is the import of saying that laws are (merely) patterns of property instantiation. So what provides a metaphysical explanation for the arrangement of qualities in the world? The distinctive reply of neo-Humeanism is that there is no such metaphysical explanation: the distribution of properties across objects is taken to be 'metaphysically accidental'. Generally speaking, the project of neo-Humeanism is to analyse metaphysical concepts such as 'law', 'causation', and 'chance' with the arrangement of qualities as its starting point. But this starting point is taken as primitive. In consequence, therefore, if the physical modal role of a categorical property is (somehow) provided by its placement in the world's matters of facts, then given that these matters of fact are free from the influence of governing entities, the neo-Humean is able to claim that both laws and the physical modal roles of properties are contingent, since both of these are ultimately decided by 'metaphysically accidental' patterns of property instantiation.

The second position is the necessitation theory. Philosophers associated with this position include Armstrong (1978), Tooley (1977), and Dretske (1977). We can understand the necessitation theory as the view that properties (and relations) are categorical entities and that laws are second-order relations that serve as governing entities. Neo-Humeanism and the necessitation theory agree on the basic construal of properties. But the necessitation theory breaks away from neo-Humeanism in taking laws to be something over and above the world's first-order matters of fact. More precisely, laws are second-order relations, i.e. relations that hold between properties as oppose to objects, which are thought to necessitate patterns of property instantiation. These second-order relations can be termed 'necessitation relations'. They qualify as governing entities in the above sense. In the basic case, a necessitation relation, N, holding between two first-order properties, F

and G, can be symbolised as 'N(F,G)'. The line of thought is that with properties and relations assayed as universals, or repeatable entities, the holding of N between F and G necessitates the regularity 'For all objects *x*, if *x* has property F, then *x* has property G'. In this way, laws are distinct from the regularities that they necessitate, although there is a commonality to each in terms of the properties in question. At this point we can see that the necessitation theory is upholding physically necessary connections between distinct existences (see below). That is to say, in virtue of the law N(F,G), if it is the case that object *x* is F, then it is necessarily the case that object *x* is G. (In the case of probabilistic laws this necessary connection has to be finessed—but we shall bypass this issue for present purposes.)

The question of whether or not there are necessary connections between distinct existences (roughly: entities that do not have each other as parts) is a central question of the properties and laws debate. As noted above, neo-Humeanism is committed to contingency claims for both laws and the physical modal roles of properties. Indeed, for the neo-Humean there is a radical contingency in the world's matters of fact. A third seminal principle that Lewis advances concerns the distribution of properties across objects in his plenitude of possible worlds. Famously—or notoriously, perhaps—Lewis defends a position of modal realism according to which there are infinitely many possible worlds, all of which are fully-fledged concrete existences. (The phrase 'the actual world' is taken in this set up to indexically pick out the world at which it is spoken.) The inventory for this plenitude is Lewis' principle of free recombination. It states that " ... patching together parts of different possible worlds yields another possible world" (1986, pp.87–8). So construed, Lewis can 'copy and paste' self-contained spacetime regions from his possible worlds to 'construct' additional possible worlds; the significance of this principle is that there is at least a possible world for every different specification of objects bearing properties and relations. With this in mind, given the neo-Humean analysis of laws and physical modal roles in terms of arrangements of qualities, we can see that Lewis' plenitude will contain possible worlds where there are minor deviations from the actual laws (e.g. where the value of a physical constant is slightly higher or lower) as well as possible worlds where the laws are wildly divergent. This radical contingency in the world's matters of fact is denied by the necessitation theorist in the following sense. The necessitation theorist claims that laws 'contingently' necessitate patterns of property instantiation. In the first place, the necessitation theorist denies that the holding of N

between F and G is either logically or metaphysically necessary. We can understand metaphysical necessity as the absolute necessity of N holding between F and G in all possible worlds; because this is denied by the necessitation theorist, they maintain that it is metaphysically possible for F and G to be lawfully unconnected. In this way, the necessitation theorist accepts contingency claims for both laws and the physical modal roles of properties (in line with neo-Humeanism). In the second place, however, if it is the case that N(FG), then the regularity 'For all objects *x*, if *x* has property F, then *x* has property G' is necessitated. This necessitation is therefore relative to the contingent law. And so the necessitation theorist accepts that there are 'physically necessary connections' between distinct existences: for in no possible world can it be the case that N(F,G) without it also being the case that all F-objects are G-objects.

The third position is dispositional essentialism. We can understand this position as the view that properties are dispositional and that laws are (in some sense) reflections of dispositional properties. Philosophers associated with this position include Ellis (2001), Molnar (2003), Mumford (2006), and Bird (2007). (I should note that Mumford and Molnar reject the term 'dispositional essentialism'. That said, I think that Bird would classify these philosophers in his third position. Mumford and Molnar typically talk of 'powers' as oppose to essentially dispositional properties.) What does it mean to say that properties are dispositional? The claim at hand is that properties have dispositional essences, where the term 'essence' is used, roughly speaking, to refer to the 'inner nature' of a given entity. (Essences can also be contrasted with accidents; in this context we are contrasting the fixed (essential) nature of a given entity with its variable (accidental) nature. For example, we might say that it is essential that I have the specific biological parents that I in fact have, whereas it is accidental that I have the specific weight that I in fact have.) The distinctive claim of dispositional essentialism is that the identity of a property is fixed by its physical modal role. Dispositional essentialism is therefore opposed to categoricalism. More specifically, dispositional essentialism aims to explicate physical modal roles primarily in terms of dispositionality—hence its title. In this way dispositional essentialism is trading upon essence as the ground of a property's identity and making the claim that this ground is provided by a certain disposition or dispositions (adapted from Barker 2013, pp.612–3). How to understand dispositionality is itself the central problem of the philosophy of dispositions, which is a neighbouring topic of the properties and laws debate. A prominent trend is to say that dispositions

are closely connected to subjunctive/counterfactual conditionals, such that it is possible to reductively analyse a disposition in terms of a conditional that makes reference to a characteristic stimulus–manifestation pair (e.g. Ryle 1949; Goodman 1954). For example, the disposition of fragility is commonly analysed as the disposition to break when struck. The conditional analysis of dispositions is first and foremost a neo-Humean attempt to deny dispositionality a fundamental status: with disposition ascriptions reductively analysed into subjunctive/counterfactual conditionals, the latter can be understood extensionally using possible worlds. In the 1990s, however, there was a number of attacks on the conditional analysis, which concerned the problems of finks and antidotes (Martin 1994; Bird 1998). I shall discuss finks and antidotes below, but for present purposes we can note that these attacks led to a renewed interest in granting dispositionality a fundamental status (Cross 2012, pp.115–6).

There are different models of dispositional properties. The standard model is the stimulus–manifestation model (Bird 2007; Ellis 2001; Yates 2012). This model takes its cue from the conditional analysis in drawing upon stimuli and manifestations for dispositional properties, although it stands opposed to a reductive analysis. Another prominent view is Martin's (2007) mutual manifestation model. In this set up there is no stimulus–manifestation or agent–patient distinction, and multiple dispositional properties are thought to 'mutually manifest' as 'reciprocal partners' (2007, pp.29–30). In addition, there are several understandings of laws in the dispositional essentialist literature, but these different approaches are unified by the view that laws are reflections of dispositional properties. At the centre of dispositional essentialism is the conviction that properties are self-governing entities. (I make a caveat for this claim below.) We can contrast this conviction with the necessitation theory, in which first-order properties are governed from above, as it were, by necessitation relations; and so too can we contrast it with neo-Humeanism, where there are no governing entities at all. Dispositional properties are often termed powers, and these powers are thought to be powerful in the sense that they are capable—from their own resources, so to speak—of manifesting further dispositional properties. On this basis, the dispositional essentialist ideal is that dispositional properties can be used to provide a metaphysical explanation for the patterns of property instantiation in the world. For this reason, dispositional essentialism agrees with the necessitation theory that there are necessary connections between distinct existences. For example, the dispositional essentialist will say that electrons repel electrons,

ceteris paribus, since it is essential to the dispositional property 'unit negative charge' that it manifests electrostatic repulsion on other negative charges. Yates (2012, pp.26–7) calls "orthodox dispositional essentialism" the view that dispositional properties act as truthmakers for subjunctive/counterfactual conditionals, which are then used to deduce laws (construed as propositions concerning regularities). According to Yates, then, orthodox dispositional essentialism involves three ideas *re* the metaphysical explanation of laws. Firstly, different types of dispositional properties have different types of stimuli and manifestations. Secondly, a given type of dispositional property bears a truthmaking relationship to the subjunctive/counterfactual conditionals that concern its physical modal role. And thirdly, laws are construed as propositions that are deduced from the totality of such subjunctive/counterfactual conditionals. Yates (2012, p.26) cites Ellis (2001) and Mumford (2006) as following this view. That said, however, Mumford (2006) has argued that laws are superfluous for the dispositional essentialist, since (briefly stated) laws *qua* governing entities cannot be either external or internal to dispositional properties. As such, Mumford would deny that dispositional properties are self-governed, although we should note that he accepts that the world's matters of fact are metaphysically explainable via the manifestations of dispositional properties. Let us also note that there are versions of dispositional essentialism that maintain that all properties are dispositional properties, termed 'dispositional monism' (e.g. Bird 2007); versions of this theory that maintain a mix of dispositional properties and categorical properties, termed 'property dualism' (e.g. Ellis 2001; Molnar 2003); and versions of this theory that maintain that properties have dispositional and categorical aspects, or otherwise that dispositionality and categoricality are identical, termed the 'limit view' or the 'powerful qualities view' (e.g. Martin 2007; Heil 2003, Jacobs 2011).

A distinctive commitment of both the necessitation theory and dispositional essentialism is that laws/dispositional properties necessitate. In terms of the necessitation theory we have the idea that if it is a law that N(F,G) and object *x* is F, then it is necessarily the case that *x* is G. And in terms of dispositional essentialism we have the idea that if a dispositional property is suitably related to its stimulus (or reciprocal partner), then it necessarily manifests. In both cases, we can think of causes, generally construed, as necessitating their effects. This idea can be broken down to separate out the closely connected concepts of necessitation, sufficiency, and necessity. To say that cause C necessitates effect E is to say that C is sufficient for E—*viz*. if it is the case that C, then it must

be the case that E. As such, where C necessitates E, if it is the case that C, then it is necessarily the case that E. A number of necessitation theorists and dispositional essentialists have thought that causes necessitate their effects in this way (e.g. Armstrong 1997; Ellis 2001; Bird 2007). But there are two caveats to this claim. Firstly, it is standardly thought that causal interactions can be subject to interference and/or prevention. For example, even if a match is properly struck, it might not light in the desired way if there is a gust of wind. And if the match head is damp, then it may not ignite at all. This problem of prevention, to use a concise term, lies behind the finks and antidotes attack on the conditional analysis that I noted above.

> Problem of prevention: the premise that causal interactions can be subject to interference and/or prevention, generally construed. Within different contexts this 'problem' takes on different guises: negative and positive. For example, in Bird's dispositional monism it raises the question of whether or not *ceteris paribus* laws are fundamental. In contrast, Mumford and Anjum use this 'problem' to set out a *sui generis* dispositional modality for dispositional properties, thereby attacking causal necessitarianism (see below).

With regard to antidotes, which are the simpler of the two devices, Johnston (1994) and Bird (1998) argued that the left–right direction of the conditional analysis is false because the manifestation of the disposition could be prevented by a further condition (e.g. the gust of wind above). Hence it is not true, in general, that for object *x* to have disposition D (with stimulus S and manifestation M) is for *x* to M if it were S: this causal interaction can be frustrated by antidote A. In line with this problem of prevention, the necessitation of regularities is standardly accompanied by a *ceteris paribus* clause that excludes additional forces (e.g. Armstrong 1997, p.231; Bird 2007, p.60). A second caveat concerns indeterminism and probability. As we noted above, there is a trend towards limiting the properties that are accepted by a metaphysical theory to the sparse properties. With this in mind, given the prevalence of non-deterministic processes in the fundamental sciences, the epistemic possibility that the sparse properties enter into indeterministic and/or probabilistic causal interactions is taken seriously by theories in the properties and laws debate. A typical strategy is to restrict the necessitation claim to deterministic causal interactions (e.g. Armstrong 1997, p.230; Ellis 2001, p.286).

A number of philosophers have argued, however, that the problem of prevention undercuts the necessitation of regularities (e.g. Cartwright 1999; Lowe 2006; Eagle 2009; Corry 2010; Schrenk 2010; Mumford and Anjum 2011). This is despite the caveat above concerning *ceteris paribus* clauses; in addition, this line of criticism is thought to be independent of the issue of indeterminism and probability. There are multiple variations on this theme. A prominent argument is based upon antecedent strengthening (Eagle 2009; Schrenk 2010; Mumford and Anjum 2011). This argument begins with the premise that monotonic reasoning is distinctive of necessitation. According to monotonic reasoning, if C necessitates E, then E is the case whenever C is the case, regardless of whatever else is the case.

If C necessitates E, then:
If C and Φ, for any value of Φ, then E

Given the problem of prevention, however, we can substitute antidotes as possible values of Φ, which leads to the conclusion that causation fails the test of antecedent strengthening. Recalling the example of the struck match, it cannot be the case that striking a match necessitates its lighting, since the following conditional is false.

If [match is struck] and [there is a gust of wind], then [match lights].

According to the antecedent strengthening argument, then, causes do not necessitate their effects if antidote-based prevention is possible. (Note that this line of criticism is deployed against both the necessitation theory and dispositional essentialism.) These 'anti-necessitarian' philosophers also attack the strategy of *ceteris paribus* clauses that their opponents use to handle the problem of prevention. For example, Armstrong's necessitation theory uses a *ceteris paribus* clause that excludes preventative factors from the antecedent of his necessitation relation. Roughly speaking, this strategy replaces N(F,G) with N(F-in-the-absence-of-preventative-factors,G). In terms of the struck match example, we have the line of thought that N necessitates the regularity 'For all objects *x*, if *x* is a struck match and *x* is in the absence of preventative factors (e.g. gusts of wind), then *x* is a lit match'. Schrenk (2011) argues that the exclusion of all of the preventative factors gives threatens to replace a fine-grained state of affairs with a maximally-specified spacetime region

(e.g. a backwards light cone). He takes this to be problematic as the original insight of Armstrong's theory was to understand laws as second-order relations that hold between sparse properties, such as specific charges and masses (Schrenk 2011, pp.590–91). On the basis of these anti-necessitarian arguments, Mumford and Anjum (2011) have a developed a 'causal dispositionalism'. This position is a version of dispositional essentialism—more specifically, it is a version of pan-dispositionalism, according to which all sparse and non-sparse properties are powers. The central claim of Mumford and Anjum's position is that powers are connected to their manifestations via a *sui generis* dispositional (or 'tending towards') modality. This claim is supported by a vector model of causation, whereby multiple powers 'push and pull' against each other for changes. According to Mumford and Anjum, then, although the powers of the match and matchbox have essential physical modal roles, the causal situation of striking the match can only tend towards its lighting: there are no necessary connections between causes and effects.

As a last issue, we should note that Bird's three-way demarcation is challenged by Barker's (2013) essay *The Emperor's New Metaphysics of Powers*. Bird takes neo-Humeanism, the necessitation theory, and dispositional essentialism to exhaust the "metaphysical underpinnings" of the properties and laws debate (2007, p.4). I have summarised these positions below. (Note that Bird classifies the necessitation theory as 'semi-Humean' because this position rejects dispositional properties (Hume's 'occult powers') and downgrades its necessary connections from metaphysical to physical.)

1. Neo-Humeanism (e.g. Lewis 1986)
   Categorical properties
   Laws are regularities
   No necessary connections

2. Semi-Humeanism (e.g. Armstrong 1997)
   Categorical properties
   Laws are second-order relations
   Physically necessary connections

3. Anti-Humeanism (e.g. Bird 2007)
   Dispositional properties
   Laws are reflections of dispositional properties
   Metaphysically necessary connections

Barker (2013) sets out a fourth position, which he terms 'brute modalism' (see also Barker and Smart 2012). Briefly stated, brute modalism is the position that it is a "basic fact" about possible worlds that categorical properties stand in (metaphysically) necessary connections (Barker 2013, p.611). According to this fourth position, possible worlds are primitive entities that have primitive natures: *viz*. objects instantiating categorical properties. With this in mind, the modal space of Barker's brute modalism is narrower than Lewis' plenitude, since the former but not the latter accepts necessary connections between distinct existences. Hence, in brute modalism there will be no possible worlds where object *x* is F but not G (for example). To accomodate his brute modalism, Barker outlines a different demarcation of the properties and laws debate, which trades upon "three degrees of involvement that physical modality might have in relation to reality at large" (2013, p.606). The first-degree uses worlds as a whole to fix physical modal facts (e.g. patterns of property instantiation). Lewis' neo-Humeanism qualifies as the paradigm first-degree position, since his best systems theory extracts laws from a systematisation of the world's matters of fact. Barker's brute modalism also qualifies as a first-degree position; according to brute modalism, it is the primitive natures of worlds themselves that fix the distributions of properties across objects. The second degree uses second-order relations, and the third degree uses properties; these approaches

are represented by the necessitation theory and dispositional essentialism, respectively. Assuming that Barker's brute modalism is internally consistent, Bird's three-way demarcation is excluding a fourth position. According to Barker, '1.' above should be replaced by '1st degree'.

1st degree

Neo-Humeanism

Categorical properties

Laws are regularities

No necessary connections

Brute modalism

Categorical properties

Laws are trans-world regularities [accepting this claim involves upgrading brute modalism to what Barker terms 'transworld Humeanism']

Metaphysically necessary connections

The dialectical purpose of Barker's brute modalism is to undermine the traditional versions of anti-Humeanism. (In contrast to Bird's usage, I prefer to use the term 'anti-Humeanism' to refer to both the necessitation theory and dispositional essentialism.) More specifically, Barker argues that the four central articulations of dispositional essentialism are either internally inconsistent or otherwise disguised versions of brute modalism. In addition, Barker argues that the necessitation theory (ironically) draws upon the resources of dispositional essentialism, since the only tenable understanding of the necessitation relation is that it has a second-order dispositional essence. Given that the project of dispositional essentialism is in crisis, Barker concludes that both of the central versions of anti-Humeanism—i.e. the necessitation theory and dispositional essentialism—are illusionary metaphysics. Accordingly, there are two main choices for the properties and laws debate: neo-Humeanism and brute modalism. In short, Barker argues that brute modalism is a non-standard version of anti-Humeanism that has been downplayed in the properties and laws debate.

For example, Barker's criticism of Bird's articulation of dispositional monism concerns the difficulty of retrieving a 'governing role' from his SM-relations. According to Bird's stimulus–

manifestation model, all dispositional properties play the roles of 'disposition', 'stimulus', and 'manifestation' by standing in second-order stimulus–manifestation relations, which we can term 'SM-relations'. Bird (2005c) argues that his dispositional properties overcome a central criticism of the necessitation theory: *viz*. that the necessitation relation, as a categorical entity, cannot be used to metaphysically explain patterns of property instantiation. Given that Bird's properties have dispositional essences, Bird argues that laws can be successfully derived from these entities, as noted above. That said, however, Barker (2013, pp.623–28) argues that both Bird's and Armstrong's theories are equally unable to account for this governing role. The governing role is thought to capture a 'fact of necessitation'. Roughly speaking, in terms of Bird's theory the fact of necessitation is as follows: 'If it is the case that SM(P^1, P^2, P^3) at metaphysically possible world *w*—i.e. if it is the case that the SM-relation holds between these three properties at *w*, so as to configure these three entities as causally-relevant dispositional properties in this metaphysically possible world—then all objects *x* that are P^1&P^2 at *w* are also P^3 at *w*. Upon close examination, Barker argues that Bird's SM-relations are analogous to Armstrong's necessitation relation *re* the governing role: both posits are quiddistic entities. With this in mind, Barker argues that Bird has failed to account for the governing role, in line with Armstrong. In addition, Barker argues that Bird overlooked this issue because he confused the fact of necessitation at question with the concept that his dispositional properties are relationally constituted by the network of SM-relations (see also Barker and Smart 2012). Let us term this issue 'Barker's problem of the governing role'. Taken together, Barker argues that Bird is either faced with a regress problem or the acceptance of brute necessary connections.

1.4 Structure and aims of the thesis

I want to investigate the question of whether or not dispositional properties are able to necessitate their manifestations. I have chosen to divide this question into three aspects; correspondingly, I have also divided this thesis into three main sections, with each section discussing a different aspect of the question. In this part of the chapter I shall begin by briefly stating the aims and structure of this thesis.

In this thesis I provide three main discussions that reflect the three aspects of my question. The

first and second discussions concern different aspects of the problem of prevention. In the first discussion I examine whether or not antidotes *qua* preventative entities are metaphysically possible within the context of Bird's (2007) dispositional monism. I argue that Bird's theory raises a problem of ontological representation *re* antidotes. The line of thought in this discussion is that it is difficult for Bird to say what antidotes are and how they operate; nevertheless, in this discussion I provide a solution to my problem that stays within the confines of Bird's dispositional monism. In this section of the thesis I remain neutral on the necessitarianism–dispositionalism issue, but I take myself to clarify the question of whether or not dispositional properties are able to necessitate their manifestations by criticising Bird's model of antidotes/prevention and setting out a replacement. In short, at this stage of the thesis the metaphysical possibility of antidotes is under scrutiny.

In the second discussion I examine Mumford and Anjum's (2011) anti-necessitarian strategies. Mumford and Anjum's causal dispositionalism encompasses a theory of dispositional properties, antidotes, and prevention. In addition, Mumford and Anjum draw upon dispositional actualism as a modal metaphysics. (Roughly speaking, dispositional actualism is the view that actual dispositional properties are the grounds for necessities and possibilities, whether physical or metaphysical.) Mumford and Anjum's causal dispositionalism is not subject to the problem of ontological representation that Bird's theory raises; nevertheless, I argue that their theory is multiply problematic. In the first place, I argue that Mumford and Anjum's antecedent strengthening argument is incompatible with their understanding of causation. And in the second place, I argue that Mumford and Anjum's modal premise—that it is always possible, at least in principle, for a causal interaction to be subject to prevention—is either false or trivial. The purpose of this discussion, taken as a whole, is to show that a recent strategy for attacking the necessitarian claim of dispositional essentialism is weaker than it has appeared to a number of philosophers. In this section of the thesis I move from a neutral stance on necessitarianism to a defensive stance.

At this point I have examined the two aspects of the problem of prevention that are within the scope of this thesis. I have examined whether or not antidotes are metaphysically possible (within the context of Bird's dispositional monism) and I have examined whether or not the problem of prevention can undercut the necessitarian claim of dispositional essentialism (within the context of Mumford and Anjum's causal dispositionalism). With this in mind, at the beginning of the third

stage of the thesis I take myself to be in a position to draw the following conclusion. Dispositional properties are able to necessitate their manifestations if (i) Bird's problem of ontological representation *re* antidotes is avoided, and if (ii) the anti-necessitarian strategies of Mumford and Anjum are countered in the way that I propose. This is the first of two central conclusions that I make in this thesis: *viz*. I conclude that dispositional properties are able to necessitate their manifestations. In other words, I defend Mumford and Anjum's antithesis, i.e. causal necessitarianism. Crucially, this conclusion allows that dispositional properties do not necessitate their manifestations if they enter into indeterministic and/or probabilistic causal interactions.

The third discussion concerns Barker's (2013) problem of governance. At this stage of the thesis I examine a third aspect of the question of whether or not dispositional properties are able to necessitate their manifestations. This stage of the thesis involves a change of direction. In the first two stages of the thesis, which concern the problem of prevention, I work with the background assumption that dispositional essentialism is a tenable position. I do not question the tenability of a property-based understanding of physical modality, and I tacitly assume that dispositional properties are the kinds of beings that are able to provide a governing role. In the third section of this thesis, however, I begin by endorsing Barker's (2013) essay. As we noted in the previous part of this chapter, Barker's central argument is that the main articulations of dispositional essentialism are either internally inconsistent or otherwise disguised versions of brute modalism, where brute modalism focuses upon possible worlds as oppose to properties.

Given that I accept the central argument of Barker's essay, I spend the remainder of the third section of the thesis developing a position that I term 'temporal essentialism'. I advance temporal essentialism as a prototype position in the properties and laws debate. On the one hand, this position is designed to bypass Barker's criticisms of dispositional essentialism and the necessitation theory, since it does not draw upon either dispositional properties or necessitation relations as governing entities. On the other hand, however, temporal essentialism is non-identical to Barker's brute modalism; in addition, I take temporal essentialism to differ from brute modalism in that the former can provide a metaphysical explanation for why there are lawful regularities. (In the case of brute modalism, it is a brute fact that a possible world has a certain pattern of properties.) The line of thought in this discussion is that Barker's problem of governance is a more fundamental

aspect of my question than the problem of prevention, since if dispositional properties cannot provide a governing role, then, *a fortiori*, these entities cannot necessitate or dispose towards their manifestations. At this more fundamental level of investigation, I make the second central conclusion of this thesis: although dispositional essentialism is untenable, temporal essentialism is a promising alternative.

Temporal essentialism is a two-category ontology of objects and (categorical) Platonic universals. I analyse laws as second-order relations that hold between first-order properties, in line with the necessitation theory. That said, however, I do not call upon these entities to provide a governing role. In contrast, the duty of these second-order relations is to provide a function (in the sense of a unique mapping) from their first place to their second place. With this in mind, I term these second-order relations 'selection relations' as oppose to 'necessitation relations'. I symbolise a selection relation as '$', and where it is the case that $(F,G), fixing upon F as the input fixes upon G as the output. The central concept in temporal essentialism is that Platonic universals can provide this 'selection role', and that a candidate for Barker's governing role is the cooperation of laws *qua* selection relations with what I term a 'formal ontological operation' (see below). I think that a source of difficulty for the necessitation theory and dispositional essentialism is that these positions have asked properties/relations to carry the burden of a governing role on their own. The proposal at hand, however, is that the selection relations provide a set of instructions, so to speak, that are acted upon by a different actor; and as the title of my position suggests, this actor is time. Time is called upon to play a role of 'actualisation'.

This proposal involves two main steps. In the first place, I draw upon Tooley's (1997) growing block model, which is a dynamic theory of time whereby past and present states of affairs are actual whereas future states of affairs are non-actual. According to Tooley, necessitation relations govern patterns of property instantiation across time; in addition, Tooley suggests that his necessitation relations provide a metaphysical explanation for the passage of time: *viz*. states of affairs are actualised via the governing role of laws. In the second place, however, temporal essentialism construes the passage of time as the performance of a formal ontological operation, *pace* Tooley's necessitation theory. I can introduce a formal ontological operations as a development of Lowe's (2006) formal ontological relationships. According to Lowe, formal

ontological relationships (e.g. instantiation) are not themselves entities, or 'elements of being'. Nevertheless, these posits are thought to set out the possible ways that different types of entities can stand to one another in virtue of their real essences. Formal ontological operations are formal in this sense, but their structure is non-relational. More specifically, I take formal ontological operations to be a type of operation that is performed by the ontology in all and only those cases where its condition is true. In short, formal ontological operations are the 'ontological correlates' of imperative sentences *qua* if–then commands. Roughly speaking, formal ontological operations have the following structure.

> If [condition] is true, then perform [operation]
> If [condition] is not true, then do not perform [operation]

How can we understand the passage of time as the performance of a formal ontological operation? In line with Tooley's growing block model, the performable operation modifies the temporally-variable aspects of temporal essentialism: *viz*. objects and (first-order) states of affairs. The domain of objects and first-order states of affairs is temporally-variable in the sense that (i) those objects that are actual and (ii) those first-order states that are actual vary with the passage of time. This is the central concept of a dynamic theory of time (in the context of a states of affairs ontology). *Pace* Tooley's necessitation theory, however, the actualisation of states of affairs in temporal essentialism is construed as the iterated performance of a formal posit (contrast entity—i.e. contrast necessitation relation or dispositional property). I term the formal operation in question the 'temporal imperative'. Simplifying, it has the following structure.

> If object *x* is present, and *x* instantiates first-order property X, such that $(X,Y), then actualise! state of affairs *y*'s being Y at the next present moment, where Y is a function of X via $.

In this way, the condition–operation structure of the temporal imperative is modifying the temporally-variable aspects of temporal essentialism, such that this modification is sensitive to laws, construed as second-order relations (selection relations). In short, I argue that this is a time-based metaphysical explanation of lawful regularities. The line of thought is that dynamic

temporality is built into the form of the ontology, and that, so construed, the form of the ontology is active. In addition, the content of the ontology is self-regulating if this activity is 'instructed' by the selection relation.

It will be useful at this point to make a number of remarks that concern the motivation for this thesis, the scope that I have chosen, and the original contributions that I intend to make towards contemporary metaphysics.

With regard to the motivation for this thesis, I have chosen to investigate the question of whether or not dispositional properties are able to necessitate their manifestations for two reasons. In the first place, dispositional essentialism is currently undergoing a period of expansion. Perhaps since the late-1990s, with the publication of Mumford's (1998) *Dispositions*, there has been a growing interest in taking properties to have dispositional essences. Important books in this movement include Ellis' (2001) *Scientific Essentialism*, Molnar's (2003) *Powers*, Mumford's (2004) *Laws in Nature*, Martin's (2007) *The Mind and its Place in Nature*, Bird's (2007) *Nature's Metaphysics*, and Mumford and Anjum's (2011) *Getting Causes from Powers*. Some classic books and papers that fall within this tradition include Popper's (1959) *The Logic of Scientific Discovery*, Mellor's (1974) *In Defence of Dispositions*, Harré and Madden's (1975) *Causal Powers*, and Shoemaker's (1980) *Causality and Properties*. At the present moment, there is a vast literature on dispositions and dispositional properties, and philosophers have sought to apply dispositional essentialism to a range of issues that extend beyond the properties and laws debate, such as mental causation in the philosophy of mind and virtue theory in ethics. My own view is that this fresh perspective on dispositional properties is partly responsible for the high level of activity that the properties and laws debate commands. With this in mind, a background motivation of this thesis is to contribute towards contemporary metaphysics by making a number of critical arguments that concern two recent versions of dispositional essentialism, as well as constructing a prototype position in the properties and laws debate.

And in the second place, the necessitarianism–dispositionalism issue is significant for dispositional essentialism. Whether or not dispositional properties are able to necessitate their manifestations is a question that is closely connected to the dispositional essentialist approach to laws and causation.

In addition, this question is bound up with the following associated topics in metaphysics and the philosophy of science: prevention, determinism, probability, uncaused events, and the distinction between physical and metaphysical modality. The necessitarianism–dispositionalism issue places a spotlight upon what we can term the 'manifestation operation' of dispositional properties. Dispositional essentialists agree that dispositional properties are the kinds of beings that can manifest additional entities (standardly, these additional entities are dispositional properties). So construed, dispositional properties have a manifestation operation, whereby, for example, additional dispositional properties are actualised in response to stimulus properties. With this in mind, to clarify the modality of this manifestation operation is to clarify the model of dispositional properties at hand. As such, the question of whether or not dispositional properties are able to necessitate their manifestations is of high importance for a fundamental question of dispositional essentialism: What are dispositional properties, and what are these kinds of beings able to do? In this thesis I conclude (in the first instance) that dispositional properties are able to necessitate their manifestations, and in drawing this conclusion I hope to show that Bird's understanding of what dispositional properties are is untenable, and that Mumford and Anjum's understanding of what dispositional properties are able to do is untenable. With regard to the third section of the thesis, I think it is healthy—given the prominent status of dispositional essentialism—to criticise this movement, and, where necessary, to set out alternative versions of anti-Humeanism. If there are serious problems for dispositional essentialism in Barker's essay, then it is beneficial for anti-Humeanism that philosophers are charting out a different approaches to the governing role.

I have restricted the scope of this thesis in two ways. Firstly, I have chosen to divide the question of whether or not dispositional properties are able to necessitate their manifestations into three aspects. These three aspects are: (i) the metaphysical possibility of antidotes in Bird's dispositional monism; (ii) the anti-necessitarian strategies of Mumford and Anjum's causal dispositionalism; and (iii) temporal essentialism as a solution to Barker's problem of governance. But there are additional aspects to the question of this thesis that I shall not engage with. Perhaps the two most pressing aspects that I have chosen to exclude are: (iv) how dispositional essentialism can understand indeterministic and/or probabilistic causal interactions, and (v) how dispositional essentialism can provide truthmakers for negative truths. Aspects (iv) and (v) are both significant for the problem of prevention. Aspect (iv) is a sub-theme of the second section of the thesis,

although I do not provide a systematic treatment. My reason for this is that I think that the question of how dispositional essentialism can understand indeterministic and/or probabilistic causal interactions should draw upon the philosophy of science to a significant extent, but in this thesis I want to keep the focus upon the metaphysics of necessitation and governance. And whilst aspect (v) is important for the problem of prevention, I think it is outweighed by aspects (i)–(iii).

A second way in which I have restricted the scope of this thesis is to focus upon two recent versions of dispositional essentialism: in the first section of the thesis I investigate the metaphysical possibility of antidotes within the context of Bird's dispositional monism, and in the second section of the thesis I investigate the anti-necessitarian strategies of Mumford and Anjum's causal dispositionalism. My own view is that the cost of this restriction is outweighed by the benefit of a systematic treatment. In this thesis I have adopted—to use these phrases—a 'narrow and deep' approach as oppose to a 'wide and shallow' approach. With regard to the first section of the thesis, the problem of ontological representation *re* antidotes is tied up with different components of Bird's dispositional monism; these include his treatment of the conditional analysis of dispositions, his stimulus–manifestation model of dispositional properties, and his arguments on the existence of antidotes and *ceteris paribus* laws. It takes some pains to show that it is difficult for Bird to say what antidotes are and how they operate—one reason for this is that Bird argues for the elimination of antidote-sensitive dispositional properties. A key argument of Chapter 3, however, is that Bird's elimination strategy (counter intuitively) requires both antidotes and antidote-sensitive dispositional properties. As such, I have chosen to dedicate the first section of the thesis to Bird's dispositional monism, since I want to set out a well-developed criticism. In any case, Bird's theory is (in my opinion) the most detailed version of dispositional essentialism in the properties and laws debate, and his stimulus–manifestation model of dispositional properties is the ideal background for investigating the metaphysical possibility of antidotes. With regard to the second section of the thesis, although a number of philosophers have advanced anti-necessitarian arguments within the context of dispositional essentialism, Mumford and Anjum have recently brought these issues to the fore in a book-length treatment. And whilst I take Mumford and Anjum's *Getting Causes from Powers* to be a significant and original book, I think that its authors are subject to a number of interconnected oversights. For the purposes of defending causal necessitarianism, then, I believe that a detailed discussion of these oversights and their interconnections is of greater significance

than a survey of anti-necessitarian arguments from different quarters. And lastly, with regard to the third section of the thesis, although I advance temporal essentialism as a prototype position in the properties and laws debate, I provide a careful and extended discussion of this theory. In doing so I aim to clearly articulate the way in which dynamic time can interact with the properties and laws debate.

1.5 Original contributions

What original contributions is this thesis making to contemporary metaphysics? Briefly stated, in this thesis I set out two lines of criticism. The first targets Bird's dispositional monism; the second targets Mumford and Anjum's causal dispositionalism. These lines of criticism are extended and culminate in two important points for the properties and laws debate. On the one hand, I aim to show that antidotes—the lead actors of the problem of prevention—are currently receiving no ontological representation in their author's metaphysics: Bird's dispositional monism. As far as I am aware, this troubling issue has gone unnoticed in the properties and laws debate. And on the other hand, I aim to show that the leading contemporary defenders of causal dispositionalism, Mumford and Anjum, have committed systematic errors. As such, I set out a systematic critique of their position. My hope is that this systematic critique can be used by philosophers to ward off the central arguments that have been deployed against causal necessitarianism. Constructively speaking, I also develop a prototype position for the properties and laws debate: temporal essentialism. This position is a serious attempt to solve Barker's problem of the governing role. To do so, I introduce a new theoretical posit: formal ontological operations. Accepting formal ontological operations requires a break from the prevalent conception of how ontological theories can be constructed; these posits also set the groundwork for a new approach to time and its passage. Temporal essentialism aims to show that there is a fertile and under cultivated connection between the properties and laws debate and the philosophy of time.

More specifically, although each of the nine chapters to follow contain various levels of exposition, they all set out original arguments, whether minor or major (see below). (The exception to this is Chapter 7, which is purely expository.) The first two sections of the thesis are, for the most part, critical, whereas the third section of thesis is exclusively constructive. In building my three primary

lines of argument—those that relate to the three aspects of my question—I also develop secondary points, which are used to support the overarching discussion. For example, Chapter 2 introduces Bird's dispositional monism and prepares for the central argument of Chapter 3 by criticising Bird's reading of Coulomb's law. In addition, Chapter 5 prepares for the central argument of Chapter 6 by criticising Mumford and Anjum's understanding of probabilistic dispositional properties. Chapter 4 introduces Mumford and Anjum's causal dispositionalism and sets out a criticism that I take to be fatal for their position—this is the most 'stand-alone' chapter of the thesis, so to speak. Chapters 8–10 outline temporal essentialism, but the original motivation for this position, i.e. Barker's *The Emperor's New Metaphysics of Powers*, is re-introduced in Chapter 10.

1.6 Chapter outlines

In this part of the chapter I shall provide outlines of the nine chapters to follow. The first section of the thesis contains two chapters—chapters 2 and 3. Chapter 2, *Alexander Bird's Dispositional Monism*, sets out Bird's dispositional monism and provides a criticism of his reading of Coulomb's Law. This chapter prepares for the main argument of this section of the thesis, which is presented in Chapter 3, *Potencies and Antidotes*. As noted, Chapter 3 argues that Bird's dispositional monism gives rise to a problem of ontological representation *re* antidotes. I also develop a solution for this problem.

Chapter 2, *Alexander Bird's Dispositional Monism*, begins by outlining Bird's derivation of laws from dispositional properties, or 'potencies' as he prefers. At the centre of this derivation is two theses. The first is Bird's stimulus–manifestation model, which assigns a stimulus and manifestation property to each dispositional property. (Given dispositional monism, these stimulus and manifestation properties are themselves dispositional properties.) And the second is the conditional analysis, construed as a metaphysically necessary truth. With these theses in hand, Bird derives laws (understood in this context as regularities) from the subjunctive conditionals that reflect his dispositional essences. The critical discussion of Chapter 2 concerns his reading of Coulomb's Law. This criticism trades upon the issue of stimulus conditions: *viz*. the types of states of affairs that provide the stimulation condition for a dispositional property—e.g. 'Sx' or '$S^1x\&S^2y$'). I argue that Bird is using the conditional analysis to specify the stimulus conditions of dispositional

properties. But this is a problematic division of labour: Bird's reading of Coulomb's law uses a complex stimulus condition that his network of SM-relations cannot explain. On this basis, I set out two modifications for Bird's dispositional monism. Firstly, I suggest that dispositional properties can fall into different sets. These different sets will have different arrangements of stimulus and manifestation properties. This modification involves using a distinct type of SM-relation for each set of dispositional properties, since in Coulomb's law we require a four-place internal relation. And secondly, I suggest that each set of dispositional properties will have to be primitively associated with a different version of the conditional analysis. My line of thought is that the conditional analysis is providing the specification of the stimulus condition, and so with each different type of stimulus condition we require a different metaphysically necessary truth.

Chapter 3, *Potencies and Antidotes*, begins by outlining two strategies that Bird develops for dealing with the problem of prevention. Bird's *ceteris paribus* strategy modifies the conditional analysis by adding a clause, C, that excludes finks and antidotes. In contrast, the elimination strategy modifies his stimulus–manifestation model by replacing a dispositional property that is sensitive to antidotes with a different dispositional property that is 'antidote-free'. This involves replacing the relevant stimulus property, i.e. the Platonic universal, S, with a different stimulus property: 'S-in-the-absence-of [all possible antidotes]'. (This elimination strategy is backed up by Bird's argument that finks are metaphysically impossible at the fundamental level of reality with which his theory is poised—hence their absence.) Both of Bird's strategies for dealing with the problem of prevention raise a question of ontological representation: how are we to understand what antidotes are and how they operate within the context of Bird's dispositional monism? I argue that Bird has no answer to this question. Chapter 3 provides a repair for Bird's *ceteris paribus* approach, which is the stronger of the two strategies. There are two steps to this repair. The first is to modify Bird's SM-relations such that there are additional places for dispositional properties to play the role of antidotes. And the second is to modify the form of Bird's subjunctive conditionals, such that we can build the negation of the instantiation of the antidotes into the antecedent of the conditional. At the end of this chapter I note that this gives a passive understanding of prevention, since the antidotes are simply dispositional properties that are required to be instantiated; but I suggest that this is symptomatic of Bird's stimulus–manifestation model.

The second section of the thesis contains three chapters—chapters 4, 5, and 6. Chapter 4, *Stephen Mumford and Rani Lill Anjum's Causal Dispositionalism*, sets out Mumford and Anjum's causal dispositionalism and argues that its two main components are in conflict. Chapter 5, *Probabilistic Powers in the Vector Model of Causation*, prepares for the next chapter by arguing that Mumford and Anjum's understanding of probabilistic powers is ontologically uncritical. Chapter 6, *Possible Prevention* aims to show that Mumford and Anjum's modal premise—that it is always possible, at least in principle, for a causal interaction to be subject to prevention—is either false or trivial.

In Chapter 4, *Stephen Mumford and Rani Lill Anjum's Causal Dispositionalism*, I begin with a discussion of Mumford and Anjum's position. I divide their causal dispositionalism into two main components. The first is a vector model of causation, which encompasses a distinctive view of dispositional properties, or powers. The central feature of this approach is that it uses a double understanding of manifestation. Mumford and Anjum say that powers 'operate' when they are in certain circumstances. These operations are construed as component vectors, which can interact via vector algebra. This set up facilitates the ontological analysis of complex causes, where different causal factors (i.e. operative powers) 'push and pull' against one another. Mumford and Anjum's second understanding of 'manifestation' draws upon the resultant vector of a given causal situation. I term this understanding 'manifestation *qua* change'. In those causal situations where there is sufficient magnitude, a new power or set of powers are instantiated upon a subject of change. This is the effect in Mumford and Anjum's vector model of causation. The second component of Mumford and Anjum's causal dispositionalism is their antecedent strengthening argument against necessitation. As noted, this argument underlies the claim that powers are connected to their manifestations *qua* changes via a *sui generis* dispositional (or 'tending towards') modality. The critical discussion of Chapter 4 aims to show that Mumford and Anjum's antecedent strengthening test is incompatible with their vector model of causation. The line of thought is that Mumford and Anjum's vector model of causation approaches complex causes as resultant vectors; so construed, the attempt the strengthen a causal situation with countervailing powers (i.e. antidotes) moves from one resultant vector to another. Problematically, however, the antecedent strengthening test requires (in this context) that the complex cause retains its identity so as to be 'strengthened' by the antidote.

In Chapter 5, *Probabilistic Powers in the Vector Model of Causation*, I introduce Mumford and Anjum's model of probabilistic powers, criticise this model, and provide a replacement that stays within the boundary of their vector model of causation. Mumford and Anjum construe the operation of probabilistic powers as multi-headed component vectors. The operations of probabilistic powers are directed towards two different types of change, where each direction has a certain magnitude. In this chapter, however, I argue that Mumford and Anjum's model of probabilistic powers is metaphorical, in the sense that there is no metaphysical explanation for how probabilistic powers can secure the possibility of different alternative manifestations *qua* change within a single causal situation. What Mumford and Anjum should have said, I think, is that probabilistic powers operative disjunctively, such that, in the simplest case, there is either a component vector directed towards change F or a component vector directed towards change G. The motivation for this replacement view is that it uniquely secures the possibility of different alternative manifestations *qua* change within a single causal situation. In addition, I propose that we have now secured a genuine notion of anti-necessitarian behaviour as this notion properly applies to probabilistic (and indeterministic) powers.

In Chapter 6, *Possible Prevention*, I provide a discussion of the connected concepts of determinism, probability, and dispositional actualism as these apply to Mumford and Anjum's causal dispositionalism. The overall objective of this chapter is to show that Mumford and Anjum face a dilemma concerning the modal premise of the antecedent strengthening argument. The modal premise in question states that it is always possible, at least in principle, for a given causal situation to be subject to countervailing powers, such that the effect (i.e. the manifestation *qua* change) is prevented. The dilemma that I discuss proceeds as follows. The opening move is to emphasise that Mumford and Anjum's case against causal necessitarianism is thought to be independent of the question of whether or not there are probabilistic powers and/or uncaused events in the actual world. As such, the first horn of the dilemma is for Mumford and Anjum to attempt to maintain the truth of their modal premise in spite of the lack of these (comparatively uncontroversial) failures of necessitation. But this route leads to a significant difficulty, which is that if there are no probabilistic powers or uncaused events, then it is impossible—counter intuitively, perhaps—for powers to be in merely possible (i.e. non-actual) spatial locations. The argument for this claim is slightly complex, but the basic line of thought is that if there are no probabilistic powers in the

world, then it is physically impossible for powers to be in merely possible spatial locations; and if there are no uncaused events in the world, then it is metaphysically impossible for powers to be in merely possible spatial locations. This is important because the modal premise of the antecedent strengthening argument effectively states—in the context of Mumford and Anjum's vector model of causation—that it is possible, at least in principle, for powers to be in non-actual spatial locations. The second horn of the dilemma is for Mumford and Anjum to explicitly draw upon probabilistic powers and/or uncaused events. But this route trivialises the antecedent strengthening argument, since we are accepting in advance that the world contains probabilistic causal processes, and it is relatively uncontroversial that such causal processes do not necessitate their effects. I also argue that uncaused events do not affect the necessitarianism–dispositionalism issue: uncaused events would serve to make a world temporally indeterministic but not causally indeterministic.

The third section of the thesis contains four chapters—chapters 7, 8, 9, and 10. Chapter 7, *Stephen Barker's Brute Modalism*, sets out Barker's three degrees of physical modal involvement, his brute modalism, and two of his arguments that affect anti-Humeanism. Chapters 8, 9, and 10 develop temporal essentialism. Chapter 8, *Temporal Essentialism I*, provides its basic ontology, which draws upon Tooley's Platonic factualism. Chapter 9, *Temporal Essentialism II*, discusses Tooley's growing block model, and its application in temporal essentialism. Chapter 10, *Not a World of Powers but a Powerful World*, outlines Lowe's form–content distinction, the concept of a formal ontological operation, and the concept of a time-based metaphysical explanation for lawful regularities. I have already discussed Barker's *The Emperor's New Metaphysics of Powers* relative to the scope of this introduction, so let us begin with the outline for Chapter 8.

Chapter 8, *Temporal Essentialism I*, begins by introducing temporal essentialism. I discuss the basic line of thought in this position, as well as listing its ontological categories and formal ontological posits. Briefly stated, this line of thought is as follows. Firstly, a dynamic theory of time is accepted, in this case Tooley's growing block model. Secondly, Lowe's distinction between ontological form and ontological content is accepted. Thirdly, I propose that we can understand a temporally dynamic world in terms of a rule-following ontology, where the rule in question is provided by a formal ontological operation. The ontology is rule-following in this sense: the actualisation of objects and first-order states of affairs is the consequence of a formal ontological

operation. And fourthly, I propose that by modifying the formal ontological operation—to make it either sensitive or insensitive to the content of the ontology—we can classify the resulting world, respectively, as either anti-Humean or neo-Humean. In this way, there is a conceptual connection to be made between the structure of dynamic time and the properties and laws debate (specifically: the issue of necessary connections between distinct existences). The second task of Chapter 8 is to set out the basic ontology of temporal essentialism. To this end I draw upon Tooley's Platonic factualism, which is a states of affairs ontology. The basic ontology at hand centres around a distinction between objects (existentially dependent concrete entities) and Platonic universals (existentially independent abstract entities). Strictly speaking, it recognises four ontological categories: (i) objects, (ii) first-order properties, (ii) a first-order relation, and (iv) a second-order relation. Chapter 8 outlines the motivation for accepting Platonic universals, the theoretical roles of the four ontological categories, and their distinguishing features.

Chapter 9, *Temporal Essentialism II*, begins by discussing Tooley's growing block model, which is a dynamic theory of time. Roughly speaking, a theory of time is dynamic if the totality of states of affairs are different at different times. According to Tooley's growing block model, states of affairs that are past and present are actual whereas states of affairs that are future are non-actual. In addition, actual states of affairs are (dynamically) indexed to times, such that future states of affairs are actualised with the passage of time. Tooley's central argument for his growing block model draws upon a thesis concerning singular causation and probability. The overall picture is that states of affairs can only be causally related in a world that approximates—to a significant degree—the growing block model. How is Tooley's growing block model applicable to temporal essentialism? As a necessitation theorist, Tooley argues that necessitation relations govern patterns of property instantiation across time; in addition, he suggests that his necessitation relations provide a metaphysical explanation for the passage of time: states of affairs are actualised via the governing role of laws. But this line of thought is subject to Barker's problem of the governing role—or so I suggest. Accordingly, my approach is to use the resources of Tooley's growing block model to set out a different metaphysical explanation for lawful regularities and the passage of time (*viz*. the formal ontological operation). First and foremost, I draw upon Tooley's concept of 'actual at a time', which indexes states of affairs to a positive integer—e.g. *a*'s being F is actual at t^1. With this in mind, I set out a four-part operation for the temporal imperative. If the condition of

this formal ontological operation is satisfied, then its performable operation modifies the temporal index of first-order states of affairs (and objects), adds objects to the domain of temporal essentialism, and constructs states of affairs (both monadic and dyadic).

Chapter 10, *Not a World of Powers, But a Powerful World*, begins by outlining Lowe's form–content distinction. Roughly speaking, Lowe's formal ontological relationships (e.g. instantiation) delimit the possible ways that different types of entities can stand to one another in virtue of their real essences. I argue that these formal posits set out the 'synchronic syntax' of Lowe's four-category ontology. For example, objects in Lowe's theory can instantiate kinds but not attributes; as such, the state of affairs 'object *a* instantiates kind K' is metaphysically possible, whilst the state of affairs 'object *a* instantiates attribute A' is metaphysically impossible. The metaphysical explanation for this is essence-based: objects, kinds, and attributes have general essences, i.e. real essences that are shared by the members of these ontological categories. In this way, objects are (essentially) the types of entities that can instantiate kinds but not attributes, and this delimitation of states of affairs is temporally invariant. On this basis, I approach formal ontological operations as 'active' formal posits that control the 'diachronic syntax' for states of affairs. At this point I assume a diachronic model of lawful regularities, according to which the lawful regularity 'All Fs are Gs' $=_{df}$ 'If at time t^n object *x* is F, then at time t^{n+1} object *y* is G'. Given this assumption, if there are necessary connections between distinct existences *qua* causes and effects, and if it is a law that $(F,G), then the diachronic syntax of the ontology will actualise the state of affairs *b*'s being G (at t^2) in response to the state of affairs *a*'s being F (a t^1). The middle part of Chapter 10 defends the concept of a formal ontological operation. The end part of Chapter 10 argues that temporal essentialism is a candidate solution for Barker's problem of the governing role. This solution involves dividing the governing role into a role of actualisation (provided by the temporal imperative) and a role of selection (provided by the selection relation).

Section One

The Metaphysical Possibility of Antidotes

2

Alexander Bird's Dispositional Monism

2.1 Introduction

This chapter has two aims. Firstly, I shall provide a description of Bird's (2007) theory of dispositional monism. This will be useful for our investigation in the next chapter of the thesis, where I criticise Bird's model of antidotes. A second aim of this chapter is to provide a critical discussion of Bird's understanding of 'stimulus conditions' as oppose to 'stimulus properties'. This discussion will also be of use in the next chapter when we use it to understand antidotes in Bird's stimulus–manifestation model.

2.2 The derivation of laws and the problem of finks and antidotes

A key feature of Bird's dispositional monism is that it is restricted to sparse properties, and the fundamental sparse properties at that. (This distinguishes Bird's view from some other recent work on the metaphysics of dispositions that has supported the admission of macroscopic predicates (fragility, solubility, and so on) into the ontological category of dispositional properties (e.g. Vetter 2010; Mumford and Anjum 2011)—such predicates are 'non-fundamental sparse' properties in Bird's terminology (see below). Accordingly, then, Bird (2007, pp.10–5) proposes the following two-fold assumption for his ontology: (i) there is a genuine difference between sparse and abundant properties; (ii) this difference is genuine insofar as it is a difference of ontology. At this point Bird claims that sparse properties are universals, whereas abundant properties are not. This is the sense in which the sparse-abundant distinction is reflective of a genuine ontological difference: given the further assumptions that all properties belong to a single ontological category—namely, the ontological category of properties, however that is conceived—as well as the idea that no predicate can be admitted to the ontological category of objects, it follows, at least for a two-category ontology of objects and properties, that abundant predicates do not refer to

existing entities. If we go back to Lewis' (1986) distinction, where he characterises abundant properties as capturing the semantic values of meaningful predicates, we can see that Bird is in line with the quite widely-accepted idea that there is not a corresponding property for every meaningful predicate (e.g. Armstrong 1978; Heil 2003). Having rejected abundant properties, there is a further decision to make regarding the spectrum of sparse properties. Bird's discussion here draws upon Schaffer (2004). The question is whether or not non-fundamental sparse properties, such as those inventoried by the 'non-fundamental' sciences, e.g. chemistry and biology, should be accepted as universals in addition to the fundamental properties, assumed to be those studied by fundamental physics (or at least a hypothetically-finalised physics). Two main views are identified, which Bird remains neutral between, though he prefers the first view. The first view is that only the sparse fundamental properties exist. There can then be a graduated sparse to abundant distinction, with the former being properties closer to physics and the latter being properties further away. The second view is that all sparse properties exist, whether fundamental or not (Schaffer 2004 defends this view). No need for a gradual distinction in this case: all sparse properties exist, and the sparse-abundant distinction maps onto the 'exists/non-exists' distinction.

As a last point on this issue, throughout his book Bird seems to accept a two-category ontology of objects and universals, drawing upon Armstrong (1978). But the variation that he prefers makes use of Platonic universals as oppose to Armstrong's Aristotelian universals. As is the case at a number of points in his position, Bird does not require that the dispositional essentialist adopt Platonic universals, though he argues that understanding properties as necessary existents brings certain advantages (2007, pp.50–9). All that is required at this stage, Bird suggests, is an ontological distinction between sparse and abundant properties.

With this in mind, Bird's (2007) dispositional monism is the view that all fundamental properties are dispositional properties in virtue of their dispositional essences. Dispositional monism is a version of dispositional essentialism, the thesis that at least a subset of fundamental properties are dispositional properties in virtue of their dispositional essences. According to Bird, the foundations of dispositional essentialism support a theory of laws that bypasses the central difficulties of regularity theories (e.g. Lewis 1986) and necessitation theories (e.g. Armstrong 1983). These central difficulties are, respectively, the problem of accidental regularities and the problem of

contingent necessitation (Bird 2005b, pp.355–7). As a first pass, Bird models dispositional essences upon the conditional analysis (CA).

(CA) $D_{(S,M)}x \leftrightarrow (Sx \Box\!\!\rightarrow Mx)$

Note that *x* is the object of predication, $D_{(S,M)}$ is the dispositional predicate, S is the stimulus and M is the manifestation. According to (CA), dispositional predicates have a stimulus and manifestation, such that, were the stimulus to be co-instantiated (with the object bearing the disposition), then the manifestation would be produced. Hence, on the left–right direction of (CA), true dispositional predications entail true counterfactual/subjunctive conditionals that refer to the stimulus, manifestation and object of predication. And *vice versa* for the right-left direction.

In line with the dispositional predicates of (CA), Bird's dispositional properties (i) have a stimulus and manifestation, such that, (ii) were the stimulus to be co-instantiated, then the manifestation would be produced. Taken together, (i) and (ii) are the form of the dispositional essence of a dispositional property: (i) concerns the essential relationship that holds between a dispositional property, stimulus and manifestation, whereas (ii) concerns the essential relationship that holds between the co-instantiation of the stimulus and the production of the manifestation, i.e. a counterfactual/subjunctive implication.

> To say that a property has a dispositional essence or is essentially dispositional is to say first that that property has some essence that may be characterised dispositionally ... Thus according to dispositional essentialism, the real essence of some potency P includes a disposition to give some particular characteristic manifestation M in response to a characteristic stimulus S (Bird, 2007, p.45).

Note that dispositional properties are termed 'potencies' by Bird. Note also that Bird (2007, pp.45–6) accepts the strong thesis that the dispositional essence of a dispositional property is sufficient for fixing its identity. That is to say, the essence of a dispositional property is 'exhausted' by its dispositional essence. The weaker thesis, cited above in Bird's "P includes a disposition ... " but in fact rejected, is that the essence of a dispositional property is 'partially exhausted' by its

dispositional essence; in this case, whilst dispositional properties have dispositional essences, the latter are insufficient for fixing the identity of the former. That being said, however, the weaker thesis (termed DE_p) is sufficient for Bird's theory of laws.

(DE_p) $\quad \Box(Px \rightarrow D_{(S,M)}x)$

Recall that Bird is modelling dispositional essences upon (CA). Accordingly, (CA) is taken to be a metaphysically necessary truth. "Since the dispositionalist holds that the dispositional nature of properties is essential, (CA) is not merely an analysis of the dispositional concept 'D' but rather characterises the nature of the property D. Hence (CA) is metaphysically necessary" (2005b, p.355).

$(CA_{\Box})$ $\quad \Box(D_{(S,M)}x \leftrightarrow (Sx\Box \rightarrow Mx))$

As a first pass, then, Bird's theory of laws makes use of (DE_p) and the left–right direction of $(CA_{\Box})$. Bird takes laws to be general regularities that are ontologically grounded by dispositional properties. For the reason that dispositional properties are the ontological grounds of laws, the general regularities in question are thought to be lawful or non-accidental regularities (Bird 2007, p.46). Given that the dispositional essences of dispositional properties are the ontological grounds of general regularities, laws are thought to be metaphysically necessary (Bird 2007, pp.48–50).

Bird's (2007, pp.46–8) formal characterisation of laws draws upon first-order modal logic with modus ponens for the subjunctive/counterfactual conditional. It runs as follows. First, the right-hand side of (DE_p) is substituted for the right-hand side of $(CA_{\Box})$. That is to say, Bird substitutes the dispositional essence $D_{(S,M)}x$ in (DE_p) for the counterfactual/subjunctive conditional $Sx\Box \rightarrow Mx$ in $(CA_{\Box})$.

(1) $\Box(Px \rightarrow (Sx \Box\!\rightarrow Mx))$

Second, the stimulus is assumed to be co-instantiated.

(2) $Px \& Sx$

Third, the production of the manifestation is derived.

(3) Mx

Fourth, the assumption is discharged.

(4) $(Px \& Sx) \rightarrow Mx$

And fifth, Bird generalises over the unbound variable *x*.

(5) $\forall x((Px \& Sx) \rightarrow Mx)$

That said, the left–right direction of (CA) is thought to be false, in virtue of finks and antidotes (Martin 1994; Bird 1998). Given that, *ipso facto*, ($CA_{\Box}$) is false, the first pass of Bird's theory of laws is thought to be false (Bird, 2005b, p.359).

In general, counter-examples to the left–right direction of (CA) aim to show that true dispositional predications do not entail true counterfactual/subjunctive conditionals. Martin's (1994, pp.5–7) 'reverse-cycle' fink makes use of a wire with the dispositional property 'live'. In line with (CA), the dispositional property 'live' has a stimulus and manifestation; these are, respectively, 'touched by a conductor' and 'conduct electricity'. So construed, (CA) states that the true dispositional predication 'the wire is live' entails the true counterfactual/subjunctive conditional 'if the wire were to be touched by a conductor, then the wire would conduct electricity'. Martin's fink, however, is a device that has a sensor for detecting the touching of the wire by the conductor and a mechanism for rendering the wire dead. It operates such that if the wire were to be touched by a conductor,

then the fink would render the wire dead. On this basis, Martin argues that the left–right direction of (CA) is false: in virtue of the fink, the (true) dispositional predication 'the wire is live' does not entail the counterfactual/subjunctive conditional 'if the wire were to be touched by a conductor, then the wire would conduct electricity'. Accordingly, the left-side of (CA) is true, whereas the right-side of (CA) is false.

Bird (2007, pp.25–6) argues that finks (reverse-cycle and forward-cycle) draw upon two key characteristics of dispositional properties. The first is that there is a time delay in between the co-instantiation of the stimulus and the production of the manifestation. For example, at t^1 the wire is touched by the conductor (the co-instantiation of the stimulus), at t^2 the wire 'starts' to conduct electricity and at t^3 the wire 'is' conducting electricity (the production of the manifestation). In this case, the wire 'starting' to conduct electricity at t^2 is the time delay. The second key characteristic is that it is possible for objects to lose/gain dispositional properties. Taken together, these 'formal characteristics' give rise to the possibility of the following pattern of states of affairs. At t^1 object *x* has dispositional property D and stimulus S, but ~D at t^2 (in virtue of the stimulus causing the fink to effect the loss of D from *x*). Given the assumption that the continued persistence of a dispositional property from t^1 to t^3 is a necessary condition of the production of the manifestation, in this case it follows that the manifestation is not produced (~M at t^3). Overall, then, finks prevent the production of the manifestation in virtue of the stimulus causing the reverse-cycle fink to effect the loss of the dispositional property. In this way, a necessary condition of the production of the manifestation is not satisfied.

In contrast, Bird's (2007, pp.27–9) antidotes are thought to interfere with the circumstances of a dispositional property, such that the production of the manifestation is prevented. In this case, the circumstances of a dispositional property are a different type of necessary condition for the production of the manifestation (in contrast to the continued persistence of the dispositional property *re* finks). Bird says:

> [W]e can see how the exceptions [to the left–right direction of (CA)] may arise. Let *x* have the disposition D to yield manifestation M in response to stimulus S. On normal occasions, when *x* does yield that manifestation in response to that stimulus, this occurs because of the

> combined operation of (i) the properties of *x* that constitute the causal basis of D and (ii) certain additional, typically environmental conditions. The exceptions [to the left-left right direction of (CA)] arise when one or other of these is absent. If (i) is made to be absent then the disposition suffers from a fink; when (ii) is absent it suffers from an antidote (Bird 2004, p.262: my square brackets).

Bird's (1998, p.228) counter-example to the left–right direction of (CA) makes use of a poison (arsenic) and its medical-antidote (dimercaprol). Let us take arsenic to have the dispositional predicate 'poisonous'. Its stimulus and manifestation are, respectively, 'ingested by a person' and 'kill the person'. So construed, (CA) states that the true dispositional predication 'the arsenic is poisonous' entails the true counterfactual/subjunctive conditional 'if the arsenic were to be ingested by a person, then the arsenic would kill the person'. Dimercaprol, however, is a medical-antidote that interferes with the causal process of arsenic, such that, if the former were ingested by a person, then the latter would not kill the person. Accordingly, the left-side of (CA) is true, whereas the right-side of (CA) is false.

Note that Bird sets out a number of explanations for antidotes; *prima facie*, these draw upon two different types of operation. In the first place, the operation of antidotes is taken to be their interference with the circumstance of a dispositional property: "[An] antidote to a disposition leaves the disposition unchanged but alters the environmental conditions that are required to permit the disposition to yield its characteristic manifestation" (Bird 2005b, p.358–9). In the second place, however, the operation of antidotes is taken to be their interference with the causal process of the production of the manifestation. Bird explains this point:

> An object *x* is disposed to display response *r* under stimulus *s*. At time *t* it receives stimulus *s* and so in the normal course of things, at some later time *t'*, *x* gives response *r* ... An antidote to the above disposition would be something which, when applied before *t'*, has the effect of breaking the causal chain leading to *r*, so that *r* does not in fact occur (Bird 1998, p.228).

In clarification, then, these two explanations appear to draw upon two different types of operation: the first interferes with circumstances whereas the second interferes with causal processes; it

follows, *prima facie*, that the production of the manifestation has two necessary conditions *re* antidotes. First, the circumstance of a dispositional property has to be suitable for the production of the manifestation (but it may become unsuitable via interference). And second, the causal process of the production of the manifestation has to be unbroken (but it may become broken via interference). Either way, the operation of interference in question is thought to prevent the production of the manifestation.

Recall that the left–right direction of (CA) is thought to be false, in virtue of finks and antidotes. Given that, *ipso facto*, ($CA_{\Box}$) is false, the first pass of Bird's theory of laws is thought to be false (Bird, 2005b, p.359). In response, as a second pass Bird models dispositional properties upon a *ceteris paribus* conditional analysis (CA*).

(CA*) $D_{(S,M)}x \rightarrow (Sx \& CP\Box \rightarrow Mx)$

Note that CP is the exclusion of finks and antidotes for $D_{(S,M)}$. As a second pass, then, Bird's dispositional properties (i) have a stimulus and manifestation, such that, (ii) were the stimulus to be co-instantiated and there are no finks and antidotes, then the manifestation would be produced. In the case of (ii), the essential relationship that holds between the co-instantiation of the stimulus and the production of the manifestation is a '*ceteris paribus* counterfactual/subjunctive implication'.

In line with the rejection of ($CA_{\Box}$) and the acceptance of (CA*), the second pass of Bird's theory of laws makes use of (DE_p) and (CA*). Bird (2007, p.60) does not provide the following details, but we might reconstruct it as follows. Firstly, the right-hand side of (DE_p) is substituted for the right-hand side of (CA*). (Below I have drawn upon Vetter (2009, p.227).)

(1*) $\Box(Px \rightarrow (Sx\Box\&CP \rightarrow Mx))$

Second, the stimulus is assumed to be co-instantiated, such that there are no finks and antidotes.

(2*) $Px\&Sx\&CP$

Third, the production of the manifestation is derived.

(3) Mx

Fourth, the assumption is discharged.

(4*) $(Px\&Sx\&CP) \rightarrow Mx$

And fifth, Bird generalises over the unbound variable *x*.

(5*) $\forall x(\textit{ceteris paribus}((Px\&Sx) \rightarrow Mx))$

Accordingly, in the second pass of Bird's theory of laws, dispositional properties are the ontological grounds of *ceteris paribus* regularities (Bird 2007, p.59–60). Bird explains:

> The counterexamples to (CA) would make serious trouble for the dispositionalist view of laws, if all laws were straightforward exceptionless universal generalisations. But we know that they are not. For many laws are *ceteris paribus* laws (cp-laws) ... My suggestion is two-fold. First, we can see these cp-laws as reflections of dispositions. Second, the disturbing factors that are required to be absent are precisely the sorts of factor that provide counterexamples (finks and antidotes) to the conditional analysis (Bird 2005b, p.359).

At this point the direction of argument is that the second pass of Bird's theory of laws is not false in virtue of finks and antidotes, since finks and antidotes are counter-examples to ($CA_{\Box}$) but not (CA*). Accordingly, the second pass runs as follows. (i) Bird models dispositional properties upon

(CA*) and (ii) draws upon these entities as the ontological grounds of *ceteris paribus* regularities. In addition, however, Bird sets out a direction of argument that moves from the *explanandum* of *ceteris paribus* regularities to the *explanans* of dispositional properties that are modeled upon (CA*), together with the existence of finks and antidotes. As Bird puts it:

> [The] moral of this story is that the failure of (CA) due to finks and antidotes is no difficulty for the dispositionalist account of laws. *On the contrary, the very existence of finks and antidotes explains why not all laws are perfectly general but some are exclusive cp-laws.* Had (CA) been true, then the dispositional conception would have required all laws to be perfect generalisations—which would have permitted cp-laws to have refuted the dispositional conception (Bird 2005b, pp.361–2: my italics).

So Bird makes use of finks and antidotes as *explanans* for the *explanandum* of *ceteris paribus* regularities. As such, in so far as there are *ceteris paribus* regularities, the existence of finks and antidotes is advantageous, not disadvantageous. We will return to this issue in the next chapter.

2.3 Finks and antidotes at the fundamental level

At this stage Bird sets out a pair of arguments concerning the non-existence of finks and antidotes at the fundamental level (see also Bird 2004, pp.262–7).

The argument against the existence of finks at the fundamental level is thought to be decisive (Bird 2007, p.62). It begins by noting that the operation of reverse-cycle finks, i.e. the removal of the causal basis of the disposition after the stimulus but before the manifestation, cannot take place at the fundamental level for the reason that such dispositions do not have distinct causal bases: at the fundamental level, dispositional properties are their own causal bases. Nevertheless, it is thought that objects may gain/lose properties 'directly' at the fundamental level (Bird cites electrons changing their spin direction as a candidate case of fundamental objects directly gaining/losing properties). If the idea of objects gaining/losing properties in this direct manner is workable, then it seems that Bird has a basic model of fundamental 'finkish instantiation' (the form of which is identical to the non-fundamental case, with the modification that the dispositional property is lost

directly after the stimulus but before the manifestation). With this in mind, Bird notes two conditions of fundamental finkish instantiation. The first is that the manifestation cannot be simultaneous with the stimulus; otherwise there would be no time-delay for the direct loss of the dispositional property. And the second is that the stimulus cannot be sufficient for the manifestation (sufficient 'simpliciter'), for in that case we could have the stimulus and dispositional property suitably paired together, and the dispositional property removed from the object, but the manifestation nevertheless occur (as a kind of delayed effect). For the finkish-instantiation to work, it seems as though we need both a time gap for the removal of the disposition, as well as some kind of dependence of the manifestation on the persistence of the disposition (after the stimulus). As Bird notes, both of these conditions are mysterious.

At this point (2007, pp.60–2) an argument is set out that attacks the idea of there being successive states of affairs at different times that are not intrinsically different. The basic idea is that fundamental finks cannot operate as there is no time to remove the dispositional property. So far we have this basic model, which is built on both of the above conditions: *x* has P and S at t^1 and M occurs at t^n, such that (i) these times are not the same time, and (ii) such that P is required to persist for M to occur at t^n. But because there is no intrinsic difference between any of the states of affairs in between t^1 and t^n, Bird argues that one of these cannot have a consequence that the others do not have, and so we cannot assume that M uniquely depends on the occurrence of one of these states of affairs. This principle (i.e. same intrinsic character gives same possible effects) leads Bird to conclude that either (i) the manifestation of P is simultaneous with S, such that there is no chance of finkish-removal, or (ii) there are no times in between t^1 and t^n, such that the latter time is the next moment (here Bird uses quantised time). But this also has the consequence of there being no possibility of finkish-removal, and so Bird concludes that finks cannot occur at the fundamental level.

Whereas the argument against fundamental finks is thought to be successful, Bird notes that antidotes are more difficult to deal with, as they are "more common" (2007, p.62). The argument is also defeasible, which is interesting when thinking about the possible existence of *ceteris paribus* laws. Some background to the argument is necessary. Bird (2007, pp.38–41) sets out some difficulties for translating antidote-sensitive dispositions into antidote-free dispositions (this is

within the context of Choi's (2003) response to Bird's arguments against the conditional analysis). Here Bird is concerned to criticise the following strategy: the antidote-sensitive disposition to give manifestation M in response to stimulus S can be replaced with the antidote-free disposition to give M in response to S {in the absence of A^1, A^2, A^3, ...}, where this is the set of all possible antidotes to the disposition in question. The core of this strategy is that the stimulus of the disposition is replaced with a complex 'property': 'S in the absence of ...'. But there are several problems with this, according to Bird. One such argument (2007, pp.39–40) aims to show that a covert disposition that can be multiply realised cannot be replaced by an overt disposition with antidote-free stimulus. (We can note that a 'covert' disposition is one that does not have an explicit stimulus–manifestation profile, such as 'fragility' in comparison to 'the disposition to break when struck'.) Here the thought seems to be that the disposition 'being poisonous' could be realised by distinct causal bases, such that these poisons all work in different ways and are different types of poisons. Bird then says that a given antidote, A, whilst being an antidote to some poisons, is not an antidote to all poisons. He then says that the following overt disposition, which is antidote-free, cannot be used to analyse 'being poisonous': *viz*. the disposition to kill (M) in response to ingestion in the absence of all antidotes to all poisons (S). This is because we could have somebody who is bitten by a snake and so ingests snake venom and dies (despite administering A). (We suppose then that antidote A has no effect on snake venom.) Now, on the one hand, it is clear that the death can be explained by reference to the poisonous nature of the snake venom. On the other hand, however, since A has been taken, this case cannot be explained by using the above antidote-free disposition.

I return now to the consideration of fundamental antidotes. A general model is given for antidotes: "the failure of a disposition to manifest itself is due to interference not with the disposition itself but rather with the additional conditions that are required" (Bird 2007, p.62). Bird then suggests that the arguments against the translation of covert dispositions that are antidote-sensitive into overt antidote-free dispositions have less bite when we are considering the fundamental level. In particular, the multiple realisation problem cannot arise (dispositions have no realisers distinct from themselves at this level). Bird thinks that this leaves two main options for fundamental antidotes. The first is that the antidote may operate by way interfering with a mechanism that may be broken down into distinct steps. Bird gives the example of a row of 100 dominoes, such that

the first domino has the disposition to bring about the fall of the 100th domino in response to being knocked over (the idea here is that we have the antidote of removing, say, the 29th domino). But, it seems natural to replace this process with 99 dispositions (all acting at a single level). In this case, we can replace the disposition above with separate dispositions, e.g. to knock over the next domino if knocked over (and this will be antidote-free, apparently for the reason that the aforementioned antidote, i.e. removing a domino, will be the removal of the stimulus or manifestation itself) (Bird 2007, pp.62–3). A second possibility, however, is that the manifestation has no mechanism: it is the same direct gaining of properties that were discussed in Bird's anti-fink argument. This is the general model: "[T]here is no mechanism bringing about manifestation M—it is brought about by D and S directly. However, the further possible condition A is such that D and S will not bring about M" (2007, p.63). (I note here that this is slightly different to the first antidote model: here the antidote interfered with additional conditions that are required; in this case it seems to be the additional condition (i.e. 'A') that prevents M's coming into being.) But, in any case, Bird is optimistic for the elimination of these dispositional properties into their antidote-free versions. Here is what he says:

> However, one might be less sceptical about the eliminativism route considered above. Since we are dealing with the fundamental level, and have already removed the problem of multiple realizability, it might be reasonable to expect that any dispositions of this sort will suffer from relatively few antidotes. In which case their incorporation into an antidote free disposition will not look so gerrymandered. Thus in this case it will be up to our fundamental science to decide whether there are antidote sensitive dispositions and ceteris paribus laws. But the direction of the development of physics with ever fewer fundamental properties and corresponding forces indicates that the prospects for antidote-free fundamental properties and thus strict laws only at the fundamental level are promising (Bird 2007, p.63).

What is the pair of arguments intended to establish? The following, I think. First, it is not fatal to Bird's position if there are finks and antidotes, since that just means we might have some 'strict' laws (following the derivation above) and also some *ceteris paribus* laws, in those cases where the finks and antidotes operate (or perhaps all laws are *ceteris paribus*). Second, however, when we closely examine finks and antidotes, and question whether or not they could exist at the

fundamental level, we find that the answer is, respectively, 'no' and 'probably not'. Taken together, then, Bird looks to be saying that *ceteris paribus* laws are improbable.

2.4 Discussion on stimulus properties and stimulus conditions

In the next chapter I shall begin to make my argument against Bird's understanding of antidotes. By way of preparation, however, I want to firstly set out a consideration that concerns the resources of Bird's ontology and the notion of 'stimulus conditions'.

We should make a distinction between the stimulus property of a potency and its stimulus condition. The stimulus property of a potency is a *bona fide* potency, given Bird's thesis of dispositional monism. Bird's 'SM-relations' are asymmetric three-place relations that hold between three potencies, such that, relative to each other, these relata play the roles of dispositional property, stimulus property and manifestation property (2007, p.145). When we consider a given potency *qua* dispositional property, we are considering the first relatum in a given SM-relation, such that its stimulus property and manifestation property are the second and third relata, respectively. But there is more to the antecedents of Bird's subjunctive conditionals than a stimulus property. In the default case, which is typically assumed, the antecedent requires not merely that the stimulus property is instantiated, but rather that it is instantiated by the same object that instantiates the potency—that it is instantiated by the 'potency-object', as we might say. This move from a stimulus property to a stimulus condition is apparent if we recall (DE_p) and ($CA_\Box$). Note that x is a variable and P, D, S and M are constants.

(DE_p) $\quad \Box(Px \rightarrow D_{(S,M)}x)$

($CA_\Box$) $\quad \Box(D_{(S,M)}x \rightarrow (Sx\Box \rightarrow Mx))$

A stimulus property is a potency that is playing a role (i.e. S), whereas a stimulus condition is a state of affairs (i.e. Sx); the latter but not the former is drawn upon by ($CA_\Box$). More specifically, the stimulus condition is a type of state of affairs, where the object is a variable and the stimulus property is a constant. (Hence, where a and b are constants, a's being S and b's being S are tokens of the type of state of affairs x's being S.) In the default case, then, given that the stimulus condition

(S*x*) uses the potency-object (*x*) for its object-variable, if the stimulus condition is the case, then it is 'automatically' the case that the potency and stimulus property are co-instantiated. The default case is such that the co-instantiation of the potency and stimulus property is subjunctively sufficient for the production of the manifestation, but the stimulus condition does not explicitly refer to the potency. In contrast, the requirement of co-instantiation is achieved by default: it is a consequence of the stimulus condition (S*x*) using the potency-object (*x*) for its object-variable.

This raises a point of interest. Given that ($CA_{\square}$) is specifying the stimulus condition in the default case, is it the case that ($CA_{\square}$) is to be modified where we have a more complex stimulus condition? I think that's right, but I'd like to introduce some supporting ideas to begin with.

A more difficult potency requires that the stimulus property is instantiated by some 'foreign' object that is nevertheless related to the potency-object in a specific way. This requires a correspondingly more complex state of affairs for the stimulus condition. Such a case is provided by Bird's reading of Coulomb's law. Under pressure from his dislike of multi-track potencies, Bird fragments Coulomb's law into single-track potencies (2007, pp.21–4). Consider a given track, where Q^1 is the charge of interest, Q^2 is the opposing charge, R is the spatial relation and F is the component force. Where *x* is Q^1, the associated subjunctive conditional is: 'if it were the case that *y* is Q^2 and *x* has R to *y*, then it would be the case that *x* is F. Here we have two stimulus properties—Q^2 and R (R is in fact a dyadic relation)—that are embedded, respectively, in the stimulus condition '*y* is _ and *x* has _ to *y*' (with properties removed for illustration).

These observations raise the issue of object-sensitivity for potencies. We could take the same stimulus properties above, Q^2 and R, but provide a different stimulus condition, e.g. '*x* is Q^2 and *y* has R to *z*'. Needless to say, this is a bad reading of Coulomb's law. Pressingly, *x*'s being Q^2 loses the idea—essential to Coulomb's law—that Q^1 and Q^2 are charges of distinct particles. More pressingly, *y*'s having R to *z* loses the idea—also essential to Coulomb's law—that the spatial relation holds between the charged particles that have the charge of interest and the opposing charge, i.e. *x*'s being Q^1 and *y*'s being Q^2. Potencies are object-sensitive, then, in that their stimulus conditions disclose the required objects of their stimulus properties. Sacrificing this feature

threatens a sensible understanding of scientific predicates and law statements (in this case charge and Coulomb's law).

It is important to note that potencies can also be object-sensitive *qua* their manifestation property. Bird (2007, p.165) makes a useful distinction between active and passive potencies: the former but not the latter produce their manifestation property on a foreign object that is, presumably, related to the potency-object in a specific way. As it happens, the object-sensitivity of charge draws upon the 'default case' of a passive potency, i.e. the potency and manifestation property are co-instantiated (where x is Q^1, the produced manifestation is x's being F). It is tempting, then, to say that potencies have manifestation conditions as well, where these disclose the required objects of their manifestation properties. This is correct, but we might dislike the term 'condition' being used for the manifestation property and its required object, since, in contrast to the stimulus condition, it is not a condition *qua* the content of the antecedent of the subjunctive conditional, i.e. there is a sense in which it is not a condition proper. Where the need arises, I shall use the term 'manifestation circumstance' for this reason.

I return now to the point of interest, raised earlier. Here the worry was that ($CA_{\Box}$) would have to be modified as we move between potencies with different object-sensitivities, since it is responsible for specifying these object-sensitivities. To reinforce this issue, I think it is useful to consider the close connection between (DE_p) and Bird's SM-relations. Because Bird's SM-relations (stimulus–manifestation relations) are three-place relations, I shall sometimes term them 'DSM-relations'.

(DE_p) $\Box(Px \rightarrow D_{(S,M)}x)$

(DSM) $DSM[P, P_S, P_M]$

Having distinguished the stimulus property from the stimulus condition, a natural question to ask is whether or not Bird's DSM-relations specify stimuli properties or stimuli conditions. (I leave the parallel point on manifestations to one side for simplicity and in light of the Coulomb case.) I think the answer has to be that the DSM-relation provides a function from a specific potency to a specific stimulus property. As noted, Bird's DSM-relations are asymmetric three-place relations that hold

between three potencies. I agree that these relations have some interesting formal properties; for example, they might be construed as second-order relations that are internal to their relata and constitutive of their relata (Barker 2009, p.247), but I do not see how the relation nor their relata have any obvious connection to object-variables, which is of concern when we are thinking about object-sensitivity. So stimulus conditions will not be found in Bird's graph theoretic machinery. As is well known, Bird has argued that his potencies can be structurally individuated on a graph theoretic basis. The idea, in short, is that if the population of potencies standing in the network of DSM relations meets well-defined criteria of strong asymmetry, then the identities of its dispositional properties are fixed by their structural positions (Bird 2006).

This interesting limitation suggests a nice reading of Bird's thesis (DE_p). We can put the same question to it: is the subscript (S) in $D_{(S,M)}$ referring to a stimulus property or a stimulus condition? Given that the stimulus condition S*x* is explicit in the subjunctive conditional of ($CA_{\Box}$), it is natural to think that the subscript (S) in $D_{(S,M)}$ is referring to the stimulus property, not the stimulus condition. One consideration is that we have (S) rather than (S*x*) as the subscript. But a more interesting consideration is that, if the subscript (S) in (DE_p) is thought to be a stimulus property, then this thesis matches up nicely with Bird's DSM-relations. That is to say, the left–right reading of (DE_p) describes the function that is provided by Bird's DSM-relation. In both cases we move from the specification of a potency to its stimulus property and manifestation property (and no more).

There is a connection between this observation and Barker and Smart's (2012) distinction between constitution and governing roles for potencies that I think is worth drawing out. A brief treatment of Barker and Smart's distinction will suffice for now, since it is topic of Chapter 7. In short, Barker and Smart suggest that Bird's potencies have two roles or aspects, but that Bird only accounts for one of these, ontologically speaking. The first role is one of constitution, such that the identity of a potency is constituted by its entering (along with the totality of other potencies) into a network of DSM-relations (termed 'SR-relations' by Barker and Smart). The constitution role for potencies is targeting the idea that the identity of a potency is fixed by its place in the network of DSM-relations and other potencies. But this role is separated from a governing role, which, in contrast, is targeting the idea that a potency can produce its manifestation property—forcing its instantiation,

so to speak, in response to the obtaining of its stimulus property. In effect, Barker and Smart's issue is that Bird's graph theory resources, i.e. his DSM-relations, only account for the constitution role, such that the governing role, which is obviously central to anti-Humean metaphysics, is left without ontological foundation. (Note that Barker (2013) argues for the stronger claim that the graph theoretic resources are unsuitable for even their constitution purposes). Important as this issue is in itself, I think it is interesting to see that, if we are right about the object-sensitivity of potencies being left out of the workload of the DSM-relations and (DE_p), under Barker and Smart's distinction the issue of object-sensitivity and the specification of stimulus conditions then becomes a matter of governance. Following their line of thought, it then becomes something without ontological foundation. In short, whilst we might have had the idea that the DSM-relations fixed the identity of potencies, this can only be upheld if we divorce the issue of object-sensitivity from that of the identity of a potency. This raises an interesting question for Bird: what is the ontological basis of the stimulus conditions? If these are not involved with the essence of a potency *qua* its constitution, i.e. *qua* its position in the network of DSM-relations, are we to say that a potency can have different stimulus conditions (whilst keeping its identity and therefore keeping the same stimulus property)? Given my brief comments on the importance of object-sensitivity for more complex potencies like Q^1 in Coulomb's law, this might be a question of concern.

I think it may be helpful at this point to reiterate my points so far. First, there is a distinction between stimulus properties and stimulus conditions. The former are potencies whereas the latter are types of states of affairs. Second, this distinction is an important one, since it is a way of understanding the object-sensitivity of physical predicates and law statements in 'dispositional essentialist' terms. At the very least, an account of object-sensitivity is a desideratum of a theory of potencies. Third, Bird's DSM-relations do not account for object-sensitivity: they provide the stimulus property of a potency, not its stimulus condition. In addition, given the close connection between Birds DSM-relations and (DE_p), it is left to ($CA_{\Box}$) to upgrade the stimulus property of a potency, which is fixed by its DSM-relation, into a fully-fledged stimulus condition. Fourth, and lastly, the issue has a connection to Barker and Smart's complaint that the governing role is unsupported by Bird's graph theoretic resources (the object-sensitivity of potencies is as well).

So far, then, it looks as though ($CA_{\Box}$), which is closely connected to Barker and Smart's governing role, is carrying the burden of specifying the object-sensitivity of potencies. I explained at the beginning of this section how the requirement of co-instantiation can be achieved by simply using the potency-object as the object-variable for the stimulus property. But, obviously, this move cannot work for the single-track interpretation of Coulomb's law. Let's now look at the mismatch that this brings, before I set out my recommendation for Bird in dealing with the problem. Below are two sets of schemes, detailing a DSM-relation together with (DE_p) and ($CA_{\Box}$). Only their left–right directions are important. The first set have the stimulus property and manifestation property removed, so as to show their form in the absence of these entities. The second set show, in bold, how the DSM-relation 'plugs' the stimulus property and manifestation property into the subjunctive conditional.

(DSM) DSM[P,_,_]
(DE_p) $\Box\,(Px \rightarrow D_{(\_,\_)}x)$
($CA_{\Box}$) $\Box\,(D_{(\_,\_)}x \rightarrow \_x \Box\rightarrow \_x)$

(DSM) DSM[P,**S**,**M**]
(DE_p) $\Box\,(Px \rightarrow D_{(\mathbf{S},\mathbf{M})}x)$
($CA_{\Box}$) $\Box\,(D_{(\mathbf{S},\mathbf{M})}x \rightarrow \mathbf{S}x \Box\rightarrow \mathbf{M}x)$

Whilst the now substantive responsibilities of ($CA_{\Box}$) may be worrying, there does not seem to be any further problems so far as simple potencies are concerned, i.e. so far as those potencies that require no special object-sensitivity requirements are concerned. What Bird's reading of Coulomb's law shows, however, is that ($CA_{\Box}$) will have to be modified so as to properly model the object-sensitivity of the potencies at hand. The problem is that the default form for the subjunctive conditional '$\_x \Box\rightarrow \_x$' is multiply unsuitable. We can clearly see this if we set out the various elements of Q^1, a potency of one of Bird's single-track readings of Coulomb's law.

Potency: Q^1

Potency-object: *x*

Stimulus properties: Q^2 and R

Stimulus condition: *y* is Q^2 and *x* has R to *y*

Manifestation property: F

Manifestation circumstance: F*x*

There appear to be two differences between the default case and the Coulomb case, as we might call it. Firstly, the potency has two stimulus properties, Q^2 and R. This raises the issue that the antecedent of the subjunctive conditional requires a complex antecedent. Is this a major problem? I don't think it is. At several places in his (2007) book, Bird envisages that complex stimuli will be a complication of the more standard presentation of his dispositional monism. For example, in his discussion of multi-track dispositions and their prospective reduction into single-track dispositions, the case of a conjunctive stimulus is thought to be non-reducible (pp.21–4). Another example is Bird's (p.103) discussion of the essence of potencies, where it is stated that, "If the potency is 3-adic, because it has a two-part stimulus, then it will be essentially 3-adic, on the grounds that the stimulus and manifestation of a potency are essential to it". If there is a two-part stimulus, then the obvious move is to replace the DSM-relation with a 'DSSM-relation'. This modified relation is an asymmetric four-place relation that holds between four potencies. Its first place is the dispositional property place, the second that of the first stimulus property, the third that of the second stimulus property, and the fourth that of the manifestation property. Perhaps saying that the second place of the DSM-relation is occupied by two dispositional properties might resist this move. But I think this reply starts to put pressure on the sense in which Bird's graph theory is using our understanding of relations to explain the numerical identity of potencies, since it is a non-standard view that a three-place relation can have four relata. A different view might be that we could keep the DSM-relation as a three-place relation, but have the conjunction of the two stimulus properties, Q^2 and R, as a single relata. That might be more promising, I think, given that conjunctive properties are typically permitted on factualist lines. Note that factualism is Bird's background ontology, signalled explicitly at (2007, p.107). The second general problem is one that we have already noted: the object-sensitivity for the stimulus properties (Q^2 and R) and the manifestation property (M)

have specific requirements if we are to understand Coulomb's law in terms of objects having distinct dispositional properties.

So we can see that the requirements of Coulomb's law take us beyond the standard set up of a single stimulus property with the default object-sensitivity (i.e. where the stimulus property is required to be co-instantiated by the same object that bears the potency). At this point I want to note the following. Firstly, in the Coulomb case it would appear that we need to modify Bird's DSM-relations in something like the way that I alluded to in the previous paragraph. There will be many ways to do this, but I suggest the following method (which is loosely based upon one of the previous methods). With regard to the dispositional properties that feature in Coulomb's law, we can use a four-place relation, which we can term a 'DSRM-relation'. Its first place will be the dispositional property place for Q^1, the second that of the charge Q^2 stimulus property, the third that of the displacement relation R, and the fourth that of the component force manifestation, F. As far as I can see, something needs to be changed in Bird's framework, since we want there to be a way of moving from Bird's graph theory resources to the relevant subjunctive conditionals. The suggestion at hand can provide a starting point, I suggest, since we can view the DSRM-relation as providing a function from Q^1 to the other properties/relations Q^2, R, and F. I'd like to put Barker and Smart's worries to one side in this section of the thesis, since I will discuss these at the end of our investigations. So we are not presently concerned that there is a general problem in moving from relationally-constituted dispositional properties to subjunctive conditionals. Rather, our present discussion is concerning a point of detail. With this in mind, the point at hand is simply that Bird's DSM-relations look ill-equipped to handle three stimulus/manifestation universals, as oppose to the standard number of two. But a second component to the problem is that the form of the subjunctive conditional is different in the Coulomb case than it is in the standard case. As we have noted above, we have the following difference.

> Default case: 'If it were the case that [stimulus property]*x*, the it would be the case that [manifestation property]*x*'
> Coulomb case: 'If it were the case that [stimulus property/Q^2]*y* and *x*[relation/R]*y*, then it would be the case that [manifestation property/F]*x*'

What we can see now is that there is no straightforward move from (i) specifying the stimulus and manifestation properties of a potency to (ii) specifying the required stimulus condition and thereby the form of the subjunctive conditional in question. We can see this because we could keep the DSRM-relation above, and thereby keep fixed our quartet of properties (Q^1, Q^2, R, and F) but use the 'default case' subjunctive, as below.

'If it were the case that [Q^2 and R]*x*, then it would be the case that [F]*x*'

But, for the reasons that we have noted, this is unsuitable. So for the Coulomb case we need not only a specific number of properties/relations (three properties and one relation), but also the right type of subjunctive conditional to 'plug' these into. And as the dummy subjunctive directly above shows, upholding Bird's version of ($CA_{\Box}$) for all potencies, whereby we move from the specification of a stimulus—manifestation profile to a single type of subjunctive conditional (the default one), will give the incorrect results. Accordingly, as far as I can see Bird needs to make the following changes to accommodate his reading of Coulomb's law. First, different types of potencies can be involved with different types of constitution relations. Some potencies will have simple pairs of stimuli and manifestations, whereas some potencies (such as Q^1 and its relatives) will have more complex combinations of stimulus properties and relations. And second, we will need to associate a different form of subjunctive conditional with different types of potencies. So we might have multiple potencies that require the default subjunctive conditional, but there will also be a number of potencies that require the Coulomb form of the subjunctive, which we have looked at above. And we can of course envisage more complex 'dispositional essentialist' understandings of laws, whereby the stimulus conditions and manifestation circumstances differ from both the default case and the Coulomb case. Restricting ourselves to the default case and the Coulomb case, however, I show below how this would work for these types of dispositional property.

Default case:

(DE_p) $\quad \Box(Px \rightarrow D_{(S,M)}x)$

$(CA_\Box)$ $\quad D_{(S,M)}x \rightarrow (Sx\Box \rightarrow Mx)$

DSM-relation:

[disposition, stimulus property, manifestation property]

Subjunctive:

If [stimulus property]*x*, then [manifestation property]*x*

Coulomb case:

(DE_p^*) $\quad \Box(Px \rightarrow D_{(S,R,M)}x)$

$(CA_\Box^*)$ $\quad D_{(S,R,M)}x \rightarrow (Sy \& xRy\Box \rightarrow Mx)$

DSRM-relation:

[disposition, stimulus property, relation, manifestation property]

Subjunctive:

If [stimulus]y and *x*[relation]*y*, then [manifestation property]*x*

In the next chapter I shall apply this kind of approach to Bird's antidotes. As a concluding remark we can notice that despite these different structures for dispositional essences, this modification would still give Bird a unified stimulus–manifestation model, since we still have the underlying idea that there is a subjunctive sufficiency from one group of properties (e.g. Q^2 and R) to another (e.g. F). And subjunctive sufficiency from one group of entities to another is one notion of what the stimulus—manifestation distinction is attempting to capture. As far as I can see, however, the connection between a given version of (DE_p) and a given version of $(CA_\Box)$ will have to be taken as primitive.

3

Potencies and Antidotes

3.1 Introduction

My contention in this chapter is that Alexander Bird's (2007) dispositional monism cannot explain the operation of antidotes, *viz*. their interference with the circumstances that are necessary for a dispositional property to produce its manifestation. Bird introduced antidotes as a counterexample to the left–right implication of conditional analyses of disposition ascriptions, such that disposition ascriptions do not entail counterfactual/subjunctive conditionals if antidotes are exercising their operation of interference (Bird 1998; c.f. Johnston 1992). In the case of extrinsic antidotes, the thought is that dispositional properties produce their manifestations as a combination of (i) the obtaining of their stimulus and (ii) the obtaining of extrinsic circumstances, where these elements are individually necessary and jointly sufficient for the production of the manifestation. Accordingly, antidotes are designed to prevent the manifestation of a dispositional property by exercising their operation of interference upon the extrinsic circumstances of a dispositional property, such that these do not obtain (i.e. such that the extrinsic circumstances are unsuitable for the production of the manifestation).

Unfortunately, however, Bird's dispositional monism cannot explain the operation of interference that antidotes exercise upon external circumstances—or so I argue. The reason for this is simple: Bird's dispositional monism does not contain antidotes, external circumstances, or the operation of interference. In contrast, Bird's dispositional monism is exhausted by objects and dispositional properties, where the latter are thought to be natural properties that are essentially dispositional. Hence, there is a *prima facie* problem of improper ontological representation: Bird's ontology of objects and dispositional properties cannot properly represent antidotes, external circumstances, or the operation of interference. It follows *a fortiori* that Bird's ontology cannot properly represent the antidote-based prevention of the manifestation of a dispositional property.

What are the prospects for dissolving this *prima facie* concern? In this chapter I consider two general strategies, both of which are problematic. The first is Bird's *ceteris paribus* strategy for making his potencies sensitive to antidotes. And the second is Bird's elimination of antidotes. At a first pass, this second strategy looks to frustrate my topic in this chapter. For suppose that we agree that there is a problem of improper ontological representation *re* antidotes; if Bird can successfully argue that there are no antidotes then this would be a difficulty of little importance. This dialectical point is well received. (I am grateful to Matthew Tugby for discussion on this issue). Nevertheless, when we examine Bird's strategy for eliminating antidotes in more detail, we will see that what he is actually doing is eliminating dispositional properties that are sensitive to antidotes in favor of dispositional properties that are not sensitive to antidotes (i.e. he is eliminating antidote-sensitive dispositional properties in favor of antidote-free dispositional properties). It is important to realise, however, that this is not equivalent to eliminating antidotes. In fact, I shall suggest that Bird's elimination strategy ends up presupposing the existence of antidotes. (To jump the gun slightly, what Bird's elimination strategy does do is to replace a type of stimulus property with another (suspicious) type of stimulus property.)

3.2 The *ceteris paribus* strategy

Let us briefly recap Bird's first treatment of antidotes. Here the basic dialectic is as follows. In his essay *Laws and Essences*, Bird introduces the notion of a simple essentialism, by which he means a version of his dispositional monism that completely bypasses, or ignores, the problem of finks and antidotes (2005a, p.442). As we would expect, when restricting our attention to 'sure fire' or 'deterministic' potencies, these entities generate exceptionless regularities that concern, in the default case, the co-instantiation of the potency and stimulus property, on the one hand, and the production of the manifestation property, on the other. But simple essentialism is of course unsuitable as it stands.

This is the case for two connected reasons. The first is that there are numerous examples of *ceteris paribus* laws, at least at on a macroscopic level. It is a platitude that water boils at 100°C, but this is only the case at standard atmospheric conditions. With higher pressures, a greater temperature

is required for the boil; at lower pressures, a lesser temperature will suffice. (Indeed, it is possible to boil water at room temperature, given the right conditions). Accordingly, there is not a strict regularity between a sample of water being 100°C and it boiling. A second point, connected to the first, is that the discussion of finks and antidotes in the conditional analysis literature (e.g. Martin 1994; Lewis 1997; Bird 1998; Gundersen 2002) provides examples, typically this-worldly and macroscopic, of dispositions that fail to produce their supposed manifestation because of some interfering or preventative factor (i.e. because of the fink or antidote under discussion). Taken together, these considerations are problematic for Bird's simple essentialism, which consequently looks dogmatic and uncritical. But no matter, Bird's simple essentialism was never designed as a metaphysics of nature, but rather as a stepping stone that illustrates his chosen model of potencies and their close connection to the conditional analysis. What the problems do require, however, is that Bird somehow has to account for imperfect regularities in nature, whilst simultaneously accommodating the counterexamples to the basis of his derivation of lawful regularities, i.e. whilst simultaneously accommodating the counterexamples to the conditional analysis. His resolution to these twin difficulties is quite neat: Bird suggests that, to the extent that a system of dispositional essentialism may require the grounding of imperfect regularities and *ceteris paribus* laws, this can be achieved by using finks and antidotes as the preventative entities, i.e. by using those entities that prevent the manifestation in the cases of exception (Bird 2005b, p.359).

This is Bird's first treatment of finks and antidotes (the first of two lines of thought he presents). It basically involves modifying the subjunctive conditional that is associated with a potency from having a mere stimulus condition to having both a stimulus condition and a second condition, the latter of which is some kind of clause that excludes the presence of finks and antidotes. As I shall explain below, this is a slightly complicated move, which Bird himself admits to be problematic (2007, pp.36–8). We should note for the time being that this move upgrades Bird's simple essentialism into what we might call a critical essentialism, which is thought to be apt for a metaphysical representation of reality in all of its (epistemically possible) untidy and imperfect details. (Note that the introduction of the exclusion condition is independent of the potency having a conjunctive stimulus property, which was a matter that we discussed in Chapter 2.)

3.3 The elimination strategy

Bird's second treatment of finks and antidotes is interesting. As I outlined in Chapter 2, Bird presents arguments against the existence of finks and antidotes at the fundamental level. Given that Bird has connected the issue of *ceteris paribus* laws to finks and antidotes, what is effectively at stake in these arguments is the requirement for Bird's dispositional essentialism, which is explicitly designed for the fundamental level, to generate imperfect regularities. A word of warning here. One understanding of Bird's first treatment of antidotes, i.e. the *ceteris paribus* strategy, is that it is set up for the macroscopic realm. I think this is a misreading. At all times Bird is focused on the fundamental level, but the first treatment stands to the second as a backup position. This is a non-trivial standing, since, as Bird explains, his argument against antidotes at the fundamental level is speculative and defeasible. That said, given that Bird is at least expecting the absence of finks and antidotes at the fundamental level, we might wonder, as noted in the introduction to this chapter, how these entities could pose a problem for Bird's dispositional monism. The key point here is that Bird's elimination strategy does not eliminate antidotes, but rather presupposes their existence; indeed, they are now used to explain why potencies produce their manifestations. In this chapter I take no issue with Bird's argument against finks, hence my focus upon antidotes; but I think Bird's argument against the existence of antidotes at the fundamental level is problematic. I should note that Bird's argument against fundamental finks is also accepted by Corry (2011). In outline, this elimination strategy involves recasting a potency that suffers from antidote-based prevention into a different potency that has a decidedly unstable metaphysical nature: the new potency has as its (single) stimulus property S-in-the-absence-of-antidotes. Crucially, we should note that Bird's elimination strategy for finks and antidotes does not give the same system as that of his simple essentialism, despite possible initial impressions.

The issue can be clearly made by distinguishing between two senses in which one could eliminate antidotes. The first is to say that antidotes do not exist in the way that one might say that witches do not exist. That is, we deny the membership of antidotes into the fundamental level of the actual world. A second strategy is to say that antidotes do not exist in a certain way, but that they still exist in another way. The second sense of 'elimination' is what Bird goes for. Bird eliminates not antidotes, but potencies that are sensitive to antidotes in favor of potencies that are antidote-free.

It is crucial for my argument that this is different to what we might call the elimination of antidotes proper, i.e. the first route. Indeed, when we consider what being an antidote-free potency consists in, we will see that Bird's elimination strategy is curiously named twice over. First, antidotes are not eliminated. And second, potencies are still sensitive to antidotes (although in a different way).

To see how this works, we need to go back to the discussion of antidotes in Lewis (1997) and Choi (2003; 2006). (Manley and Wasserman (2011) provide a wide-ranging discussion of the conditional analysis literature.) If we consider Bird's medical antidote as a putative counterexample to the simple conditional analysis, there are two strategies (amongst others) that its defenders could take so as to preserve the left–right direction. One is to deny the counterexample outright, i.e. to deny that there are the kind of medical antidotes under discussion, such that, *a fortiori*, death by ingestion cannot be prevented by medical antidotes. That looks rather dogmatic, given that there is nothing flashy about the counterexample. In addition, it is to invite further counterexamples, since this strategy would have to be upheld across all putative antidotes. What is worse, however, is that even if all of the candidate examples of antidotes in the empirical world were somehow denied, Bird could then move on to merely possible cases of antidotes, such as the physicist-sorcerer, who prevents the breaking of a vase by administering shockwaves that cancel out the vibrations that would otherwise lead to fracture lines. (I should note that Gundersen (2002, p.401) takes issue with this "modalised-masking", i.e. he takes issue with the idea that a workable counterexample to the conditional analysis need only show that there is some possible world in which the disposition obtains the stimulus but that the manifestation does not occur (see also Gundersen 2004). Nevertheless, denying that antidotes exist is one way of saving the simple conditional analysis. On this type of elimination, we deny that (i) there are antidotes, such that (ii) if the stimulus property and the disposition property are co-instantiated, then there is always a manifestation property. Consider this hypothetical exchange:

Bird: (CA) is false because there are cases of D and S being co-instantiated but where M is not produced. This can be so even for a deterministic disposition, because the antidote A can prevent D from producing M.

Defender of (CA): There are no such cases. It is true in all possible worlds that $D_{(S,M)}x \rightarrow (Sx \Box \rightarrow Mx)$. Deterministic disposition or otherwise, there are no A-like entities to prevent the production of M.

The strategy of Lewis and Choi, however, is to build the absence of the antidote into the stimulus property of the disposition. According to Lewis' two-step approach to the conditional analysis, we firstly analyse a covert disposition term into an overt disposition term (by specifying its stimulus and manifestation), before analysing the overt disposition term by way of some kind of counterfactual or subjunctive conditional. Importantly, both of these steps can be simple or complex, and the elimination strategy at hand involves rejecting the first step as a simple analysis. So, in the case of fragility, we could have as a simple analysis 'the disposition to break when struck' or the complex analysis 'the disposition to break when struck in the absence of the physicist-sorcerer [and perhaps also all other antidotes]'. (Below I will provide a more detailed discussion of these steps and how they are related to Bird's system.)

What is interesting about this strategy is that it achieves two things. Firstly, we do not deny the existence of the antidote (the physicist-sorcerer can still exist). And secondly, we do not deny that there can be exceptions to the co-instantiation of properties D and S and the production of M. But it is not the case that the physicist-sorcerer prevents the manifestation of breaking in response to the vase's being struck. And this is because the vase never was disposed to break when struck, but rather it was disposed to break when struck in the absence of the physicist-sorcerer. In terms of Bird's ontology, what this means is that the stimulus property of the disposition is no longer a simple property (i.e. the stimulus property proper, S), but rather a complex property where the first property is the stimulus property proper, S, and the second property is the absence of possible antidotes ' ... -in-the-absence-of A^1, A^2, A^3, ... '. This is how Bird proposes we can eliminate antidotes.

Importantly, on this strategy antidotes will still have an explanatory role. Their absences now feature as 'causes' for the triggering of dispositions. And interestingly, present or obtaining antidotes can still prevent the manifestation of a disposition in some sense of this term. For consider the case where *x* is disposed to M if S, but where antidote A is present. In this situation the complex stimulus property will not be satisfied (although the object is stimulated the antidote is not absent), and so the disposition will not manifest. So we have a kind of prevention by denial of stimulus condition. These two understandings of prevention are given below.

Prevention 1:

An object has a disposition that has a simple stimulus. This simple stimulus obtains but its manifestation does not occur due to prevention by some antidote.

Prevention 2:

An object has a disposition that has a complex stimulus. This complex stimulus does not obtain, though the disposition obtains its stimulus property proper. The failure of its complex stimulus to be satisfied via the presence of the antidote (which is required to be absent) prevents the production of the manifestation by preventing its being triggered.

To see the importance of this, let's go back to Bird's scheme of a fundamental antidote. It is a condition, A, such that *x* has $D_{(S,M)}$ and *x* is S, but M does not occur. Note that $D_{(S,M)}$ is a 'standard' dispositional property, with a simple stimulus property (i.e. its stimulus condition is just its stimulus property proper, plus some object-sensitivity). We have the following type of state of affairs. I place the antidote on a different object to avoid the issue of intrinsic antidotes.

(i) D*x* & S*x*, A*y*

Because D is a standard dispositional property, we are here understanding A as preventing the manifestation M in line with Prevention 1. Everything is right for the production of M, but M does

not occur, hence the status of A as a counterexample to the simple conditional analysis. In contrast, where A is absent (and where we are ignoring finks), M will be produced if *x* is S and D.

(ii) D*x* & (S&~A)*x* & M*x*

We can think of (i) and (ii) as two different forms of complex states of affairs (as they contain different types of properties, and also a different number of objects) that we want to model if we not simply denying the existence of antidotes and the exceptions to regularity that they give rise to (as we might deny the existence of witches). In the case of (i), although D and S are co-instantiated, M is not produced (due to A). And in the case of (ii), D and S are co-instantiated and A is absent, so M is produced (and M is produced partly because A is absent).

The significance of this is as follows. The elimination strategy that Bird sets out is not what it may appear to be. When Bird says that he is denying that there are *ceteris paribus* regularities and antidotes at the fundamental level, we might have thought that he is taking the hypothetical stance above. That is to say, we might have thought that he thinks there is the following kind of exceptionless regularity: For any object, *x*, if *x* has D and S, then *x* has M. And this because, quite bluntly, there are no antidotes. But that is dogmatic and non-empirical. Perhaps nature is like that, but Bird does not want to be hostage to that fortune. Instead, antidotes are eliminated in such a way that the exceptions to the regularities that they are associated with are still accepted. And this, of course, is because the absence of the antidote is now a requirement of the production of the manifestation. Hence, where the antidote is present, the manifestation will not fire, feigning (i) above; and where the antidote is absent the manifestation will fire, since the dispositional property now has attained its complex stimulus property, (ii) above. That is why Lewis and Choi's strategy for antidotes is quite clever: it preserves the appearances (empirical cases of D&S&A but not-M), but alters the analysis such that D&S does not give the triggering of the manifestation (which is really D&(S-without-A)). This can be disguised by lumping together simple and complex stimulus properties under the term 'stimulus'. In effect, the counterexample of antidotes works by using the stimulus property proper as the stimulus condition *qua* antecedent of the conditional; the elimination response is to expand the 'stimulus' to require the absence of the antidote (and this is achieved, as I shall further explain below, by modifying 'what it is to be' a stimulus property).

3.4 How do Bird's two strategies stand to the conditional analysis?

In this section of the chapter I want to try and get a clearer picture of Bird's *ceteris paribus* and elimination strategies. As we shall see, there are problematic aspects to both strategies.

A profitable way to understand what is going on here is to look at Bird's approach towards the two steps of Lewis' conditional analysis. The first of these steps involves the translation of a covert disposition predicate into an overt disposition predicate, the latter of which has an explicit stimulus and manifestation pair. This can be done in a 'simple' or 'complex' manner. According to the simple manner, 'fragility' would translate into the disposition to 'break when struck'. According to the complex manner, however, 'fragility' might be translated into the disposition to 'break when struck in the absence of possible antidotes'. Note that this is Lewis' (1997) and Choi's (2003) strategy for dealing with antidotes as a counterexample to the conditional analysis. The second step of the conditional analysis, Lewis explains, involves choosing a certain counterfactual or subjunctive conditional for the overt dispositional predicate. This too can have a simple and a complex procedure. The simple case would involve the antecedent of the conditional referring to the stimulus predicate/property, which is fixed in the first step above, as well as specifying the object-requirements of that predicate/property. In the default case, this is the same object-variable as the object-variable that is used for the disposition. Hence, where *x* has the disposition, the antecedent of the conditional is 'S*x*'. A similar setup is used for the consequent of the conditional. As is well known, however, Lewis' complex subjunctive conditional breaks away from this route and adds the requirement of the continued existence of the causal basis of the disposition etc. so as to bypass the problem of reverse-finks. Thinking more generally about Lewis' distinction between these two steps, there are other types of complication that we can use for the subjunctive conditional whereby the second step of the conditional analysis is complex.

First Step: a covert disposition is translated into an overt disposition.
Second step: the overt disposition is linked to a counterfactual/subjunctive conditional.

Unsurprisingly, given Bird's model of potencies, his two main theses (DE_p) and ($CA_{\Box}$) directly correspond to these two steps.

(DE_p) $\Box(Px \rightarrow D_{(SM)}x)$ [like the first step]

($CA_{\Box}$) $\Box(D_{(SM)}x \rightarrow (Sx\Box \rightarrow Mx))$ [like the second step]

First consider the left–right direction of (DE_p). Bird uses this entailment to move from a certain object instantiating a certain potency (where the latter is a fundamental property with a dispositional essence) to the same object having a certain disposition. This reveals Bird's model of dispositional essences as using a stimulus-manifestation model of dispositions. As I suggested in Chapter 2, we can read this thesis as fixing the stimulus property and manifestation property of a potency, once we fix upon a given potency. So construed, there is a close connection to Lewis' first step, since that involves moving from a covert disposition to an overt disposition with a stimulus and manifestation pair. Now consider the left–right direction of ($CA_{\Box}$). This entailment also mirrors what is going on in Lewis' second step, since we are associating a certain disposition (that has its stimulus and manifestation specified) with a certain subjunctive conditional.

Let us term Bird's *ceteris paribus* strategy his 'CP model' and his elimination strategy his 'E model'. What is interesting is that Bird's CP model and E model use opposite combinations of simple steps and complex steps for (DE_p) and ($CA_{\Box}$). Given that these two thesis correspond to Lewis' two steps, which can either be simple or complex, so too can (DE_p) and ($CA_{\Box}$) be either simple or complex.

Simple Essentialism:

(simple DE_p) $\Box(Px \rightarrow D_{(SM)}x)$
(simple $CA_\Box$) $\Box(D_{(SM)}x \rightarrow (Sx\Box \rightarrow Mx))$

CP Model:

(simple DE_p) $\Box(Px \rightarrow D_{(S,M)}x)$
(**complex** $CA_\Box$) $\Box(D_{(S,M)}x \rightarrow (Sx\mathbf{\&}\mathbf{C}x\Box \rightarrow Mx))$

E Model:

(**complex** DE_p) $\Box(Px \rightarrow D_{(\mathbf{S\text{-}absence\text{-}A},M)}x)$
(simple $CA_\Box$) $\Box(D_{(\mathbf{S\text{-}absence\text{-}A},M)}x \rightarrow (\mathbf{S\text{-}absence\text{-}A}x\Box \rightarrow Mx))$

Let us start with the CP model. Bird's CP model involves adding a requirement to the subjunctive conditional that C*x* is the case, where C is thought to be a condition that excludes antidotes. The overall idea is that Bird wants to make his potencies *sensitive* to antidotes and finks. As we have noted, simple essentialism is dogmatic, and so we have to find a way to explain why, for example, water does not boil at 100°C. In the view at hand, C might be a condition that excludes non-standard atmospheric pressures (amongst other things). But the following is very important. Unlike the E model (see below), Bird has not argued for any change to the specification of the stimulus or manifestation of his potencies. Because of this, (DE_p) is simple but ($CA_\Box$) is revised, i.e. complex. This corresponds to Lewis' complex second step, where we connect a certain overt disposition to a certain complex counterfactual/subjunctive. Importantly, in contrast to the subjunctive conditionals of Bird's simple essentialism, we are now using a conjunctive or complex antecedent (where C*x* is the new conjunct).

Moving on to the E-model, we have the same form of subjunctive conditional as we have for Bird's simple essentialism. That is to say, the antecedent is simple. But Bird has now changed the form of the stimulus property from S to S-absence-A (or, more precisely, to S in the absence of all

possible antidotes: I shall often omit this complication). This directly corresponds to Lewis' and Choi's strategy for dealing with antidotes. Note that the E Model has changes (in bold) to both (DE_p) and ($CA_{\Box}$), but this is only because the change to the former is 'carried through' to the latter. Getting these relationships clear puts us in a better place for understanding Bird's strategies for dealing with antidotes and the problems that they might face.

3.5 Further discussion on the *ceteris paribus* strategy

With this in mind, let us return once more to the *ceteris paribus* strategy. At a point in his book (2007, pp.36–8) where *ceteris paribus* laws and antidotes are discussed within the context of the conditional analysis, Bird provides a discussion of the model of subjunctive conditional that he will use for his CP strategy (i.e. complex $CA_{\Box}$). Bird explains how finding a function from a disposition to its conditions that exclude antidotes is difficult, and at the time of writing has not been solved. What we want to avoid is just saying that C is the conditions where the disposition does not manifest, as this might involve triviality (which is important to avoid for a conceptual analysis of dispositions). But now this strategy is being used as an ontological thesis, i.e. as a 'general truth' such that a dispositional property entails a certain subjunctive conditional. I say this because Bird has already said that ($CA_{\Box}$) is "metaphysically necessary" (2005, p.355); so it is reasonable to assume that the refined version for the CP strategy should also be metaphysically necessary.

I think Bird's problem for the function is connected to my original worry that Bird does not have an ontological category of antidotes nor a forthcoming metaphysical analysis of what it means to be an antidote. For these reasons, he does not have a way of moving from a given potency to the ontological import of C in C*x*. Just as in the context of the conditional analysis C*x* may be trivial without the required function, in Bird's theory of laws, since C*x* is doing work (it is used to explain why a potency does or does not manifest), without some understanding of what antidotes are and a method of linking them up to dispositional properties, C*x* can be argued to be ontologically uncritical.

One way to bring out this issue is as follows. Despite the issue of object-sensitivity that I noted in the last chapter, there is a 'good connection' between the ontological resources of Bird's theory and his simple essentialism. What I have in mind is that the ontological resources of Bird's theory are exhausted by objects and (to take his preferred view) Platonic universals. But, correspondingly, Bird's two central theses—(DE_p) and ($CA_\Box$)—only refer to object variables and constants for universals. So when we make the theory 'critical' for the purposes of interference and prevention, we can see that both of Bird's strategies introduce new kinds of beings—'C' in the CP model and 'S-absence-A' in the E model. Hence the problem of a possible lack of ontological representation. In both cases, we can investigate whether or not these kinds of beings can be understood in terms of properties. With regard to the CP model—our current concern—we are now going to see if we can provide a function from a given potency to its antidotes.

A first point is that what we want C*x* to exclude in a property-based metaphysics of laws is the manifestation property of what we can call an 'antidote-property'. Consider the example of the moderating boron rod (Mellor 1974; Bird 1998). It is plausible that the boron rod has some property—'made of boron', let us say—that explains why it can prevent the nuclear pile from blowing up. Indeed, I presume that boron is good at absorbing radiation. That said, it cannot be the mere presence of an antidote object (with its relevant properties) that is sufficient for prevention, since the first antidote may be subject to another, i.e. there may be double prevention. Because of this, it seems that what we want to be absent is the manifestation of the property 'made of boron'. A simple model would have the manifestation be the proxy property 'absorption'. To clarify, I suggest that antidotes should be seen to prevent on the basis of their properties, and that it looks plausible that it is the manifestations of these properties that are important. So far, then, we have the following idea.

Antidote property: A is disposed to M^1 if S*
Antidote-sensitive property: D is disposed to M if S; D is 'sensitive' to M^1.

So the idea is that the C conditions for the antidote-sensitive property, D, should be capturing M^1. Given Bird's dispositional monism, M^1 is of course a potency (Note in the above I term the stimulus for the antidote property, in this case boron, as S*. This is to remain neutral on whether or not the

antidote property can have the same stimulus property as the antidote-sensitive property, i.e. D. We of course have to provide 'boron' with some kind of stimulus and manifestation, since Bird's view is that all properties fall under the stimulus–manifestation model).

That said, it will be useful to have a backup position: perhaps it is just certain properties that we want to exclude, which we will call the 'antidote properties'. But I think that both suggestions are an improvement on Bird's model of a possible fundamental antidote, which approaches these entities as 'conditions'. That, I think, is a non-starter for the ontology of Bird's dispositional monism, since it only has objects and properties/relations at its disposal. As such, my charge of a poor ontological representation of antidotes could be easily made.

For the default case of object-sensitivity where M^1 is required to be absent from the potency-object (i.e. where we want to stop the object that bears the potency from being co-instantiated with M^1), we can suggest the scheme below.

CP Model:

(simple DE_p) $\Box(Px \rightarrow D_{(S,M)}x)$
(complex $CA_{\Box}$) $\Box(D_{(S,M)}x \rightarrow (Sx \& Cx\Box \rightarrow Mx))$

Cx = it is not the case that M^1x

This is the starting point of my repair to Bird's CP model. The next step is to link up the antidote-sensitive potency, D, to M^1. Here I suggest, building on the material in Chapter 2, that we can use a reconfigured SM-relation. The idea is that the relation now has an extra place for the manifestation of the antidote property that we want to exclude. I call it a 'DSAM-relation'. All it does is to give a function from a given place on the relation to its other places (hence, if we fix its third relatum, say, then we fix a determinate universal that stands in, say, the second place). Here is a simple case where there is one antidote. (I envisage that further places would be needed for more antidotes: so the constitution relation could get a high adicity.)

DSAM-relation: $\{P^1,P^2,P^3,P^4\}$

Note that P^1–P^4 are potencies in this ordered relation. The proposal is that this DSAM-relation links a potency to a stimulus property, antidote-manifestation, and manifestation. At this point I raise the issue that although we have provided a function from a potency to its possible antidote(s), we have not explained the content of C*x*. This is important, because C*x* *prima facie* involves negatives or absences. (I am grateful to Matthew Tugby for discussion on this matter.) Given my work in chapter 2, where I argue that ($CA_{\Box}$) is doing some important work of fixing object-sensitivity, I can adapt Bird's complex second step in his CP model (i.e. the complex subjunctive conditional) so that it has the following form: 'If it is the case that *x* is _ and not the case that *x* is _, then it will be the case that *x* is _'. Using the same diagrams as before, we can show this scheme as follows. Blow it, I show Bird's original CP model for reference.

Modified CP Model:

DSAM-relation [D,_,_,_]

(DE_p [now complex]) $\Box(Px \rightarrow D_{(\_,\_,\_)}x)$

($CA_{\Box}$[now complex in a different way]) $\Box(D_{(\_,\_,\_)}x \rightarrow (\_x \,\&\, \sim\_x \,\Box\!\!\rightarrow\, \_x))$

Original CP Model:

DSM-relation [D,_,_]

(simple DE_p) $\Box(Px \rightarrow D_{(\_,\_)}x)$

(complex $CA_{\Box}$) $\Box(D_{(\_,\_)}x \rightarrow (\_x \& Cx \Box\!\!\rightarrow \_x))$

The first line shows Bird's modified DSM-relation, with a place added for the manifestation of an antidote-property (e.g. 'absorbs' for 'made of boron'). This is the DSAM-relation. Given that I suggested that (DE_p) is closely connected to Bird's graph theory, we now have a different general model of a disposition. For one antidote, dispositional properties are now 'three-place operators', with a stimulus property, antidote-manifestation, and regular manifestation. This is shown in the second line, where we have a replacement for (DE_p). And lastly, we have my version of Bird's

complex subjunctive conditional. I have changed the form of this proposition so that it has a ready built place for the antidote-manifestation. The motivation for this is that we can avoid having a 'material absence'. Here the idea is that the antidote manifestation will be a positive property that the form of the subjunctive conditional requires not to be the case. I further discuss the relevance of material absences below.

As with the discussion of Coulomb's law, I am arguing that different types of dispositional properties will have different requirements for their subjunctive conditionals. In the case of antidote-sensitive properties, Bird has already committed himself to the idea that we can have a complex antecedent, where the second conjunct excludes antidotes. Chapter 2 argues that there is something going on with subjunctive conditionals that is not provided for in the constitution relations of dispositional properties (namely, object-sensitivity). My response is to say that Bird needs to take as primitive that his potencies are connected to different forms of subjunctive conditional. The subjunctive conditional will have different possible forms, and these will be filled with properties by the graph theory. I think all of this gives a suggestion for dealing with Bird's problem of the 'C*x* function' and its ontological representation. Here is the same type of scheme as above but with some property constants.

Modified CP Model:

DSAM-relation [D,S,M^1,M]

(DE_p [now complex]) $\Box(Px \rightarrow D_{(S,M1,M)}x)$

($CA_\Box$[now complex in a different way]) $\Box(D_{(S,M1,M)}x \rightarrow (Sx \ \& \sim M^1x \ \Box\!\!\rightarrow Mx))$

This could be used for where we want to exclude M^1 from the same object that instantiates D. With regard to antidote-manifestations that need to be excluded from other objects that are spatially related to the potency object, we can combine the above suggestion, i.e. the DSAM-relation, with the suggestion of the previous chapter that is focused on Coulomb's law. Let us call this a 'DSARM-relation'. It has the following places: disposition, stimulus, antidote-manifestation, relation, manifestation]. I show two lines below for how this relation would plug properties into a version of ($CA_\Box$).

$(CA_{\Box})$ $(D_{(S\_,\_,\_,\_)}x \rightarrow (\_x \,\&\, \sim\_y \,\&\, x\_y \,\Box\!\!\rightarrow\, \_x))$

$(CA_{\Box})$ $(D_{(S,M1,R,M)}x \rightarrow (Sx \,\&\, \sim M^1y \,\&\, xRy \,\Box\!\!\rightarrow\, Mx))$

I should summarise our discussion so far. We are currently investigating Bird's *ceteris paribus* strategy for antidotes. Crucially, this strategy involves saying that the subjunctive conditional that is associated with a given potency is complex, in the sense that it has a conjunctive antecedent. In this antecedent, Bird postulates a condition, C*x*, which is thought to exclude finks and antidotes. In our discussion we have only looked at antidotes (given that Bird argues, decisively I believe, against the existence of finks at the fundamental level). But there is a problem of ontological representation, which Bird himself alluded to in his discussion of the conditional analysis. It is this: how can we provide a function from a given disposition predicate to its set of all possible antidotes? Well, I am not sure how we could do that in the context of a conceptual analysis of dispositions, but I do think that a sensible modification to Bird's view *re* the ontological correlate of this problem is to alter Bird's graph theoretic resources. We have now answered the question of what antidotes are: they might either be the manifestations of regular potencies, where the latter are now identified as antidotes, or otherwise they might just be sets of potencies (where these masking potencies come from, as it were, would be of no relevance). This is my suggestion for the ontological representation of 'conditions' in Bird's ontology. But the prices seem quite high. Firstly, we need to modify the graph theoretic resources. And secondly, we need lots of different versions of $(CA_{\Box})$, understood as metaphysically necessary truths. As far as I can tell, there is no way to move from a given potency standing in certain second-order relations to the precise subjunctive conditional that this strategy requires. So it will have to be taken as primitive that, for example, that DSARM-relation above matches up with the subjunctive conditional in question. (In a way, this issue is encroaching upon Barker and Smart's (2011) complaint that dispositional essentialism faces an 'explanatory gap'. We discuss this in Chapter 7.) I note that Bird appears to require both of these general types of modification anyway, given our discussion in the last chapter concerning object-sensitivity. And finally, it is interesting to see that Bird would need to provide a truthmaker for the absence of the antidote-manifestation.

3.6 Further discussion on the elimination strategy

I want to briefly move back to Bird's elimination strategy, or E model. Let us recall the difference between Bird's CP model and his E model *re* Lewis' first and second steps. In particular, the E model uses a simple second step (so the subjunctive has a simple antecedent, just like Bird's simple essentialism), but it uses a complex first step, such that the stimulus property is now 'S in the absence of A'. At this point, we can note that there are several possible understandings of the term 'stimulus' that might surround Bird's system.

(1) The stimulus property, taken as a monadic universal (i.e. 'S')
(2) The stimulus condition, which can be many things. For example, we can have a monadic universal with a specific object variable (e.g. S*x*). Or we could have the stimulus condition of the CP strategy (e.g. S*x*&C*x*). A more complex combination would be, for instance, 'S*x*C*y*'.
(3) The antecedent of a subjunctive conditional, which can be many things.
(4) A stimulus property, taken as some kind of complex universal.

In contrast to the CP model, which uses (2), Bird's E model uses (4). We can recall the following scheme.

E Model:

(**complex** DE_p) $\Box(Px \rightarrow D_{(\textbf{S-absence-A},M)}x)$
(simple $CA_{\Box}$) $\Box(D_{(\textbf{S-absence-A},M)}x \rightarrow \textbf{S-absence-A}x\Box \rightarrow Mx)$

The bolded text is showing that Bird has modified his graph theory resources. So we now have a different kind of modification to the CP model. In the E model we are basically changing 'what it is to be' a stimulus property. This is different to the (original) CP model because in that case the graph theory resources were left untouched, but Bird added a clause to the subjunctive conditional. (To avoid confusion here I should reiterate that in my discussion of Bird's CP model I suggested that he should modify the graph-theory resources to provide a function from a potency to its

antidotes; I also suggested further changes to the form of the subjunctive conditional.) Interestingly, however, the elimination model raises two problems. First, as I argued above, we still have antidotes in the system. We can clearly see this because the complex property 'S in the absence of all possible antidotes' is bearing some type of relation to antidotes. This is our problem of what antidotes are for an ontology of objects and potencies. But the E model also raises a new problem, which is the metaphysical status of the new understanding of stimulus properties. How do these entities, which involve both absences and antidotes, fit in with Bird's idea that the identity of potencies is to be structurally determined by a network of SM-relations?

Here we might introduce a fork for Bird. Either the property 'S-absence-A' is a simple property (option (1) above) or it is a complex property (option (4) above). If we go down the first route, then the predicate 'S-in-the-absence-of-A' refers just to the monadic universal, 'S', and 'in the absence of A' just means that the possible antidotes do not exist, or otherwise that the possible antidotes are not suitably related to the potency. That is to say, the second part of the predicate is not really a property name but rather a description of either the state of the graph theory network or otherwise the state of the circumstances of the potency object *x*. So the idea would be that the predicate 'S-absence-A' is referring to (i) the standard stimulus properties of Bird's simple essentialism and his (original) CP model, on the one hand, as well as (ii) capturing, somehow, the fact that there are no antidotes that are relevant to the potency of which S is playing the stimulus role. The central problem with this approach, however, is that it not clear how it is any different to the original CP model, since, as we have discussed, Bird's (original) CP model is basically the idea that we do not have to meddle with the objects and properties of Bird's system but that we can nevertheless have a clause that makes potencies sensitive to antidotes. So if this were Bird's approach, then his E model would use a simple (DE_p) with a complex ($CA_{\Box}$), *pace* the schemes above.

Instead, I think that if Bird wants a distinctive E model then he has to follow the second route above and say that 'S-absence-A' is a complex property. But it is quite mysterious what this complex property would be. I can think of two possible strategies. Firstly, we could say that in Bird's graph theory network we keep the standard DSM-relation, but suggest that the middle place of this relation accepts a conjunction of universals, namely S and not-A. (There would be two

properties in the simple case where there is a single antidote, but perhaps the conjunction would be infinite if there are infinite antidotes that can 'attack' the potency.) Then the DSM-relation can 'plug' properties into the subjunctive conditional in the way that we envisaged in this chapter and the last, except that the (simple) antecedent of the conditional would receive both S and not-A. The second strategy would be that we forgo negative universals and understand antidotes in terms of the constitution relation. So on this view, we would need to say that the DSM-relation is replaced by a DSAM-relation, where we have a place for the potency of interest, the stimulus property, the antidote, and the manifestation. But here is the problem. We cannot understand the absence of the antidote, which on this way of thinking is the property that stands in the 'A' place of the four-place relation, in terms of the subjunctive conditional requiring the inserted property to be absent. This is how it was with the modified CP model that I presented above. Instead, as we know by my labouring this point, the E model is building the antidote sensitivity into the stimulus property itself, whatever that might mean. With this in mind, the subjunctive of the E model has to have the basic form 'If P were the case, then Q would be the case', where there is a subjunctive sufficiency from the antecedent to the consequent. Now, if we are not building the absence of the antidote into the subjunctive conditional, nor accepting genuine negative properties, the only remaining resource, as far as I can see, is to understand the 'absence' aspect of 'in the absence of A' as arising though the DSAM-relation. So the view now is that it is somehow built into this constitution relation that the antidote property (which is really just a garden-variety potency, we should remember) is required to be absent. But I do not know how such a proposal would proceed.

3.7 Active and passive conceptions of antidotes

A curiosity that emerged in our discussion of Bird's treatment of antidotes is that these entities receive a distinctively passive construal; in short, they are not construed as causal entities whose 'effective operation' is one of prevention, but rather as components of a condition of exclusion (his CP model) or otherwise shadow-like attenuations of potencies (his E model). This may look inappropriate for a system of dispositional monism, where we might have required that antidotes, if they are not to be genuinely eliminated, should at least be modelled as a type of causal agent, if not directly construed as regular potency-bearing objects. (I am grateful to Matthew Tugby for discussion on this topic.) Taking this idea as a starting point, at this final stage of the chapter I set

out some active understandings of antidote-prevention, and contrast these with Bird's approaches. I think it is clear from the outset that we are interested in properties here as oppose to objects: dispositional monism, as with the other major positions in the properties and laws debate, is a property-driven metaphysics.

Beginning with the active construal of antidote-properties, a central distinction is whether or not we would like to buy into a basic or primitive operation of prevention. To introduce this idea, we can consider the following. One way of thinking about Bird's potencies is that they have a certain manifestation action: in response to the suitable obtaining of the stimulus property, the manifestation property is produced. To be sure, as we move between different theories of dispositional properties, the nature of the manifestation operation will vary. With regard to Bird's theory, the manifestation operation has two central formal characteristics: (i) at least in the case of sure-fire potencies, the relationship between the stimulus condition and the manifestation property is one of subjunctive sufficiency; (ii) the operation of production is conceived by Bird, interestingly, as that of 'concretising' a state of affairs, or, more specifically, as 'making concrete' a 'contingently abstract' manifestation circumstance (Bird 2007, p.114). I think this raises the question of whether there could be another operation, one of prevention. According to this view, a given antidote, e.g. a moderating boron rod, would be an object that has a certain property—let's say, for simplicity, being 'made of boron'; and this property would prevent the nuclear pile from chain-reacting in virtue of its basic operation of prevention. Taking properties to have a dedicated prevention operation raises a sub-question. Might we have dispositional properties, perhaps all of them or a certain number, with both of these operations, i.e. with both a manifestation operation and a prevention operation? Or might the view be that there are dedicated antidote-properties that uniquely have the prevention operation? Martin (2007, p.29) appears to hold the first view, when he says that "a disposition line is what the disposition is for, what it is not for, and what it is prohibitive against with alternative actual or nonactual reciprocal disposition partners"; as far as I know, the second view has not been upheld.

A second understanding of active antidote-properties seeks to understand these entities using only the manifestation operation of a dispositional property. In the case of Bird's dispositional monism, the idea would be that some antidote-property just is a standard potency, with a stimulus condition

and manifestation circumstance. The key distinction between this second view and the first, of course, is that we are no longer thinking about a dedicated prevention operation. In contrast, the idea at hand is that antidote-properties just are potencies, and hence we need to find a way to understand their putative operation of prevention in terms of the manifestation operation of garden-variety potencies. (As we shall discuss in Chapter 4, Mumford and Anjum hold a view like this, whereby interference and prevention are understood in terms of the 'operation' of powers.)

Whilst there may be further possible models of active antidote-properties, in this chapter I have outlined what I take to be the two central understandings. My choice of these two models is motivated by the idea that, effectively, Bird could either accept or reject a dedicated prevention operation. If he accepts such a dedicated prevention operation, then we would expect his actual treatment of antidotes to be replaced by this new machinery. (I should note that Schrenk (2011) has outlined several schemes for understanding interference and prevention within the context of Armstrong's system that are related to the two schemes above.) On the other hand, if Bird rejects the basic prevention operation but still seeks some active construal of antidotes, then the most natural idea would be to understand antidotes in terms of potencies, that is to say, to understand the putative prevention operation of boron rods and the like in terms of the manifestation operation of potencies. So too would this hypothetical decision involve replacing his actual treatments of antidotes.

I'd now like to move on and explain why Bird's actual treatment of antidote-properties uses a passive metaphysics of prevention. At this point we can define an active-passive distinction, which up until now has been assumed as intuitive. When we consider the two active strategies considered above, we can see that they both construe the 'efficacy' of prevention, as it were, as the outcome of some operation. In both cases, where we have a token case of prevention, it will have occurred in virtue of the operation at hand. With the first active model, we considered the prevention operation to be basic; whereas, with the second model, we envisaged that the prevention operation would be collapsed into the manifestation operation of regular potencies. In either case, it is the execution of some operation that is doing the preventative work. With regard to Bird's treatments, however, antidote-properties enter the picture either as the content of some exclusionary condition, or otherwise as the stimulus property itself, suitably reconfigured of course. I think this shows a

key difference that we can exploit for our distinction. In both of Bird's cases, as well as my modification, the antidote-property is not causally operative, but only "causally relevant". (This is a turn of phrase that Ellis (2001, pp.135–8) uses to defend categorical relations, e.g. spatial relations, in the context of his scientific essentialism, a property dualism for dispositional essentialism). In short, on the passive conception, antidote-properties are not 'doing' anything *qua* operation, though their instantiation is nevertheless relevant to whether or not the potency that is connected to these entities is able to manifest. I think this is a useful way of understanding an active-passive distinction for the metaphysics of prevention (at least with regard to dispositional properties).

Let's now take another look at Bird's treatment of antidotes with our distinction in mind. I'll concentrate upon the *ceteris paribus* strategy, which looks to be the stronger of the two strategies. We noted in our earlier discussion that Bird does not explicitly focus upon antidote-properties as oppose to antidotes (construed as objects). I said that this was important, because antidotes are *prima facie* propertied-objects. Nevertheless, Bird recognises the problem of specifying a function from the potency to its possible antidotes, whatever their specific construal. I suggested that we can solve Bird's issue by reconfiguring the DSM-relation into a higher-place relation that designates a set of potencies as the possible antidote-properties of the potency of interest. In summary, antidotes are now being thought of as potencies that are connected to the potency of interest in a similar way that the stimulus property is. A crucial difference, however, is that it is the absence of the antidote-properties that is required in the antecedent of the subjunctive conditional.

This set up is obviously different to our active models of antidote-properties, which I canvassed above. I think the most important difference is as follows. If we consider the requirements of Bird's dispositional monism, where all potencies fall under a stimulus-manifestation model, we can see that the antidote-properties are themselves potencies. Indeed, the approach of reconfiguring Bird's graph theory resources presupposes this arrangement. So construed, however, in direct contrast to the active models (both of them), the manifestations of the antidote-properties are not connected in any obvious way with the potency of interest. This point is easy to see with an example. If we think of Bird's nuclear pile, the idea is that the nuclear pile has the disposition to chain react in

response to, say, too much water evaporating away (Bird 2007, p.32). Suppose, then, that too much water has boiled away, but that the moderating boron rod is in place. We suggested earlier that it is the properties of the boron rod that are responsible for its preventative role, and a simplified construal is that being made of boron will be of primary relevance. Taken together, then, a simple model is that the nuclear pile is an object that has a dispositional property to chain-react in response to too much water evaporating. However, there is an antidote-property to this disposition: being made of boron. I suggest that Bird's *ceteris paribus* strategy can be approached as saying that the obtaining of the stimulus property (water evaporation) and the non-obtaining of the antidote property (being made of boron) is subjunctively sufficient for the manifestation to chain-react. But now consider the property being made of boron. Given dispositional monism, it has its own DSAM-relation, which may or may not concern the properties of 'water evaporation' and 'chain reacting'. That is, according to our model so far, the antidote-property's absence is needed for the potency of interest to manifest, but the antidote-property's own stimulus and manifestation have no immediate connection to this act of prevention nor to the stimulus property and manifestation property of the potency of interest.

One reason why this is perhaps troubling is that the antidote examples in the conditional analysis literature often trade on the antidote's causal profile. With the case of the boron rod, it is its absorption of radiation that will be cited in explanations of how it prevents the nuclear pile from chain-reacting. Another example of an antidote that is introduced using its causal profile is Bird's medical antidote, which can be thought of as frustrating the causal chain that leads from a poison's stimulus to its manifestation. There are quite a lot of complications here, but one discernible worry is that Bird's passive treatment of antidotes has ended up quite far removed from some of his original examples. To clarify, on the treatment at hand potencies are sensitive to antidote-properties simply in so far as these entities are required to be absent; there is no mention of the causal profiles of antidote-properties, i.e. their stimulus-manifestation profiles. This is what I was attempting to capture in saying that the passive approach to prevention denies any role for the operation of the antidote-property: in short, its manifestation (e.g. absorption) has nothing to do with its role as a preventative entity.

In light of our discussion of active and passive approaches to prevention, we can state again a modification to the DSAM-relation, i.e. to my suggestion for Bird's *ceteris paribus* strategy for antidotes. Perhaps it should be the manifestation of the antidote-property that is required to be absent from the proximity of the potency of interest, not the antidote-property itself. Quite aside from Bird's dispositional monism, I think there may be a good theoretical reason for saying this. This is that we can have cases of double prevention, such that a preventer is prevented from preventing (e.g. Mumford and Anjum 2009). Staying with our simplified case of the nuclear pile, if we were to have a second antidote, one that worked on the boron rod, such that it could no longer absorb the radiation, then we might think that the chain reaction could occur despite the presence of the boron rod, since it would now be ineffective in absorbing radiation. Because of this, we may think that it is the absorption of the boron rod that has to be absent, so to speak, not the boron rod itself. In this way, we would expect a better link between the explanation of antidote-prevention in the conditional analysis literature and our model of antidote-sensitive potencies.

I think there is something to this line of thought, but there are two problems that it raises. Both of these problems are difficult to evaluate, and I shall not attempt to do so. Nevertheless, I present them to the reader as points of interest. A first problem is as follows. By making the manifestation of the antidote-property the relata of the DSAM-relation, it is at least the manifestation of the antidote-property that is a causal relevance to the potency of interest. But it is still only a causal relevance. What has happened now is that, using again the case of the boron rod, it is the instantiation of the property of absorption that is required to be absent if the potency of interest (i.e. being disposed to chain react, or being critically radioactive) is to manifest. By our active-passive distinction above, however, this still qualifies as a passive conception. Although it is the manifestation of the antidote-property that is important, it is not the execution of the manifestation operation of the antidote-property that really prevents anything; rather, the manifestation of the antidote-property is merely connected to the potency of interest as a property that has to be absent. Whether this is a significant problem or not, I am not sure.

A second point may also be of interest. One objection to the above line of thought is that Bird's examples of antidotes are macroscopic, and hence, at the fundamental level with which his ontology is interested, we should be careful in thinking that antidotes can have preventative

operations such as absorption and breaking causal chains. Bird himself thinks that the only possible fundamental case of an antidote is a 'condition' such that whilst the stimulus of a potency is present the manifestation does not occur (Bird 2007, p.63). (Note that Bird thinks this because the idea of the antidote frustrating a causal chain, which is drawn upon for a number of macroscopic examples, including the medical antidote, can be seen to involve a causally redundant disposition; in short, given Bird's single track approach, a chain of dispositions and manifestations will give a number of separate little dispositions, not a single big disposition with the first stimulus of the chain as its stimulus and the last manifestation of the chain as its manifestation.) It is perhaps interesting to note that this suggests a passive construal of antidotes; the term 'conditions' fits well with the *ceteris paribus* strategy fitting antidotes into an exclusionary clause as entities that need to be absent, as oppose to thinking of antidotes as some sort of causal agent *re* the potency of interest.

Section Two

Anti-Necessitarian Strategies

4

Stephen Mumford and Rani Lill Anjum's Causal Dispositionalism

4.1 Introduction

Our first task in this chapter is to outline Mumford and Anjum's causal dispositionalism. For the sake of simplicity, I shall refer to this theory as 'dispositionalism'. In this outline I have chosen to divide Mumford and Anjum's dispositionalism into two components. The first component is their vector model of causation, which draws upon Lombard's (1986) notion of events and quality spaces. This component also includes Mumford and Anjum's adaptation of Martin's (2007) conception of powers as mutual manifestation partners. The second component is Mumford and Anjum's antecedent strengthening argument. This argument is Mumford and Anjum's main tool in their criticism of causal necessitarianism. (Again, for the sake of simplicity I shall refer to their target theory as 'necessitarianism'.)

My motivation for dividing Mumford and Anjum's dispositionalism into these two components is that whilst they are designed to work cooperatively in the critique of necessitarianism, the antecedent strengthening argument trades upon a modal thesis that is independent of the vector model of causation. The modal thesis at hand states that it is always possible, at least in principle, for a token causal process to be subject to 'additive prevention'. Importantly, the support for this modal thesis is not the vector model of causation, but rather a background metaphysics of modality. In the next two chapters, I shall argue that this metaphysics of modality does not support the modal thesis that the antecedent strengthening argument requires. It follows, I believe, that Mumford and Anjum's vector model of causation is in fact neutral between dispositionalism and necessitarianism. Given this line of argument, it is useful for my purposes to divide Mumford and Anjum's dispositionalism into these two components.

In the second half of this chapter I argue that Mumford and Anjum's antecedent strengthening argument cannot be applied to their own vector model of causation. More specifically, I argue that there is something self-refuting about the application of additive prevention to complex causes that are understood in terms of resultant vectors.

4.2 The vector model of causation

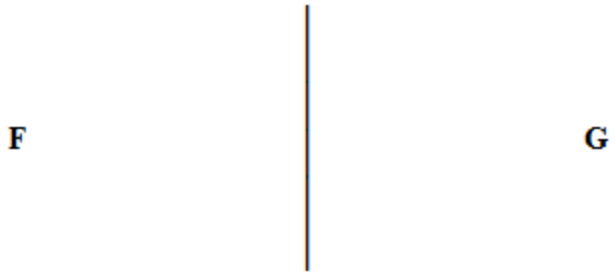
Let us shall begin, therefore, with Mumford and Anjum's vector model of causation. Its first aspect is a basic ontology. Mumford and Anjum accept a version of pandispositionalism according to which all properties are powers. In general, powers are individuated at the type-level by their type of manifestation. In line with pandispositionalism, these manifestations are further powers (or clusters of further powers). The type–token distinction is understood in terms of Armstrong's (1978) immanent realism. So construed, a type of power, P, is thought to be strictly identical to its tokens, p^1–p^n (Mumford and Anjum 2011, p.14). A point of importance is that Mumford and Anjum's powers are multi-track, such that these entities are individuated at the type-level by their *types* of manifestations. I shall return to this issue below, however, since it is tied in with Mumford and Anjum's conception of powers as component vectors.

The second aspect of Mumford and Anjum's vector model of causation is their adoption of Lombard's notion of events and quality spaces. According to Lombard, events are essentially changes. More specifically, events are essentially changes for a 'subject of change' with regard to a 'dimension of change'. Let us consider, for example, the ripening of a banana. As the banana ripens it changes from green to yellow. Let us also assume that it changes from small to large. In this case we would have two Lombardian events. Both of these would be centred on the banana as the subject of change, but the first would have colour as its dimension of change whereas the second would have size as its dimension of change. According to Lombard's notion, then, a single subject of change can undergo different events during the same temporal interval, where these different events are distinguished under different dimensions of change. Lombardian events are closely connected to quality spaces. According to Lombard, a quality space is a set of mutually exclusive properties. These mutually exclusive properties are understood in terms of determinates

and determinables. In the case of the banana, for example, this subject of change has the mutually exclusive determinates green and yellow that belong to the determinable colour. If a subject of change loses a member of a quality space, P, then it must gain a different member, Q. In so doing, the subject has changed with regard to this dimension of change (Lombard 1986, pp.113–9).

According to Mumford and Anjum adoption, a quality space is a background for possible changes, whereby a subject of change moves through the quality space as it changes (2011, pp.23–7). In line with Lombard's framework, quality spaces are centred upon a subject of change for a dimension or dimensions of change. (The basic case makes use of a single dimension of change). Mumford and Anjum's quality spaces have a 'starting point' that is represented by a central line. The starting point is the subject of change as it stands to the dimension of change at a moment. For example, in the case of temperature, the subject of change might be 24°C. In the basic case, there is not only a single dimension of change (in this case temperature), but also just two mutually exclusive properties for the subject of change to gain. These are represented by the 'F' and 'G' that flank the central line on either of its sides. In line with our example case, F might be the hotter temperature of 25°C and G might be the cooler temperature of 23°C. A movement through Mumford and Anjum's quality spaces, then, is the subject of change losing its starting temperature of 24°C and gaining either 25°C or 26°C. In line with pandispositionalism, the starting point and the properties F and G are thought to be powers (or clusters of powers). (Note that all diagrams to follow are adapted from Mumford and Anjum 2007).

Diagram 1. The F–G quality space



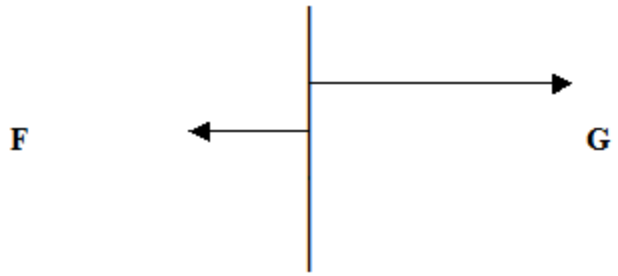
Mumford and Anjum's leading idea is that 'operative powers' can be represented as component vectors. This is the third aspect of their vector model of causation. Let us begin with the notion of operative powers. Mumford and Anjum accept a modified version of Martin's (2007, p.51) model of powers as mutual manifestation partners. The basic aim of this approach, I think, is to downplay (e.g. Bird's 2007) distinction between the 'active' dispositional property and the 'passive' stimulus property (c.f. Tugby 2013a). In addition, the agent–patient distinction of Aristotle's model of capacities is bypassed (Aristotle *Met*. Θ.3). In contrast, a set of powers has each other as their 'reciprocal partners for mutual manifestation'. Given their acceptance of this model, Mumford and Anjum do not think that powers are distinguished into disposition and stimulus roles. Nevertheless, powers have a conditional aspect. The concept of stimulation is rejected, but powers still 'come together' for mutual manifestation. As a first pass, then, powers P^1–P^n are operative just in case they are reciprocal partners that are suitably related to each other. But what does this 'suitable relation' consist in? There is no well-defined answer to this question, but Mumford and Anjum often talk of spatiotemporal bringing together (2011, p.26) as well as geographical proximity (2011, p.100). Taken together, then, powers P^1–P^n are operative just in case they are proximate reciprocal partners. (For the sake of simplicity I shall use the term 'proximate' to capture the general idea of reciprocal partners being suitably related. A plausible point of detail is that different reciprocal partners have different proximity requirements, such as 'contact' or '10 meters' etc.) Let us note that Mumford and Anjum's powers are multi-track in the sense that a type of power, P^1, can operate with different reciprocal partners—with, for example, P^2 in one case and P^3 in another.

Importantly, there is a distinction between the operation of a power and the manifestation of a power. In particular, a power can be operative without manifesting. This distinction is completely removed from Bird's (2007) theory, as well as the other central views of dispositional properties in the literature (e.g. Ellis 2001; Molnar 2003; Mumford 2004; Martin 2007). What is the distinction? I said above that Mumford and Anjum's powers are individuated at the type-level by their type of manifestation. I have also explained how Mumford and Anjum's model of powers makes use of the notion of reciprocal partners. But here lies a set up of considerable complexity. The starting point to Mumford and Anjum's notion of the manifested power is that powers P^1–P^n are reciprocal partners if and only if their types of manifestation fall into the same dimension of change. We can recall that that a dimension of change concerns the determinate–determinable distinction and its application to mutually exclusive properties. The thought at hand is that P^1–P^n have as their manifestation types either F or G, where F and G are the possible changes of a quality space. (More complex dimensions of change would place a correspondingly looser restriction on what it is to be a reciprocal partner.) Let us say, for example, that P^1 is the power of 'fire' whereas P^2 is the power of 'ice'. These are reciprocal partners for the reason that P^1 has as its manifestation type 'makes hot' whereas P^2 has as its manifestation type 'makes cold'. P^1 and P^2 are therefore powers whose manifestation types concern the same dimension of change: temperature. P^1 and P^3 would also be reciprocal partners, where P^3 is the power of 'laser' with the manifestation type 'makes hot'. (Please forgive the examples.) In this way, different types of powers have different types of manifestations. (Note that the same type of power can have different types of manifestations: hence, fire can 'heat' as well as 'melt'. This is a second sense in which the powers of Mumford and Anjum's vector model of causation are multi-track.) In virtue of these types of manifestations, sets of powers have a "causal relevance" to one another where their manifestation-types concern the same dimension of change (Mumford 2011, p.26).

Accordingly, there is a close connection between Mumford and Anjum's quality spaces and their model of powers. The former are based around a dimension of change, whereas the latter have manifestation-types that fall into causal relevancies. We can recall that Mumford and Anjum's quality spaces are also centred upon a subject of change. In the typical case, this is a single object, though in more complex cases it could be a collection of objects, such as a pile of sand (Mumford and Anjum 2011, p.27). Putting the pictures together, then, consider a subject of change that is a

certain temperature, let us say a volume of air that is 24°C. The powers 'fire' and 'ice' have manifestation-types that are causally relevant in that they concern the determinable of temperature. Where tokens of these types of powers are proximate to the subject of change and each other, they will become operative. According to Mumford and Anjum's vector model of causation, these operative powers are represented by component vectors that are directed with a certain magnitude towards their types of manifestation. Crucially, these types of manifestation are, in turn, represented by properties in the quality space; for example F (25°C) and G (23°C). (The manifestation-type 'make hot' would be a proxy, I think, for e.g. 'make 25°C at spatial distance *r*'. Note that this is a second sense in which Mumford and Anjum's powers are multi-track: 'fire' can 'make hot' in different magnitudes depending upon its geographical proximity to a subject of change.)

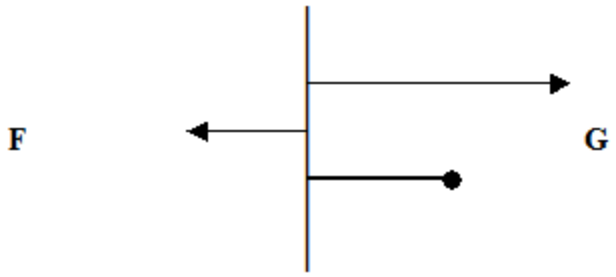
Diagram 2. The F–G quality space with component vectors



Mumford and Anjum employ a standard notion of vector algebra for their component vectors. To recapitulate, a component vector is representing a token power that is operative with regard to a certain subject of change. In the simple case of a one-dimensional quality space, the properties F and G are the manifestation types of the operative powers. As such, there will be a number of component vectors that are directed towards either F or G with a certain magnitude. The resultant vector, then, will be one of two possibilities. The first possibility is that the addition of the component vectors gives a resultant vector that is directed towards either F or G with a certain magnitude. The second possibility, however, is that the component vectors cancel out such that there is no overall directed magnitude towards F or G. Mumford and Anjum term the first possibility a "directed resultant" and the second a "zero resultant" or "equilibrium" (Mumford and

Anjum 2011, pp.27–30). (If we understand the F-side of the quality space to involve positive units and its G-side to involve negative units, then the F-directed component vectors will be positive magnitudes and the G-directed component magnitudes will be negative magnitudes; so construed, a resultant vector that is neither positive nor negative will be a zero resultant.) (Diagram 3. shows a directed resultant vector as a circle-arrow.)

Diagram 3. The F–G quality space with resultant vector



The fourth and final aspect of Mumford and Anjum's vector model of causation is their notion of manifestation *qua* change. We have already discussed how Mumford and Anjum's powers are individuated at the type-level by their type of manifestation. But so far we have only applied this discussion to the notions of operative powers and quality spaces. Perhaps the cornerstone of Mumford and Anjum's vector model of causation, however, is that there is a double understanding of disposition, manifestation, cause, and effect. Let me outline these dualisms before explaining how powers manifest *qua* change.

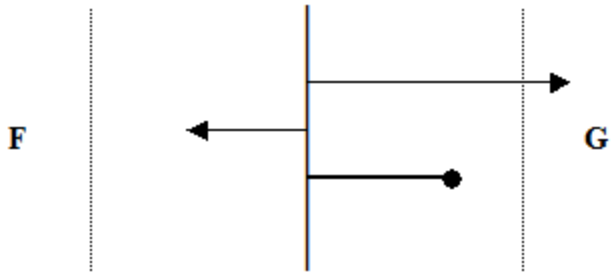
The first idea of disposition takes place in Mumford and Anjum's notion of operative powers. This is a classic idea of dispositionality in that a power does not have to be operative to be able to be operative. If something can Φ in virtue of its nature without having to be Φ, then it arguably has a disposition to Φ. More specifically, reciprocal powers are operative if and only if they are proximate. Interestingly, there is no way to interfere and/or prevent the *operation* of a power on Mumford and Anjum's vector model of causation. (I shall discuss this issue further in the next two chapters.) The operative power, then, is a first idea of dispositionality. (Given that powers are operative when they are proximate to their reciprocal partners, this operation of powers is also

suggestive of a first sense of manifestation.) But where Mumford and Anjum break away from the standard approach is that the operation of a power does not result in any change. In particular, it does not result in a property-instantiation. In contrast, the operative power simply 'pushes' towards its manifestation type, which is why component vectors represent operative powers. According to Mumford and Anjum's vector model of causation, these pushes are themselves dispositional (Mumford and Anjum 2011, p.74). A causal situation, whereby a number of token powers are operative with regard to a subject of change for a dimension of change, is no more than a 'resultant disposition' towards the manifestation of the powers proper. And this second notion of dispositionality and manifestation concerns the notion of manifestation *qua* change, as opposed to a push towards a change. As a final issue, it is important to note that Mumford and Anjum have a double understanding of causation. In the first place, the coming together of operative powers is itself causation, even if there is no change. And in the second place, *bona fide* change is causation. More on this below.

The notion of manifestation *qua* change draws upon the use of a 'threshold line' for the quality space. I will qualify the modality of the present sentence in the next section of this chapter, but a first pass at the notion of a threshold line is that it is a point on the quality space for each of its possible changes such that, if the resultant vector meets one of these points, then the appropriate possible change is actualised. For example, with regard to the quality space for temperature, the threshold line for F would be a point such that, if the resultant vector meets this point, then the subject of change gains F (i.e. 25°C) and loses its starting point for this dimension of change (i.e. 24°C).

> The idea is that an effect occurs when there is enough for it. Given the complexity of causation—its polygenous nature—an effect is typically produced by many different factors working at once, some of them disposing towards the effect in question, and some of them disposing away. When c_1–c_n [the operative powers] do succeed in producing *e*, it is like the causes reaching a finishing line or threshold for *e* to occur (Mumford and Anjum 2011, p.72: my square bracket).

Diagram 4. The F–G quality space with threshold lines



If a manifestation *qua* change occurs, then the subject of change is thought to have moved through the quality space. It is important to note, however, that the quality space itself does not show a change, *pace* Lombard's (1986, pp.114–9) graphs of changes. Mumford and Anjum propose that a change will take the subject of change (e.g. the volume of air) into a new quality space where the starting point is different. Each quality space shows how the operative powers are disposing towards a possible change at a given moment. We would therefore expect different moments to have different operative powers in light of the different manifestations *qua* changes that are taking place from moment to moment.

> Events will be produced by powers at work: at least the events that are caused will be (whether some events are uncaused, we leave open). Events will be the changes produced when powers exercise themselves. And some of these changes will then push other powers together. The exercising of one power may put sugar into tea, for instance. When suitable partnered powers are pushed together, they will in turn manifest themselves. And so it goes on (Mumford and Anjum 2011, pp.2–3).

I shall conclude this section of the chapter with a discussion of Mumford and Anjum's endorsement of complex causes. Mumford and Anjum (2011, pp.11–3) appeal to Mill's (1843, p.217) concept of the composition of causes as well as Molnar's (2003, p.194) concept of polygenic causation. In both cases the basic idea is that a cause is complex. According to Mill, a cause is the totality of positive and negative factors that are constantly conjoined with the effect. Molnar's polygenic concept does not use negative factors, but the idea in this case is that multiple powers are typically

the cause of a single effect. Complex causes are important for Mumford and Anjum. As we shall discuss in the next section this chapter, Mumford and Anjum's case against necessitarianism trades upon the possibility of 'additive prevention'. The point of departure for their line of argument, then, is to set out a model of prevention. As the previous chapters have aimed to show, this is no easy task. Mumford and Anjum's chosen route is to understand interference and prevention in terms of 'countervailing powers'. These are operative powers that are directed away from a possible change; they are countervailing with respect to this possible change. Hence, in the case of the temperature, the operative power 'ice' would be countervailing with respect to the possible change F (the hotter temperature of 25°C). According to Mumford and Anjum's vector model of causation, then, the first notion of cause is the operative power, which is represented by the component vector. And the second notion of cause is the totality of operative powers, which are represented by the resultant vector.

> The model shows what it is to be *a* cause, namely, to be one of the operating powers, represented as a vector, that disposes towards that effect. But whether, how, and to what extent the effect occurs will be determined polygenically: by many factors working together (Mumford and Anjum 2011, p.31: original italics).

Lastly, let us note again that Mumford and Anjum accept that there are effects *qua* operating powers and effects *qua* manifestations (i.e. effects understood as manifestations *qua* change). Importantly, this entails that there can be causation where there is no change, in line with Mumford and Anjum's view that the operation of powers is itself causation (2011, p.30).

4.3 The antecedent strengthening argument

Such is the first component of Mumford and Anjum's dispositionalism. Let us now move on to its second component: the antecedent strengthening argument. Additional details of the vector model of causation will be introduced as appropriate.

The opening move of Mumford and Anjum's antecedent strengthening argument is the claim that prevention is a *prima facie* problem for the thesis of necessitarianism. We can recall that

necessitarianism is the general thesis that a cause necessitates its effect. Mumford and Anjum understand necessitation as the sufficiency of the cause for the effect (as oppose to the cause merely being a necessary condition for the effect). "The necessity view is that whenever we have the cause *C*, we must have the effect *E*" (2011, p.60). The opening move, then, is to point out that in cases of successful prevention we do not have the effect E even though the cause C occurs. Mumford and Anjum's case against necessitarianism is further motivated by their point that necessitation should be a universal concept, such that it is a mistake to speak of C necessitating E in some cases but not in others (i.e. in all those cases that are not subject to prevention). "If someone were to say that, in some cases being water necessitated being H_2O, but in other cases it did not, *prima facie* it would seem as if they did not understand the meaning of necessity" (Mumford and Anjum 2011, p.47). (Note that it will be convenient on occasion to use 'necessity' and 'necessitation' synonymously; as is the case in Mumford and Anjum's text, the context should make clear that there is no confusion on these two terms.)

There are two aspects to Mumford and Anjum's antecedent strengthening argument. The first aspect is a view that concerns monotonic reasoning. Mumford and Anjum propose that monotonic reasoning is distinctive of necessity. According to monotonic reasoning, if A necessitates B, then B is the case whenever A is the case, regardless of whatever else is the case. Mumford and Anjum propose that: "In the case of genuine necessity, where *A* necessitates *B*, no new information or extra premise can prevent *B* if *A* is the case" (2011, p.57). Monotonic reasoning is to be contrasted with non-motonic reasoning, where we can revise the sufficiency of A for B in light of a new premise. On this basis, Mumford and Anjum propose their antecedent strengthening test for causation. Where a cause putatively necessitates its effect, Mumford and Anjum think that we should have a true conditional of the form: 'If C and Φ, for any value of Φ, then E'.

The second aspect of Mumford and Anjum's antecedent strengthening test is a thesis concerning the possibility of additive prevention. Let us begin, however, with their distinction between interference and prevention. The intuitive distinction is that a causal process is subject to interference when its effect occurs in a non-standard way. For example, a bullet that is fired from a gun may begin travelling towards its intended target, but a gust of wind may blow it off course to a certain degree, such that it no longer hits the bull's eye but rather one of the surrounding rings.

In terms of the vector model of causation, interference is represented by a directed resultant that is frustrated by a countervailing power. The operative powers are still favouring one side of quality space, but the resultant vector has a lower magnitude than it would have had were it not for the countervailing powers. In contrast, a causal process is subject to prevention, intuitively, if its effect does not occur. In terms of the vector model of causation, prevention is represented by a zero resultant. In this case, the countervailing powers are such that there is no overall disposition towards one side of the quality space. The overall idea, then, is that interference involves a directed resultant, whereas prevention involves a zero resultant (Mumford and Anjum 2011, pp.53–6).

Mumford and Anjum's antecedent strengthening argument makes use of additive prevention. This is a case where there is no directed resultant and where the equilibrium has been achieved by the addition of a countervailing power. There is a principled reason for Mumford and Anjum's focus on additive prevention. In the first place, given that Mumford and Anjum think that there is causation occurring even if the threshold line is not met, a case of additive interference is less interesting for their anti-necessitation purposes. In the gun scenario above, for example, there is a sense in which the bullet still hits the target, even though the shooter's central intention has not been fulfilled. More importantly, however, where the prevention involves the addition of a countervailing power, Mumford and Anjum will be able to deploy their premise that the cause plus *any addition* to the cause should be sufficient for the effect. (Let us note that there are cases of subtractive interference and prevention; in these situations, the powers that are pushing towards one side of the quality space are removed, such that the countervailing powers have a stronger hold on the resultant vector).

We can return to the modal thesis. It states that it is always possible, at least in principle, for a token causal process to be subject to additive prevention. The support for this thesis is complex, but for current purposes we can note two things. In the first place, Mumford and Anjum take the modal thesis to be "empirically plausible" (Mumford and Anjum 2011, p.56). This statement is motivated by the prevalence of actual cases of additive prevention. In the second place, however, Mumford and Anjum later state that the type of modality at hand is metaphysical: so construed, it is metaphysically possible that all token causal processes could be subject to additive prevention. (We shall discuss this issue in Chapter 6.)

With these two aspects of the antecedent strengthening argument in place, Mumford and Anjum conclude that causes do not necessitate their effects.

> Let us assume the Millian thesis that the causes of an event are complex. Suppose, for the sake of argument, that there are four causes of an effect *e*, namely, c_1, c_2, c_3 and c_4. Let us assume also that there is an instance where c_1–c_4 in fact produced *e* ... even if c_1–c_4 caused *e*, they did not necessitate *e* because there was at least the possibility that some additional factor, let us call it c_i, could have occurred and, had it occurred, even though c_1–c_4 occurred, *e* did not occur (Mumford and Anjum 2011, p.56).

> We cannot say that if *A*, then necessarily *B*, even where *A* is typically a cause of *B*. We can take the conditional if C_1–C_4, then *E*, and strengthen the antecedent with C_i, and produce a conditional that is false. C_1–C_4 may be the striking of the match, the presence of oxygen, the dryness of the wood, the flammability of the tip, and they may, when combined, succeed in producing fire. But now we can add more to the antecedent—there was also a gust of wind—and we see that this additional factor could result in the match failing to light, even though C_1–C_4 remain in place (Mumford and Anjum 2011, p.58).

We can see that the antecedent strengthening argument is trading upon the idea that the operative powers of a cause can "remain in place" whilst the additive preventer (in these examples a fifth operative power) ensures that the effect does not occur. We therefore have a line of thought that fits into the formal machinery of the antecedent strengthening argument. Let us take c^1–c^4 to be the cause, A; e to be the effect, B; and c^i to be a possible value of Φ. It follows that the conditional 'If A and Φ, then B' is false. And this conclusion is generalisable to all tokens of all types of causal processes (via different possible values of Φ). On this basis, Mumford and Anjum conclude that necessitarianism is false (2011, p.58). Given that dispositionalism is at least in part the rejection of necessitarianism, Mumford and Anjum's antecedent strengthening argument plays a central role in establishing their position. (In the next two chapters I shall further examine the positive content of Mumford and Anjum's dispositionalism.)

4.4 Complex causes and totality clauses

In this section of the chapter I want to outline a response to Mumford and Anjum's dispositionalism that is attributed to Matthew Tugby (Mumford and Anjum 2011, pp.67–70). Afterwards, I shall outline Mumford and Anjum's counter-response. In the last section of this chapter, I shall defend Tugby's response against Mumford and Anjum and provide a development. For the purposes of this chapter, I shall accept the truth of Mumford and Anjum's modal thesis. Accordingly, it is metaphysically possible for a countervailing power to be added to all token causal process. (In the next two chapters, however, I shall question Mumford and Anjum's support for this modal thesis.)

Tugby's response concerns the idea that additive preventers can (or perhaps should) be *excluded* from the complex cause. (I shall use the terms 'additive preventers' and 'countervailing powers' synonymously in this context.) This strategy is termed the "Σ*-strategy" by Mumford and Anjum (2011, p.67). Briefly stated, the background to this term is Mumford and Anjum's (2011, pp.64–7) prior discussion of the "Σ-strategy". The Σ-strategy is the idea that the complex cause might be too small in Mumford and Anjum running example of the lighting match, which uses a four-part complex cause, c^1–c^4. "Instead of there being just four causes of the match lighting, wouldn't there be a great many, c_1–c_n, including everything that is needed?" (Mumford and Anjum 2011, p.65). In turn, this prompts the more general thought that it is the specification of *all* of the causal factors that would necessitate the effect. Mumford and Anjum discuss Mill's (1843, §3.5) proposal that the philosophical concept of cause involves the totality of positive and negative causal factors, as well as Hobbes' (1655, §9) proposal that the "entire cause" is the totality of the accidents of all agents and patients (cited in Mumford and Anjum 2011, p.65). Accordingly, the Σ-strategy is a strategy of completeness: it is a maximally complex cause, Σ, that necessitates its effect. Mumford and Anjum's central response to this strategy is that it is still possible for countervailing powers to be added, such that a token causal process can nevertheless be subject to prevention.

> No matter how big Σ becomes, it still cannot exclude the possibility of prevention. There remains some possible c_i that could prevent *e* even if all that is included within Σ occurs. The Millian strategy thus misses the point because the size of the cause is not relevant to the

effectiveness of the antecedent strengthening argument against necessitarianism (Mumford and Anjum 2011, p.66).

With this in mind, the Σ*-strategy aims to exclude countervailing powers. One version of Tugby's strategy that Mumford and Anjum set out makes use of Armstrong's (1997; 2004) totality states of affairs. On this view, the Σ*-strategy states that "[T]he full cause of *e*, the Σ*, is the full collection of causal factors together with the totality fact that there no more additional causal factors than these. Σ* = (c_1–c_n, plus the totality fact T), which then necessitates *e*, allegedly" (Mumford and Anjum 2011, p.69).

Mumford and Anjum have a two-fold counter-response to Tugby's proposal. In the first place, they claim that the Σ*-strategy assumes necessitarianism. With regard to Armstrong's totality clause, Mumford and Anjum state that 'c_1–c_n, plus the totality fact T' merely assumes that causes necessitate their effects, which is what their own dispositionalism denies (2011, p.69). And in the second place, Mumford and Anjum complain that the Σ*-strategy is a refusal to take the antecedent strengthening test.

> The very strategy is a refusal to take the test. The strategy is to exclude automatically anything that can be added to Σ. The strategy is thus one that precludes an antecedent strengthening test and is thus the very reason for our scepticism about any claims of necessity resulting from Σ*" (Mumford and Anjum 2011, p.70).

Expanding upon this second point, Mumford and Anjum speculate that the Σ*-strategy is a kind of admission of defeat for the necessitarian, on the basis that it is implicitly agreeing that the addition of suitable (countervailing) powers would prevent the effect from occurring (2011, p.70).

4.5 The antecedent strengthening argument is self-refuting

In this section of the chapter I shall argue that Mumford and Anjum have mishandled Tugby's response. I set out two arguments. The first argument concerns the use of resultant vectors in Mumford and Anjum's vector model of causation. I argue that (i) the resultant vector is playing a

vital explanatory role in Mumford and Anjum's theory. Crucially, it is the basis for understanding manifestations *qua* changes, since it is the resultant vector that has to meet the threshold line if (this type of) causation is to occur. In addition, I argue that (ii) there is a notion of totality in the resultant vector. The idea behind this claim is that the operation of addition can only make sense if the number of operands to be added are fixed. (I am grateful to Matthew Tugby for discussion on this matter.) We therefore have a notion of 'these operands and no more'. On the basis of these two arguments, I propose that Mumford and Anjum's antecedent strengthening argument cannot be applied to their own vector model of causation. That is to say, there is something self-refuting about the application of additive prevention to complex causes that are understood in terms of resultant vectors. I support this claim with the observation that Mumford and Anjum's discussion of the antecedent strengthening argument equivocates between two understandings of 'cause'. A diagnosis of this situation is that Mumford and Anjum have downplayed this problematic aspect of their dispositionalism by presenting the issue of totality clauses as a mere strategy for saving necessitarianism. Totality clauses can do this, I think, but a more pressing matter is that Mumford and Anjum's own vector model of causation is at odds with their antecedent strengthening argument.

The second argument that I develop concerns the charge that Mumford and Anjum direct towards totality clauses. Does the Σ*-strategy merely assume necessitarianism, without providing a reason for thinking that causes necessitate their effects? In my discussion I set out a consideration for thinking that totality clauses *do* provide a reason for thinking that a cause necessitates its effect. The basic idea is that a totality clause can work in conjunction with Mumford and Anjum's vector model of causation, such that manifestations *qua* changes can be explained in terms of the tokens of powers that are operative with regard to a subject of change. This discussion is a further development of part (i) of the first argument, above: if the resultant vector, which is a disguised totality, is indispensable for Mumford and Anjum's understanding of manifestations *qua* changes, then a totality clause had better be able to work with Mumford and Anjum's operative powers so as to determine whether or not a subject of change moves through its quality space. In short, the idea of this discussion is that totality clauses should not provide a reason as to why causes necessitate their effects on their own, but only in tandem with a theory concerning the different

parts of the complex cause. Accordingly, the necessitarian can counter Mumford and Anjum's reply on this issue by drawing upon their own vector model of causation.

Let us begin with the first argument. A first point to be established is that the resultant vector is not a mere optional extra within Mumford and Anjum's vector model of causation, but that, in contrast, its role is indispensable. We can begin by considering the role that complex causes are playing for Mumford and Anjum's purposes. Let us recall that the adoption of complex causes is Mumford and Anjum's strategy for modelling interference and prevention. These phenomena are not the result of specialised operations that powers are able to perform, over and above their standard manifestations. (This was a possible approach that we envisaged for Bird in Chapter 3: the view in this case was one where dispositional properties can both manifest a property and prevent the manifestation of a dispositional property.) In this sense Mumford and Anjum's approach to interference and prevention is economical. Countervailing powers—the basis for Mumford and Anjum's understanding of interference and prevention—come for free once we have the ideas of a quality space containing different types of manifestation *qua* change in tandem with *multiple* operative powers. For a countervailing power is simply a power that is operating, where its manifestation-type is distinct to that of another operating power. We have different manifestation-types, but the same type of action. So it is important to remember that complex causes, with their component operative powers, are a fundamental element of Mumford and Anjum's approach to the problem of how to understand interference and prevention. Saying that causes are complex allows Mumford and Anjum to understand different parts of the complex cause as pushing against one another.

A next step is to see that Mumford and Anjum are making use of vector addition in their explanation of manifestations *qua* changes.

> The model shows what it is to be *a* cause, namely, to be one of the operating powers, represented as a vector, that disposes towards that effect. But whether, how, and to what extent the effect occurs will be determined polygenically: by many factors working together (Mumford and Anjum 2011, p.31: original italics).

Mumford and Anjum's necessitarian language is not important in this citation. What is important, I think, is that Mumford and Anjum require a notion of the overall result of a multiplicity of operative powers. The resultant vector is the keystone for Mumford and Anjum's account of manifestations *qua* changes. We can recall that Mumford and Anjum have a pluralistic conception of cause and effect. The minimal understanding is that causation is occurring whenever there are operative powers (Mumford and Anjum 2011, p.30). The more substantive understanding, however, is that a subject of change can move through its quality space, whereby a power or cluster of powers are placed upon the subject of change. As we discussed earlier in this chapter, Mumford and Anjum's explanation of manifestation *qua* change draws upon the threshold line and the resultant vector. Manifestation *qua* change is a central part of Mumford and Anjum's dispositionalism, since, as previously noted, the manifestations of powers or clusters of powers in causal processes will ultimately explain how different causal processes come to be. "Events will be the changes produced when powers exercise themselves. And some of these changes will then push other powers together" (Mumford and Anjum 2011, p.2).

The resultant vector contains the notion of the total number of operative powers. We can observe Mumford and Anjum's own discussion of the resultant vector, which straightforwardly draws upon the term "all" at numerous stages.

> At the moment all the requisite powers are assembled, they all make their contribution (Mumford and Anjum 2011, p.32).

> We can perform a simple analogical addition by placing the tail of one vector on the head of another ... First we add all those in the direction of *F*, one on top of the another, and then, from the point that we reach, we start subtracting all the vectors towards *G* in the same way, the tail of one connecting to the head of another. When we have added and subtracted all the vectors, we get the resultant *R* ... (Mumford and Anjum 2011, p.28).

At this stage, however, we can see that there is a problem with Mumford and Anjum's presumption that we can strengthen the antecedent of a causal conditional. Given that complex causes are being understood as *all* of the powers that are operative within a causal situation, the addition of a

countervailing power will fail to strengthen the same complex cause but will rather move us to a different complex cause. This point can easily be brought out by considering that the vector addition operator will provide a function from its input (i.e. all of the component vectors) to its output (i.e. the resultant vector). That is to say, if we fix all of the operative powers as a determinate input, then there will only be a single possible resultant vector. Consider the case that Mumford and Anjum are using. Here we have four operative powers: c^1, c^2, c^3, and c^4. Given that these operative powers make up the complex cause, these powers are the only powers that are operative within the envisaged causal situation. Accordingly, there is a function from the set $\{c^1, c^2, c^3, c^4\}$ to the resultant vector $R^{c1–c4}$. Let us now add a new operative power, c^i, which is the countervailing power. In what sense does this addition modify the original complex cause with the resultant vector $R^{c1–c4}$? According to Mumford and Anjum's own discussion, a complex cause exhausts all of the operative powers within a causal situation. (The above citations clearly show this.) We are forced to say, then, that one complex cause is being replaced by another complex cause. In short, the addition of c^i to the set $\{c^1, c^2, c^3, c^4\}$ moves us from the resultant vector $R^{c1–c4}$ to the distinct resultant vector $R^{c1–ci}$. Adding new operative powers cannot modify the same complex cause, then, but only move us to a new complex cause.

If complex causes involve a sense of totality, then we should expect Mumford and Anjum's antecedent strengthening argument to equivocate between two understandings of 'complex cause'. And this, I think, is exactly what we can observe in Mumford and Anjum's discussion. Let us keep in mind that this problem has arisen because complex causes are thought to include *all* of the powers that are operative within a causal situation. Let us consider again the following citation, where I have added two markers: [1] and [2].

> We cannot say that if *A* [1], then necessarily *B*, even where *A* is typically a cause of *B*. We can take the conditional if C_1–C_4, then *E*, and strengthen the antecedent with C_i, and produce a conditional that is false. C_1–C_4 may be the striking of the match, the presence of oxygen, the dryness of the wood, the flammability of the tip, and they may, when combined, succeed in producing fire. But now we can add more to the antecedent—there was also a gust of wind—and we see that this additional factor could result in the match failing to light, even though C_1–C_4 [2] remain in place (Mumford and Anjum 2011, p.58).

In the first part of this citation, Mumford and Anjum are referring to the complex cause of the effect e. As the citation develops, we can see that it has four components: c^1, c^2, c^3, and c^4, which we can represent by the set $\{c^1, c^2, c^3, c^4\}$. Before the envisaged addition of c^i, this set of operative powers is a *bona fide* complex cause. That is to say, the members of this set exhaust the powers that are operative in the causal situation. This is the totalistic understanding of 'cause' implicit at [1]. When we add c^i, however, we move to a new set of operative powers. It has the members: c^1, c^2, c^3, c^4, and c^i. The problem at hand, then, is that Mumford and Anjum are moving between two complex causes. The first has four operative powers but the second has five operative powers. Given that we have added c^i to the operative powers of the causal situation, the understanding of 'cause' at [2] has to be taken not as a complex cause *qua* the totality of operative powers, but rather as a complex cause *qua* the subset of a superset of operative powers. In the case at hand, the set $\{c^1, c^2, c^3, c^4\}$ is a subset of the superset $\{c^1, c^2, c^3, c^4, c^i\}$. The reason why the understanding of 'cause' at [2] cannot be taken as a complex cause *qua* the totality of operative powers is that this understanding will have to be reserved for the use of the term 'cause' at [1], where the operative powers c^1, c^2, c^3, and c^4 exhaust the causal situation, in line with Mumford and Anjum's official understanding of complex causes.

In general, it is no threat to necessitarianism that a cause C does not necessitate its effect E because E is not the case when C is not the case. Rather, the necessitarian thesis is that if C is the case, then E is (necessarily) the case. A concern for necessitarianism, then, is if C is the case and E is not the case. But this sufficiency has not been challenged. All that Mumford and Anjum have shown is that we can replace (not 'modify' or 'strengthen') a totality of operative powers with a different totality of operative powers. This move can be shown in the two causal conditionals below.

If $\{c^1, c^2, c^3, c^4\}$, then e
If $\{c^1, c^2, c^3, c^4, c^i\}$, then e

The first conditional, under Mumford and Anjum's own discussion, is true. Here the four operative powers will give a resultant vector $R^{c1–c4}$, which, we can suppose, meets the threshold line for *e*. The second conditional is false: here we are keeping the same effect e but changing the complex

cause. In this case, we have the new resultant vector $R^{c1–ci}$, which, we shall assume, does not satisfy the threshold line for e. But this in no way shows that the 'same cause' can be expanded in such a way that the effect e does not occur. In fact, Mumford and Anjum's argument at this point only shows something trivial. It merely shows that a set of operative powers can have another set of operative powers as a subset. I was gesturing towards this fact above, when I said that the set $\{c^1, c^2, c^3, c^4\}$ is a subset of the superset $\{c^1, c^2, c^3, c^4, c^i\}$. This is why, I think, Mumford and Anjum say that the operative powers c^1–c^4 "remain in place" (2011, p.58). But this is of no matter when we are working with totalistic complex causes. Mumford and Anjum have set out a view where a complex cause is the totality of operative powers, and it remains to be shown why fixing a set of operative powers does not also fix a unique resultant vector and therefore either trigger or not trigger (i.e. necessitate or not necessitate) a specific manifestation *qua* change.

As a last point on this matter, we can see that the application of the antecedent strengthening argument is in fact impossible for Mumford and Anjum's vector model of causation. I shall use a simple complex cause that consists in the operative powers c^1 and c^2. Let us consider the 'strengthening' of the appropriate causal conditional with the countervailing power c^i. If we unpack what is implicit in Mumford and Anjum's vector model of causation, we can see that they are committed to the following. (I give the form of the antecedent strengthening test before filling in the required content.)

> If A necessitates B, then:
> If A and Φ, for any value of Φ, then B
>
> If c^1 and c^2 necessitate e, where $\{c^1, c^2\}$ are all of the operative powers, then:
> If c^1 and c^2, where $\{c^1, c^2\}$ are all of the operative powers, and c^i, where $\{c^1, c^2, c^i\}$ are all of the operative powers, then e

The 'strengthened' conditional is logically contradictory. It has this form: 'If P and not-P, then Q'. This appears to mean that no countervailing power is ever a *possible value* of Φ. If we attempt to keep the complex cause of the original conditional, then the set $\{c^1, c^2\}$ exhausts the operative powers. Accordingly, the addition of c^i requires that the same complex cause has two different sets

of (exhaustive) operative powers. The only way to avoid this problem, as I said above, is to think of c^1 and c^2 in the original conditional as forming a subset of the superset $\{c^1, c^2, c^i\}$. And this, I think, is to equivocate over the term 'cause' by using two notions: a totalistic cause on the one hand, and a mere multiplicity of operative powers (a mere subset) on the other.

If this argument is sound, then I think it should be taken as a fatal blow for Mumford and Anjum's project. For it attempts to show that the two components of their dispositionalism are in conflict. The vector model of causation draws upon a totalistic conception of complex causes. As we have discussed, this approach is not suited to the idea of 'strengthening' the antecedent of a causal conditional. If we attempt to do so, then we switch between different resultant vectors and therefore end up with the non-problem that C does not necessitate E because C might not be the case. We can see by the form of Mumford and Anjum's antecedent strengthening argument, presented above, that we require the complex cause to retain its identity whilst the additive preventer is added; but this, I think, demands a metaphysics of causation and prevention whereby a cause *can* retain its identity regardless of whether or not it is in the company of the additive preventer. And this requirement is not provided by Mumford and Anjum's vector model of causation. I conclude, therefore, that Mumford and Anjum's dispositionalism is fatally flawed: the application of the antecedent strengthening argument to a vector model of causation is self-refuting.

Given that Mumford and Anjum's use of antecedent strengthening is problematic, it is interesting to ask why this type of argument has looked attractive to a number of other philosophers. In particular, Schrenk (2010) develops the antecedent strengthening approach in his criticism of necessitarianism, whereas Eagle (2009) uses it to undermine the dispositional actualist semantics for counterfactual conditionals. Let us focus on Schrenk's essay. In this context, Schrenk is using the antecedent strengthening argument to question Ellis' (2001, p.106) idea that there is a metaphysically necessary connection between a cause event C and its effect event E via the dispositional property D.

> Suppose, for the purpose of argument, that there is a disposition D to react with E in circumstances C ... As I read Ellis, this is to say that there is a natural kind of process: the process from C events to E events. Further, C events and E events are (when mediated by the

> disposition) joined as a matter of metaphysical necessity ... The problem now is that in antidote cases, E does not come about even though C does occur. Yet, how can it be possible if C and E are, due to D, linked by metaphysical necessity? Not even an antidote should be able to interfere with necessary connections. The crucial point is that necessity is *monotonic*: if C *necessarily* leads to E, so must C plus the antidote A (Schrenk 2010, p.733; original italics).

Let us put aside the problematic issues surrounding antidotes that we discussed in chapters 2 and 3. Ellis' scientific essentialism differs in a key respect from Mumford and Anjum's vector model of causation with regard to the antecedent strengthening argument. In particular, the event C retains its identity whether or not it is conjoined with the envisaged antidote A. Hence, we can legitimately apply the antecedent strengthening argument: if necessitation is monotonic, then C should (incorrectly/impossibly) necessitate E despite the presence of the operative antidote. What is key here is that C is the same event where it is under and not under the duress of A. But this is not so for Mumford and Anjum. As they have constructed their correlate of 'C' as including the totality of operative powers (into which the operative antidote should fall), we cannot say that C is the same entity where A is absent as when A is present. In short: where we have the 'atomic' conception of causal relata (e.g. Ellis 2001; Bird 2007), the argument can be applied, but where we have the 'holistic' conception (Mumford and Anjum 2011) it cannot. (I take this to mean that the problem set out above does not apply to Schrenk's antecedent strengthening argument. Nevertheless, the issue that I discuss in Chapter 6, which concerns the possibility claim of Mumford and Anjum's dispositionalism, should be extendable to deflect Schrenk's anti-necessitarian arguments in a different way, although I shall not argue for the details as we are concentrating upon Mumford and Anjum's position in this section of the thesis.)

4.6 Totality clauses and threshold lines

I want to move back now to consider the applicability of totality clauses to the project of necessitarianism. This approach was raised by Tugby but dismissed by Mumford and Anjum for two reasons. First, it was seen to presuppose necessitarianism. And second, it was seen to avoid the antecedent strengthening test, which Mumford and Anjum see as a kind of admission of defeat.

Given the line of argument in the previous section, however, we now have a show of reason to be wary of Mumford and Anjum's remarks. What has emerged is that Mumford and Anjum are themselves covert users of totality clauses, since the resultant vector is a disguised completion. There is therefore a more complicated dialectic at hand, which involves Mumford and Anjum defending their dispositionalism by construing one of its internal tensions (i.e. the issue of totality) as a mere defence of their target thesis: necessitarianism. I do not want to say that this is what Mumford and Anjum have done purposefully, but I think that this is what they have done effectively. A problem, P, with their theory, T, has been downplayed by the idea that P is merely a defence of their antithesis A that question-beggingly refuses to engage with their argument for T.

In fact, I think the real situation is reversed twice over. First, totality clauses do not presuppose necessitarianism, since they are compatible with probabilistic causation (I develop this point in Chapter 5). In addition, a totality clause is first and foremost a thesis concerning what is actual in a world, or what is actual at a time, not a thesis that concerns how causes are related to their effects. (I shall unpack this claim below.) And second, whilst there is something to be said for the idea that totality clauses are a means by which antecedent strengthening cannot get started, we cannot conclude from this that the necessitarian has simply avoided Mumford and Anjum's otherwise destructive argument, since they cannot apply it to their own theory either. We have seen that the antecedent strengthening argument requires that a cause, generally construed, can retain its identity in the face of the operative preventer. As such, the antecedent strengthening argument is applicable to 'atomistic' views of causal relata, but not 'holistic' ones of the kind that Mumford and Anjum have problematically employed. In light of this, I think a blanket application of the antecedent strengthening argument is dangerous. If it is only applicable to certain types of theories, then we should not say that the use of totality clauses avoids the antecedent strengthening argument in a way that is *ad hoc*. Perhaps the totality approach is necessitarian precisely because it does not allow additive prevention without dismantling the complex cause: so much the worse for antecedent strengthening? At this stage, we might suspect that Mumford and Anjum's vector model of causation moves necessarily from a cause to its effect, precisely because fixing the cause fixes the resultant vector (i.e. the basis for understanding manifestations *qua* change). Can we say that

Tugby's proposal is really in a poorer position? (I set about answering these questions in the next two chapters.)

In this section of the chapter I shall explain why I think that Tugby's proposal does not disarm the necessitarian of a reason to think that causes necessitate their effects. I shall continue with the 'guerrilla tactics' of the previous discussion and use Mumford and Anjum's own resources against themselves. My aim is that this discussion will prepare the reader for the themes of the next two chapters, which centre on chance, possibility, and necessitation. Let us recall the issue at hand.

> Why should we agree that c_1–c_n together with the totality fact necessitates e? And why agree with Mill that the consequent invariably follows? All these claims merely assume what we deny, namely, that a cause necessitates its effect. The match lights in all the closest worlds in which it is struck only if it is necessitated. What we need is some reason to think that the match will light in all the closest possible worlds in which it is struck, in other words some reason to believe that the cause necessitates the effect (Mumford and Anjum 2011, p.69).

In the context of this citation, Mumford and Anjum are discussing a possible interpretation of totality clauses in Lewis' (1986) modal realism. Briefly, the idea is that Lewis' semantics for counterfactual conditionals ensures a *de facto* consistency in the external circumstances of causal processes, where the only modification is the actuality of the antecedent (cf. Eagle 2009). This is because a genuinely counter-fact conditional is true just in case the closest possible world (where the antecedent is true) is one where the consequent is also true. I have not discussed this view, however, so I shall take from the above citation the more general idea that totality clauses in any form are missing explanations for necessitation. (I think that this is what Mumford and Anjum would have in mind.)

There is a brief answer, hopefully not too simple, that we can give to Mumford and Anjum in light of the discussion of this chapter so far. If it is the case that their vector model is using totality clauses, at least in a covert form, then it should be able to provide the explanation for why a cause necessitates its effect. I think it is important to say here that the use of a totality clause, say in the context of Armstrong's (1997, p.231) necessitation theory of laws, should not be seen as providing

the entire explanation of why a cause necessitates its effect. In the case of Armstrong's theory, whilst totality clauses will have a part to play in fixing what the causal factors are, the brunt of the explanatory burden is carried by his theory of laws. And it is not clear that we cannot say the same in this context. Let us therefore say that we have the complex cause $\{c^1, c^2, c^3, c^4\}$. And let us also say that we have a truthmaker for why no more powers are operative in this causal situation. Perhaps we will require a dedicated ontological posit to do this, as Armstrong suspects, or perhaps the task can be performed in some way by the vector addition operation (as it requires a determinate number or arity for its operands). It follows by the vector model of causation that we have a unique resultant vector R^{c1-c4}. In addition, it follows that this resultant vector either meets or does not meet the threshold line for the manifestation types of the quality space. If it does, then we have a manifestation *qua* change. If it does not, then we have the second-class sense of causation whereby the operative powers are unsuccessfully pushing for a possible manifestation *qua* change. Looking at the situation in this 'necessitarian' way, there is a clear division of labour between the totality clause and the machinery of the vector model of causation. And more importantly, it is the latter that is providing the explanation for why the effect follows from the cause (in both possible senses of causation that Mumford and Anjum employ). We can think of the division of labour in this sense: the totality clause is involved in the input for the causal process. It is fixing the operating powers. We might think of it as placing the curly brackets around the operative powers, as above. But the function from this input to the output (where the output is the effect, whatever its nature) is being provided by Mumford and Anjum's story of vector addition, resultant vectors, and threshold lines. Lastly, we can note that a totality clause is first and foremost a tool for fixing that the entities in a given situation (e.g. the actual world, a certain time, a certain causal situation) are all of the entities that are in play. In light of this, it is unclear to me why Mumford and Anjum think that the use of totality clauses either presumes necessitarianism or renders the explanation of necessitation vacant. These are duties for the metaphysical theory of causation/laws to perform in cooperation with the fact that 'these causes are all of the causes'.

5

Probabilistic Powers in the Vector Model of Causation

5.1 Introduction

In this chapter I introduce Mumford and Anjum's model of probabilistic powers, criticise this model, and provide a replacement that stays within the boundary of their vector model of causation. Mumford and Anjum construe the operation of probabilistic powers as multi-headed component vectors. The operations of probabilistic powers are directed towards two different types of change, where each direction has a certain magnitude. In this chapter, however, I argue that Mumford and Anjum's model of probabilistic powers is metaphorical, in the sense that there is no metaphysical explanation for how probabilistic powers can secure the possibility of different alternative manifestations *qua* change within a single causal situation. What Mumford and Anjum should have said, I think, is that probabilistic powers operative disjunctively, such that, in the simplest case, there is either a component vector directed towards change F or a component vector directed towards change G. The motivation for this replacement view is that it uniquely secures the possibility of different alternative manifestations *qua* change within a single causal situation. In addition, I propose that we have now secured a genuine notion of anti-necessitarian behaviour as this notion properly applies to probabilistic (and indeterministic) powers. In addition, throughout this chapter and the next I aim to show that Mumford and Anjum have mishandled Barker's criticism concerning determinism.

5.2 Determinism

A significant feature of Mumford and Anjum's dispositionalism is its alleged neutrality on the issue of determinism. In their replies to objections, Mumford and Anjum (2011, pp.74–5) cite Stephen Barker as raising the problem that their dispositionalism would rule out determinism *a priori*, when the truth or falsity of this thesis should be, at least in part, a matter *a posteriori*. Their reply to this

worry involves distinguishing two conceptions of determinism. The first conception of determinism draws upon causation as the "vehicle by which determinism does its business" (Mumford and Anjum 2011, p.75). I shall refer to this conception of determinism as the 'causal conception'. Mumford and Anjum claim that the causal conception lies behind Barker's problem.

> "In [Barker's problem] ... determinism is taken automatically to mean causal determinism, which then looks to be the very same as causal necessitarianism ... Isn't the reason for equating these two theses [determinism and causal necessitarianism] simply an assumption that causes necessitate and are thus the means by which determinism does its work?" (Mumford and Anjum 2011, p.75: my square brackets).

Mumford and Anjum's response is to set out a second conception of determinism. Its starting point is the claim that the key notion of determinism is the fixation of the future by the past (Mumford and Anjum 2011, p.75). As such, Mumford and Anjum's temporal conception is non-causal. A candidate version is defined as follows: "the total state of the world Φ_1 at time t_1 dictates that only one state Φ_2 is possible at t_2" (2011, p.76; c.f. Anscombe 1981, p.142). I shall refer to this conception of determinism as the 'temporal conception'.

Mumford and Anjum think that the temporal conception is superior to the causal conception. Their reasoning is that the causal conception cannot handle uncaused events. If determinism is understood in terms of causes necessitating their effects, then uncaused events cannot be determined. On this basis, Mumford and Anjum claim that a world with uncaused events cannot be deterministic: "we do not have a deterministic universe if there are also some events [the uncaused events] outside of the grip of causation" (2011, p.75: my square bracket). Mumford and Anjum's temporal conception, however, is thought to rule out uncaused events. In light of its non-causal terminology, both caused and uncaused events will fall under 'states' that are to be 'dictated' (Mumford and Anjum 2011, p.76). Accordingly, if there are uncaused events, then either these can be dictated by the total state of the world Φ^1 at t^1, such that whilst these events are uncaused they are nevertheless dictated, or otherwise they cannot be dictated and so 'correctly' result in a failure of determinism. Given its non-causal terminology, Mumford and Anjum's temporal conception is thought to be orthogonal to their dispositionalism. In the first place, Mumford and Anjum think

that their dispositionalism can handle indeterministic and probabilistic causation (see below). Hence, dispositionalism is not committed to either the truth or falsity of the temporal conception of determinism. (That said, it is committed to the correctness of this understanding of determinism.) In the second place, however, Mumford and Anjum deny that their antecedent strengthening argument requires indeterministic and/or probabilistic causation. Taken together, this is the outline of Mumford and Anjum's response to Barker's concern.

> [T]he argument against causal necessitarianism does not rest, as Anscombe's [1981] argument does, on indeterministic causation being the case. Hence, it is consistent with the antecedent strengthening argument against necessity that if two tokens of the same dispositions were placed in identical contexts—identical in every causally relevant respect for that disposition—they would produce identical manifestations. The argument against necessity required only that if something had been different, the manifestation need not have occurred (Mumford and Anjum 2011, p.76: my square bracket).

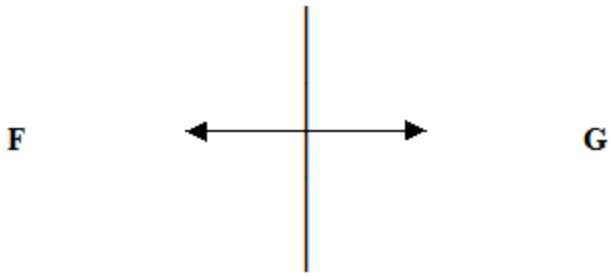
> It should again be reiterated that the antecedent strengthening argument does not rest on there being probabilistic causation. Ours is an antecedent strengthening argument against necessity (Mumford and Anjum 2011, p.77).

5.3 Probabilistic powers as double-headed component vectors

Mumford and Anjum also make a distinction between indeterministic causation and probabilistic causation: the former is thought to involve complete randomness whereas the latter is thought to involve a weighted chance that is less than one but greater than zero. Let us outline their model of probabilistic powers for the purposes of the arguments of this chapter. (I shall largely ignore indeterministic causation for reasons that I shall explain in the next chapter.) Mumford and Anjum define a probabilistic disposition as one that "tends towards a certain distribution of events only; it never necessitates that distribution" (2011, p.78). Their discussion of probabilistic causation centres on a hypothetically fair coin whose toss has a 0.5 chance of landing heads and a 0.5 chance of landing tails. So construed, the fair coin is thought to have a single disjunctive probabilistic disposition, since 'landing heads' and landing tails' are the exclusive possibilities for its toss. In

terms of their vector model of causation, this is represented as a 'multi-directional' operative power: i.e. as a (single) double-headed component vector. This is shown in the diagram below, where F and G stand for the manifestation types 'landing heads' and 'landing tails', respectively.

Diagram 5. A double-headed component vector for the fair coin



There are two complications for this model of probabilistic causation. Firstly, if the coin was biased or loaded, then the double-headed component vector would be shifted towards the F or G manifestation type as appropriate. For example, a loaded coin that had a 0.7 chance of landing heads and a 0.3 chance of landing tails would have its double-headed component vector positioned over the starting line such that 70% of its extent were on the F-side of the quality space and 30% of its extent were on the G-side of the quality space. And secondly, just as there can be quality spaces with more than two manifestation types in 'standard' causation, there can also be additional dimensions for the quality spaces of probabilistic causation; for example, Mumford and Anjum outline a six-dimensional quality space for the roll of a fair die (2011, pp.78–9).

Mumford and Anjum's model of probabilistic causation raises a puzzle concerning 'lonely' powers, i.e. powers that do not have a reciprocal partner. That lonely powers are accepted for Mumford and Anjum's vector model of causation was a complication that I passed over in the previous chapter. But they are relevant for the argument of this chapter: so let us briefly consider lonely powers in themselves before examining the puzzle for probabilistic causation. Mumford and Anjum accept lonely powers in addition to 'partnered' (i.e. non-lonely) powers; in doing so they are modifying Martin's (2007) model of powers (2011, pp.34–8). If we recall the notion of operative powers from the previous chapter, we can recall that powers P^1–P^n are operative just in case they are proximate

(i.e. suitably related) reciprocal partners. This definition is unsuitable for lonely powers, however, since lonely powers do not have reciprocal partners and *a fortiori* do not have proximity conditions. (In this sense it is significant that the 'coming together' of powers is understood in terms of Martin's terminology of reciprocal partners for mutual manifestation; that is to say, the proximity of powers is understood in terms of *reciprocal partners* being suitably related.) Mumford and Anjum are aware of this issue and seem to suggest that lonely powers can spontaneously operate and manifest—citing radioactive decay as a credible example (2011, pp.36–7). Lonely powers operate by pushing towards a manifestation type in the same way as partnered powers, but it is possible, by what has been said so far, that a lonely power can operate uniquely within a quality space. In other words, we could have a quality space with just one operative power. (In contrast, partnered powers must always operate in groups of at least two). Let us note that Mumford and Anjum's discussion of lonely powers suggests that non-probabilistic (and non-indeterministic) powers can be lonely powers (2011, pp.34–8). So we have the following taxonomy of powers. Firstly, partnered powers can make use of proximity conditions, since these triggering conditions are understood in terms of reciprocal partners coming together. As far as I can tell, Mumford and Anjum take all partnered powers to be non-indeterministic and non-probabilistic; that is to say, the partnered powers do not make use of Mumford and Anjum's double-headed component vectors. And secondly, we have the lonely powers, which are comprised by both standard (single-headed) component vectors, as well as indeterministic and probabilistic (double-headed) component vectors. We should also note that whilst Mumford and Anjum's lonely powers do not have proximity conditions, in the usual case they will nevertheless feature in quality spaces with other component vectors. So the idea, I take it, is that all powers (partnered and lonely) fall into groups of causal relevance, in virtue of which they can participate in common quality spaces for common dimensions of change.

(i) Partnered powers [have proximity conditions]

(1.) Standard powers [single-headed component vectors]

(ii) Lonely powers [do not have proximity conditions]

(1.) Standard powers [single-headed component vectors]
(2.a) Indeterministic powers [double-headed component vectors]
(2.b) Probabilistic powers [double-headed component vectors]

The connection between lonely powers and probabilistic causation has arisen, of course, because Mumford and Anjum's model of probabilistic causation is using singular component vectors (that are nevertheless double-headed) . Here is the puzzle set out for the example of a coin. On the one hand, where the double-headed component vector is centred upon the starting line—as it is in the case of the fair coin—its looks as though the two sides will cancel out, so as to leave a situation where nothing happens. On the other hand, however, where the coin is loaded it looks as though the coin could spontaneously land heads or tails (depending on the direction of its bias). Hence the puzzle: fair coins can land heads or tails (*contra* the picture that the equilibrium conjures up); and whilst a spontaneous manifestation might be appropriate for some examples of probabilistic causation, such as radioactive decay, it does not look suitable for coins and dice, which typically require a mechanism to toss the coin or roll the die (Mumford and Anjum 2011, pp.80–1). Mumford and Anjum's response to this puzzle is as follows.

> In all the real-world situations we encounter, this probabilistic disposition never occurs alone. Gravity, for instance, holds the dice down on a flat surface so even a loaded dice does not move without some further push. But if there were some solitary probabilistic power loaded in one direction, with no other powers at work, then again the response would be to say that it could manifest itself. It is doubtful this could ever occur, however. Both the dice and the coin need gravitational powers in order to land. A coin toss in zero gravity would be pointless and result-less (Mumford and Anjum 2011, p.80).

So we have two aspects to the puzzle and two replies. The first aspect is that with fair probabilistic powers the double-headed component vector is cancelling out. The response is to say that additional operative powers are needed to 'tip' the fair coin or fair die into a certain manifestation *qua* change. The second aspect is that unfair probabilistic powers look to be able to spontaneously manifest. Mumford and Anjum's reply is to say that although this is theoretically possible, in most cases additional operative powers are also required (e.g. gravitational forces).

5.4 Probabilistic powers as disjunctive operators

Mumford and Anjum's response to this puzzle is commonsensical, but it raises a difficulty for their theory. In outline, the difficulty is that there is a possible equivocation over the term 'disposes towards' in Mumford and Anjum's vector model of causation when probabilistic powers enter the picture. In a first sense of 'disposes towards' we are to consider Mumford and Anjum's antecedent strengthening argument. On the basis of this argument, Mumford and Anjum state that even a resultant vector does no more than 'dispose towards' a manifestation *qua* change (2011, pp.175–81). In short, because causal interactions can be subject to prevention, causes do not necessitate their effects but only dispose towards these with a *sui generis* modality (I shall elaborate upon this aspect of their dispositionalism in the next chapter). But there is a problem here, since, as we shall see, Mumford and Anjum's dispositional modality (i.e. the *sui generis* modality) is what 'most' philosophers take to be distinctive of probabilistic causation, in contrast to 'standard' non-probabilistic causation. In other words, what Mumford and Anjum have effectively done, a 'typical' philosopher might say, is to paint all causal processes with the modal brush of probabilistic causation. Accordingly, probabilistic and non-probabilistic causes alike merely dispose towards their effects. Why is this problematic? The reason is that for Mumford and Anjum a non-probabilistic cause is thought to merely dispose towards its effect on the basis of antecedent strengthening considerations, as oppose to this distinctive modality being a consequence of the various components of their vector model of causation: i.e. operative powers, vector addition, and threshold lines. Mumford and Anjum's vector model of causation is not inherently dispositional *qua* anti-necessitarian; rather, we have the idea that there could always be different operative powers in a causal situation; hence my worry for probabilistic causation. In this case we require a different reason for thinking that a cause merely disposes towards its effects. A probabilistic cause

does not merely dispose towards its effect because the operative powers could have been different: there is something 'intrinsically' anti-necessitarian about it (I use this term loosely for the moment). And so there is a second sense of the term 'dispose towards' that specifically concerns probabilistic powers. In setting out their model of probabilistic causation, however, Mumford and Anjum have recycled the machinery of their vector model of causation (i.e. their ideas of operative powers, vector addition, and threshold lines). We are told that a probabilistic power disposes towards a distribution of events, rather than necessitating any such distribution; but it is not clear how a double-headed component vector can perform this role.

A brief summary of this line of thought will be useful. A first sense of 'dispose towards' is based upon antecedent strengthening. Importantly, the vector model of causation uses a number of posits that are not especially anti-necessitarian. (I think this holds for the operation of powers, the composition of component vectors, and the passing of a threshold line.) In contrast, however, a second sense of 'dispose towards' concerns *bona fide* probabilistic causation. The intended problem is that Mumford and Anjum are seeking to explain the second sense of this term on the basis of their vector model of causation—without the appropriate modifications. This leads me to think that Mumford and Anjum's model of probabilistic causation is metaphorical: the two heads of the double-headed component vector 'dispose towards' their manifestation types, but we have not been given any reason, over and above the antecedent strengthening argument, as to why this should be. It seems, however, that Mumford and Anjum's model of probabilistic causation should not 'piggy back' upon their antecedent strengthening argument. So we should ask: how exactly do probabilistic powers 'dispose towards' their effects? I suspect that we shall find a metaphorical approach and a possible equivocation on term 'dispose towards'.

In developing this line of criticism I want to go back for a moment to Mumford and Anjum's notion of a *sui generis* modality. With regard to our present concern, their view is that causes are connected to their effects by a worldly modality that is a *sui generis* dispositional modality. This dispositional modality cannot be understood in terms of necessity or possibility without distortion. First and foremost, the dispositional modality is negatively construed, via its divergence from these standard modalities as they might be applied to causation (2011, pp.175–83). The positive

construal of their dispositional modality draws upon the concept of a 'selection function', whereby a power selects a manifestation from all possible types of manifestation.

> Dispositionality, it will be suggested, can be understood as a sort of selection function—a natural one in this case—that picks out a limited number of outcomes from all those that are merely possible ... There is an irreducibly dispositional connection between the powers in the world and the outcomes they can bring about. Solubility, for instance, selects dissolving as its manifestation and will sometimes succeed in bringing it about. But it irreducibly only disposes towards that manifestation: and similarly for each individual disposition and its manifestation (Mumford and Anjum 2011, pp.189–90).

This notion of the selection function, however, is not developed very far. In addition, Mumford and Anjum do not want to analyse their *sui generis* dispositional modality in terms of this selection function; accordingly, we should conclude that the modal commitments of their dispositionalism are primarily negative. (In particular, my own view is that Mumford and Anjum's dispositionalism basically amounts to the rejection of necessitarianism.) In terms of the line of criticism at hand, the point that I want to establish is that the antecedent strengthening argument is the basis for Mumford and Anjum's *sui generis* dispositional modality. "The main argument against the causal necessitarian view was that a disposition can always be prevented or interfered with by other dispositions. This indicates a contrast between dispositionality and necessity" (2011, p.176). That being said, however, Mumford and Anjum do not disclose the other 'minor' arguments against necessitarianism. (Perhaps we are to take these other arguments to be the alleged advantages of their dispositionalism; in any case, it is fair to say that they are not given a central place in the text.) Interestingly, however, Mumford and Anjum do say that probabilistic causal interactions provide a "fine corroboration of anti-necessitarianism" (2011, p.77). Before we continue let us note a useful citation where Mumford and Anjum remind the reader that resultant vectors do no more than dispose towards their effects.

> It might be wondered, at this stage, whether the vector model fails to depict causation at all or only shows the powers. After all, on our account, even if we have a resultant vector that meets a certain threshold, given the lack of necessitation, we cannot guarantee that the

> threshold will actually be met ... [the resultant vector] depicts only a resultant power, which still no more than disposes towards its effect (Mumford and Anjum 2011, p.74: my square bracket).

With this in mind, let us return again to the issue of probabilistic powers. We are presently concerned that Mumford and Anjum's understanding of probability is trading upon their antecedent strengthening argument, such that there is no independent ontological basis to think that a double-headed component vector should 'dispose towards' a manifestation *qua* change in the required probabilistic sense. We can draw attention to this issue with the following consideration. Mumford and Anjum have responded to the puzzle of how the fair coin can land heads or tails: it must be subject to additional operative powers, such as gravitational forces. I note that these additional operative powers do not have to be probabilistic powers, according to Mumford and Anjum's discussion; that is to say, they can be 'single-headed' component vectors. Let us therefore consider the following quality space. F and G are the manifestation types, where F is landing heads and G is landing tails. In addition, let us take two sets of operating powers. The first set is exhausted by the operative power of the fair coin: a double-headed component vector that is centralised over the starting line. The second set includes a number of single-headed component vectors that are standing in for gravitational forces and the like. There are several options for these non-probabilistic powers, but let us simply say that this second set has one or more members. Taking the two sets together, in terms of the direction and magnitudes of these component vectors, we can group of all of possibilities into two classes. The first class has a resultant vector that meets the threshold line of either F or G; the second class has a resultant vector that does not reach either of these threshold lines.

What is interesting about this scenario is that the probabilistic power does not make any difference to the resultant vector. This is, of course, because the double-headed component vector is centralised over the starting line, in accordance with Mumford and Anjum's discussion of the fair coin. Hence its F-side head and its G-side head perfectly cancel out. But this means that the two possible manifestations *qua* change for the coin—i.e. landing heads or landing tails—are entirely driven by the gravitational forces etc. of the causal situation. Accordingly, Mumford and Anjum have not modelled a fair probabilistic power but rather a completely passive power, which is a

strange idea in itself. It is important to bear in mind that the fair coin is standing in for a genuinely probabilistic power; so the coin is not simply well-balanced, such that there is a poor chance of predicting how it land in simple tosses. In contrast, the landing of the coin once tossed is thought to be a matter of irreducible chance (Mumford and Anjum 2011, p.78). We can see the difficulty this raises by considering that a specification of the details of the causal situation—i.e. fixing the members of the second set of operative powers, as well as their directions and magnitudes—only permits a single manifestation *qua* change (assuming that the resultant vector passes the threshold line). As such, Mumford and Anjum's ontological model of probability is flawed. I think they are correct to say that a probabilistic power should only tend towards a certain distribution of events, rather than necessitate this distribution; but this is only half of the requirement. What we also want a probabilistic power to do, I suggest, is to facilitate different possible changes within a single circumstance. By 'circumstance' I mean a given spatiotemporal arrangement of objects bearing powers (i.e. a complex state of affairs). I note that Mumford and Anjum say in their discussion of determinism that their dispositionalism can handle indeterministic causation, of which they think probabilistic causation is a sub-type (2011, p.76–7). More specifically: "[I]t is consistent with causal dispositionalism that two tokens of the same disposition could produce different manifestations in identical contexts, if there were irreducibly indeterministic dispositions for instance" (Mumford and Anjum 2011, p.76). We would expect the same to hold for probabilistic powers, though the problem at hand suggests that this feature is not going to be secured. Staying with the fair coin example, what should be happening is that upon its being tossed, the coin has a power such that it can either land heads or tails. (In this sense the example is a little strange, since we do not think that coins have such probabilistic powers; but this complaint does not affect the problem at hand, which concerns the machinery of Mumford and Anjum's theory.) Fixing the members of the set of non-probabilistic powers amounts to fixing the background conditions for the tossing of the coin (e.g. the environment within which it is tossed, as well as the nature of the toss). As we have seen, however, fixing these causal factors will in fact 'determine' how the coin will land, since the resultant vector is unaffected by the centralised double-headed component vector.

At this point Mumford and Anjum will object that causes do not necessitate their effects, such that 'fixing the causal factors' cannot 'determine' how the coin will land. As I suggested above, though,

this response would conflate two distinct issues. What we require is a probability-based explanation of how the fair coin can either land heads or tails in this circumstance. Calling upon the idea that the operative powers could have been otherwise will not serve this task: indeed, specifying a new circumstance will give a new resultant vector that will in turn only allow a single possibility, whether this be a manifestation *qua* change or Mumford and Anjum's operative notion of causation (where a change does not occur). So we have a specific problem for fair probabilistic powers. Because the double-headed component vectors in question are centralised over the starting lines of the quality spaces, whilst we can say that the probabilistic power is operative, it will give no net 'push' towards either side of the quality space. Accordingly, if the threshold line of either manifestation type is met, this will only be due to the operation of additional powers. This generates the problem that fair probabilistic powers in casual interactions are making no overall contribution to the outcome, such that a fair coin that is tossed in exactly the same way will land exactly the same way each time. This is, of course, contrary to the result that Mumford and Anjum's discussion aims to establish.

Let us briefly consider the other case, which concerns weighted probabilistic powers. Mumford and Anjum say that weighted lonely probabilities, whereby the double-headed component vector is unevenly orientated with regard to the starting line, can manifest *qua* change in theoretical conditions (2011, p.80). But it is difficult to see how this could be so according to their theoretical resources. Let us take a probabilistic power that has a 0.7 chance for F and a 0.3 chance for G, where F and G are its manifestation types. Let us also assume, in line with Mumford and Anjum's remarks, that no other operative powers are required for a manifestation *qua* change. How can the resultant vector, which will favour F, ever reach the threshold line of F without the use of additional operative powers? There is no explanation for how this could occur. A more severe problem arises for the G manifestation type. The resultant vector disfavours this change, but Mumford and Anjum will want to say that it is nevertheless possible (although less likely) that the lonely probabilistic power can manifest this type of change. Again, there is no explanation for how this could be so. What has happened in this case, I think, is that Mumford and Anjum have invested their component vectors with 'powers' that they do not have, so to speak. In light of the antecedent strengthening argument, we have the general idea that even a resultant vector does not necessitate a manifestation *qua* change. The operative powers could have been different. But we should not move from that

idea to the separate idea that component vectors are themselves 'sufficient grounds' for possible changes (I explore this idea in the next chapter). As far as I can see, it is only in this manner that we could say that a weighted probabilistic power could manifest *qua* change either of its manifestation types on its own. (Recall that Mumford and Anjum deny that fair probabilistic powers can spontaneously manifest on their own.) Accordingly, this type of case (the weighted probability) has the distinctive shortcoming that it does not fit into Mumford and Anjum's account of threshold lines; and this account, I assume, is a fundamental component of their vector model of causation.

A short summary of both of these difficulties will be useful. Mumford and Anjum say that fair probabilities require additional operative powers if they are to manifest *qua* change. But when we add additional operative powers, it turns out that any manifestations *qua* change will be a direct reflection of these additional operative powers. Accordingly, we fail to secure the crucial idea that a probabilistic power could have affected the outcome of a causal interaction in different ways (with the other causal factors remaining fixed). In contrast, it is allowed as a theoretical case that a weighted probabilistic power could spontaneously manifest *qua* change. Again, this goes against the account of the vector model of causation, since the threshold lines cannot be met.

On the basis of these observations, I think that Mumford and Anjum's account of probabilistic powers is metaphorical. The component vectors of probabilistic powers are being called upon for duties that were not secured for them in the setting out of the vector model of causation. More specifically, the only reason that we were given for thinking that complex causes do not necessitate their effects was the antecedent strengthening argument. From this argument we are intended to conclude that causes merely dispose towards their effects. Importantly, this mere 'disposing towards' is characteristic of probabilistic causation also. But the required modifications to the vector model of causation have not been made. The idea that probabilistic powers operate as multiple-headed component vectors raises new difficulties and does not secure the correct outcomes. As far as I can see, then, Mumford and Anjum are equivocating over the term 'disposing towards' in the following sense. In the vector model of causation, as it stands apart from probabilistic powers, operative powers dispose towards their manifestation type. Operative powers do not necessitate a manifestation *qua* change, because there is always the possibility of additional

countervailing powers. But probabilistic causation uses a different sense of 'disposing towards', which Mumford and Anjum have not secured. In this sense even a total cause that contains a probabilistic power will merely push towards a certain outcome without necessitation. Significantly, this lack of necessitation is independent of any considerations concerning antecedent strengthening. Let us term the first sense of this disposing towards 'disposing *qua* strengthening' and the second sense 'disposing *qua* probability'. The problem is that Mumford and Anjum are providing a model of disposing *qua* probability, but its ontological resources are only anti-necessitarian in the sense of disposing *qua* strengthening. On this basis, I suggest that Mumford and Anjum will be forced to equivocate on these two senses when they say, for example, that a probabilistic disposition "tends towards a certain distribution of events only; it never necessitates that distribution" (2011, p.78).

In light of these problems, I think Mumford and Anjum should have said that probabilistic powers can operate in disjunctive ways. Let us consider again the fair coin. When the probabilistic power that is responsible for the fair coin's landing heads or tails becomes operative, we should say that either the F-side or the G-side component vector is placed upon the quality space (exclusive 'either–or'). This probabilistic power—let us call it 'spin' for lack of a better term—does not operate with a single double-headed component vector, but rather its operation involves a disjunctive 'push' for one of two manifestation types. Each of these 'pushes' will be a single-headed component vector. In line with Mumford and Anjum's propensity-based approach to probability, we can say that there is a 0.5 chance for spin's operation to push to the F-side and a 0.5 chance for spin's operation to push to the G-side. This will capture the idea that spin is responsible for the fair coin's landing heads or tails.

It will be useful to motivate this strategy. Why should Mumford and Anjum say that probabilistic powers operate disjunctively? As far as I can see, this is the only strategy that will secure both of Mumford and Anjum's requirements on this matter. Firstly, on the basis of Mumford and Anjum's vector model of causation, we require the distinction between operations and manifestations *qua* change to remain in force. This means that we cannot retreat into the more standard view that a probabilistic dispositional property directly manifests its manifestation property *qua* disjunctive property instantiation. (I think this is how Bird and Ellis, for example, would approach the issue.)

Mumford and Anjum want probabilistic powers to be able to 'interact' with other operative powers for the purposes of complex causation and interference/prevention. Accordingly, we must understand the probabilistic power as operating *qua* component force if we are to maintain Mumford and Anjum's wider aims. Secondly, however, my proposal has the unique advantage over Mumford and Anjum's present set up in that I can properly establish the important result that a circumstance involving a probabilistic power can lead to different manifestations *qua* changes. That is to say, upon fixing a spatiotemporal arrangement of powers that contains a probabilistic power, the disjunctive operation of this probabilistic power will allow the same causal context to give multiple sets of component vectors and therefore multiple possible resultant vectors. (In the case of spin, we would have two such possibilities; but more complex probabilistic powers for higher dimensional quality spaces would generate more possibilities.) If we want to keep Mumford and Anjum's apparatus of resultant vectors and threshold lines, which I assume we do, then the only option is to say is that the component vectors could have been different when a probabilistic power becomes operative. Only in this way can we maintain that one circumstance can lead to multiple outcomes, which is the distinctive characteristic of causal interactions involving probabilistic powers. Or so I shall assume for the purposes of this chapter and the next.

5.5 Calculation procedure

One way to reinforce this point is to make a four-way distinction between the different 'calculation stages' of Mumford and Anjum's dispositionalism. A first step is to establish those powers that are operative. The second step is to place the appropriate component vectors of these operative powers upon a quality space. A third step is to calculate the resultant vector. And finally, we have to check if this resultant vector passes a threshold line, and 'update' the arrangement of objects bearing powers if this is the case.

Calculation procedure for a given subject of change:

(1) Check the circumstance, i.e. the spatiotemporal arrangement of propertied-objects to specify those powers that are operative.
(2) Plot component vectors, such that we specify the total cause.

(3) Plot resultant vector of this total cause.

(4) Check for threshold line (together with possible 'update' of the world)

It is interesting to see how Mumford and Anjum's anti-necessitarian strategies are being carried out with regard to these conceptual distinctions. As a first remark, we can note that the antecedent strengthening argument is targeting stage (1). That is to say, the specification of operative powers does not necessitate its effect because the operative powers could have been different. Quite strikingly, however, we can see that stages (2), (3), and (4) are 'necessitarian' through and through. For consider: Mumford and Anjum have provided no argument that operative powers do not have to 'push' for their manifestation type (i.e. that operative powers do not require us to plot their component vectors)—indeed, the component vectors are identical to the operative powers. Once we fix the operative powers, therefore, we have fixed the component vectors of the quality space. (Note that this holds for Mumford and Anjum's probabilistic powers, which is generating our present difficulties). Hence, the move from (1) to (2) is classic necessitarianism: a given circumstance is sufficient for a given set of component vectors. A similar point holds for aspects (3) and (4), because these stages are mathematical: the resultant vector is a straightforward vector addition function from the component vectors, whereas the threshold line question is a simple subtraction. To provide a quick example of the latter: can the value of the threshold line (e.g. 10 units) be subtracted from the value of the resultant vector (e.g. 12 units) to give either a positive remainder or zero? If 'yes', then the resultant passes/meets the threshold line. Taking all of this together, we can see that the yes/no answer of stage (4) is in fact a (more complex) function of stage (1). So necessitation abounds for Mumford and Anjum.

With this in mind, we can diagnose Mumford and Anjum's present difficulty more clearly. What they have done with probabilistic powers is to collapse aspects (1) and (2). This is natural, of course, since the component vectors are meant to represent operative powers. As we have discussed, however, the approach of double-headed component vectors is too weak, such that it cannot generate alternative manifestations *qua* change from one and the same circumstance. My proposal is to separate stages (1) and (2) in the case of operative probabilistic powers: they can contribute different alternative component vectors. To clarify, the idea is that we can start with a single circumstance, i.e. a given spatiotemporal arrangement of propertied-objects, but end up with

multiple (albeit alternative) total causes. For example, if the spin property of the coin operates in the F-direction, then we will have one total cause, and if it operates in the G-direction, then we will have a different total cause (as the component vectors will be different in the two cases). We can see that this disjunction of possibility will trickle down the calculation stages to allow probabilistic powers to exert their influence in different resultant vectors and therefore in different manifestations *qua* change.

5.6 Discussion on types of probabilistic power

There is a difficulty that concerns the issue of indeterminism and probability in the context of Mumford and Anjum's vector model of causation that we have so far bypassed in our discussion. This is that there are two main senses in which we will want to say that the operations of powers could be 'disjunctive'. Firstly, we can have the idea of a power that operates disjunctively in that when it becomes operative, the component vector that is plotted is one of alternative disjuncts. And secondly, we can have the idea of a type of power whose operation is non-conditional. Let us consider Mumford and Anjum's partnered powers, which use single-headed component vectors with proximity conditions. As noted, Mumford and Anjum accept that the suitable relationship (or 'coming together') of these powers is sufficient for their operation. In other words, the satisfaction of the proximity requirements of these powers is sufficient for their component vectors to be plotted. And this is because, as we discussed in the previous chapter, such powers are operative just in case they are proximate to their reciprocal partners. But for some powers, we can suggest, there is no subjunctive sufficiency for their operation. In general, there may be some types of power whose operation is itself a matter of indeterministic randomness or probabilistic chance. In this case we would have a disjunctive operation in this sense: in a single circumstance, it might or might not be the case that the power operates.

It is this first type of power that I have been discussing above, since in saying that probabilistic powers can operate disjunctively, I assumed that such powers were operative to begin with. (Accordingly, the disjunctive operation was a matter that concerned what the power would do, so to speak, not whether the power would do anything at all.) These two senses of disjunctive operation are connected to the different examples that Mumford and Anjum discuss when setting

out their notion of double-headed vectors. Consider the case of the fair probabilistic power for the coin. One issue that Mumford and Anjum note is that it is problematic to say that this probabilistic power can spontaneously manifest in either a heads-landing or a tails-landing—other component vectors are needed to represent the toss of the coin in a gravitational field. Let us recall that the theoretical motivation for this remark was to alleviate the concern that the centralised double-headed vector would cancel out. We can make a simple connection between the fair coin example and the first type of case that I outlined in the previous paragraph. That is to say, we can take the probabilistic power of the fair coin to be a conditional power that nevertheless has a probabilistic outcome. Intuitively, the thought would be that, once the fair coin is tossed, it is necessary that it lands on one of its sides, but where we are imagining the 'spin' of this coin to be irreducibly probabilistic, what side it does land on will be a matter of fair chance. And we can assume that the coin cannot land on either of its two sides unless it has been tossed. Mumford and Anjum also discuss the case of radioactive decay in motivating the idea that probabilistic (and indeterministic) powers can spontaneously manifest in specific contexts. There is also a simple connection that we can make between radioactive decay and the second case of disjunctive operations, canvassed above. In the case of the unstable atom, whether or not the atom 'does anything' is a matter that is completely insensitive to external circumstances. All that we can say is that there is a certain probability that the atom will emit radiation during a certain time interval. I shall summarise these two senses below.

(i) Disjunctive operations *qua* plotted component vectors: This sense of disjunctive operation concerns the second step of Mumford and Anjum's calculation procedure. Upon becoming operative, the power can operate with one of alternative disjuncts (perhaps with weighted chance).

(ii) Disjunctive operations *qua* spontaneity of operation: This sense of disjunctive operation concerns the first step of Mumford and Anjum's calculation procedure. Whether or not the power becomes operative is itself a matter of disjunction, in the sense that the power might or might not become operative (perhaps with a weighted chance).

Where do these considerations leave our general discussion? I suspect that what is going on here is that Mumford and Anjum are aware of these distinctions, which is indeed why they have discussed coin tosses and radioactive decay—examples that seemingly illustrate senses (i) and (ii) above. But there is a problem. Although there is nothing intrinsically wrong with using a vector to represent, say, whether or not an atom will emit radiation, this strategy does become problematic within Mumford and Anjum's vector model of causation. And this is because 'standard' cases of causation, which do not draw upon either of these two senses of disjunctive operation—hammers striking vases, and so forth—approach component vectors as causal factors that are 'occurently happening'. In other words, component vectors are primarily introduced in Mumford and Anjum's theory to understand causal factors that are operative *qua* active and actual. (In fact, we can see that sense (i) above, which is the modification that I introduced for Mumford and Anjum in the previous part of this chapter, also concerns active and actual causal factors. If 'spin' operates to the F-side, then this causal factor is occurently happening, and if 'spin' operates to the G-side, then this causal factor is occurently happening, and so on.) But we are asking the same theoretical apparatus to do two different things if we ask component vectors to represent both actual and active causal factors, on the one hand, and what we can term 'disjunctive possibilities for action', on the other—where the latter concept concerns sense (ii) above. On this basis, I am tempted to say the following. If we hold sense (ii) in mind, i.e. the idea that a power might or might not become operative, then this 'disjunction of operation' is not something that can be understood within Mumford and Anjum's quality spaces as a component vector. For if we do attempt to understand it as a component vector, then we are collapsing together two different types of 'causal factor'. Generally speaking, and dropping the specific meanings of Mumford and Anjum's terms for a moment, this approach would collapse together 'powers that are operative' and 'powers that could be operative'.

This is clearly a difficult issue, and I am unable to take it any further in this chapter. What will be useful, however, is to clarify the types of power that we shall require for the argument of the next chapter. From this point onwards I am going to assume that Mumford and Anjum's treatment of probabilistic causation is unworkable, on the basis of the arguments that I have presented in this chapter. As things stand, however, we currently have two senses of disjunctive operation that cut across one another, and I think this will create unnecessary complexity for the next discussion. For example, we could have a power whose operation/non-operation was itself a matter of chance, but

where the operation would lead to one of many component vectors being plotted upon its quality space (thereby utilising both senses above). A second complexity is whether or not it is correct to say that all probabilistic/indeterministic powers lack proximity conditions, which is a commitment that my reading of Mumford and Anjum's taxonomy of powers suggested (see §5.3). I can see the motivation for this idea, but our discussion of the fair probabilistic coin stands against it, since in this case we have disjunctive operations *qua* plotted component vectors but not disjunctive operations *qua* spontaneity of operation. In plain terms: once tossed the coin has to land a certain way but which way it does land is deemed to be a matter of weighted chance. But let us leave these loose ends behind and move on.

The argument of the next chapter requires a distinction between three types of powers. This simplified taxonomy replaces the one that I charted in this chapter for the purposes of the sequel. Firstly, let us call Mumford and Anjum's regular partnered powers 'single-operative powers'. These powers shall be taken to have conditional proximity conditions and fixed component vectors: so if these powers are proximate (i.e. stimulated), then it is necessary that they operate with a (fixed) single-headed component vector. (In other words, single-operative powers do not draw upon either of the two senses of disjunctive operation that I have outlined above.) Next, let us accept 'disjunction-operative' powers as a main type of probabilistic/indeterministic power. These are the powers that I have been working with in the main body of this chapter; we will take these powers to use the first sense of disjunction but not the second sense of disjunction, as outlined above. That is to say, disjunction-operative powers are partnered powers that have proximity conditions—so whether or not these powers operate is not itself a matter of weighted chance or complete randomness. But upon operating, we have our 'either F-side or G-side' notion. And thirdly, let us accept what I shall term 'spontaneous powers' as the other main representative of probabilistic/indeterministic powers. This species of power will draw upon the second but not the first sense of disjunctive operation. Hence, whether or not the power operates is a matter of chance/randomness; but given the operation of the power, we shall have a fixed single-headed component vector. These three types are summarised below. (We can note, of course, that we are now dispensing with Mumford and Anjum's double-headed component vectors.)

(i) Single-operative powers: these powers have (1.) a conditionality for their operation/non-operation and (2.) fixed component vectors.

(ii) Disjunction-operative powers: these powers have (1.) a conditionality for their operation/non-operation and (2.) a disjunction of alternative component vectors. They are 'partnered powers' in Mumford and Anjum's terminology.

(iii) Spontaneous powers: these powers have (1.) a non-conditionality for the operation/non-operation, i.e. they do not have proximity conditions in line with Mumford and Anjum's 'lonely powers'. But (2.) these powers have fixed component vectors.

I should again stress that this taxonomy is a simplification for the purposes of the next chapter. What we are doing here is separating out the two senses of disjunction that we have discussed, and making the simplification that they cannot cut across one another. With this in mind, the conclusion of the argument in the next chapter will be tacitly restricted to accommodate this simplification. That said, however, I shall note two points. First, this simplification does not significantly affect the overall thrust of the argument. And second, given that we are representing the 'main parties' as far as Mumford and Anjum's implicit distinctions go, I think that the conclusion of the next chapter could be applied to Mumford and Anjum's original taxonomy (or at least my reading of it) with a little extra investigation, if the reader so wishes.

6

Possible Prevention

6.1 Introduction

In this section of the thesis I want to develop a dilemma for Mumford and Anjum's dispositionalism that concerns determinism. I shall use it to support Barker's criticism that Mumford and Anjum's dispositionalism rules out determinism *a priori*. Let us recall that Mumford and Anjum's reply to Barker's criticism involved distinguishing two conceptions of determinism—a causal conception and a temporal conception. The causal conception was thought to lie behind Barker's criticism and also presuppose necessitarianism, whilst the temporal conception was thought to be orthogonal to the necessitarianism–dispositionalism issue. Mumford and Anjum also argued that the temporal conception was superior to the causal conception because the latter cannot handle uncaused events. To recapitulate, the temporal conception of determinism claims that if the world is deterministic, then the total state of the world at t^1 dictates a single possible total state of the world at t^2.

There is another side to this topic that concerns the connection between the modal premise of the antecedent strengthening argument and Mumford and Anjum's neutrality on the temporal conception of determinism. Let us recall that the modal premise of the antecedent strengthening argument states that it is always possible for a causal process to be subject to additive prevention. (We can also recall that additive prevention involves the addition of a countervailing power to a complex cause—the operation of which modifies the resultant vector in question to equilibrium.) In the present discussion I will try to show that Mumford and Anjum cannot have additive prevention if the temporal conception of determinism is true. Accordingly, the modal premise of the antecedent strengthening argument (implicitly) rules out the temporal conception of determinism *a priori*, which is in line with the general characteristic of Barker's criticism.

An overview of this argument will be useful. The first stage is to consider the different ways in which Mumford and Anjum's dispositionalism might reject the temporal conception of determinism *a posteriori*. I argue that the inclusion of either (i) indeterministic causation or (ii) probabilistic causation would be (independently) sufficient to rule out the temporal conception of determinism. Mumford and Anjum's position on this matter is that their dispositionalism could incorporate either (i) or (ii), but that this incorporation is not necessary for their antecedent strengthening argument: in this way Mumford and Anjum think that they are remaining neutral on the issue of determinism under the temporal conception. But on this point I think Mumford and Anjum are mistaken. If (i) and (ii) are rejected *a posteriori*, then Mumford and Anjum lose the truth of the modal premise of the antecedent strengthening argument and therefore lose the soundness of the antecedent strengthening argument. Accordingly, if the modal premise is to be true, then it must be the case that either (i) or (ii) are incorporated into their dispositionalism. But this is just to say that Mumford and Anjum's dispositionalism (implicitly) rules out the temporal conception of determinism *a priori*, since the temporal conception of determinism is false if either (i) or (ii) are accepted.

Why do Mumford and Anjum require either indeterministic or probabilistic causation for the modal premise of the antecedent strengthening argument? This is the second stage of my argument. Let us focus, for the sake of simplicity, upon probabilistic causation as oppose to indeterministic causation. (This does not affect the argument, since what is important is the disjunctive-operations that are shared by both indeterministic and probabilistic causation, not the distinction between complete randomness and weighted chance.) In short, the problem is as follows. The modal premise of the antecedent strengthening argument requires the possible addition of a countervailing power for all causal processes. This possibility will be a 'mere' possibility, i.e. a non-actual possibility. So the complex cause to which the countervailing power could have been added does not actually contain that countervailing power. But we should ask: where are the possible additive preventers for a given complex cause coming from? It is important to say at this point that Mumford and Anjum accept a version of dispositional actualism according to which 'natural' possibilities are grounded by actual powers. This raises the question of whether or not we can account for the possibility of the additive preventers on the basis of non-probabilistic powers. We cannot. The additive preventers will have to be either actual powers that could have been

operative upon the complex cause, or otherwise non-actual powers that could have been actual (via a manifestation *qua* change) and that, in addition, could have been operative upon the complex cause. Problematically, however, both of these options involve mere possibilities that demand the disjunctive-operations of probabilistic powers. This is because both options require the actual spatiotemporal arrangement of powers to have been different, which is a type of mere possibility that is uniquely secured by probabilistic powers. I conclude that Mumford and Anjum's modal premise requires either indeterministic or probabilistic causation if the possibility of additive preventers is to be 'natural' (i.e. if it is to be grounded by the powers of the actual world).

Let us consider uncaused events. Mumford and Anjum allow 'non-natural' possibilities, which are possibilities that are not grounded by powers—uncaused events fall into this category. Importantly, the *a posteriori* acceptance of uncaused events also constitutes a failure of the temporal conception of determinism. Taken together, these facts raise the question of whether or not the possible additive preventers could be non-natural (mere) possibilities in the form of uncaused events. In this third stage of the argument I argue as follows. Although this option would secure the truth of the modal premise, drawing upon uncaused events requires the rejection of the temporal conception of determinism, which is again to fall foul of Barker's criticism. Hence, if the modal premise is to be true, then the temporal conception of determinism cannot be true. In addition, at the end of this chapter I argue that there is a sense in which uncaused events are irrelevant to the necessitarianism–dispositionalism issue.

On this basis, I suggest the following dilemma for Mumford and Anjum's dispositionalism. (This is the third and final stage of the argument) The first horn is that Mumford and Anjum stick to their guns concerning their neutrality on the temporal conception of determinism. But this allows us to set up a version of the actual world where there is no indeterministic causation, probabilistic causation, or uncaused events (so as to give a temporally deterministic world). Crucially, however, the modal premise of the antecedent strengthening argument would be false in such a world, *pace* Mumford and Anjum's discussion. The second horn of the dilemma is that Mumford and Anjum explicitly accept a world that is not temporally deterministic. In doing so, they can safeguard the modal premise of the antecedent strengthening argument. But there is a high cost: their dispositionalism is not neutral on the issue of determinism. I think this is a major drawback for

their dispositionalism, since it is relatively uncontroversial that indeterministic and/or probabilistic causes fail to necessitate their effects; accordingly, there is no distinctive argument against necessity from antecedent strengthening if its modal premise already requires the rejection of necessitation. Again, uncaused events play a slightly different role in the dilemma to indeterministic/probabilistic powers, and I shall explain this difference at the appropriate time. As a last point, I have decided to exclude spontaneous powers from the majority of this discussion so as to simplify the issues; but these entities will be re-introduced at the end, and their role in the dilemma will be explained.

6.2 Stage one: how the world might be temporally indeterministic

Let us begin the first stage of the argument. I shall assume in this part of my discussion that Mumford and Anjum could accept or reject the following theses *a posteriori*: (i) indeterministic causation, (ii) probabilistic causation, and (iii) uncaused events. By this I mean to say that their dispositionalism is neutral on these theses, such that, from their perspective, it would be a matter of science as oppose to metaphysics whether or not, for example, there is any indeterministic causation in the world. What I want to establish at this point is the way in which (i)–(iii) connect to the temporal conception of determinism. We can recall that Mumford and Anjum have responded to Barker's criticism by arguing that it presupposes the causal conception of determinism, which is a 'disguised' version of necessitarianism. Or so they claim. But it is important to consider how Mumford and Anjum can make sense of the causal neutrality of the temporal conception of determinism. How exactly is this temporal conception working? A *prima facie* concern is that the term 'dictates' has been chosen as a causally neutral alternative for 'causes' or 'necessitates'. We need to investigate, therefore, the sense in which Mumford and Anjum think that their dispositionalism could be true whilst the world is either dictating or not dictating its future states.

Mumford and Anjum's (2011, pp.75–6) discussion of the temporal conception of determinism suggests that they take the acceptance of (i)–(iii) to be (independently) sufficient for its falsity. Hence, if indeterministic causation is the case, then the world is not temporally deterministic, and so on for the other two theses. Consider in the first place that immediately after discussing the

temporal conception of determinism, Mumford and Anjum explain that it is consistent with their dispositionalism that two tokens of the same type of power would produce "identical manifestations" if placed in identical types of context (2011, p.76). The converse is also accepted for the case of indeterministic causation: it is possible for two tokens of the same type of (indeterministic) power to be in identical context-types yet manifest in different ways. Given that probabilistic causation is thought to be a sub-type of indeterministic causation, this discussion suggests that both indeterministic and probabilistic causation would constitute a failure of the temporal conception of determinism. Let us bring together indeterministic and probabilistic causation under the term 'non-deterministic causation'. The idea, so construed, would be that the *a posteriori* acceptance of non-deterministic causation in the world is sufficient for the total state of the world at t^1 to fail to dictate a single possible state of the world at t^2. Consider in the second place that Mumford and Anjum have rejected the causal conception of determinism on the grounds that it cannot handle uncaused events. Indeed, this shortcoming is used in support of the temporal conception of determinism (Mumford and Anjum 2011, p.75). So it looks as though the *a posteriori* acceptance of uncaused events would also be sufficient for the falsity of the temporal conception of determinism. If there are uncaused events, then the total state of the world at t^1 cannot dictate a single possible total state of the world at t^2. This is because, we might suppose, any number of uncaused events can enter into the total state of the world at t^2 quite independently of the total state at t^1. A complication at this point, which arises because Mumford and Anjum have not explained what 'dictates' means, is that we might say that the state at t^1 can dictate uncaused events at t^2, such that fixing the former state fixes the latter state regardless of whether or not there are uncaused events: on this view the t^1 state can dictate what caused and uncaused events there will be at the t^2 state. That said, I think that Mumford and Anjum's discussion of uncaused events with regard to the causal conception of determinism suggests that they take these types of events to constitute a failure of determinism. The point, therefore, is that the causal conception cannot say that the world is non-deterministic if there are uncaused events, whereas the temporal conception can, which is to its merit. Taken together, then, the *a posteriori* acceptance of (i)–(iii) is (independently) sufficient for the falsity of the temporal conception of determinism. Just to note a final issue: when we are saying that the temporal conception can be false in the present context, we are not denying that this approach to determinism is false; the idea, rather, is that the temporal

conception is the 'right way' to think about determinism, but that the world does not satisfy the requirement: *viz*. it is temporally indeterministic.

Before we consider the second stage of the argument it is useful to question how (i)–(iii) can be rejected *a posteriori* without accepting necessitarianism. For the necessitarian will propose that, in particular, the rejection of non-deterministic causation is sufficient to establish the thesis that causes necessitate their effects. Why? For this reason: if we have operative powers that can only give a single component vector, i.e. if we have powers that do not have disjunctive-operations, then it seems that fixing the cause fixes the effect. Mumford and Anjum's response to this line of thought, of course, is that their dispositionalism is trading upon the antecedent strengthening argument, which does not require non-deterministic causation but rather the modal premise that 'things could have been otherwise'. (In general, this is why Mumford and Anjum think they can remain neutral on the question of determinism under the temporal conception.) But there is a question here. How can the world dictate its future states if it does not necessitate them? This question has arisen because Mumford and Anjum reject necessitation in nature but think that they can have a temporally deterministic world, i.e. a world where future states are dictated. How then is the dictation of the world's events different to their necessitation? Mumford and Anjum's reply to this question is to suggest that there can be non-causal forms of necessitation.

> The core idea in determinism is the fixity of the future by the past. This can be expressed in a number of ways, none of which involves the claim that causes necessitate their effects. There may be some necessitation involved, but causation does not have to be its *modus operandi* (Mumford and Anjum 2011, p.75: original italics).

> Dispositionality is thus never a source of the necessity of something in the world, even if it exists alongside it. In the deterministic case, for instance, where it is necessary that *Fa*, that is not because there was a disposition towards it. What delivers the necessity is that, somehow, everything got fixed. This will include the fixedness of all the background conditions—including which dispositions do, and which do not, act to produce the necessitated outcome—but it was not those powers that necessitated the outcome (Mumford and Anjum 2011, pp.178–9).

I think that this style of response is dangerous for two reasons. A first point, which is minor, is that Mumford and Anjum have not explained what this non-causal source of necessitation could be. Accordingly, it is not clear whether or not Mumford and Anjum have established that their dispositionalism is compatible with alternative forms of necessitation, e.g. the 'dictation' of the temporal conception of determinism, since we do not have a clear picture of the latter. A second point that I take to be more serious is as follows. If we consider the second citation above, we can see that Mumford and Anjum are allowing that the proximity of powers can be necessitated in a non-causal sense. (We can recall that operative powers are partnered powers that are proximate, i.e. suitably related.) The problem here is that Mumford and Anjum's vector model of causation should be providing the metaphysical explanation for why objects and properties are spatially arranged as they are—at least where uncaused events are removed from the picture. Consider again this citation.

> Events will be produced by powers at work: at least the events that are caused will be (whether some events are uncaused, we leave open). Events will be the changes produced when powers exercise themselves. And some of these changes will then push other powers together. The exercising of one power may put sugar into tea, for instance. When suitable partnered powers are pushed together, they will in turn manifest themselves. And so it goes on (Mumford and Anjum 2011, pp.2–3).

This citation suggests that the vector model of causation can provide a metaphysical explanation of the spatiotemporal pattern of events. Consider the world at a time. There will be a number of objects bearing powers that stand in certain spatial relations (given Mumford and Anjum's pandispositionalism, these spatial relations will be further powers). This arrangement, taken as a whole, will fix the powers that are actually operative for the various subjects of change, since a power is operative just in case it is suitably related to its reciprocal partners. In turn, the operation of these powers will result—via Mumford and Anjum's *sui generis* dispositional modality—in a new spatial arrangement of objects bearing powers at the next time. In this way, we can see that Mumford and Anjum's vector model of causation and its apparatus of manifestations *qua* changes encompasses a putative metaphysical explanation for the spatiotemporal patterns of events. This is

as it should be, since Mumford and Anjum are setting out a model of causation that is purported to provide a metaphysical explanation of various causal aspects of the world. And the distribution of objects and powers across space and time is a clear *explanandum* for any such theory. In order to remain neutral on the issue of determinism, however, Mumford and Anjum are now claiming that 'background conditions' can be necessitated by a non-causal source. But the background conditions of one causal process are the effects of other causal processes (notably temporally prior causal processes). This admission is rather grave, therefore, since it suggests that the complete spatiotemporal pattern of events in the world is (or at least could be) the outcome of the non-causal source of necessitation. If so, then what explanatory role can the vector model of causation play in a temporally deterministic world? Mumford and Anjum cannot say, as they should be able to, that the background condition of a causal process is itself subject to metaphysical explanation insofar as it is produced by a set of temporally prior causal processes, since they have just admitted that such background conditions can be necessitated by a non-causal source. And it looks obscure to say that a state of affairs could be subject to a causal explanation that uses a *sui generis* dispositional modality whilst it is also subject to a non-causal explanation that uses strict necessitation.

That said, I shall leave open whether or not this is a substantive problem for Mumford and Anjum. I suspect they would repeat their thesis that a dispositional type of modality can co-exist with the necessitation of a deterministic world. Given that we do not know what this foreign necessitation is, it is not clear to me that the problem can be taken any further. But our discussion so far has opened up a line of argument that can have more definite results. We shall now move on to the second stage of my discussion, which aims to show that the modal premise of the antecedent strengthening argument requires a world that is not temporally deterministic.

6.3 Stage two: the modal premise cannot be true in a temporally deterministic world

Let me begin this stage of the argument by outlining Mumford and Anjum's position on the connection between dispositionality and possibility. We have already noted that Mumford and Anjum take their dispositional modality to be *sui generis*, such that it cannot be analysed in terms of necessity or possibility; nevertheless, they do think that there is a connection between powers

and possibility that is relevant to our current discussion. Mumford and Anjum accept a version of actualism according to which 'natural' possibilities are to be grounded by actual powers. More precisely, all natural possibilities are the manifestations of powers, whether or not these manifestations are actually manifested.

> In the sense of natural possibility, therefore, it would actually be the case that if *F* is possible then there is a disposition towards *F*. No contrast is being offered, therefore, between dispositionality and possibility. On the contrary, the former may ground entirely what the latter consists in. What better candidate could there be for supplying the world with natural possibility than the dispositions that particular things have? (Mumford and Anjum 2011, p.182)

Mumford and Anjum accept a sufficiency claim for (mere) natural possibilities that is shared by a number of philosophers in the dispositional actualist literature (e.g. Williams and Borghini 2008; Vetter 2010; Jacobs 2010; Pruss 2011). It states that "if something is disposed to be *F*, then it is possible that it be *F* (and that it not be *F*)" (Mumford and Anjum 2011, p.179). In this manner, for example, Williams and Borghini (2008, p.26) claim that "State of affairs S is possible iff there is some actual disposition d, the manifestation of which is (or includes) S". These sufficiency claims for possibility are comparable, although we can note that Mumford and Anjum's version is more restrictive in the sense that the possibility involves the same object that bears the power coming to have the manifestation of that power. (In the case of Williams and Borghini, the possible state of affairs S does not have to include the object that bears the disposition of which it is the manifestation.) Mumford and Anjum's other central principle on possibility is that "it is not the case that if it is possible that something is *F*, then it is disposed towards *F*" (2011, p.179). In this manner, Mumford and Anjum allow that there are possibilities that are not grounded by powers as their manifestations. These are Mumford and Anjum's 'non-natural' possibilities, which include uncaused events as well as logical possibilities, such as the existence of unicorns.

With this in mind we can set out a problem for Mumford and Anjum. (This will be working towards the first horn of my envisaged dilemma.) We can develop this problem on the basis of two observations. Firstly, we can recall that the *a posteriori* rejection of either indeterministic or

probabilistic causation (together termed non-deterministic causation), is sufficient for the falsity of the temporal conception of determinism. Accordingly, we can expect Mumford and Anjum's dispositionalism to hold water if the actual world does not contain any non-deterministic causation, since they wish to remain neutral on the issue of determinism under their temporal conception. The second observation is that Mumford and Anjum have made a distinction between natural and non-natural possibility in the context of their actualist metaphysics. But the modal premise of the antecedent strengthening argument does not make use of either natural or non-natural possibility: it is not explicit about this matter either way. So in what sense—natural or non-natural—is it possible for all causal processes to be subject to additive prevention? Mumford and Anjum admit that it should be at least metaphysically possible (although perhaps not physically possible) for countervailing powers to be added to complex causes (2011, p.63). Mumford and Anjum's distinction between natural and non-natural possibility roughly maps onto the distinction between physical and metaphysical possibility, respectively. As we shall see below, however, this admission is to ignore Barker's line of criticism, where it is suggested that Mumford and Anjum's dispositionalism is in tension with the acceptance of determinism. In a nutshell, we shall see that Mumford and Anjum cannot say that it is naturally possible (i.e. physically possible) for complex causes to be subject to additive prevention whilst rejecting non-deterministic causation.

The antecedent strengthening argument is trading upon the premise that we can always strengthen a complex cause with a countervailing power, such that the operation of this additive preventer will modify the resultant vector of the complex cause to equilibrium. The additive preventer in question is therefore a merely possible operative power. But we are currently concerned as to where these operative powers are coming from. Let us begin, therefore, by assuming that the additive preventers are actual powers. These actual powers will not be actually operative, but it should be possible that they be operative (so as to play the roles of countervailing powers for a given complex cause).

Putting aside spontaneous powers for the time being, we can see that actual powers that are not actually operative could only have been operative if they could have been in a different spatial relation to their reciprocal partners. We can see this because Mumford and Anjum have understood operative powers as powers that are suitably related to their reciprocal partners, with the further

suggestion that this 'suitable relation' is to be understood in terms of spatial proximity. Let us consider a token complex cause, which is a collection of operative powers. Supposing that its additive preventer is some actual power, we should be able to say that at least one actual power in the world that is not operative for this complex cause could have been. In fact, we require that at least one non-operative power in the actual world that would modify the resultant vector to equilibrium could have been operative. Unfortunately, there is a simple argument to show that this requirement cannot be met without non-deterministic causation, so long as we are interested in Mumford and Anjum's natural conception of possibility, which is closely connected to physical possibility. Let us term the set of candidate actual powers for additive prevention, as canvassed above, 'P'. (To reiterate, the members of P are actual powers that are not operative upon the complex cause, but which, we are supposing, could have been.) For the reason that we are currently interested in natural possibility, we will need to get at least one of the members of P into spatial proximity with a reciprocal partner for the complex cause solely on the basis of the manifestations of powers. This latter requirement is arising, of course, because Mumford and Anjum's natural possibilities are all and only those possibilities that can be manifested by powers. (Hence, if we consider a firework that has not exploded, then it would be a (mere) natural possibility that it could explode, since this manifestation *qua* change is the manifestation-type of the power 'being a firework'.) As we noted in the previous chapter, however, it is distinctive of non-deterministic powers (i.e. single-operative powers) that a single circumstance can only give rise to a single possible 'push' or component vector. This problematises the idea that a member of P could have been a countervailing power for our complex cause. If we consider the history of a given member of P leading up to the time of the complex cause, then what we require is a causal process whereby this member could have travelled into spatial proximity with the reciprocal partners of the complex cause. But if all powers are single-operative, then no such opportunity will present itself, since all of the causal processes that this putative preventer is actually involved in will only have allowed one possible effect, be this a manifestation *qua* change or Mumford and Anjum's operative notion of effect (where no change occurs). I was motivating this idea in the previous chapter, when I discussed the 'calculation procedure' for Mumford and Anjum's theory. In short, if powers can only give one 'push' in a given circumstance, as is the case for single-operative powers, then there will be no degrees of freedom, so to speak, for merely possible spatial positions of powers. We can

conclude that Mumford and Anjum cannot get naturally possible prevention from actual powers whilst they are rejecting non-deterministic causation.

This line of thought also applies to the view that the additive preventers of a complex cause could be non-actual powers (though we are still sidestepping uncaused events). The reasoning is again simple. If all powers are single-operative, then there will be no opportunity for non-actual powers to arise: it follows *a fortiori* that these impossible powers cannot prevent. Considering any circumstance (i.e. spatial arrangement of powers), there will be a single possible resultant vector and therefore a single possible type of effect. We can therefore say that if a power is non-actual, then it could not have been actual.

These considerations are in line with the common idea that if the laws of nature are physically necessary, then there is a single physically possible temporal evolution of the world, relative to some background condition or initial state. But the context is different: we are currently working with Mumford and Anjum's actualist metaphysics and their vector model of causation. The key point at the moment, I think, is that we have a principled reason to think that the rejection of non-deterministic causation will bring trouble for Mumford and Anjum's claim that it is naturally possible for all causal processes to be subject to additive prevention. When we unpack this claim we see that it collapses into the idea that non-actual spatial arrangements of powers are possible via the manifestations of the powers of the actual world. But it is unclear how these non-actual spatial arrangements could arise from causal processes that feature functional relations from actual spatial arrangements of powers to their effects (as is the case with causal processes that exclusively utilise single-operative powers.) Throughout the above discussion we should remember that Mumford and Anjum cannot say that the initial conditions as a whole could have been different. And this is because we are currently focusing upon their notion of natural possibility. So the only 'moves' that Mumford and Anjum have open to them, so to speak, are those that 'flow' from what powers can do. This is a severe restraint for single-operative powers.

6.4 Supplement for stage two of the argument: dispositional actualism

I think it will be useful to discuss a shortcoming of Mumford and Anjum's sufficiency claim for possibility that is arguably responsible for our present difficulty. The aspect of the claim that we are currently interested in concerns the idea that the instantiation of a power is sufficient for the possibility of the instantiating-object to have the manifestation of that power. In other words, if it is the case that object *x* has power P, where the manifestation of P is M, then *x*'s having P is sufficient for the natural possibility of *x*'s having M. I think it is important that Mumford and Anjum's (2011, pp.179–83) discussion of modality does not involve their distinction between operations and manifestations *qua* changes. This raises the question of whether the term 'manifestation' in the sufficiency claim is restricted to manifestations *qua* changes. I assume that it is. But to see why this is of interest, let us adapt the sufficiency claim for operations in the following way: if *x* has P then it is possible that *x* is operative *qua* component vector C, where C is a specific component vector.

In this adaptation I have left open what type of possibility we are dealing with. The reason for this is that the adapted claim is false under some understandings of possibility and true under others. Consider first McCall's (1969, p.427) notion of 'physical' modality, which is better introduced as a type of temporally-indexed modality. When we are thinking of possibility in this manner, we are considering what is possible at a certain time, such that we hold as fixed everything at that time. For example, we might say that it is temporally impossible for even a skilled builder to build at a certain time if she is not presently equipped with her tools and building materials. In terms of Mumford and Anjum's operations, we should also say that it temporally impossible for P to operate with C if *x*'s being P is not suitably related to P's reciprocal partners. What is common to these two cases is that both the skilled builder and the power P have requirements that are unfulfilled at the time in question: the former requires tools and building materials that she does not have, whilst the latter requires (to simplify) a certain spatial relation to another power that does not obtain. That said, the two cases differ in that the skilled builder can choose whether or not to build when her requirements are met, whereas the conditionality of Mumford and Anjum's operations requires that a power must operate when it is proximate to its reciprocal partners. In the case of temporal possibility, then, the adapted sufficiency claim is false. This is because it does not mention whether

or not P is proximate: in terms of single-operative powers, where P is proximate it will be temporally necessary that it operates with C—*ipso facto* it will be temporally possible that it operate with C. In contrast, where P is not proximate, we should say that it is temporally impossible for P to operate with C. (We can recall that my adaptation of Mumford and Anjum's model of probability was to say that probabilistic powers can operate disjunctively in a single circumstance. With this in mind the case of a skilled builder whose requirements are met and the probabilistic power that is in proximity are comparable: my modification allows that probabilistic powers can choose what to do, as it were. We will return to this issue in a moment *re* spontaneous powers.)

Let us stay with the adapted sufficiency claim for a moment. There are two alternative readings of the term 'possible' in which it is true. Firstly, we might have a metaphysical notion of possibility that seeks to understand what is possible for a certain entity insofar as it is a member of a certain ontological category. (In this connection, I discuss Lowe's (2006) form–content distinction in Chapter 10.) For example, we might say that it is possible for objects to instantiate properties, since this is how the ontological category of objects stands to that of properties. But it would be incorrect, we can suppose, to say that it is possible for properties to instantiate objects: that would be a 'category mistake' with regard to the essences of objects and properties. Accordingly, we might construe the adapted sufficiency claim as saying that powers are the kinds of beings that can operate with component vectors, which is something that Mumford and Anjum do in fact say. Nevertheless, we can note that this metaphysical reading of the term 'possibility' matches poorly with C being a specific component vector, i.e. with C being a component vector with a specific direction (for a manifestation-type) and a specific magnitude. This is because, so we are assuming, there is a respectable understanding of the sufficiency claim that is poised at the level of ontological categories. But if we are thinking about possibility at this very broad level, then it would be less of a mismatch to say (more simply) that powers can operate with component vectors. Secondly, then, we might 'zoom in' from ontological categories to types of powers. So construed, the adapted sufficiency claim would link up a specific type of power with a specific type of component vector: if *x* has P then *x* can operate with C. Again, this is something that Mumford and Anjum require for their theory. We can note that it is a non-trivial claim: *x*'s having P will not be sufficient for *x*'s operating with C', where C' is non-identical to C.

So far we have separated out three readings of the term 'possibility' that can plausibly be used for the adapted sufficiency claim. The same distinctions also hold, I believe, for Mumford and Anjum's regular sufficiency claim (for manifestations *qua* changes). In particular, there is a problem in saying that *x*'s having P is sufficient for the temporal possibility of *x*'s being M. With a temporal modal claim, we are thinking about what it necessary and/or possible at a specific time. For the reason that Mumford and Anjum's powers require proximity if they are to manifest *qua* change, the sufficiency claim incorrectly predicts that the mere instantiation of a power is sufficient for its manifestation *qua* change being possible; but what we also require is that the circumstances are suitable for a manifestation *qua* change to take place at the time in question. And this, of course, is a contingent matter. (I should note to the reader that we are again ignoring spontaneous powers for the present moment.)

What is the moral of this discussion? It is problematic that Mumford and Anjum's regular sufficiency claim is false under the temporal reading of possibility. This is because there should be a close connection between dispositional actualism and the temporal understanding of modality. We can see this close connection by asking how a power could serve as the ground of a mere possibility. Why should a power be able 'support' a non-actual entity nevertheless being possible? Why, for example, should objects (as oppose to properties) not be able to ground mere possibilities in a powers ontology? Presumably the idea is that powers are the kinds of beings that have manifestations, such that even if a power does not manifest its manifestation it could have done so. This is a standard idea about powers. But if powers can have merely possible manifestations, then we can move, it seems, from the idea that (i) a power does not need to manifest its manifestation in order for this power to have a (possible) manifestation, to (ii) in those cases where powers have unmanifested manifestations, these unmanifested manifestations are mere possibilities. I suggest that this is the basic line of thought in attempting to ground mere possibility in actual powers. But we can notice something important. Where a power does manifest its manifestation, we have the idea that one entity in the actual world—the token power F—is responsible for another entity also being in the actual world—its token manifestation G. This is another platitude about powers that concerns metaphysical explanation: powers provide metaphysical explanations as to why certain patterns of events hold across space and time. What is significant about this metaphysical explanation is that it is taking place within the actual world. That is to say, both the *explanans* and

the *explanandum*, to use these terms, are actual entities. We might also talk of the ground and the grounded. On this basis, it is attractive to say that a power can only serve as the ground of a mere possibility insofar as the unmanifested manifestation of this power could have been a member of actual world. So construed, the dispositional actualist grounding of mere possibility is concerned with 'how things could have been otherwise' *qua* how the actual world itself could have been. I think this notion of the actual world developing in non-actual ways should capture the dispositional actualist conception of possibility. The contrast position would involve a power being sufficient for a mere possibility *qua* member of a different world. (I think this is how a powers theorist might read Armstrong's (1997) combinatorial model, where the constituents of states of affairs can be recombined into different maximal configurations of states of affairs. Each of these maximal configurations is a different possible world—a *bona fide* alternative to the actual world.)

We can now see the close connection between dispositional actualism and the temporal understanding of modality. If we consider the world at a time, then the temporal possibilities will be those entities that could be the case relative to how things are at that time. (The non-mere possibilities will be those entities that could be the case and are the case; the mere possibilities will be those entities that could be the case and are not the case) In terms of powers, this temporal understanding of temporal possibility is isolating the manifestation-operation of powers. Crucially, the dispositional actualist view is that powers can be used as the grounds of mere possibility. If we are to say this, then we should be able to say that the mere possibilities in question could have been actual solely on the basis of what powers are able to do, i.e. solely on the basis of their manifestation-operation. The connection between this idea and McCall's temporal understanding of possibility is that when we are considering what is possible at a time, we are restricting the possibilities to both (i) what objects are able to do in virtue of their intrinsic natures, as well as (ii) what objects are able to do insofar as the requirements of these intrinsic natures are either satisfied or unsatisfied. (This distinction is made by Makin (2006) and Beere (2009) in their discussion of Aristotle's Metaphysics *Θ*.) This is the point of the skilled builder example. The skilled builder is such that she can intrinsically build houses—she has the required knowledge. But she he is not a magician—she requires her tools and materials if she is to build a house. Hence, if we keep as fixed that these external requirements are not met, then, relative to this absence, it is impossible for the skilled builder to exercise her skill. And this is what is happening with Mumford and

Anjum's theory, I think. Spontaneous powers aside, the powers in Mumford and Anjum's theory use proximity requirements. Hence, if these requirements are not met, then there is a serious sense in which the operation of these powers and so their manifestations *qua* change are not possible. But if we now consider that the only way to get these powers into their proximity requirements is to modify their spatial arrangement, then the same problem arises. For the only way to modify this spatial arrangement of powers is to get some other powers to have acted differently (despite their given spatial arrangement). And so on. So the fixity of present states of affairs in the temporal manner of thinking about possibility invites us to think about what it possible purely on the basis of powers. In light of these considerations, I think that Mumford and Anjum's sufficiency claim for possibility is uncritical. In particular, it is fails to engage with the conditional aspect of powers.

6.5 Additional supplement for stage two of the argument: spontaneous powers and uncaused events

Let us now turn our attention to spontaneous powers and uncaused events. How do these types of entities affect our present discussion? Well, the *a posteriori* acceptance of either spontaneous powers or uncaused events is (individually) sufficient for the failure of temporal determinism. (I should note that we have already discussed uncaused events and their connection to temporal determinism above, but let us reconsider the issue briefly.) The main consideration is simply that both spontaneous powers and uncaused events replace the conditionality aspect of Mumford and Anjum's single-operative and disjunction-operative powers with a spontaneous aspect. In particular, spontaneous powers can spontaneously operate with a component vector and uncaused events can spontaneously enter spacetime. As such, it would be most obscure to say that the relevant changes (e.g. the manifestation *qua* change that arises via a spontaneous power, or the insertion into spacetime of an uncaused event) could be 'dictated' by the state of the world at a given time. Indeed, as I mentioned earlier, Mumford and Anjum appear to hold their temporal conception of determinism precisely because (*pace* the causal conception) it can register the activity of uncaused events as sufficient grounds for non-determinism.

At this point, however, we can see that Mumford and Anjum are in fact required to take either spontaneous powers or uncaused events to uphold the premise that it is always possible for there

to be additive prevention. Well, more carefully, they are required to take one of these two types of entity if they are already rejecting non-deterministic causation (as we understood this term in the above discussion). For there are no other sources for the merely possible preventers. To this end, it is useful to see how spontaneous powers and uncaused events could provide the merely possible preventers. In the case of spontaneous powers, we have the idea that whilst a token spontaneous power did not manifest at a given time in the actual world, it could have done, such that there could have been (via its manifestation *qua* operation) a different arrangement of component vectors. The case for the uncaused events is basically the same; the only difference between the two cases is that we are not thinking of uncased events as being the manifestations of actual powers. So we can just take a state of affairs, *a*'s being F, to enter into the world without being the result of any manifestation, generally construed. It is clear to see that such changes to the world's content could given different operative powers and therefore additive prevention as Mumford and Anjum require. But the same strategy can be run as before. If Mumford and Anjum are to remain neutral on the issue of determinism, then I am permitted to require their modal premise to be true even in the context of a temporally deterministic world. So we can again require that the world does not in fact contain any spontaneous powers or uncaused events. If this is the case, however, then in light of Mumford and Anjum's (hypothesised) rejection of non-deterministic causation, we can see that they will not have any merely possible additive preventers. And so their argument against causal necessitation will be unsound, since the modal premise will be false. As far as I can see, then, if Mumford and Anjum are to avoid this problem they must be tacitly assuming that there are either spontaneous powers or uncaused events (relative to the above hypothesised rejection of non-deterministic causation). But this means that they are tacitly assuming that temporal determinism is false, i.e. that the world is temporally indeterministic, which is out of phase with their supposed neutrality on this issue.

6.6 Stage three: dilemma for possible prevention

We can now pose our dilemma for Mumford and Anjum. The first horn of the dilemma is that Mumford and Anjum stick to their guns concerning determinism. As we have now seen, this lets us insist that Mumford and Anjum's modal premise should hold true even in a world where there is no breach of their temporal determinism (which might be this world, doxastically speaking). In

general, however, it is not true that it is always possible for there to be additive prevention if there is no (i) non-deterministic causation, nor (ii) either spontaneous powers or uncaused events. The second horn of the dilemma is that if Mumford and Anjum explicitly build temporal indeterminism into their theory, then they forfeit the non-triviality of the antecedent strengthening argument. To see how this aspect of the dilemma works, however, we need to consider a final issue.

In our discussion above, I presented the following as routes through which the world could be temporally indeterministic: (i) indeterministic causation, (ii) probabilistic causation, (iii) spontaneous powers, and (iv) uncaused events. I grouped (i) and (ii) together as 'non-deterministic causation' and argued in the last chapter that Mumford and Anjum need to approach these types of causal processes as involving disjunction-operative powers. At this stage we can note that (i), (ii), and (iii) are sources of physical or 'natural' modality under Mumford and Anjum's discussion. In particular, given Mumford and Anjum's dispositional actualism, they will suggest that these three types of powers are the ontological grounds of mere possibilities (along with regular single-operative powers). We can recall that the basic scheme in question is that the instantiation of a power P is sufficient for the mere possibility of its manifestation M. (As we noted, however, there is some uncertainty over whether the possible manifestation is the component vector, or the manifestation *qua* change, or both.) It may also be useful to note that (iii) (i.e. spontaneous powers) are giving physical modality as oppose to Mumford and Anjum's metaphysical (or 'non-natural') modality. Why is this? Well, despite lonely powers not drawing upon a conditionality aspect (and this distinguishes them from single-operative powers and non-deterministic powers) they are still powers 'in the world' and so satisfy the restraints of dispositional actualism. Interestingly, we can say that spontaneous powers, which are able to spontaneously manifest, are the only types of powers that really satisfy the dispositional actualist sufficiency claim. And this is because the conditionality requirement, which is not respected by the sufficiency claim, is not applicable to spontaneous powers. Lastly, we have Mumford and Anjum's metaphysical possibilities, which are here represented by uncaused events.

With this in mind we can notice the following. If Mumford and Anjum explicitly accept either (i) indeterministic powers, (ii) probabilistic powers, or (iii) spontaneous powers, in any combination, then they will have their notion of merely possible preventers. The problem here, however, is that

we now have a more direct argument for the conclusion that causes do not necessitate their effects. With regard to (i) and (ii), the argument will be that these types of powers can operate disjunctively, such that, in one and the same circumstance, i.e. spatiotemporal arrangement of powers, we can get different sets of component vectors and therefore different possibilities for manifestations *qua* change. And so, in general, it will be false that a specific arrangement of powers necessitates some effect, since the effect that is produced (if indeed one is produced) will depend upon how the non-deterministic powers 'fire' their component vectors. With regard to (iii), the spontaneous powers, we have the same general line of thought. But here the point is that if a spontaneous power is a part of a complex cause, then it might fire its component vector or it might not; and this is also a feature of the world that will undercut the thesis that complex causes necessitate their effects. Taken together, then, Mumford and Anjum's explicit acceptance of (i), (ii), or (iii), whereby any combination of these types of powers are built into their theory, will result in the antecedent strengthening argument being superfluous, since we have a more basic reason as to why causes do not necessitate their effects: *viz*. there are types of powers in the world whose 'basic actions' are either probabilistic, indeterministic, or spontaneous.

The case of uncaused events is a little more problematic. Let us firstly restrict the dilemma to uncaused events, thereby putting aside (i)–(iii) above. The first horn of the dilemma would be that Mumford and Anjum keep their view that the antecedent strengthening argument is neutral on the topic of determinism. Our arguments in this chapter have suggested, however, that the modal premise of the antecedent strengthening argument would be false if there were no uncaused events in the world. And so the world must be temporally indeterministic. I suggest, therefore, that Mumford and Anjum would be faced with the second horn of the dilemma, which is that their strategy against necessitation presupposes that necessitation is false via some more basic reason (such as the acceptance of disjunction-operative powers, as above). But in the case of uncaused events, I think Mumford and Anjum might say that whilst the acceptance of uncaused events does entail that the world is temporally indeterministic, *pace* their original discussion, we can at least avoid the issue that causation is 'already' anti-necessitarian, as is the case with (i)–(iii) above. In other words, because uncaused events are not caused events, their merely possible insertion into spacetime so as to act as merely possible preventers does not involve agreeing in the first place that causation is 'intrinsically' anti-necessitarian. We can recall that this was the issue with

Mumford and Anjum's treatment of probabilistic powers: I suggested that there should be something intrinsically anti-necessitarian about the way that such powers behave (that goes beyond the argument from antecedent strengthening).

6.7 Uncaused events

I think that this is a difficult problem, but my inclination is to handle it in the following way. We might propose that Mumford and Anjum's distinction between causal and temporal determinism can also be used by the necessitarian. More specifically, I suggest that complex causes can necessitate their effects such that the world is causally deterministic. Alongside this, however, the world can be temporally indeterministic via uncaused events. I shall explain how I think these conceptions cooperate for the necessitarian before saying why this is of relevance for Mumford and Anjum. In the previous chapter we discussed a 'calculation procedure' for Mumford and Anjum's theory. The basic idea, to recapitulate, was that we firstly fix upon the causal circumstance, i.e. the arrangement of powers, before moving on to plot the component vectors. Afterwards, we decide upon the resultant vector and check to see if the threshold line for a manifestation *qua* change is met. This is to put the matter in practical terms, but the metaphysical point was that the different components of Mumford and Anjum's theory are not especially anti-necessitarian. (Rather, this feature is provided by the antecedent strengthening argument.) Well, with this in mind, I think the necessitarian should say that if there is any combination of (i) probabilistic powers, (ii) indeterministic powers, or (iii) spontaneous powers, then causes do not necessitate their effects. And this, of course, is because there is something intrinsically anti-necessitarian about these kinds of powers. So (i)–(iii) above constitute a failure of causal determinism. I also think that they constitute a failure of temporal determinism. But uncaused events, (iv), constitute a failure of temporal determinism only: they are non-applicable to the issue of causal determinism. Mumford and Anjum agree with this last point at least. After all, as we have noted, one of their reasons for preferring the temporal conception of determinism over its causal correlate is that only the former can correctly deem a world with uncaused events to be indeterministic. But this raises a question. If uncaused events are orthogonal to the question of causal determinism, then how can they be relevant to the question of causal necessitation? In the end, I do not think that uncaused events are relevant. Recalling Mumford and Anjum's calculation procedure, we can see that we require first

and foremost a determinate (i.e. non-vague) arrangement of powers. I say this because the composition principle is set up to give a resultant vector. Accordingly, there can be no vagueness in the spatiotemporal arrangement of powers, since, if there were, then there would be a vagueness in the component vectors that are to be summed. As we might put this thought, if the complex cause were vague, then there would be a 'flickering' between different resultant vectors. It might be objected at this point that this is effectively what Mumford and Anjum are saying, since they have suggested, in a way, that complex causes are always 'revisable'. But we can bypass this point by simply saying that there should at least not be any flickering (or vagueness) as we keep within one complex cause in the actual world (we are thereby ignoring the addition of merely possible preventers at the moment). The relevance of this for uncaused events, I suggest, is that we should be agreeing upon what events are relevant to a given causal situation before we start the calculation procedure, whether or not these events are caused. In other words, if uncaused events want to be involved in the calculation procedure, then they have to be 'entered' in the beginning, when we specify what the causal situation is, i.e. when we specify those powers that are proximate for a given subject of change.

Let us now consider Mumford and Anjum's model of temporal determinism with the assumption that (i)–(iii) above are not the case. Two options are before us. First, there are no uncaused events. In this case we would have the following set up. Taking into account the total arrangement of powers of the world at a given time, we would be led to a large set of manifestations *qua* change via the calculation procedure. (I should stress that the 'calculation procedure' is really just a way of understanding how the apparatus of Mumford and Anjum's theory is working; or rather, it is a way of understanding how I think it is working.) Let us call set of manifestations *qua* change C*. And let us call the state of the world before these changes S^1 and the state of the world after these changes, at the next time, S^2. I propose that if there are no uncaused events, then the difference between S^1 and S^2 is given by C*. In other words, C*, the set of all of the manifestations *qua* change, is what is required to move the world from S^1 to S^2. What this means, of course, is that if there are no uncaused events, then there is both a function from each complex cause to its effect and a function (though a demanding one) from the world at the prior time to the world at the latter time. And in this case we have both of our conceptions of determinism. Firstly, causes are necessitating their effects, since fixing the causal factors for a subject of change is sufficient to fix

a manifestation *qua* change (or not as the case may be); secondly, the state of the world at a time 'dictates' the state of the world at the next time; or, as we can put the matter, only one future is possible given this envisaged present. So how does this differ if there are uncaused events in the picture? I suggest the following. We will still have causal necessitation, since whatever uncaused events did actually enter spacetime at the first time will be 'plugged in' to the calculation procedure. But we will forgo the temporal determinism. For let there be some arbitrary uncaused events at the latter time. All this amounts to, I think, is that the difference between S^1 and S^2 will not be given by C*, but rather by C* and U*, where U* is the set of uncaused events that we have added at the latter time. If this is a good picture, then we can have causal necessitation with uncaused events. In this special case of cooperation, what is happening is that a proper part of the second time, to put the issue this way, is a result of the causal necessitation, whilst the remainder part is due to any uncaused events that spontaneously enter spacetime. If we were to run this same calculation procedure over and over, then we would find that the necessitated aspect of the second time is invariant, whilst, we can suppose, the spontaneous aspect would be variable.

At this point I imagine that Mumford and Anjum would protest that the real issue is that the uncaused events at each time could have been different. But here I want to insist on our principle of non-vagueness. If the calculation procedure for Mumford and Anjum's theory is requiring a definite causal situation as its starting point, then we can suggest, in line with Chapter 4, that strengthening the 'same' complex cause with a different uncaused event will in fact move us between different causes. But in this case the argument will be subtly different. We can recall that in Chapter 4 the basic idea was that Mumford and Anjum cannot strengthen sets of component vectors with an additional component vector because they are using a resultant vector, which is, I think, to draw upon a notion of a totality of component vectors. In this case the thought is that Mumford and Anjum will have to make their complex causes precise: agreeing at the beginning of the calculation procedure what powers are and are not in operation. And this will include, of course, any powers that uncaused events might bring along with them. The current line of thought differs from the argument of Chapter 4 in the following sense. When we discussed antecedent strengthening in Chapter 4, the issue was that adding a component vector to a complex cause would switch between different totalities of component vectors. Importantly, this would disallow a disjunctive operator from contributing towards the resultant vector with a different component

vector (as the set of component vectors would be different). And the argument of Chapter 4 would also disallow a spontaneous power from manifesting its component vector in one case but not in another as we attempt to stay within a single complex cause (as the number of component vectors would be different and so the resultant vector would again be different). But the thought at the moment is simply that the causal situation needs to be precise, i.e. that the powers that are proximate for a given subject of change need to be determinate and non-vague. And as my discussion of the calculation procedure in Chapter 5 will suggest, this insistence will allow for the disjunctive possibilities that are associated with probabilistic and indeterministic powers to take effect, as well as for the spontaneous action of spontaneous powers. Cutting to the chase, then, what is secured by the proposal that Mumford and Anjum's complex causes must be determinate, in the sense that we fix upon a precise spatiotemporal arrangement of proximate powers? Well, on the one hand, uncaused events that are causally relevant to a subject of change will have to declare themselves, so to speak, at the outset. So we are trying to secure the idea that modifying the uncaused events will modify the complex cause, again with the intention of blocking Mumford and Anjum's proposal that causes do not necessitate their effects because additional prevention is always possible. To this end, we can agree that those uncaused events that are inserted into spacetime could have been different at each time, such that what uncaused events are actualised at a time is a contingent matter, but we can disagree with the thought that we can strengthen the same cause with different uncaused events. On the other hand, however, *pace* the discussion in Chapter 4, probabilistic powers, indeterministic powers, and spontaneous powers can give rise to different resultant vectors. And this is because we are requiring that Mumford and Anjum keep fixed proximate powers, not a set of component vectors. To clarify, we can think about 'complex causes' either as spatiotemporal arrangements of powers, which provide proximity for powers, or otherwise as sets of component vectors; it is the former concept that is relevant for this argument. In this general way I would attempt to downplay the relevance of uncaused events for the question of causal necessitation, whilst allowing one and the same causal situation to give rise to different sets of component vectors and thereby to alternative manifestations *qua* change.

Section Three

The Governing Role

7

Stephen Barker's Brute Modalism

7.1 Introduction

The aim of this chapter is to set the scene for the last section of the thesis. In this final section we will be focusing upon a challenge that Barker has raised in his (2013) essay *The Emperor's New Metaphysics of Powers*. The basic idea of this essay is that the four central articulations of dispositional essentialism are either incoherent or otherwise disguised versions of a foil position that Barker terms 'brute modalism'. Brute modalism is the view that it is a brute or primitive fact about a world that its categorical properties stand in metaphysically necessary connections. It is a 'foil position' insofar as it denies the anti-Humean a metaphysical explanation for these necessary connections. In addition, Barker argues that the necessitation theory (ironically) draws upon the resources of dispositional essentialism, since the only tenable understanding of the necessitation relation is that it has a second-order dispositional essence. Given that the project of dispositional essentialism is in crisis, however, Barker concludes that both of the central versions of anti-Humeanism—i.e. the necessitation theory and dispositional essentialism—are illusionary metaphysics. Accordingly, there are two main choices for the properties and laws debate: neo-Humeanism and brute modalism—the latter of which is a non-standard version of anti-Humeanism.

I agree with Barker's arguments concerning the necessitation theory and dispositional essentialism. In this section of the thesis, therefore, I set out the key aspects of a position that I term 'temporal essentialism'. Temporal essentialism is a two-category ontology of objects and Platonic universals that is explicitly aligned to a dynamic conception of time, in this case the growing block theory. With regard to Barker's essay, this position is of interest insofar as it does not attempt to secure a governing role for properties, which is a difficulty that Barker raises for Bird's dispositional monism (see also Barker and Smart 2012). In contrast, the governing role for temporal essentialism

is understood in terms of the structure of dynamic time; temporal essentialism seeks to provide a time-based metaphysical explanation for necessary connections and lawful regularities. In short, my strategy is to build a sensitivity towards physical modality into the structure of dynamic time, such that the 'output' of the process of temporal becoming (i.e. the actualisation of states of affairs) is a function of present states of affairs via laws. But let us discuss this proposal at length in the following chapters. Dialectically speaking, I will present temporal essentialism as a second non-standard version of anti-Humeanism that does not collapse into Barker's brute modalism.

Accordingly, in this chapter I shall discuss Barker's brute modalism and his critique of anti-Humeanism. To limit the scope of this chapter, I shall concentrate upon his arguments against Armstrong's necessitation theory and Bird's dispositional monism.

7.2 Three degrees of physical modal involvement and brute modalism

Barker's essay begins by setting out a three-part taxonomy of degrees of physical modal involvement. This encompasses "three degrees of involvement that physical modality might have in relation to reality at large" (Barker 2013, p.606). We can understand this notion of 'degrees of physical modal involvement' in terms of different options for the metaphysical grounding of facts of physical modality. The phrase 'facts of physical modality' is taken in the present context to mean those facts that concern the associated notions of causation, law, disposition, counterfactual, and chance, as well as those of physical necessity and possibility. (The fact that it is a law that all Fs are Gs, such that the co-instantiation of these properties is physically necessary, is a paradigmatic fact of physical modality.) In outline, Barker's three-part taxonomy of degrees of physical modal involvement (henceforth 'Barker's three-part taxonomy' or 'Barker's three degrees') is as follows. The first degree is the view that worlds as a whole (either the actual world by itself or a number of actual and/or possible worlds) are the metaphysical grounds of physical modality. Barker cities Lewis' (1986) modal realism as the paradigm first-degree position in the contemporary debate. According to Lewis' theory of physical modality, a possible world as a whole is the metaphysical ground for its laws via his best-systems theory; in turn, these laws are used to fix facts of comparative similarity and thereby counterfactual truths. The second degree is the view that second-order relations are the metaphysical ground of physical modality. Armstrong's (1983)

necessitation theory is the mainstream second-degree position. According to this degree of physical modal involvement, second-order relations necessitate (or 'make probable') co-instantiations of first-order properties. Barker's second degree is therefore more fine-grained than the first degree, since we are focusing upon relations as oppose to worlds. According to Barker's third degree, however, first-order properties on their own are the metaphysical ground of physical modality. Dispositional essentialism is the third-degree.

Barker's three-part taxonomy draws upon his preferred understanding of several key concepts in the properties and laws debate: necessary connection, distinct existence, real possibility, and quidditism. We shall begin with a brief survey of Barker's approach to these notions.

The concept of necessary connection is understood in a standard way using metaphysically possible worlds. Barker states: "A necessary connection holds between A and B if and only if for every metaphysically possible world, if A exists, then B exists" (2013, p.609). So construed, the existence of A is sufficient for the existence of B across metaphysically possible worlds. The notion of distinct existence, however, is approached with the use of a notion of 'containment', which concerns ontological dependence. A is said to contain B if and only if A ontologically depends upon B (2013, p.609). (Note that A's ontological dependence upon B is understood in the present context to consist in the real definition of A making reference to the real definition of B. Hence, where the real definition of a whole makes reference to the real definition of one of its parts, the whole is said to ontologically depend upon this part; in Barker's terminology the whole 'contains' the part.) Taken together, then, A and B are distinct existences if and only if A does not contain B and B does not contain A.

These two concepts (necessary connection and distinct existence) lead to Barker's version of the neo-Humean principle that there are no necessary connections between distinct existences: "If A does not contain B, then it is metaphysically possible for A to exist without B" (2013, p.609). The motivation for Barker's approach to the concept of distinct existence, which uses a notion of containment, is that the intuitive understanding of distinct existence in terms of non-identical entities results, straightforwardly, in a false principle. Or so Barker argues. For example, whilst a whole is non-identical with its parts, there is, plausibly, a necessary connection that holds between

a whole *w* and one of its parts *p*, such that all *w*-worlds are *p*-worlds (2013, p.609). Accordingly, a standard thesis of mereology—i.e. that a whole is non-identical to its parts—provides a simple counterexample to the neo-Humean principle that there are no necessary connections between distinct existences (distinct *qua* non-identical). In light of this counterexample, the neo-Humean might reject the standard thesis of mereology, but Barker bypasses this issue with the requirement that distinct existences are distinct *qua* non-containing as oppose to distinct *qua* non-identical. To summarise his version of the neo-Humean principle that there are no necessary connections between distinct existences, then, where A does not contain B (i.e. where A does not ontologically depend upon B, such that the real definition of A does not make reference to the real definition of B), it is metaphysically possible for A to exist without B. (I shall refer to this principle henceforth as the 'neo-Humean principle'.)

According to Lewis' modal realism and his approach to the concept of real possibility, there cannot be violations of the neo-Humean principle. Barker takes Lewis to reduce possible worlds to combinations of distinct existences (distinct *qua* non-containing). So construed, combinations of distinct existences are basic ontology whereas possible worlds are "derivative ontology" (Barker 2013, p.611). In line with Lewis' principle of recombination, whereby "patching together parts of different possible worlds yields another possible world" (1986, pp.87–8), distinct existences A and B co-exist and fail to co-exist across possible worlds. Lewis' principle of recombination is used to articulate a thesis of plenitude, according to which, roughly speaking, all logical space is occupied by the plurality of possible worlds (1986, p.86). In light of this liberal approach to the concept of real possibility, a necessary connection between properties F and G will be restricted to a subset of the metaphysically possible worlds (i.e. restricted to the subset of metaphysically possible worlds where all Fs are Gs). And so Lewis' system cannot violate the neo-Humean principle: the remainder set will contain metaphysically possible worlds where not all Fs are Gs.

In contrast, brute modalism is designed to violate the neo-Humean principle. It uses a basic ontology of possible worlds, such that properties stand in metaphysically unexplainable necessary connections. This is, of course, a non-combinatorial approach to the concept of real possibility. According to brute modalism, the primitive natures of possible worlds are distributions of objects instantiating properties. (Note that objects in this context might be assayed as bundles of

categorical properties; as far as I am aware, Barker does not discuss this detail.) As such, there is no metaphysical explanation of 'lawful' or 'non-accidental' regularities; possible worlds and their primitive natures are accepted as brute modalism's basic ontology. It is distinctive of brute modalism that properties are quiddistic but nevertheless stand in necessary connections.

> Call *brute-modalism* the view that it is a basic fact about worlds that regularities ... obtain. Given brute-modalism, the properties in regularities ... are quiddities whose instantiations have necessary connections to other quality-instantiations, which just reflect the primitive nature of possible worlds themselves ... If brute-modalism is correct, then necessary connections are brute facts about worlds. Each world is just a mosaic of local matters of fact involving qualities. Unlike combinatorialism—which reduces possibility to combination of distinct existences—brute-modalism treats *possible world* as primitive. This may be unattractive, but there's no contradiction involved (Barker, 2013, p.612: original italics).

Barker's approach to the concept of quidditism is used to bypass the straightforward objection that necessary connections cannot hold between quiddistic properties. A 'permute' thesis, according to which a property is quiddistic if and only if it has different modal roles across different possible worlds, is rejected. In its place, the concept of quidditism is approached in terms of identity and essence. Barker states: "A property F is quiddistic if and only if its identity is *fixed* by features that in themselves are non-modal. Its real definition involves only these features" (2013, p.611: original italics). This point is in line with Kit Fine's (1994) *Essence and Modality*, since Barker thinks that the essence of a quiddistic property is not "simply what's necessary to that [property]", but rather "that which *grounds* the identity of [that property]" (Barker 2013, p.612: original italics, my square brackets). According to Barker, brute modalism is a "coherent hypothesis" that shows that "a thesis about what's essential to properties—what fixes their identity—cannot merely be captured by facts about what's necessary" (2013, p.612).

Brute modalism is upgraded from a thesis concerning real possibility to first-degree theory of physical modality in the guise of Barker's 'transworld Humeanism'. This position takes brute modalism as its starting point, but supplements it with the claim that laws are regularities holding across possible worlds. Hence, in light of the distribution of objects instantiating properties (i.e. in

light of the primitive natures of possible worlds), transworld Humeanism takes laws to be metaphysically necessary regularities that are nevertheless metaphysically unexplainable. To clarify, brute modalism is the thesis that (i) possible worlds are basic ontology; (ii) these possible worlds have primitive natures; (iii) these basic natures are distributions of objects instantiating properties; and (iv) properties are quiddistic. Transworld Humeanism is the additional thesis that (v) laws are regularities holding between possible worlds (Barker 2013, p.615). Transworld Humeanism qualifies as a first-degree approach to physical modality as it is worlds as a whole that metaphysically ground facts of physical modality. In particular, possible worlds are basic ontology and laws are construed as general regularities that hold across possible worlds.

7.3 Armstrong's necessitation theory

In this part of the chapter I shall set out Barker's treatment of Armstrong's necessitation theory. We can recall that Barker's overall strategy is to argue that the second and third degrees are untenable, such that their representative theories are either internally inconsistent or otherwise disguised versions of brute modalism (or transworld Humeanism). Let us begin with Barker's discussion of Armstrong's necessitation theory, in which he argues that the only tenable understanding of the necessitation relation is that it has a second-order dispositional essence.

The starting point for Barker's discussion of Armstrong's necessitation theory draws upon Bird's (2005c; 2007) regress argument; see also van Fraassen (1989). According to Armstrong, laws are second-order states of affairs that have the form N(F,G). N is a second-order relation that holds between the first-order properties F and G, such that—in the deterministic case—N necessitates the co-instantiation of F and G. We can capture this with the following 'fact of necessitation'. If it is the case that N(F,G) at metaphysically possible world *w*, then it is the case that R(F,G) at *w* (Barker and Smart 2012, p.715). Note that R(F,G) symbolises a second-order relation R of extensional inclusion that holds between F and G if and only if '$\forall x(Fx \rightarrow Gx)$'.

The *prima facie* problem for explaining the physical necessitation of N is Armstrong's thesis of categoricalism, which states that the identities of properties and relations are determined independently of their causal/lawful profiles. So construed, the essences of properties and relations

are qualitative or otherwise non-modal (in a physical sense of modal, i.e. modal *qua* causal/lawful). In general, categorical properties and relations have no (non-trivial) necessary connections to distinct entities. As such, it is not a part of the identity of F or G that N(F,G) is the case. In addition, it is not a part of the identity of N(F,G) that R(F,G) is the case—*prima facie*, at least. The point here is that N(F,G) does not have the (complex) first-order state of affairs 'all Fs are Gs' as a mereological part, such that there is a straightforward necessary connection between the former and the latter (Bird 2007, pp.94–6). Because of this, N(F,G) is a distinct existence (distinct *qua* non-containing, as Barker would say) *re* the general regularity that all Fs are Gs. In light of Armstrong's thesis of categoricalism, Bird (2005c; 2007, pp.92–4) argues that there is a single principled answer to the question: why is the fact of necessitation true? This is to draw upon a third-order necessitation relation N* that holds between N and R such that N* necessitates the co-existence at possible worlds of N(F,G) and R(F,G). This can be displayed with a higher-order fact of necessitation: If it is the case that N*(N,R) at metaphysically possible world *w*, then, if it is the case that N(F,G), then it is the case that R(F,G). And so on. Bird argues that the regress is vicious, since the necessitation of N^n is explained by the necessitation of N^{n+1}. As we will discuss below, Barker (2013, p.628) argues that Bird's dispositional monism faces a parallel problem, since there is a structural similarity between Bird's and Armstrong's theories of laws (see also Barker and Smart 2012, pp.719–20).

Barker (2013, pp.616–9) develops this line of criticism by outlining four different ways in which we might explain Armstrong's physical necessitation. The first strategy is to say that it is a "brute fact" that if it is the case that N(F,G), then it is the case that all Fs are Gs (Barker 2013, pp.617–8). So construed, however, Barker claims that Armstrong's necessitation theory is effectively a second-order version of transworld Humeanism, whereby it is "just a brute fact about worlds" that the law N(F,G) co-exists with the general regularity all Fs are Gs. Barker's line of thought is that if it is taken as primitive that N(F,G) co-exists with R(F,G) across metaphysically possible worlds, then N is not a "source" of necessitation; "The necessitation would be, on the contrary, just a brute fact about the worlds at large" (Barker 2013, p.618). Given that the first degree is distinguished from the second degree in that the former uses worlds as a whole whereas the latter uses second-order necessitation relations, this strategy is thought to collapse into brute modalism, such that it is a basic fact about worlds that N(F,G) and R(F,G) are necessarily connected. (According to

Barker (2012, p.716), Bird overlooks this option due to his overlooking brute modalism.) The second strategy is to use a third-order necessitation relation, in line with Bird's regress argument. For the reason that, *prima facie*, this strategy does not draw upon worlds as a whole, it is not at risk of collapsing into the first degree. Nevertheless, as Bird's regress argument shows, there is a failure of explanation for the necessitation at each level. On this basis, Barker discounts this strategy. In addition, he notes that if it is taken as primitive that N^* forces the co-existence of N(F,G) and R(F,G), then we have retreated to a third-order version of the previous strategy. Hence, we will have a third-order version of transworld Humeanism where it is a brute fact about worlds that if it is the case that N*(N,R), then, if it is the case that N(F,G), then it is the case that R(F,G) (Barker 2013, p.618). A third strategy concerns Barker's concept of 'world-making' (pp.612–3). This type of approach to the properties and laws debate is also thought to collapse into a version of brute modalism. I shall delay our discussion of world-making until the last chapter of this thesis, since temporal essentialism draws upon this concept. And lastly, a fourth strategy for explaining the physical necessitation of Armstrong-style laws is to take N to be "inherently powerful" (Barker 2013, p.618). The thought is that N has a type of dispositional essence that forces the co-instantiation of F and G. In this way, Barker concludes that the second degree, represented in this case by Armstrong's model of laws, is hostage to the fortunes of dispositional essentialism. Here is a useful citation from Barker's essay that shows the present dialectic. (Note that T is a version of Armstrong's N relation for probabilistic laws.)

> If there is to be a second degree at all, then second-order facts like N[F,G] have to *constrain* or *govern* first-order facts of natural property instantiation. But as we have seen, that requires that N[F,G] necessitates lower order facts *by virtue of the inherent nature of* N. But this means N has to be powerful in a way analogous to the third-degreer's powerful natural properties. Thus, the second degree needs something like a powers view of N and T, otherwise it collapses into brute-modalism. If the second degree affirms brute-modality for N, then it ceases to be a second-degree view. It is just a variation on transworld Humeanism; physical modality is fixed by worlds-at-large. If the powers view proves to be an illusion, brute-modalism and quidditism are unavoidable, then, the only real views of physical modality are first-degree views (Barker 2013, p.621: original italics).

7.4 Bird's dispositional monism

Let us move on and consider Barker's criticism of Bird's dispositional monism. This theory is discussed in two of Barker's four central articulations of dispositional essentialism. The first articulation is a method of relational constitution for dispositional properties; the second articulation is a graph-theoretic approach. Within this chapter I want to focus upon Barker's distinction between constitution and governing roles, which is a prelude to Barker's discussion of relational constitution (see also Barker and Smart 2012, p.720).

The basic idea of relational constitution as a way of articulating dispositional essentialism is that the "identities of natural properties are fixed by their entry into certain second-order modal relations with each other" (Barker 2013, p.623–4). This approach is attributed to Bird (2007) and Mumford (2004). As we discussed in Chapter 2, Bird's SM-relations designate that triplets of dispositional properties play the relative roles of 'disposition', 'stimulus', and 'manifestation'. Barker characterises such relations as second-order relations "whose instantiation by properties explains why events featuring those properties enter into certain patterns of physical necessitation and causation" (2013, p.624).

At this point it will be useful to consider Barker's (2009) essay, *Dispositional monism, relational constitution and quiddities*. In this essay Barker agrees with Bird that the graph-theoretic approach to property individuation can bypass Lowe's (2006) regress problem. This problem targets the dispositional monist set up where the identity of a dispositional property is provided by non-identical dispositional properties: "[*N*]*o property can get its identity fixed*, because each property owes its identity to another, which in turn owes *its* identity to yet another—and so on and on, in a way that, very plausibly, generates either a vicious regress or a vicious circle" (Lowe 2006, p.138: original italics). As noted, Barker agrees that Bird successfully responds to Lowe's problem (Barker 2009, p.243). Bird's response is to deny that the identity of a dispositional property D is provided by non-identical dispositional properties S and M; in contrast, the identity of D, S, and M is provided by the network of SM-relations meeting a graph-theoretic asymmetry G. That said, however, Barker argues that the status of Bird's SM-relations is problematic. In short, Barker argues that Bird's SM-relations are both internal and quiddistic.

Barker construes Bird's SM-relations as internal in two senses (2009, pp.246–7). First, the SM-relation is thought to be internal *qua* constituting its relata. This is the identity-fixing aspect of Bird's graph-theoretic approach: although D's identity is not provided by S and M *qua* dispositional properties, the network of SM-relations holding between dispositional properties wholly constitutes—via structural differentiation—the identities of these relata. And second, the SM-relation is thought to be internal *qua* the mere existence of its relata entailing its instantiation. The line of thought, I think, is that if Bird's dispositional properties are relationally constituted in the above sense, then his dispositional properties cannot exist without the instantiation of their SM-relations; in contrast, the constituting relations and the constituted relata 'stand and fall' together. Hence, the mere existence of a set of dispositional properties entails the instantiation of (a relevant) set of SM-relations. Crucially, however, Barker denies that Bird's SM-relations, so construed, are supervenient *qua* 'ontological free lunches'. That is, Bird's SM-relations are "ontologically substantial" (Barker 2009, p.247). As such, the SM-relation is opposed to a Leibniz-style conception of internality, which is defined as follows. "A relation *R* is internal iff *R*'s instantiation by relata holds in virtue of monadic features of these relata" (Barker 2009, p.247).

With regard to the quiddistic status of Bird's dispositional properties, Barker argues that a categoricalist construal is the only possibility after exhausting two alternatives. The first alternative is that the SM-relation is itself a power; this option is discarded on the basis of regress difficulties and a proposed contradiction (2009, pp.244–6). The second alternative is that the SM-relation is a non-mereological tie. This option is also rejected, since, briefly stated, Barker argues that the SM-relation requires a directionality that a non-mereological tie cannot provide (2009, pp.247–8). All in all, then, why are Bird's SM-relations problematic? In short, the basic idea is that both the necessitation theory and Bird's dispositional monism are setting forth the same sort of metaphysical position.

> It seems no advance has been made in relation to the fundamental question about the nature of physical modality: what is causation? What is physical necessitation? What is chance? Both [dispositional monism] and the non-humean quidditists [i.e. Armstrong] give the same answer: physical modality has its source in a primitive higher-order, quiddistic, relation

instantiated by natural properties (Barker 2009, p.249: my square brackets)

7.5 The governing role and Bird's dispositional monism

With this in mind, Let us return to Barker's (2013) essay. At this point he claims that the relational constitution approach has a structural similarity to the second degree, since the latter also takes facts of physical modality to be fixed by second-order relations. In both cases second-order relations are forcing the co-instantiation of first-order properties (Barker 2013, p.624). As we have discussed, Bird's SM-relations are analogous to Armstrong's necessitation relations in that both posits are second-order categorical entities. In addition, both posits are 'ontologically substantial'. On this basis, Barker thinks that both Bird and Armstrong are drawing upon a governing role. Using 'X' as a neutral second-order relation, Barker's scheme for the governing role is as follows.

> Governing Role: "X holding of F and G determines that if F is instantiated by object *x*, then G will be instantiated, (or will tend to be), by *x* or something related to *x*" (Barker 2013, p.625).

This governing role is distinguished from a constitution role, which is given the following scheme.

> Constitution role: "X holding of F and G enters into constitution of F and G. The identities of F and G are fixed by their entering into X relations" (Barker 2013, p.625).

According to Barker, the second-degree is drawing upon the governing role, whereas the third degree, at least under the relational constitution approach, is drawing upon both the governing role and the constitution role. This difference *re* the constitution role has arisen because Bird's SM-relations are internal *qua* constituting, whereas Armstrong's necessitation relations are external.

> At this point it may seem obvious that the third-degreer's X-relations—the stimulus-response and the mutual-manifestation-partner relation—are just the second-degreer's N- or T-relations in so far as they play both governing and constitution roles. So the difference between the second degree and the third-degree relationalist is simply this: the second-

> degreer thinks the N- and T-relations play only one role, and the relationalist thinks they play both. This is what I think is the case. But the third-degreer cannot welcome this conclusion (Barker 2013, pp.625–6).

Why is the conclusion unwelcoming? The conclusion of Barker's argument against Armstrong was that the necessitation relation requires a type of second-order dispositional essence if it is to necessitate patterns of property co-instantiation. In making this conclusion he discarded three alternatives: brute modalism, a regress of necessitation relations, and a world-making conception of physical modality (yet to be discussed). Given that Bird's dispositional monism has a structural similarity to Armstrong's theory, however, Barker is able to claim that Bird's position also requires third-order relations (although in this case the higher-order relations will be internal, in line with Barker's discussion of Bird's SM-relations). In other words, Bird's regress argument affects his own dispositional monism (see also Barker and Smart 2012). In this connection, Barker says the following: "According to relationalists [e.g. Bird, Mumford] if X is powerful, then that can only be because X is relationally constituted through a higher-order relation R that is powerful, in the sense that it governs X's behaviour" (Barker 2013, p.626: my square bracket). Barker goes on to say that there are two ways for the relational constitution approach to avoid this regress. The first is to accept brute modalism and claim that it is a brute fact that if it is the case that X(F,G), then it is the case that all Fs are Gs. (With regard to Bird's scheme, of course, the claim would be that it is a brute fact that if it is the case that SM(P^1, P^2, P^3), then it is the case that all P^1&P^2s are P^3s; and so on for Mumford's (2004) model of dispositional properties.)

> But then, X ceases to *constrain*. Relationalism collapses into the first-degreer's brute-modalism, just as the second degree does ... The only difference is that quiddities have structural essences—as in [the constitution role]. But merely affirming structural quiddities is not a powers view. The structures also have to *constrain* natural property instantiation, but that is the issue that is at stake here (Barker 2013, p.626).

The second alternative, Barker explains, is to use a different conception of the "powerfulness of properties that can be applied to X". This alternative gets into Barker's discussion of the other three articulations of dispositional essentialism, since the view at hand is that the relational constitution

approach has to be supplemented by a different approach to dispositional essences. Unfortunately, it is beyond the scope of this chapter to consider these additional arguments.

At this stage it is useful to note three points that concern this restriction of scope. Firstly, let us recall that the above material concerning governing and constitution roles is a prelude to Barker's discussion on the relational constitution approach. In fact, the central task of this section of Barker's essay is to argue that several proposals for understanding how dispositional properties can be relationally constituted turn out to be illusionary, which is to say that these proposals are internally contradictory and metaphysically impossible (2013, pp.627–34). As such, this section of Barker's essay goes over and above the problem that Armstrong and Bird cannot deliver a governing role from properties; the section at hand concerns constitution roles for properties. Secondly, and relatedly, the other criticism in Barker's essay that affects Bird's dispositional monism—*viz*. his discussion of graph-theoretical approaches—concludes, very roughly, that there is a confusion in this strategy with regard to the type–token distinction. The overall picture is that graph-theory is unsuitable for articulating dispositional properties. Note that this argument goes beyond Barker's (2009) essay, where he is willing to agree that Bird's graph-theoretic approach can respond to Lowe's regress problem. In a similar way, however, I read Barker's (2013) attack on graph theory as further investigating the constitution aspect of dispositional essentialism. Why is this? The basic reason is that if Bird's SM-relations *qua* constituting relations cannot provide a governing role, then I find it difficult to see how a thesis concerning structural differentiation could do any better: both approaches use relations/relationships, generally construed. And thirdly, even if Bird's dispositional monism could be salvaged with the supplementation of resources from either of the other two articulations of dispositional essentialism—*viz*. functional roles and powerful qualities—this would entail a major revision of Bird's position. With this in mind, I suggest that we are ready to move on with a substantive problem for Bird's dispositional monism in hand: Barker's problem of the governing role.

That being the case, however, I think it will be useful to briefly run through the central point that Barker and Smart make in their (2012) essay, *The ultimate argument against dispositionalist monist accounts of laws*. In this essay Barker and Smart are arguing that Bird is subject to his own regress argument (the (2005c) argument that he pitched against Armstrong's necessitation theory).

After setting out the distinction between governing and constitution roles, Barker and Smart claim that the governing role is responsible for the regress problem. The line of thought is that this role captures the following fact of necessitation: 'If SM(P^1, P^2, P^3) obtains in any metaphysically possible world *w*, then every *x* that is P^1&P^2 in *w*, is (or will tend to be) P^3 in *w*' (adapted from Barker and Smart 2012, p.719). In addition, Barker and Smart propose that the governing role should be the basis for Bird's constitution role.

> We can put our point this way: The governing role is basic to *SR* [i.e. the SM-relation] and its constituting role is secondary. It's because natural properties enter into *SR*-relations with each other, and *SR* has the governing role, that natural properties get to have an essential modal profile. *SR* does not get its governing role by entering into relational constitution of properties. If that's right, we are left to explain the necessitation implicit in the governing role (Barker and smart, 2012, p.720: original italics).

At this point Barker and Smart consider a reply for Bird: could he not say that the fact of necessitation, i.e. the governing role, is essential to his SM-relation? In response, Barker and Smart (2012, pp.720–21) set out a dilemma for Bird. It asks for the nature of the connection between the second-order state of affairs SM(P^1, P^2, P^3) and a fact of necessitation 'NEC'. NEC states: In every possible world in which an object *x* P^1&P^2, *x* is P^3 (adapted from Barker and Smart 2012, p.721). The first horn of the dilemma is a disjunction: either the second-order state of affairs SM(P^1, P^2, P^3) is identical to NEC, or it is not. With regard to the first disjunct, Barker and Smart argue as follows.

> [SM(P^1, P^2, P^3) is identical to NEC]. But if that is right, then there is no stimulus–response relation. Rather, there is just a fact about possible worlds, [NEC]. But if that is the view, why is it distinct from the idea that there are brute necessary connections between categorical properties [P^1, P^2, and P^3]? Since there is no relation in [NEC], we lose the relational constitution that is meant to make natural properties essentially modal (Barker and Smart 2012, p.721: my square brackets).

And with regard to the second disjunct, Barker and Smart argue as follows.

> [SM(P^1, P^2, P^3) is not identical to NEC]. If so, [SM(P^1, P^2, P^3) and NEC] are distinct existences. But then we have to explain what their connection is. Why is it that because [SM(P^1, P^2, P^3)] obtains [NEC] obtains. If Bird claims that it is just a brute fact then more or less the same line is open to Armstrong, i.e. that it's a brute necessary connection that links *N*[*F*,*G*] with to its necessitation role (Barker and Smart 2012, p.721: original italics, my square brackets).

The second horn of the dilemma is Barker's (2009) argument that Bird's SM-relation is a second-order quiddistic relation. As we have noted, this line of attack challenges the separation of Bird's dispositional monism from a second-order approach such as Armstrong's.

With all of this in mind, Barker and Smart conclude that Bird either faces his own regress problem, which is to say that there is no explanation for the governing role of the SM-relation, or he accepts brute necessary connections (2012, p.721). In the latter case, as Barker's (2013) goes on to argue, Bird's dispositional monism is a first-degree approach: *viz*. there is no governing role as such; there is no metaphysical explanation for lawful regularities; and the primary focus *re* physical modality concerns worlds as a whole. (As a final point, to acknowledge Ben Smart's work in his (2012) essay with Barker, I shall henceforth term the problem of the governing role 'Barker and Smart's governing role'.)

7.6 A note on temporal essentialism

At this stage I am going to assume that Barker's attack on the two central versions of anti-Humeanism—i.e. the necessitation theory and dispositional essentialism—is successful. I have outlined Barker's criticism towards Armstrong and Bird, as well as Barker and Smart's earlier difficulty for Bird's dispositional monism. But the general line of thought in Barker's *The Emperor's New Metaphysics of Powers* is that there are two main choices for the properties and laws debate: neo-Humeanism and brute modalism—the latter of which is a non-standard version of anti-Humeanism.

I agree with Barker's line of thought; but I also want to be more optimistic about the prospects of anti-Humeanism. I should note, of course, that Barker's (2013) essay does not attempt to undermine all versions of anti-Humeanism. Indeed, brute modalism is a non-standard version of this approach, and Barker restricts his discussion to four articulations of dispositional essentialism. More importantly, however, Barker does not criticise anti-Humean positions that take laws to be primitive (Barker 2013, p.608/fn.6). Maudlin's (2007) book, *The Metaphysics Within Physics*, is representative of this strategy. Roughly speaking, Maudlin's first essay in this book, *A Modest Proposal concerning Laws, Counterfactuals, and Explanations*, takes a 'two-posit' theory of (i) laws and (ii) the world. In addition, he characterises the world as having a primitive temporal direction, in virtue of which laws can "constrain" the temporal evolution of physical states (2007, p.21). As we shall see, temporal essentialism also focuses upon diachronic regularities; in addition, the passage of time plays a key role in my metaphysical explanation of diachronic regularities. But temporal essentialism does not take laws to be primitive: in contrast, I analyse laws as second-order categorical relations. In this way, I hope that temporal essentialism is of interest to the readership of *The Emperor's New Metaphysics of Powers*, since, although I am not in direct disagreement with its author, at the end of this thesis I shall take an optimistic stance on the prospects of anti-Humean metaphysical explanations.

It will be useful at this point to reconsider the overview of temporal essentialism that I provided in the introduction to this thesis. Temporal essentialism is a two-category ontology of objects and (categorical) Platonic universals. I analyse laws as second-order relations that hold between first-order properties, in line with the necessitation theory. That said, however, I do not call upon these entities to provide a governing role. In contrast, the duty of these second-order relations is to provide a function (in the sense of a unique mapping) from their first place to their second place. With this in mind, I term these second-order relations 'selection relations' as oppose to 'necessitation relations'. I symbolise a selection relation as '$', and where it is the case that $(F,G), fixing upon F as the input fixes upon G as the output. The central concept in temporal essentialism is that Platonic universals can provide this 'selection role', and that a candidate for Barker's governing role is the cooperation of laws *qua* selection relations with what I term a 'formal ontological operation' (see below). I think that a source of difficulty for the necessitation theory and dispositional essentialism is that these positions have asked properties/relations to carry the

burden of a governing role on their own. The proposal at hand, however, is that the selection relations provide a set of instructions, so to speak, that are acted upon by a different actor; and as the title of my position suggests, this actor is time. Time is called upon to play a role of 'actualisation'.

This proposal involves two main steps. In the first place, I draw upon Tooley's (1997) growing block model, which is a dynamic theory of time whereby past and present states of affairs are actual whereas future states of affairs are non-actual. According to Tooley, necessitation relations govern patterns of property instantiation across time; in addition, Tooley suggests that his necessitation relations provide a metaphysical explanation for the passage of time: *viz*. states of affairs are actualised via the governing role of laws. In the second place, however, temporal essentialism construes the passage of time as the performance of a formal ontological operation, *pace* Tooley's necessitation theory. I can introduce a formal ontological operations as a development of Lowe's (2006) formal ontological relationships. According to Lowe, formal ontological relationships (e.g. instantiation) are not themselves entities, or 'elements of being'. Nevertheless, these posits are thought to set out the possible ways that different types of entities can stand to one another in virtue of their real essences. Formal ontological operations are formal in this sense, but their structure is non-relational. More specifically, I take formal ontological operations to be a type of operation that is performed by the ontology in all and only those cases where its condition is true. In short, formal ontological operations are the 'ontological correlates' of imperative sentences *qua* if–then commands. Roughly speaking, formal ontological operations have the following structure.

If [condition] is true, then perform [operation]
If [condition] is not true, then do not perform [operation]

How can we understand the passage of time as the performance of a formal ontological operation? In line with Tooley's growing block model, the performable operation modifies the temporally-variable aspects of temporal essentialism: *viz*. objects and (first-order) states of affairs. The domain of objects and first-order states of affairs is temporally-variable in the sense that (i) those objects that are actual and (ii) those first-order states that are actual vary with the passage of time. This is

the central concept of a dynamic theory of time (in the context of a states of affairs ontology). *Pace* Tooley's necessitation theory, however, the actualisation of states of affairs in temporal essentialism is construed as the iterated performace of a formal posit (contrast entity—i.e. contrast necessitation relation or dispositional property). I term the formal operation in question the 'temporal imperative'. Simplifying, it has the following structure.

> If object *x* is present, and *x* instantiates first-order property X, such that $(X,Y), then actualise! state of affairs *y*'s being Y at the next present moment, where Y is a function of X via $.

In this way, the condition–operation structure of the temporal imperative is modifying the temporally-variable aspects of temporal essentialism, such that this modification is sensitive to laws, construed as second-order relations (selection relations). In short, I argue that this is a time-based metaphysical explanation of lawful regularities. The line of thought is that dynamic temporality is built into the form of the ontology, and that, so construed, the form of the ontology is active. In addition, the content of the ontology is self-regulating if this activity is 'instructed' by the selection relation.

8

Temporal Essentialism I

8.1 Overview of temporal essentialism

My aim in this chapter is to set out the core elements of temporal essentialism. As we noted in the previous chapter, temporal essentialism is a version of anti-Humeanism that seeks to provide a time-based metaphysical explanation for lawful regularities. The basic idea of this position is that we can understand Barker and Smart's governing role in terms of the structure of dynamic time. It will be useful to begin by setting out a survey of temporal essentialism.

Temporal essentialism is a two-category ontology of objects and properties, where the latter are construed as Platonic universals. My position also uses a second-order relation that holds between first-order properties. In contrast to the necessitation theory, however, I do not call upon this second-order relation to provide a governing role. Instead, its duty is to provide a function (in the sense of a unique mapping) from its first place to its second place. Hence, where $ is a dyadic second-order relation that holds asymmetrically between the first-order properties F and G, there is a unique mapping from the property that stands in the first place of the relation (i.e. F) to the property that stands in the second place of the relation (i.e. G). I term this second-order relation the 'selection relation' to signal its distinction from the 'necessitation relation' of the necessitation theory (I am grateful to Matthew Tugby for this suggestion). In addition, all Platonic universals are categorical entities. I take it to be unproblematic that my selection relation *qua* categorical entity can provide a function from its first place to its second place.

Given that the governing role for the second-order relation is rejected, temporal essentialism seeks to provide a metaphysical explanation for lawful regularities in terms of its explicit allegiance to a dynamic theory of time—in this case Tooley's (1997) growing block model. According to Tooley's

growing block model, states of affairs that are past and present are actual whereas states of affairs that are future are non-actual. In addition, actual states of affairs are (dynamically) indexed to times, such that future states of affairs are actualised with the passage of time. With this in mind, the basic idea of my metaphysical explanation for lawful regularities is that the actualisation of future states of affairs is a 'formal operation' that is sensitive to physical modality. I term this formal operation the 'temporal imperative'. It can be modelled using the following imperative sentence, which we shall discuss at length in this chapter and the next two chapters. (Note that $ and B are constants, whereas *x*, *y*, X, and Y are variables.)

> Temporal imperative: If object *x* is present and *x* instantiates property X, where X stands in the first place of the selection relation $, then actualise! object *y*, such that *x* instantiates the B-series earlier–later relation B to *y*, and such that *y* instantiates property Y, where Y stands in the second place of $ as a function of X.

Let me begin by explaining the status of the temporal imperative as a formal ontological operation. The first step of temporal essentialism is to accept Lowe's (2006, pp.34–51) use of formal posits (formal *qua* ontological form). A good example of these formal posits is the 'characterisation relationship' in Lowe's four-category ontology, whereby a substance is characterised by a mode, i.e. a particular property. According to Lowe, the characterisation relationship is not itself a material entity—that is to say, it is not itself a member of the ontological category of relations, whether particular or universal. In contrast, Lowe claims that the characterisation relationship does not exist, but that it is nevertheless a formal way that kinds of beings can "combine" (2006, p.48). These 'formal ways of combination' are thought to reflect the real essences of entities within Lowe's four-category ontology. For example, the real essences of substances and modes are such that these kinds of beings can combine in accordance with the scheme 'substance *s* is characterised by mode *m*'. If two entities combine in accordance with the characterisation relationship, then these entities stand in dependence relationships that are distinctive of characterisation (*viz*. if a substance *s* is characterised by a mode *m*, then *m* depends upon *s* for its existence and identity.) In short, we can think of Lowe's formal relationships as "transcendental ties" that set out the possible ways that kinds of beings can stand to one another in virtue of their real essences (Schneider 2013, p.420; see also Grenon and Smith 2004).

The temporal imperative is a formal posit in this sense: it is a 'transcendental tie' that sets out the possible ways that kinds of beings can stand to one another in virtue of their real essences. But the second step of temporal essentialism is to suggest that we can posit a formal operation in addition to Lowe's formal relationships. Accordingly, the temporal imperative is a transcendental tie that has the structure of a performable operation as oppose to the structure of a relationship. In saying that the temporal imperative has the structure of a performable operation, I mean to say that the temporal imperative is a type of operation that is performed by the ontology in all and only those cases where its condition is true. (First and foremost, temporal essentialism is a realism of performable operations.) If we consider the imperative sentence 'If it is raining, then put up your umbrella', its meaning should be taken as 'If P is true, then do Q; if P is not true, then do not do Q—at least not in response to this imperative sentence'. The temporal imperative is analogous. If the condition in its antecedent is true, then the operation in its consequent is performed. The temporal imperative, then, has the following basic structure.

> If [condition] is true, then perform [operation]
> If [condition] is not true, then do not perform [operation]

At this point I shall introduce the basic elements of the temporal imperative. If we consider the antecedent of the temporal imperative, then we can see that it utilises a complex condition that contains two conjuncts: (i) object *x* being present, and (ii) object *x* instantiating property X such that X stands in the selection relation $ as the first place of $. I have placed these conjuncts in square brackets.

> Temporal imperative antecedent: If [object *x* is present] and [*x* instantiates property X, where X is the first place of the selection relation $] ...

If both of these conjuncts are true, then the complex condition is true, and the operation is performed; if either conjunct is false, then the complex condition is false, and the operation is not performed. (Note that the second conjunct of the complex condition is itself conjunctive, since it requires that object *x* instantiates property X and that X stands in the first place of the selection

relation $.)

With this in mind, the basic idea of the temporal imperative is as follows. Where we have the selection relation $ holding between the first-order properties F and G, the property that stands in the first place of $ (i.e. F) is the 'cause' property and the property that stands in the second place of $ (i.e. G) is the 'effect' property.

_1$_2

_Cause property$_Effect property

The temporal imperative will 'check' to see if there are any present objects that instantiate a 'cause' property. Let us therefore say that it is the case that (i) object *a* is present and that (ii) *a* instantiates property F such that $(F,G). The condition in the antecedent of the temporal imperative is true and its operation is performed. At this stage it is important to say that the temporal imperative is controlling what states of affairs will be actualised in the future. (This is why I have a clause for object *x* being present—I only want the present to instruct the temporal imperative what states of affairs to actualise).

Let us move on to consider the consequent of the temporal imperative, which is its performable operation.

> Temporal imperative consequent: ... then actualise! object *y*, such that *x* instantiates the B-series earlier–later relation B to *y*, and such that *y* instantiates property Y, where Y stands in the second place of $ as a function of X.

The performable operation is to introduce a token entity into the ontological category of objects, such that this newly-introduced object instantiates the B-series earlier–later relation (henceforth the 'B-relation') to the object that instantiates the relevant 'cause' property, and such that this newly-introduced object instantiates the relevant 'effect' property. I use the phrase 'actualise!' to signal that the consequent of the temporal imperative is a performable operation, as oppose to a declarative sentence or proposition.

The standard model of laws for temporal essentialism can be defined as a material conditional.

It is a law that 'All Fs are Gs' = $_{df}$ If at time t^n object x is F, then at time t^{n+1} object y is G.

This is a simple diachronic model of laws that is discussed by Tooley (1997, pp.107–11), Armstrong (1997, pp.223–30), and McCall (1994, p.69). Let us note that the 'cause' and 'effect' objects are distinct: in a token sequence we would have object *a* being F at t^1 and object *b* being G at t^2. In the version of temporal essentialism that I shall set out in this thesis, these distinct objects are required for a perdurance theory of persistence, whereby objects persist through time by having distinct temporal parts at distinct times (Tooley 1997, p.262; Armstrong 1997, pp.99–103). So the standard model of laws for temporal essentialism involves necessary connections holding between distinct temporal parts, where the prior temporal part instantiates a property that stands in the first place of the selection relation, which 'triggers' the temporal imperative to actualise the posterior temporal part, such that this posterior temporal part instantiates the property that stands in the second place of the selection relation as a function of its first place.

I require that the B-relation holds between the 'cause' object and the 'effect' object so as to model temporal sequence. As we shall discuss below, I define present objects to be all and only those objects that stand in the second place of the B-relation without standing in its first place. (Intuitively, the B-relation is instantiated by temporal parts so as to compose multiple 'chains' of temporal parts; the present objects are all and only those objects that are at the 'end' of these chains.) In the version of temporal essentialism that I shall set out in this thesis, the B-relation is the only first-order relation that temporal essentialism will recognise. It is dyadic, asymmetric, and categorical (in line with the selection relation).

At this stage I want to depict the overall picture of my temporal essentialism. On the one hand, we have a two-category ontology of objects and Platonic universals. On the other hand, however, we have a dynamic theory of time—Tooley's (1997) growing block model. My line of thought for temporal essentialism is as follows. (I should emphasise to the reader that the themes of this survey, which are briefly stated, are to be expanded upon during the remainder of this section of the thesis.)

First, the structure of time in the growing block model is that the past and present are actual, whereas the future is non-actual. Given that the growing block model is a dynamic theory of time, actual states of affairs are (dynamically) indexed to times, such that future states of affairs are actualised with the passage of time. In short, as time passes the past 'grows' and the present is the latest 'growth' at each moment of time.

Second, it is distinctive to a dynamic theory of time that a single world, i.e. the actual world, has a different totality of states of affairs at different times. In terms of Lowe's (2006, pp.34–51) form–content distinction for ontology, which is the basis for his formal posits, we can construe a temporally dynamic world as a system of ontological categories in which the total content of these ontological categories is different at different times. That is to say, in a temporally dynamic world we can construe ontological categories as having a different totality of members at different times.

And so, third, why not propose that the content of these ontological categories is to be controlled by the form of the ontology? In other words, why not propose that the membership of ontological categories is to be controlled by the formal ways that kinds of beings can diachronically 'combine'? Temporal essentialism takes this stance by modifying Lowe's formal posits, such that we also have a mechanism for controlling both the content of a designated ontological category (i.e. objects), as well as the formal relationships that hold between objects and Platonic universals (i.e. instantiation). Simply speaking, then, temporal essentialism is the position that it is 'built into' a system of ontology that it dynamically 'adds' new entities to its ontological categories and 'constructs' states of affairs in a lawful way. More specifically, the states of affairs that are actualised as time passes are a function of present states of affairs in tandem with laws, where the latter are construed as the selection relation holding between pairs of first-order properties.

Fourth, the 'price of purchase' for such a formal posit is, as far as I can see, two-fold. A first requirement is that the mechanism for control is properly aligned to the dynamic theory of time in question. This is important, because it is the dynamic theory of time that is supporting the notion that the ontological category of objects has a different totality of members at different times; accordingly, it is the dynamic theory of time that is supporting the proposal that the members of

the ontological category of objects could be controlled by the form of the ontology. Temporal essentialism aims to satisfy this requirement by using the dynamic actualisation of Tooley's growing block model as the outcome of the temporal imperative's performable operation. In this way, the dynamic theory of time and the formal ontological operation are properly aligned, since they both concern actualisation. A second requirement is that if the temporal imperative is to be postulated as a formal device, then it should be understood in terms of the real essences of objects and/or Platonic universals. This is also important, because Lowe's motivation for construing relationships such as characterisation as formal is that these posits reflect the ways that kinds of beings can combine in virtue of their real essences. With regard to this requirement, my strategy is two-fold. In the first place, I propose that we can distinguish between neo-Humean and anti-Humean structures within the context of a growing block model. Briefly stated, the former structure involves the actualisation of 'random' states of affairs at each moment, whereby states of affairs are actualised in analogy with Lewis' principle of recombination; in contrast, however, the latter structure involves the actualisation of states of affairs that is sensitive to previously actualised states of affairs as well as laws, generally construed. (I'll discuss what I mean by a general construal of 'laws' in Chapter 10; at this stage we can note that I will not be using a governing role for properties/relations.) And secondly, I propose that if a version of the anti-Humean structure is accepted, then it should be essential to the temporal entities in the ontology they have their required roles in this structure. In short, I propose that (i) it is metaphysically possible that dynamic time has a structure that is sensitive to physical modality (*pace* the neo-Humean structure), such that (ii) this structure should be essential to its 'host' ontology—in this case, that this structure should be essential to objects, which are the temporal entities of this system. On this basis, temporal essentialism proposes that objects have temporal essences.

At this stage in the chapter I have provided a survey of temporal essentialism. To supplement this overview, it will be useful to provide a list of the different ontological categories and formal posits in temporal essentialism.

8.2 Ontological categories and formal posits in temporal essentialism

(i) Ontological categories

(1.) Objects (constants: *a*, *b*, *c*, ...) (variables: *x*, *y*)
(2.) Platonic universals [categorical]
(2.a) First-order monadic properties (constants: F, G, H, ...) (variables: X, Y)
(2.b) A first-order B-series earlier–later relation ($\__1B\__2$) [dyadic and asymmetric]
(2.c) A second-order selection relation ($\__1\$\__2$) [dyadic and asymmetric]

(ii) Formal posits

(1.) The instantiation relationship [a formal ontological relationship that holds between objects and first-order Platonic universals; e.g. *a* is F, *a*'s having B to *b*]
(2.) The characterisation relationship [a formal ontological relationship that holds between first-order properties and the second-order selection relation; e.g. $(F,G)]
(3.) Temporal imperative: If object *x* is present and *x* instantiates property X, where X stands in the first place of the selection relation $, then actualise! object *y*, such that *x* instantiates the B-series earlier–later relation B to *y*, and such that *y* instantiates property Y, where Y stands in the second place of $ as a function of X. [a formal ontological operation]
(4.) Presentness $=_{df}$ Object *x* is present if and only if either *x* stands in the second place of the B-relation without standing in its first place, or *x* does not stand in any place of the B-relation. (inclusive 'either–or') [a formal ontological predicate]

8.3 Basic ontology

In the remainder of this chapter I want to develop the themes that I have introduced so far by discussing the basic ontology of temporal essentialism. There are a number of issues on which temporal essentialism is neutral; with regard to these issues I have chosen a set up that I think is sensible and defendable.

In the introduction to this chapter I said that temporal essentialism is a two-category ontology of objects and Platonic universals. But it is more accurate to say that temporal essentialism makes use of four ontological categories, since it recognises four kinds of beings that stand to one another in distinct ways. That said, these four kinds of beings are separated out, first and foremost, by a distinction between objects and Platonic universals—so it is useful, rather than misleading, to say that temporal essentialism is a two-category ontology of objects and Platonic universals. The ontological category of Platonic universals encompasses first-order properties, the (first-order) B-relation, and the (second-order) selection relation. I envisage that these three ontological categories can all be understood as types of Platonic universal, since these three kinds of beings are unified by their transcendent existence. In this way, I suggest that whilst temporal essentialism makes use of four ontological categories, my position only requires two fundamental ontological categories—*viz*. objects and Platonic universals.

8.4 Platonic universals

My reason for accepting Platonic universals is that there is a difficulty for understanding the diachronic model of laws in terms of Aristotelian universals. Let us recall that the standard model of laws for temporal essentialism is diachronic, such that if a temporal part that is present instantiates a property that stands in the first place of the selection relation, then the temporal imperative actualises, at the next moment, a temporal part that instantiates the property that stands in the second place of the selection relation. We can represent this scheme as follows. (I have omitted the B-relation, which is used to define present objects, for simplicity.)

Actual at t^1: *a* is F
Actual at t^2: *a* is F and *b* is G

According to temporal essentialism, this token sequence of states of affairs is a lawful regularity, since it is necessitated by the temporal imperative in line with object *a*'s being present, the first-order state of affairs *a's* being F, and the second-order state of affairs $(F,G). The temporal imperative will 'check' to see if there are any present objects that instantiate a 'cause' property; if this is the case, then the temporal imperative will actualise a new object that instantiates the

relevant 'effect' property. The difficulty for Aristotelian universals is that, at t^1, *a*'s being F is the only actual state of affairs. Hence, the future state of affairs, *b*'s being G, which will be actual at the next moment, t^2, is not actual at t^1. As such, the first-order property G is not instantiated at t^1, since there is no actual state of affairs *x*'s being G (at t^1). According to the Aristotelian conception of universals, however, if the first-order property G is not instantiated, then it does not exist. This problematises the role of the selection relation: if the 'effect' property does not exist, then the selection relation cannot provide a function to this property. So temporal essentialism requires first-order Platonic universals. In all those cases where a temporally-emergent first-order property is to be actualised, the temporal imperative requires that this first-order property can exist uninstantiated. We can see that this difficulty is arising via the combination of two theses. The first is Tooley's growing block model, which claims that past and present states of affairs are actual whereas future states of affairs are non-actual. And the second is the standard model of laws for temporal essentialism; so construed, it is present states of affairs that are lawfully necessitating future states of affairs. (More specifically, when a 'cause' object is present, such that it is relevant to the temporal imperative, this object is actual at a time t^n. But the actualisation of the 'effect' object takes place at the next moment, i.e. t^{n+1}. Therefore the actuality of the 'effect' property at t^n is not guaranteed.) Given this requirement for first-order Platonic universals, I also construe the B-relation and the selection relation as Platonic universals.

This difficulty is related to Tooley's (1977, p.669; 1987, p.72) argument concerning uninstantiated laws, which aims to support his Platonic version of the necessitation theory. The basic idea of this argument is that it is plausible that there are physical modal facts concerning uninstantiated laws. Tooley's thought experiment involves ten types of particles that can collide with themselves and each other. This gives fifty-five different types of particle interaction, which can be construed as laws *qua* the necessitation theory. In his thought experiment, Tooley imagines that two of these ten types of particles will never interact, on the basis of inappropriate boundary conditions. As such, the antecedent of the law, which is a structural universal (e.g. '*x* is F, *y* is G, and *x*'s having R to *y*'), is uninstantiated. Tooley claims, however, that it is rational to assume on the basis of the other types of particle interaction that there is a physical modal fact concerning the uninstantiated law, despite its unknown nature. He concludes from this thought experiment that Platonic universals are required if the necessitation theory is to provide truthmakers for uninstantiated laws.

Armstrong's response to this argument is to 'bite the bullet' and claim that there are no uninstantiated laws. In doing so, he claims that a number of counterfactuals, e.g. probabilistic counterfactuals, have indeterminate consequents, such that the counterfactual 'if it were the case that particle type F collided with particle type G, then it would be the case that event X' can also be indeterminate. So construed, the counterfactual in question is indeterminate, in the sense that although it may be true to say that some event would occur in the collision, there is no fact of the matter as to what type of event this would be (Armstrong 1973, pp.123–6; Armstrong 1997, p.253).

As noted, the difficulty concerning diachronic laws is related to Tooley's argument concerning uninstantiated laws. But there is also a difference. In my case, the 'cause' property of the selection relation is instantiated at a time when the 'effect' property is uninstantiated. With Tooley's case, however, the antecedent of the law for particle interaction, which is analogous to the 'cause' property in temporal essentialism, is uninstantiated. (Note that Tooley's argument is neutral on whether or not the consequent of the law, i.e. 'event X' above, is instantiated.) I do not think that temporal essentialism can accept that first-order properties are Aristotelian universals; nevertheless, it is useful to note what is required if we adopt Armstrong's 'bullet-biting' response for temporal essentialism's difficulty concerning diachronic laws. In short, we would require that, for all lawful regularities, the 'effect' property of the selection relation is instantiated in the past, relative to the 'cause' property. The simplest modification of the above scheme is as follows.

Actual at t^1: *a* is F and *c* is G
Actual at t^2: *a* is F and *c* is G and *b* is G

With the addition of the otherwise irrelevant state of affairs *c*'s being G, both the 'cause' and 'effect' properties of the selection relation are actual for the purposes of the temporal imperative. But this restriction would rule out temporally-emergent first-order properties. Given that the standard model of laws for temporal essentialism is diachronic, I would require this restriction to be upheld for all lawful regularities. For example, if five different 'cause' objects are present at a time, t^n, then I would require that all of their 'effect' properties are instantiated in the past of t^n. I see this as a drawback for temporal essentialism, and so I accept a Platonist conception of universals.

That said, however, Armstrong (1997, p.239) argues that although a Platonic version of the necessitation theory is advantageous in providing truthmakers for uninstantiated laws, his Aristotelian version is, in the final analysis, to be preferred, since it does not entail the rejection of naturalism. With regard to this issue, my response is two-fold. Firstly, the overall aim of temporal essentialism is to show that there is a version of anti-Humeanism that does not collapse into Barker's brute modalism. Given that anti-Humeanism as a whole is at stake in Barker's *The Emperor's New Metaphysics of Powers*, if temporal essentialism is a distinctive version of anti-Humeanism, then this position is of dialectical interest whether or not it requires the rejection of naturalism. Hence, even if the Platonic conception of universals is found wanting, I will have shown—or at least I hope to show—that a distinctive version of anti-Humeanism is closely connected to this theory, which I take to be, in itself, a useful development of the properties and laws debate. Secondly, however, the advantage that Tooley's necessitation theory holds over Armstrong's necessitation theory translates for temporal essentialism. That is to say, in those cases where a 'cause' property is not instantiated at any time, temporal essentialism can provide a truthmaker for this uninstantaited law. More specifically, I can say that, in virtue of the temporal essences of objects, the state of affairs $(F,G) is a truthmaker for the counterfactual conditional 'If at time t^n object *x* were to be F, then at time t^{n+1} object *y* would be G'. Accordingly, if Armstrong's strategy of indeterminate counterfactuals is found wanting, then temporal essentialism will be no worse off than Tooley's necessitation theory. All in all, then, I consider the Platonic universals of temporal essentialism to be a possible disadvantage of my position—given the desirability of naturalism—that is nevertheless non-fatal. I note with regard to this issue that Bird (2007, pp.50–9) and Fales (1990, pp.216–20) have also attacked Aristotelian versions of anti-Humeanism for failing to provide truthmakers for uninstantiated laws. So there is a degree of controversy in the properties and laws debate over the relative importance of accepting Platonic universals as truthmakers for uninstantaited laws versus the rejection of these entities for the sake of naturalism.

More importantly, however, Tugby (2013) has recently argued that dispositional essentialism requires Platonic universals as oppose to tropes or Aristotelian universals. If sound, his argument shows that the central version of anti-Humeanism in the properties and laws debate (i.e. dispositional essentialism) entails the rejection of naturalism. It follows, I think, that the above concern is diminished. If dispositional essentialism requires Platonic universals, then—

Aristotelian necessitation theories aside—it cannot be a comparative disadvantage of temporal essentialism that it also requires these entities. The basic idea of Tugby's argument is two-fold. In the first part, he investigates the question of how different ontologies can understand the dispositional essentialist principle that a dispositional property is individuated in terms of its manifestation property. A first line of thought draws upon manifestation relations, such that a 'real' second-order relation necessarily holds between a dispositional property and its manifestation property. Briefly stated, Tugby argues that the trope ontology suffers a disadvantage of parsimony in comparison to the ontologies of Aristotelian and Platonic universals, since the former approach requires a distinct second-order relation for each dispositional property—given that that dispositional properties and second-order relations *qua* tropes are particulars—whereas the latter approaches can posit a single second-order relation. In addition, however, drawing upon either tropes or Aristotelian universals gives rise to a special difficulty where the manifestation property is unmanifested. More specifically, given that tropes and Aristotelian universals cannot exist uninstantiated, if the manifestation property is unmanifested, then the second-order relation lacks its second relatum, which problematizes its status as a 'real relation'.

At this point, Tugby notes that trope ontologies have typically rejected the 'manifestation relation approach'. In contrast, Heil (2003, p.80) and Martin (2007, p.29) have sought to understand dispositional properties in terms of 'directedness'. Tugby argues, however, that this approach fails to engage with Armstrong's (1997, p.79) 'Meinongian problem' of how (actual) dispositional properties can 'point beyond themselves' to their (merely possible) unmanifested manifestation properties. In short, Tugby complains, justifiably in my opinion, that neither Heil nor Martin 'cash out' the directedness approach. (I note that a parallel criticism is raised, in effect, by Bird (2007, pp.118–26) with regard to Molnar's proposal that dispositional properties are directed towards their manifestation properties with a 'physical intentionality'). In addition, Tugby dismisses the alternative view that the unmanifestated manifestation property is a 'possible existence'. This appeal to 'possibilia' is made by Bird (2007, pp.111–14). As we discussed in Chapter 3, Bird accepts a version of Linsky and Zalta's (1994) and Williamson's (1998) thesis that all metaphysical possibilities are actual, such that some of these possibilities are 'contingently concrete' whereas the rest are 'contingently abstract'. With regard to tropes and Aristotelian universals, this alternative view would provide a second relata for the manifestation relation in the case of unmanifested

manifestation properties. But it is dismissed by Tugby on the grounds that a central advantage of dispositional properties—*viz*. that these entities can serve as actual truthmakers for modal truths—is no longer utilised, since actualism, at least as it is standardly construed, is abandoned. As we shall discuss in the next chapter, temporal essentialism is a 'strict' version of actualism that does not involve 'possible existences' or 'contingently abstract' actual entities. So construed, Platonic universals are actual entities that are essentially non-spatiotemporal. (I am grateful for discussion with Matthew Tugby on this matter.)

The second part of Tugby's argument aims to show that two "platitudes" of dispositions cannot be upheld without the use of Platonic universals. The first platitude is that objects can instantiate unmanifested dispositions; the second platitude is that a number of dispositions are instantiated by objects intrinsically. Briefly stated, Tugby sets out a thought experiment whereby the external circumstances of a putative intrinsic disposition, D, which is instantiated by a given object, *a*, are modified such that the world contains no manifestations of D. As we noted above, Tugby argues that the ontologies of Aristotelian universals and Platonic universals share the advantage—over the ontology of tropes—that a single second-order relation can account for the identity of a dispositional property. In this thought experiment, however, the Aristotelian ontology cannot posit a second-order relation, since the manifestation property is uninstantiated and therefore does not exist. Accordingly, the Aristotelian version of dispositional essentialism cannot accept the two platitudes of dispositions: the second-order relation requires that the external circumstances of dispositional properties are such that there is at least one manifestation property. I agree with Tugby's arguments against the trope ontologies and the 'relational approach' for the Aristotelian ontologies.

8.5 The four kinds of being in temporal essentialism

For these reasons, I shall set out a simple system of ontological categories that approximates Tooley's (1987, pp.118–22) 'Platonic factualism' to the extent that the requirements of temporal essentialism permit. The basic idea of Tooley's Platonic factualism is that we should recognise objects and Platonic universals as contingently existing entities, whilst rejecting the 'strict' factualist thesis that these kinds of beings are 'mere abstractions' from states of affairs. This

position is based upon the thesis that only entities with 'intrinsic natures' can exist independently. The motivation for Tooley's Platonic factualism is as follows. Firstly, in line with the Platonic thesis that universals are transcendent, these entities are thought to have intrinsic natures (*qua* qualitative natures) in virtue of their categorical status. In this way, Platonic universals can exist independently. Secondly, however, Tooley aims to secure the idea that objects cannot exist as 'bare' objects. The above thesis is also thought to support this idea, since he takes first-order properties to provide objects with intrinsic natures in light of their categorical status. So all objects are required to instantiate at least one first-order property if they are to independently exist as 'substances'. And in the third place, Tooley aims to secure the idea that objects cannot exist as 'bare' objects, even if these entities stand in first-order relations. (The reasoning is that objects would not have intrinsic natures if they did not instantiate first-order properties.) He claims that it is difficult to motivate this third idea on the basis of a 'strict' reading of factualism, since, in this context, properties are standardly construed as 'one-place' relations. So construed, however, the two states of affairs *a*'s being F and *b*'s having R to *c* are unified in that they both feature 'relations holding between objects'. For these reasons, Tooley rejects a 'strict' reading of factualism and proposes that we should recognise objects and Platonic universals as entities that can contingently combine into states of affairs (Tooley 1987, pp.118–9). Given that I agree with these ideas, Tooley's Platonic factualism is a good starting point for temporal essentialism; furthermore, the adoption of his position aligns well with my focus upon his growing block model of time.

I shall now describe the different kinds of beings in the basic ontology of temporal essentialism. Let us begin with objects, first-order properties, and the B-relation. The instantiation of a first-order property (or B-relation) by a given object (or objects) is termed a first-order state of affairs.

(i) *x* is X [a given object instantiating a given first-order monadic universal]
(ii) *x*'s having B to *y* [a given pair of objects instantiating the B-relation]

In addition, I shall construe instantiation as a formal ontological relationship, in line with Lowe's formal posits. We shall discuss Lowe's form–content distinction in Chapter 10, but we can recall from the introduction that a formal ontological relationship is a way that kinds of being can combine in virtue of their real essences. At this stage there are two possible ways of combination

with regard to objects and Platonic universals. Firstly, one member of the ontological category of objects can combine with one member of the ontological category of Platonic universals to give a monadic state of affairs, as per (i) above. And secondly, two members of the ontological category of objects can combine with one member of the ontological category of Platonic universals to give a dyadic state of affairs, as per (ii). Given that first-order properties and the B-relation have these different possible ways of combination, I think that the clearest strategy is to break up first-order Platonic universals into two ontological categories: monadic properties and the dyadic B-relation. In short, I want to rule out the following types of states of affairs without accepting the factualist thesis that objects and properties/relations are 'mere abstractions' from states of affairs.

(iii) *x* is B [a given object instantiating the B-relation]
(iv) *x*'s having X to *y* [a given pair of objects instantiating a given first-order monadic property]

With this in mind, I propose that it is essential to objects and first-order properties that they can combine as per (i), whereas it is essential to objects and the B-relation that they can combine as per (ii).

I also propose that there are no 'bare' objects: all objects instantiate at least one first-order property. I shall understand this requirement in terms of Lowe's 'non-rigid' existential dependence relationships. As we shall discuss in Chapter 10, these dependence relationships are formal ontological relationships that are 'constituted' by other (more fundamental) formal ontological relationships—in this case instantiation. At this stage, however, we can say that each object depends for its existence upon the instantiation of some first-order property, without the object depending for its existence upon the instantiation of a specific first-order property (cf. Lowe 2006, p.36). So construed, objects have a non-rigid existential dependence upon first-order properties. Simply speaking, then, as we examine the members of the ontological category of objects, we will see that every object stands in the instantiation relationship to at least one first-order property.

With regard to the B-relation, I do not require a parallel existential dependence. That is to say, objects in temporal essentialism do not have to stand in this first-order relation. My motivation is as follows. A simple cosmology for temporal essentialism is that there is a first time, whereby a

contingent arrangement of states of affairs are actualised. Given this contingent arrangement, the temporal imperative will actualise states of affairs with the passage of time, as we have described. At this first time, however, there will be no earlier or later times and so there will be insufficient objects for the places for the B-relation.

To summarise. At this point I have proposed that objects can instantiate first-order properties and the B-relation, such that these kinds of being can combine into first-order states of affairs. I have also proposed that there are no 'bare' objects: each object depends for its existence upon the instantiation of some first-order property, without depending for its existence upon the instantiation of a specific first-order property. And lastly, I proposed that objects do not have a non-rigid existential dependence upon the places of the B-relation.

We can see that these three proposals distinguish three ontological categories in the following way. Firstly, there is a distinction between objects and Platonic universals: the former can only exist dependently whereas the latter can exist independently. Hence, if we examine the members of the ontological category of Platonic universals, it is not required that every Platonic universal is instantiated. Secondly, however, there a distinction between first-order properties and the B-relation, since combinations of the former kinds of being involve pairs of entities (e.g. *a* is F), whilst combinations of the latter kinds of being involve triples of entities (e.g. *a*'s having B to *b*).

With regard to the fourth kind of being—i.e. the selection relation, I use a distinct formal ontological relationship, which I term 'characterisation' (this use of the term is unrelated to Lowe's formal posit). The selection relation can characterise first-order properties but not (i) objects or (ii) the B-relation. Let us term this type of combination a second-order state of affairs.

(v) $(X,Y) [The selection relation characterising a given pair of first-order properties]

My motivation for using a distinct formal ontological relationship is two-fold. Firstly, as we have noted, this basic ontology is not a version of the 'strict' factualist thesis that properties/relations are 'mere abstractions' from states of affairs. As such, the line of thought that second-order relations can be instantiated by first-order properties, such that these relata are 'second-order objects' relative

to the second-order relation, is unavailable. According to this simple system of ontological categories, objects are existentially dependent entities, not merely the possible relata of relations. To clarify, objects are existentially dependent entities, whilst all Platonic universals—including first-order properties—are existentially independent. (Note that this entails that it is not necessary that the first-order properties stand in either place of the selection relation.) In addition, as we shall discuss in the next chapter, first-order states of affairs are actualised by the temporal imperative as time passes. Briefly stated, if it is the case that object *a* is present and that *a* instantiates property F where it is also the case that $(F,G), then the temporal imperative will actualise two states of affairs at the next present moment: *a*'s having B to *b* and *b*'s being G. In contrast, however, second-order states of affairs are not actualised as time passes, because these states of affairs concern first-order Platonic properties standing in a second-order Platonic relation (i.e. because these states of affairs concern essentially non-spatiotemporal entities). As the temporal status of first-order and second-order states of affairs is different, I think that the clearest strategy is to posit a distinctive formal ontological relationship—*viz*. characterisation—for second-order states of affairs. Simply stated: the holding of the instantiation relationship is temporal and changeable, whereas the holding of the characterisation relationship is non-temporal and fixed.

9

Temporal Essentialism II

9.1 Introduction

In this chapter I want to continue our discussion of temporal essentialism. I shall discuss Tooley's growing block model and explain the use of this theory of time in temporal essentialism.

9.2 Tooley's growing block model

In his (1997) book *Time, Tense, and Causation*, Tooley sets out his version of the 'no-future' theory of time (cf. Broad 1923). The basic idea of Tooley's growing block model is that past and present states of affairs are actual whereas future states of affairs are non-actual; in addition, actual states of affairs are (dynamically) indexed to times, such that states of affairs are actualised at the present moment with the passage of time. Tooley's central argument for his growing block model draws upon a thesis concerning singular causation and probability. The overall picture is that states of affairs can only be causally related in a world that approximates—to a significant degree—the growing block model. In addition, Tooley claims that his growing block model can avoid McTaggart's paradox and the argument from special relativity, which are two principle dangers for a dynamic theory of time (1997, pp.303–73).

First and foremost, Tooley's growing block model is a non-standard tensed theory of time. In his discussion, Tooley proposes that the standard way of distinguishing between tenseless and tensed theories of time is to draw out their opposing stances on the relative priority of tenseless versus tensed concepts/states of affairs. Roughly speaking, tensed concepts involve, either directly or indirectly, McTaggart's A-series predicates. For example, the proposition 'Event E took place five minutes ago' is a tensed proposition, since it indirectly draws upon the concept of the present: the

qualifier 'took place five minutes ago' signifies that E is five minutes past (relative to the present). And correspondingly, tensed states of affairs make use of the ontological correlates of McTaggart's A-series predicates—e.g. object *x* is present *qua* the state of affairs *x*'s having the property of presentness. With this in mind, a tenseless theory of time will standardly take tenseless concepts to be semantically prior to tensed concepts, such that the truth conditions for a tensed proposition can be specified via propositions that only contain tenseless concepts. In addition, the truthmaker for the proposition 'Event E took place five minutes ago' will be a tenseless state of affairs, i.e. the state of affairs that E stands in a (tenseless) relation of 'five minutes later than' to the proposition in question (Tooley 1997, p.17).

In contrast, however, a tensed theory of time will standardly take tensed concepts to be semantically prior to tenseless concepts. Hence, a tenseless proposition—e.g. 'There are (tenselessly) dinosaurs'—will be analysed into the tensed proposition 'Either there were dinosaurs, or there are (now) dinosaurs, or there will be dinosaurs'. In addition, a tensed theory of time will take the truthmaker for the tenseless proposition 'There are (tenselessly) dinosaurs' to be a disjunction of tensed states of affairs—i.e. either dinosaurs are past, or dinosaurs are present, or dinosaurs are future (Tooley 1997, p.18).

According to Tooley, the relative priority of tenseless versus tensed concepts/states of affairs is the standard way of distinguishing between tenseless and tensed theories of time. But a second way of distinguishing between these theories concerns whether the world is static or dynamic. Briefly stated, a theory of time is static if the totality of states of affairs are temporally fixed; in contrast, a theory of time is dynamic if the totality of states of affairs are different at different times (Tooley 1997, p.13–20). At this point Tooley argues that if tensed concepts are semantically basic and tensed states of affairs are ontologically basic, in accordance with a standard tensed theory of time, then the world must be dynamic. In other words, a tensed theory of time, as standardly construed, requires a dynamic conception of reality whereby the totality of states of affairs are different at different times. In outline, his argument is that, given a tensed theory of time, two tokens of the utterance 'Event E is present' that are uttered at different times will express the same (primitively tensed) proposition. But if the totality of states of affairs are temporally fixed in line with a static conception of reality, then the token utterances will either both be true or both be false

(Tooley 1997, pp.18–9). Crucially, however, Tooley argues that if tenseless concepts are semantically basic and tenseless states of affairs are ontologically basic, in accordance with a standard tenseless theory of time, then the world can be either static or dynamic. Confusingly, perhaps, Tooley's growing block model is a non-standard tensed theory of time in the sense that it combines a tenseless approach to semantics and ontology with a dynamic conception of reality. All in all, then, Tooley is breaking apart the 'standard' pairing of (i) tenseless approaches to semantics/ontology with a static framework and (ii) tensed approaches to semantics/ontology with a dynamic framework. (Tooley's term for his growing block model as a 'tensed' theory of time suggests that he takes the second way of distinguishing between tenseless and tensed theories of time, i.e. via the static–dynamic distinction, to be a more important method of distinction than the question of the relative priority of tenseless versus tensed concepts/states of affairs.)

> If tenseless temporal concepts, such as temporal priority, are semantically basic, does it follow that the world is a static one? It is hard to see why it does. In order for the world to be a dynamic one, all that is required is that the [totality] facts that are actual as of one time differ from the [totality of] facts that are actual as of some other time. There is no need for that difference to be a difference with respect to irreducible tensed facts. It may simply be a matter of change, over time, with respect to what tenseless states of affairs have become actual (Tooley 1997, p.19: my square brackets—see below).

With regard to the static–dynamic distinction, Tooley suggests that the "most fundamental question in the philosophy of time is whether a static or dynamic conception of the world is correct" (1997, p.13). We can think of this issue in the following way. In a four-dimensional Minkowski space-time, which is a standard model for the static conception, there can be different states of affairs at different times. That is to say, the states of affairs in one three-dimensional cross-section can be different from the states of affairs in another three-dimensional cross-section. But if we think of the totality of states of affairs—i.e. the states of affairs at all spatiotemporal locations—then it would be a mistake to say that this totality could be different at different times, since, according to the Minkowski model, these different times, or at least their contents, make up the totality of states of affairs in question (McCall 2001, p.14). According to the dynamic conception, however, the world as a whole can be different at different times. Below is a useful citation from

Tooley that explains his distinction between the static and dynamic conceptions with regard to change.

> [T]he difference between a static conception of the world and a dynamic one comes to this. According to a static conception, what states of affairs there are does not depend upon what time it is. Change, consequently, cannot be a matter of a change, over time, in what states of affairs exist. It must be a matter simply of the possession, by an object, or by the world as a whole, of different intrinsic properties at different times. According to a dynamic conception of the world, by contrast, what states of affairs exist does depend upon what time it is. As a consequence, the totality of monadic states of affairs which exist as of one time, and which involve a given object, may differ from the totality that exists of some other time, and it is precisely such a difference that constitutes change in an object, rather than merely the possession by an object of different properties at different times. Similarly, change in the world as a whole is a matter of a difference in the totality of states of affairs that exist as of different times, and not merely a matter of the possession of different properties by different temporal slices of the world (Tooley 1997, p.16).

On this basis, Tooley introduces his concept of 'actuality at a time' in opposition to the concept of 'actual simpliciter' (1997, pp.39–42). The concept of actuality at a time is a temporally-indexed concept of actuality. Given that a state of affairs can be actual at a time, as oppose to actual simpliciter, it can be non-actual at different times. This is the primary purpose of the concept of actual at a time. On the basis of Tooley's growing block model, whereby past and present states of affairs are actual but future states of affairs are non-actual, if a state of affairs is actual at a time, then it will be actual at all later times. (In contrast, a version of classical presentism may take a state of affairs to be non-actual at a time t^n, actual at a time t^{n+1}, and non-actual at time t^{n+2} as the state of affairs moves from the future to the past via the present) Simply speaking, as time passes in Tooley's growing block model, the past 'grows' and the present is the latest 'growth' at each moment of time. Accordingly, if a state of affairs is actualised at a present moment, then it will remain actual at the next present moment, although it will be a past state of affairs.

Tooley accepts his concept of actual at a time as primitive. In addition, he argues that the opposing

concept of actual simpliciter, which is drawn upon by static theories of time, also has to be taken as primitive, such that there is no comparative disadvantage for his growing block model and its concept of actual at a time. In short, Tooley's argument is that the analysis of the concept of actual simpliciter via the concept of tenseless existence is uninformative, since existential quantification and the range of the existential quantifier stand in need of analysis (Tooley 1997; pp.37–9; Tooley 2001, p.47). That said, however, Tooley also accepts the concept of actual simpliciter as primitive. Accordingly, he accepts both the concepts of actual at a time and actual simpliciter as primitive. There are two central reasons for Tooley's acceptance of the concept of actual simpliciter. The first reason is that this concept is required for non-temporal entities; in particular, Tooley construes propositions and Platonic universals as non-temporal entities (1997, p.40). To say that a Platonic universal is actual simpliciter is to say that the actuality of this entity cannot be indexed to a time, which is line with the view that Platonic universals are essentially non-spatiotemporal entities (cf. Smith 2001, p.22). The second reason is that Tooley argues that his dynamic theory of time can make sense of the concept of future (non-actual) states of affairs, as well as the totality of what is actual at a given time. Tooley draws upon the concept of actual simpliciter for these roles. This is a controversial move, which is criticised by Oaklander (2001, p.10), Smith (2001, p.22), and Sider (2001, p.23–5). The citation below is, I think, the clearest presentation of Tooley's line of thought.

> To make sense of the idea of a dynamic world, one needs the idea of states of affairs that are actual at a time. But suppose that the time in question is later than the present—such as January 1, 2010. Can one make sense of the idea of states of affairs that are actual as of January 1, 2010? To argue that someone who accepts the view that the world is dynamic cannot make sense of the idea of states of affairs that are actual as of January 1, 2010, it would seem that one must argue that such a person can make no sense of the idea of times that are later than the present, and I see no reason to accept that claim. But suppose, then, that one can make sense of the idea of states of affairs that are actual as of January 1, 2010. Surely one can also make sense, in that case, of the idea of states of affairs such that there is *some* time *t* such that the states of affairs are actual as of time *t*. Can one then form the mereological union of all such states of affairs? ... [I]f there are no intrinsic tensed properties, then states of affairs that are actual as of one time will be consistent with states of affairs that are actual as of any other time, and so one will have a consistent whole that consists of all

and only states of affairs that are actual as of one time or another (Tooley 2001, p.43: original italics).

In this way, Tooley draws upon the concept of actual simpliciter to make sense of a "total" dynamic (1997, p.40). A total dynamic world stands in contrast to a dynamic world at a given time, which trades upon the concept of actual at a time. In other words, concrete states of affairs that are actual as of 'some time *t*' are actual simpliciter. Given that Tooley's concrete states of affairs are tenseless—note that his abstract states of affairs, i.e. his laws, are also tenseless—the mereological whole of concrete states of affairs that are actual simpliciter is "consistent" (Tooley, 2001, p.42). Simply speaking, the 'content' of Tooley's growing block model, to use Lowe's term, 'fits together'. This is a point of importance, since a theory of time that uses tensed states of affairs—e.g. Smith's (2002) 'degree presentism' or Lowe's (1998) and Dummett's (2003) 'moving tense' theories—would not facilitate a consistent mereological whole of states of affairs that are acutal simpliciter: there would be McTaggart-style contradictions for the A-series properties. So the rejection of tensed states of affairs and the acceptance of the concept of actual simpliciter are closely connected.

9.3 Tooley's argument for his growing block model

As we noted above, Tooley's central argument for his growing block model draws upon a thesis concerning singular causation and the transmission of probability. This is a complex argument that is connected to Tooley's (1987) *Causation: A Realist Approach*. Stated briefly, however, the two stages of the argument run as follows.

In the first stage, Tooley develops a theory of causation and laws that trades upon three theses. The first thesis is that a realist approach to causation is correct. To this end, Tooley rejects reductive approaches to causation, whereby causal relations logically supervene upon the non-causal properties and/or relations of objects. (Note that Tooley also distinguishes a 'weaker' version of causal reductionism according to which causal relations logically supervene upon the non-causal properties and/or relations of objects together with causal laws. He rejects both the 'strong' and 'weak' versions of causal reductionism.)

Tooley sets out three arguments against causal reductionism. By way of illustration, the first argument concerns the issue of the direction of causation. Tooley notes that the actual spatiotemporal distribution of events is standardly called upon by causal reductionists to explain the direction of causation. In particular, Reichenbach (1956, pp.117–43: cited in Tooley 1997, p.86) makes use of entropic increase to understand the direction of causation. With this in mind, Tooley outlines a "possible causal world" in which a single particle causes successive temporal parts of itself (1997, p.86). Given that there is no entropic change in this counterexample, however, Tooley concludes that the causal reductionist (in this case Reichenbach) is forced to take a realist stance towards the direction of time. The line of thought is that, in response to this counterexample, the causal reductionist can only understand the direction of causation in terms of the direction of time, since the 'spatiotemporal distribution of events' in unsuitable for reductively explaining the direction of causation. According to Tooley, however, this escape route is multiply problematic. The basic issue is that Tooley defends a causal theory of time, whereby the direction of time is understood in terms of the direction of causation (1997, pp.254–300). This leads Tooley to reject a number of ways in which the causal reductionist might attempt to understand the direction of causation in terms of the direction of time. For example, he rejects the view that the asymmetry of a B-series earlier–later relation can account for the direction of time, since the asymmetry of this relation does not, in itself, distinguish between the past–future direction as oppose to the future–past direction (Tooley 1997, p.86). On the basis of these considerations, Tooley proposes that there is a *prima facie* motivation for rejecting causal reductionism in favour of causal realism. In addition, however, he argues that the causal relation is unobservable. And so it is suggested—on traditional empiricist grounds—that a realist theory of causation requires a successful analysis of the meaning of the term 'causal relation' (where the entity denoted by this term is construed as a theoretical posit). Given that Tooley believes that he can set out the required postulates to successfully analyse the causal relation (see below), he proposes that causal realism is a defendable thesis in the philosophy of causation (1997, p.99).

At this point Tooley develops the second thesis of his theory of causation and laws—*viz*. a singularist theory of causation. Tooley discusses a number of postulates for a singularist theory of causation that could disclose the "crucial analytical connections" for the causal relation (1997, p.99). Given the context of a singularist theory of causation, Tooley's examines postulates that do

not refer to causal laws. For this reason, Hume's approach of combining the postulates of temporal priority and spatial contiguity with a postulate of constant conjunction is rejected, since drawing upon general regularities, Tooley notes, is to draw upon causal laws. His preferred alternative is to indirectly describe the relation of causation. "Causation is that unique relation between events or states of affairs such that, if there are laws involving that relation, those laws must satisfy ... a certain set of postulates" (Tooley 1997, p.101). This line of thought draws upon the following steps. In the first place, Tooley makes a two-fold assumption: (i) states of affairs can stand in the causal relation without falling under a causal law, and (ii) it is logically possible that there are both causal and non-causal laws. In the second place, he reasons from these assumptions that the general concept of a law should be analysed without making use of causal concepts. In the third place, Tooley suggests that causal laws can be defined as those laws that "involve the relation of causation" (1997, p.100). And in the fourth place, he proposes that causal laws may be distinguished from non-causal laws not only in that the former uniquely involve the relation of causation, but also via a necessary truth. The necessary truth in question is that causal laws, as oppose to non-causal laws, satisfy a set of postulates. In short: "The idea is that if a law satisfies those postulates then it is a causal law, and if it is a causal law then it involves a causal relation" (Oaklander 2001, p.5). The third thesis of Tooley's theory of causation and laws, then, is that it is a necessary truth that causal laws satisfy his set of postulates.

What is the set of postulates? There are four postulates in question, which are discussed in Tooley's *Causation: A Realist Approach* (1987, pp.291–6). They are termed '(C_1), (C_2), (C_3), and (C_4)'. These postulates concern the 'transmission of probabilities' from causes to effects. According to (C_1)–(C_4), the logical relation between 'prior probabilities' and 'posterior probabilities' is different for the causes than it is for effects (Tooley 1997, p.61). The set of postulates are designed for two states of affairs, *x*'s being P and *y*'s being Q—henceforth P and Q, respectively—where P is causally sufficient for Q. With this in mind, the prior probability of a state of affairs is construed, roughly speaking, as the logical probability of that state of affairs in isolation from the information that P is causally sufficient for Q. And correspondingly, the posterior probability of a state of affairs is construed as the logical probability of that state of affairs where the information that P is causally sufficient for Q is taken into account. The central postulates are (C_1) and (C_4). According to (C_4), "the posterior probability of an effect depends upon the prior probability of the cause"

(Tooley 1997, p.107). In contrast, however, (C_1) states that "the posterior probability of a cause does not depend upon the prior probability of its effect" (Tooley 1997, p.108).

> ... [C]ausal laws must satisfy postulates (C_1) through (C_4)—postulates which entail that, if a type of event with a very low prior probability turns out to be caused by a type of event with a much higher prior probability, then the former type of event must be assigned a posterior probability that is at least as high as the prior (and also posterior) probability of the type of event that is its cause. So if ... the existence of two electrons a mile apart [relatively likely] is causally sufficient to bring about the existence of a solar system in a very precise and complex state [relatively unlikely], the latter state of affairs is no longer astronomically improbable; on the contrary, its probability is quite high (Tooley 1997, pp.105–6: my square brackets).

On the bais of (C_1)–(C_4), the second stage of Tooley's argument aims to show that this form of explanation for otherwise improbable states of affairs presupposes his growing block model, or at least a theory of time that approximates it to a significant degree. In the first step of the argument, Tooley set out his diachronic model of laws. According to this diachronic model, P is causally sufficient for Q in that P at t^n is causally sufficient for Q at t^{n+1}. And in the second step of the argument, Tooley investigates the question of how different theories of time can explain his postulates—in particular his central postulates of (C_1) and (C_4). At this point Tooley draws upon a view of the necessitation theory that is set up for his growing block model.

> How can there be causal laws that conform to postulates (C_1) through (C_4)? The basic answer that I am proposing is this. Causal laws are not merely patterns that events exhibit, for, as I argued earlier, a reductionist account of causation is untenable. Causal laws, rather than being merely regularities in the history of the world, *control* the course of history; they underlie, and account for, any patterns that the world may exhibit over time. But how is this control to be understood? One way—and, I think, the only satisfactory way—is if causal laws, in conjunction with what is actual as of a given time, determine what states of affairs are then added to what is already actual, thus determining what exists, in a tenseless sense (Tooley 1997, p.111: original italics)

I shall term this view 'Tooley's dynamic necessitation theory'. With regard to the central postulates of (C_1) and (C_4), Tooley argues that his dynamic necessitation theory can explain why the transmission of probabilities is different for causes than it is for effects. Let us recall that P and Q both have prior probabilities—i.e. logical probabilities that are isolated from the information that P is causally sufficient for Q. With this in mind, Tooley sets out the following scenario.

P is actual at t^n
Q is non-actual at t^{n+1}

In this scenario, the causal law that P is causally sufficient for Q is non-actual—i.e. the second-order state of affairs N(P,Q) is non-actual. The basic idea of Tooley's discussion, however, is to investigate the question of how to modify this scenario in order to accomodate the assumption that the causal law that P is causally sufficient for Q is actual.

On the basis of his dynamic necessitation theory, whereby causal laws together with present states of affairs actualise states of affairs at the next present moment, Tooley argues that he can explain why, if the causal law that P is causally sufficient for Q were actual, then the posterior probability of Q at at t^{n+1} would be dependent upon the prior probability of P at t^n. This is in line with postulate (C_4). The explanation is that, given his dynamic necessitation theory, the causal law N(P,Q) actualises Q in response to P. In other words, for the reasons that P is present and that it is the case that N(P,Q), Tooley's dynamic necessitation theory rules that Q should be added to the world at the next present moment, such that the prior probability of P is 'transmitted' to the posterior probability of Q. This is important, Tooley argues, since the alternative modification, which also makes this scenario consistent with the assumption that N(P,Q) is actual, is to remove P from the world. So construed, both P at t^n and Q at t^{n+1} are non-actual. Problematically, however, this modification is to violate postulate (C1). This is because removing P from the world is to modify the scenario so that the posterior probability of a cause depends upon the prior probability of its effect. More specifically, it is to modify the scenario so that " ... the posterior probability of the non-occurrence of a cause depends upon the prior probability of the non-occurrence of an effect ... " (Tooley 1997, p.109). With this in mind, Tooley argues that the two modifications are equally

legitimate for both static theories of time and versions of presentism (1997, p.108).

According to his dynamic necessitation theory, however, there is a two-fold explanation as to why the first modification—i.e. the addition of Q to the world—is uniquely legitimate. Firstly, if future states of affairs are non-actual, in line with the growing block model, then at t^n the only state of affairs that is actual is *x*'s being P. It follows, Tooley argues, that the non-occurrence of the state of affairs *y*'s being Q is non-actual at t^n. (As such, there is a principled reason for not removing P to modify the scenario.) And secondly, as noted above, if past states of affairs are actual, then the state of affairs *x*'s being P is actual at t^{n+1}. Accordingly, if t^{n+1} is the present moment, then the causal law N(P,Q) actualises the state of affairs *y*'s being Q in response to the past state of affairs *x*'s being P. All in all, then, the basic idea of this discussion is that Tooley's dynamic necessitation theory can explain why the 'transmission of probabilities' is different for causes than it is for effects in light of its concept of actual at a time and the 'actualisation role' of causal laws.

9.4 Temporal essentialism and Tooley's growing block model

In this section of the chapter I shall explain the use of Tooley's growing block model in temporal essentialism. Let us recall that the basic idea of temporal essentialism is that the temporal imperative provides a time-based metaphysical explanation for lawful regularities. More specifically, the 'leading actor' of temporal essentialism—*viz*. the temporal imperative—is a formal ontological operation that is sensitive to physical modality. In addition, let us recall that the temporal imperative can be modelled using the following imperative sentence. (Note that $ and B are constants, whereas *x*, *y*, X, and Y are variables.)

> Temporal imperative: If object *x* is present and *x* instantiates property X, where X stands in the first place of the selection relation $, then actualise! object *y*, such that *x* instantiates the B-series earlier–later relation B to *y*, and such that *y* instantiates property Y, where Y stands in the second place of $ as a function of X.

Simply speaking, temporal essentialism is the position that it is 'built into' a system of ontology that it dynamically 'constructs' states of affairs in a lawful way. More specifically, the states of

affairs that are actualised as time passes are a function of present states of affairs in tandem with laws, where the latter are construed as the selection relation holding between pairs of first-order properties.

With this mind, both objects and first-order states of affairs draw upon Tooley's concept of actual at a time. Let us consider a token object, *a*, that is present—i.e. a token object that stands in the second place of the B-relation without standing in its first place. (Let us disregard, for the sake of simplicity, the complication for this model that concerns a possible first time.) If this token object instantiates a first-order property that stands in the first place of the selection relation, then the temporal imperative actualises two states of affairs: *a*'s having B to *y* and *y*'s being Y. Given the structure of time in temporal essentialism, whereby 'chains' of temporal parts are composed from the B-relation, if object *a* is present, then object *a* is the latest 'growth' in the growing block of states of affairs. Let us therefore say that the state of affairs *a*'s being F is actual at t^1 and that t^1 is the present moment. We can think about this scenario in the following way. (As we shall discuss, the asterisked entities and states of affairs draw upon Tooley's concept of actual at a time. In addition, I use the elipsis to denote arbitrary objects.)

Members of ontological categories:

Objects* (t^1): *a*, ...

First-order properties: F, G

The first-order relation: B

The second-order relation: $

States of affairs:

Monadic first-order states of affairs* (t^1): *a* is F

Dyadic first-order states of affairs* (t^1): ...'s having B to *a*

Second-order states of affairs: $(F,G)

Given the assumption that *a* is present (i.e. given the actuality of the state of affairs ...'s having B to *a* and the non-actuality of the state of affairs *a*'s having B to ...), together with the assumption that it is both the case that *a* is F and $(F,G), the condition of the temporal imperative is true.

Accordingly, its performable operation is 'triggered'. As noted, this performable operation is to actualise two states of affairs: *a*'s having B to *y* and *y*'s being Y. (Given that it is the case that $(F,G), Y = G). These states of affairs are actualised in the following way. Firstly, a token entity, *b*, is added to the ontological category of objects. And secondly, two 'ways' of combinations for objects and Platonic universals, i.e. two first-order states of affairs, are constructed: (i) B is instantiated on *a* and *b*, and (ii) the second place of $ (i.e. G) is instantiated on object *b*. The outcome of the performable operation is shown below.

Members of ontological categories:

Objects* (t^2): *a*, *b*, ...

First-order properties: F, G

The first-order relation: B

The second-order relation: $

States of affairs:

Monadic first-order states of affairs* (t^2): *a* is F, *b* is G

Dyadic first-order states of affairs* (t^2): ...'s having B to *a*, *a*'s having B to *b*

Second-order states of affairs: $(F,G)

At this stage it is important to note two points. Firstly, let us recall that the temporal imperative is making use of variables for both objects and first-order properties. This is important, because I want the temporal imperative to actualise multiple states of affairs at a single present moment in response to multiple 'cause' objects. Let us term a synchronic actualisation of states of affairs in virtue of the temporal imperative a 'content update' (see below). With this in mind, if there are *n* 'cause' objects that are present, then the temporal imperative will actualise 2*n* states of affairs at the next present moment. More specifically, for each 'cause' object, the temporal imperative will introduce a token entity into the ontological category of objects, instantiate the B-relation on each cause 'object' and these newly-introduced objects, and instantiate the relevant 'effect' property on each newly-introduced object. (This is why I call upon the selection relation to provide a function (in the sense of a unique mapping) from its first place to its second place: given that the selection relation is a universal, a single second-order relation can provide the 'instructions' for multiple

diachronic regularities). All in all, then, each content update is the actualisation of 2*n* states of affairs for *n* 'cause' objects. In addition, although the standard model of laws for temporal essentialism is diachronic, we can nevertheless say that a content update is a synchronic actualisation of multiple states of affairs. This is because all of the states of affairs that are actualised by the temporal imperative in a single 'performance' of its operation are actualised at a single time—*viz*. at the present moment.

And secondly, I should clarify how the present moment is understood in temporal essentialism. My line of thought is that each content update assigns a new temporal index to both the ontological category of objects and the first-order states of affairs. We can think about this proposal in the following way. Firstly, let us say that objects and first-order states of affairs can be actual at a time. Given that first-order states of affairs are ways that objects and Platonic universals can combine, this is to say that a given combination of these entities can be actual at a time. (Let us recall that first-order states of affairs are concrete states of affairs, since these types of combination involve objects.) Secondly, for the reason that Tooley's concept of actual at a time is a temporally-indexed concept of actuality, we can say that objects and first-order states of affairs are indexed to a positive integer, i.e. a value of the temporal index. Hence, the state of affairs *x*'s being X is actual at a time, t^n, where the value of the temporal index, *n*, is a positive integer. As noted, both objects and first-order states of affairs are actual at a time (see asterisks).

Ontological categories:

- Objects* (t^n)
- First-order properties
- The first-order relation
- The second-order relation

States of affairs:

- Monadic first-order states of affairs* (t^n)
- Dyadic first-order states of affairs* (t^n)
- Second-order states of affairs

And thirdly, I propose that each 'performance' of the temporal imperative modifies the value of the temporal index, such that $t^n = t^{n+1}$. In this way, we can avoid the temporal imperative giving rise to the contradiction that a different totality of objects and states of affairs are actual at a single time. By illustration, let us return to the above scenario, where the temporal index is $t^{1.}$

Members of ontological categories:

Objects* (t^1): *a*, ...

First-order properties: F, G

The first-order relation: B

The second-order relation: $

States of affairs:

Monadic first-order states of affairs* (t^1): *a* is F

Dyadic first-order states of affairs* (t^1): ...'s having B to *a*

Second-order states of affairs: $(F,G)

The condition of the temporal imperative is true. In light of our current concern with the present moment in temporal essentialism, we can say that the complete algorithm for the temporal imperative is as follows. I use the phrases 'add!', 'construct!', and modify!' for the sub-operations of the temporal imperative.

Begin Operation

(i) Modify! the temporal index for objects and first-order states of affairs such that $t^n = t^{n+1}$. (In virtue of this stage, time has passed by a single unit, such that we can modify the domain of entities for temporal essentialism without giving rise to contradictions. The present moment is now t^2. So construed, object *a* and the first-order states of affairs *a*'s being F and ...'s having B to *a* are actual at t^2.)

(ii) For all objects, *x*, that satisfy the condition of the temporal imperative, add! a new token entity, *y*, into the ontological category of objects.

(iii) For all objects, *x* and *y*, construct! a dyadic state of affairs *x*'s having B to *y*. (In virtue

of this stage, object *a* loses its present status, since it stands in the first place of the B-relation, *pace* my definition of presentness. In addition, object *b*, the newly-introduced token, gains its present status, since it stands in the second place of the B-relation without standing in its first place.

(iv) For all objects, *y*, construct! a monadic state of affairs *y*'s being Y. (Given that it is the case that $(F,G), Y = G. Hence the monadic state of affairs in the above scenario is *b*'s being G.

End Operation

I take this four-part operation to replace the single operation that I described in the imperative sentence. Let us recall its consequent.

> ... then actualise! object *y*, such that *x* instantiates the B-series earlier–later relation B to *y*, and such that *y* instantiates property Y, where Y stands in the second place of $ as a function of X.

In this imperative sentence, there is a single operation to perform—*viz*. the actualisation of a new object, such that this object is a 'constituent' of two states of affairs. Given that this single operation can be broken down into three sub-operations, however, I think that the clearest strategy is to take the above algorithm to be the complex performable operation of the temporal imperative. Let us note that the first stage of the algotithm is presupposed by the second, third, and fourth stages. This is because a modification to the domain of temporal essentialism—via the addition of token entities to the ontological category of objects and the construction of first-order states of affairs—requires a transition from a time prior to the modification to a time posterior to the modification (so as to avoid the temporal imperative giving rise to a contradiction). In addition, the second stage of the algorithm is presupposed by the third and fourth stages, since the construction of first-order states of affairs requires that the 'constituents' of these states of affairs are actual. (Although the 'effect' property and the B-relation are actual simpliciter, the 'effect' object, i.e. *b*, is not actual at the time prior to the modification.) With this in mind, I shall continue to speak for the sake of simplicity of 'the performable operation' of the temporal imperative, taking this phrase to capture the four-part

operation that I have described.

On the basis of this discussion we can see that the outcome of the temporal imperative's performable operation is a basic growing block model. More specifically, we can say that the present moment is a given 'content specification' for the domain of temporal essentialism. In other words, by fixing upon a given value of the temporal index, *n*, we are fixing (i) those objects that are actual at this time, and (ii) those concrete states of affairs that are actual at this time. Hence, fixing upon a time fixes the 'temporally-variant' content of temporal essentialism. In addition, we can see that the content of a given present moment will encompass the content updates of previous times, plus the content update of that present moment. My aim is that this will mirror the general idea of a growing block model, whereby the world at a given time differs from the world at the immediate past by a single synchronic actualisation of states of affairs.

In contrast to objects and first-order states of affairs, Platonic universals and second-order states of affairs are not actual at a time. In the first place, given that Platonic universals are non-temporal entities, it does not make sense to say that they can be actual at a time. And in the second place, given that second-order states of affairs—whereby pairs of first-order properties are characterised by the selection relation—exclusively involve non-temporal entities, these 'ways of combination' cannot be actual at a time. Taken together, then, Platonic universals and second-order states of affairs are the 'temporally-invariant' content of temporal essentialism. The population of Platonic universals and second-order states of affairs cannot change over time. In addition, we can recall that Tooley uses his concept of actual simpliciter to make sense of the concept of future (non-actual) states of affairs, as well as the totality of what is actual at a given time. In this thesis, however, I shall not attempt shed any light on how this move might work.

10

Not a World of Powers, but a Powerful World

10.1 Introduction

In this chapter of the thesis I think it will be useful to discuss Lowe's form–content distinction for ontology in more detail. This will allow me to explain the sense in which the temporal imperative is a formal ontological operation. It will also allow me to explain the sense in which I take objects to have temporal essences.

10.2 Lowe's form–content distinction

Let us begin, therefore, with Lowe's form–content distinction for ontology. In the third chapter of his (2006) *The Four-Category Ontology*, which is titled *Some Formal Ontological Relationships*, Lowe discusses the nature of ontological categories and formal ontological relationships. The basic idea of this discussion is that neither ontological categories nor formal ontological relationships are entities. Note that Lowe uses the term 'entity' synonymously with the term 'being' and the phrase 'elements of being' (2006, p.45). The intended point is that neither ontological categories nor formal ontological relationships are to be "included in an exhaustive inventory of what there is" (Lowe 2006, p.43). That said, however, Lowe argues that these formal posits are crucial tools for the ontologist, since they allow her to set out various distinctions and connections, generally speaking, that pertain to kinds of beings in virtue of their real essences.

Before we consider Lowe's discussion, it will be useful to set out his four-category ontology (2006; see also Lowe 2009a). This is a hierarchical system. The top-most ontological category is that of 'entities'. Lowe states that "anything whatever" is a member of the ontological category of entities (2006, p.38). As we move down to the next level of the hierarchy, there is a distinction between

universals and particulars. Lowe defines this distinction in terms of instantiation *qua* instancing: universals are entities that do or can have instances, whereas particulars are entities that cannot have instances. Let us note that Lowe's Aristotelianism commits him to the view that there are no uninstantiated universals. So construed, all universals have instances. Nevertheless, as I understand this discussion, the universal–particular distinction is designed to be of sufficient generality so as to accomodate Platonic ontologies (hence the clause that universals are types of entities that are at least able to have instances: it is not required that Platonic universals do have instances). This distinction is exhaustive and exclusive, such that all entities are either universals or particulars (Lowe 2006, p.38). Moving down to the next level of distinction, there are four ontological categories. Firstly, the ontological category of universals divides into (a) 'kinds' (i.e. object universals, such as 'trees') as well as (b) 'attributes' (i.e. property/relation universals, such as 'greenness'). And secondly, the ontological category of particulars divides into (c) 'objects' (i.e. particular objects, such as 'a tree') as well as (d) 'modes' (i.e. particular properties *qua* tropes, such as 'this greenness'). In addition, the ontological category of objects divides into (ci) substantial objects and (cii) non-substantial objects (examples of the latter are piles and heaps). Although this system draws upon more than four ontological categories, Lowe proposes that there are only four fundamental ontological categories—*viz*. kinds, attributes, objects, and modes. The ontological categories of entities, universals and particulars are thought to be "mere abstractions and do no serious ontological work on their own account" (Lowe 2006, p.39).

Within this framework, Lowe recognises seven types of formal ontological relationship: identity, instantiation, characterisation, exemplification, constitution, composition, and dependence. (More specifically, there is a number of formal ontological relationships concerning dependence, such as 'rigid' and 'non-rigid' existential dependence, as well as identity dependence.) For the purposes of this outline, it will be sufficient to concentrate upon instantiation and characterisation. Recalling that Lowe defines the distinction between universals and particulars in terms of instantiation, he suggests that objects instantiate kinds whereas modes instantiate attributes. Hence, a particular tree, taken as an object, instantiates the kind 'trees'. And likewise, the particular greenness of this tree, taken as a mode, instantiates the attribute 'greenness'. In addition, Lowe proposes that kinds are characterised by attributes, such that, in this case, the kind 'trees' is characterised by the attribute 'greenness'. And correspondingly, the particular tree (an object) is characterised by its mode 'green'.

According to Lowe, less fundamental formal ontological relationships can be 'constituted' by more fundamental ontological relationships. Let us consider modes in the four-category ontology. Lowe says that modes depend for their identity and existence upon the objects that they characterise. Hence, if a given object, *a*, is characterised by a given mode, F, then the identity of F is determined by *a*. The line of thought is that we cannot say that the 'very same' mode, F, could have characterised an object *b* that is non-identical to *a*. This is identity dependence—applied in this case to the 'non-transferability' of modes. Lowe thinks that identity dependence entails 'rigid' existential dependence, such that a necessary condition of F's existence is the existence of *a* (Lowe 2006, pp.34–5). With this in mind, where we have object *a*'s being characterised by mode F, there will be a formal ontological relationship of characterisation holding between these two entities. Lowe proposes that this formal ontological relationship 'constitutes' the relevant formal ontological relationships of identity and rigid existential dependence. (We can recall that constitution is itself a formal ontological relationship.)

> [A]ll dependence relations between entities will be constituted by certain other formal ontological relations in which those entities stand to one another, so that these other formal ontological relations will always be, in a certain sense, more fundamental than the various dependence relations that they constitute in various different cases (Lowe 2006, p.37)

We shall return to this issue below. At this stage I want to outline Lowe's discussion of the nature of ontological categories and formal ontological relationships. Why are these posits not to be construed as entities? Lowe provides three arguments as to why ontological categories are not entities (2006, pp.40–4). More specifically, he argues that ontological categories cannot be universals, higher-order universals, or particulars. These three arguments draw upon the same strategy, which is to show that the four-category ontology gives rise to contradictions if ontological categories are construed in terms of the aforementioned entities. By way of illustration, Lowe's argument against the construal of ontological categories as universals trades upon his universal–particular distinction. In light of this distinction, if ontological categories are universals, then these entities should at least be able to have instances. Lowe argues that this proposal gives rise to a contradiction if we consider the ontological category of kinds. This is because the only plausible

candidates for the instances of this ontological category are the specific kinds, i.e. the different object universals, such as 'trees' and 'planets'. So construed, however, these specific kinds would be particulars, since they would be instances of the ontological category of kinds. In this way, the four-category ontology contradicts itself. We cannot say that entities exclusively divide into universals and particulars, since we have just allocated the specific kinds to the ontological category of particulars, which is problematic as they were originally thought to be universals (Lowe 2006, p.41). After ruling out the construal of ontological categories as higher-order universals and particulars as well, Lowe decides against ontological categories having entity-status.

> As far as I can see, the only acceptable thing to say, in view of all the preceding difficulties, is that the ontological categories are not themselves entities and are thus not to be included in an exhaustive inventory of what there is. There are, quite literally, no such things as ontological categories ... One can be a realist concerning the distinctions that are captured by a system of ontological categories without having to maintain that the categories themselves are elements of being. An object is different from a property or mode in virtue of the intrinsic natures of these entities, quite independently of us and our ways of describing or thinking of things (Lowe 2006, pp.43–4).

In addition, Lowe provides three arguments as to why formal ontological relationships are not entities. More specifically, he argues that neither characterisation nor instantiation can be construed as 'real relations' *qua* attributes. In addition, he argues that formal ontological relationships cannot be internal relations (Lowe 2006, pp.44–51). With regard to the first argument, Lowe draws upon his distinction between universals and particulars again. If characterisation is a 'real relation' (i.e. a relational attribute), he says, then it must have instances where pairs of objects and modes combine into states of affairs. (Note that Lowe uses the term 'states of affairs' for the 'coming together' of different kinds of beings—see below.) So where object *a* is characteried by mode F, we will have an instance, *c*, of the (putative) relational attribute of characterisation. Given the setup of the four-category ontology, however, this will again lead to a contradiction. This is because the instances of attributes (whether properties or relations) are modes, and modes are defined as entities that characterise objects (a single object in the case of property modes and multiple objects in the case of relational modes). In this situation, however, the instance of

characterisation, *c*, is (i) thought to be a mode, and is (ii) thought to hold between two kinds of beings, *v*iz. the object *a* and the mode F. It is therefore a non-standard entity that the four-category ontology cannot understand (Lowe 2006, pp.44–5). We can see that this argument has a similar strategy to Lowe's arguments against the construal of ontological categories as entities: *viz*. the four-category ontology cannot accomodate the proposal.

Lowe's argument against the construal of formal ontological relations as internal relations is different, however. In this case the strategy is to say that internal relations are insufficient for capturing the explanatory role of formal ontological relationships. To use Lowe's example, the basic idea to be rejected is that a particular dog, Fido, instantiates the kind 'doghood' purely in virtue of the intrinsic natures of these two entities. In this sense, the formal ontological relationship of instantiation would be comparable to the classic internal relation of 'taller than', which, we may suppose, supervenes upon the different heights of two objects. At this point Lowe says that there is something attractive about this proposal, since it moves away from construing formal ontological relationships as entities (and we have seen that Lowe is opposed to this method of construal for his formal posits). But the present suggestion falls short of the requirements of the formal ontological relationships, Lowe argues. More specifically, he says the following: "We want to say that there is a 'real connection' between Fido and doghood ... which is absent between the objects of different heights ... After all, each of the latter objects could have existed, just as it is, in the absence of the other—but Fido could not have existed in the absence of doghood" (2006, p.47). On this basis, Lowe sets out his form–content distinction for ontology.

> Instantiation and characterization clearly have something to do with being—they are, after all, *ontological relations*—and yet, for the reasons given earlier, it seems that we cannot regard them as *beings*, or entities. The lesson, no doubt, is that there is more to the business of ontology than just saying *what there is*, or even what there could be. There is also the matter of saying *how* things are, both in themselves and with respect to one another. One might have thought that this was just a matter of saying what the *properties* of beings are and what *relations* beings stand in to one another. But now we know that that can't be right, because this leaves out of account such matters as the *having* of properties ... We have established, for example, that the having of properties is not itself an element of being—a

> relational entity in which two other beings may stand to one another, the being that has a property and the property that is had by it ... What, then, is it about formal ontological relations that not only requires but permits us to regard them as having to do with *how* things are but not with *what* things are. Surely, it is above all their *formal* character. But what does 'formal' mean in this context? The proper contrast here is between *form* and *content* ... Beings, or entities, we may say, provide ontological content. But all beings also have ontological form. The ontological form of an entity is provided by its place in the system of categories, for it is in virtue of a being's category that it is suited or unsuited to combine in various ways with other beings of the same or different categories (Lowe 2006, p.47–8: original italics).

10.3 Lowe on general essences and formal ontological posits

At this point I shall introduce Lowe's understanding of real essence. This is a Finean understanding. In his (2012) essay *What is the Source of our Knowledge of Modal Truths?*, Lowe explains that he accepts Fine's (1994) argument against the modal theory of essence. According to this theory, a property F is an essential property of an object, *a*, just in case *a* is F across all metaphysically possible worlds in which *a* exists (or just in case a counterpart of *a*, *a*', is F across all metaphysically possible worlds in which *a*' exists). And correspondingly, the essence of *a* is thought to be the set of those properties that accompany *a* across all metaphysically possible worlds. The central idea of Fine's (1994) argument, however, is that the modal theory of essence confuses merely necessary properties with essential properties. Lowe explains that he accepts the conclusion of this argument and with it Fine's proposal that we should reverse the strategy and attempt to understand modality (i.e. metaphysical necessity and possibility) in terms of essence (Lowe 2012, p.934). And so Lowe sets out an Aristotelian theory of essence, according to which the essence of some entity *x* is what *x* is (or at least what *x* would be, in those cases where *x* does not actually exist). In developing this position, Lowe adopts Fine's notion of a 'real definition', which is thought to be the definition of an entity, as oppose to the 'verbal definition' of a word/phrase. Taken together, then, a real essence is a proposition that discloses what some entity is or would be (Lowe 2012, p.935). In parallel to Lowe's treatment of formal posits, he denies that essences are themselves entities; rather, essences are 'what' entities are (or could be), as oppose to entities: " ... an entity's essence is just *what that entity is*, as revealed by its real definition. But *what E is* [i.e. what the entity E is] is not some entity

distinct from *E*. It is either *identical* with *E* (and some scholars think that this was Aristotle's view) or else it is *no entity at all*: and the latter is my own view" (Lowe 2012, p.941: original italics; my square bracket).

It will be useful to conclude this section of the chapter by attempting to bring together the different concepts that we have discussed so far. In particular, it may be queried at this point how Lowe's concept of real essence is related to his concepts of formal ontological categories and formal ontological relationships. In this thesis I shall settle for a reconstruction of how I think Lowe's line of thought is proceeding. I propose that this reconstruction is more or less accurate, but I submit that Lowe's form–content distinction is intrinsically difficult. With this in mind, I think that a good starting point to Lowe's view is his general idea of a hierarchical ontology. A methodological approach to ontology that Lowe wants to reject is what he terms a "no-category ontology" (2006, p.47). This strategy of ontology is attributed to Quine (1961), and we can gloss it for present purposes as the view that the purpose of ontology is to say what entities exist. The basic idea of the phrase 'no-category ontology' is that, crucially, this approach to the subject does not involve seriously suggesting that there are different kinds of beings: " ... all things, on this view, belong to the same category, or—what amounts to the same thing—to no category at all" (Lowe 2006, p.47). In short, the distinctive feature of the no-category ontology is that it conceives of existence as a collection of entities, where there is no ontological demarcation between, for example, those entities that are more fundamental than others, or those entities that depend for their existence and/or identity in one way as oppose to another. Schaffer (2009, p.354–6) has this approach to ontology in mind when he speaks of a "flat ontology". In this essay, which is titled *On What Grounds What*, Schaffer takes the 'Quinean question' of ontology to be answered by deciding upon a domain of quantification. He contrasts this approach to his neo-Aristotelain model, which does not merely tackle the problem of what exists, but also seeks to provide the domain of quantification with a structure. Schaffer terms his approach the 'ordered ontology'. More specifically, he sets out an understanding of ontology whereby different ontological categories are construed as 'different ways of being' that depend upon the primary ontological category of substance in different senses. These different ways of being are different types of entities—such as properties/relations and mereological parts—that stand in various grounding relations to the ontological category of substance (Schaffer 2009, p.356). Lowe makes this same general type of move when he accepts a

pluralistic conception of ontology. In such a system, we are to recognise different types of entity (or different kinds of beings) that can nevertheless co-exist within a single world via a specific structure of formal ontological relationships (Lowe 2006, p.195).

Importantly, however, there is an intermediate type of ontology between the 'flat' Quinean model and the 'ordered' neo-Aristotelain model. Schaffer describes this intermediate position as a 'sorted ontology' (2009, pp.354–5). The basic idea of this approach is that we are moving beyond the Quinean method and allowing that there are different kinds of beings within our 'domain of quantification'. In this sense, the world is not comprised (or rather it does not have to be comprised) of "undifferentiated entities" (Lowe 2006, p.47). (The previous sentence is qualified because we might want to allow that there are kinds of beings that are not actual (Lowe 2006, p.44); for example, we might say that the world only contains objects, but that it could have contained objects and universals.) We are thereby accepting that the world might have a pluralistic structure. But the sorted ontology is not an ordered ontology, as Schaffer would say; more specifically, the general idea of different kinds of beings does not in itself commit us to the general idea of different kinds of beings standing to one another in certain ways. That is to say, as I understand this point, we could have a pluralistic world that contained different kinds of beings (*pace* Quine) that nevertheless rules out any ontological connections, generally construed, holding between these different kinds of beings (*pace* Lowe and Schaffer). In short, the world might contain different 'shades of existence', but these shades of existence could have nothing to do with one another that went beyond their co-existing (I am grateful to discussion with Jonathan Lowe on this issue). So there are really two moves in departing from Quine's perspective: first, there is the acceptance of a sorted ontology, where we allow that a single world can feature different kinds of beings. And secondly, there is the acceptance of these kinds of beings standing in some variety of ontological connection to one another (in particular, we might want to say that some kinds of beings can instantiate other kinds of being). According to Schaffer's terminology, we have thereby moved from a 'flat' ontology to an 'ordered' ontology, via a 'sorted' ontology.

Lowe wants to say, of course, that the world is a 'connected plurality'. And his strategy of argument for saying so will draw upon the (putative) explanatory benefits of his four-category ontology, which makes use of an elaborate setup of formal ontological relationships holding between

different ontological categories. Given that a connected plurality is the overall aim, we need to understand what these different ontological categories and formal ontological relationships are. We can think of this as the 'price of purchase' for moving firstly to a sorted ontology and then on to an ordered ontology. After all, the Quinean will not be troubled with these tasks. (Or at least the Quinean would not be troubled with the task of how different ontological categories are distinguished, since they only have one 'ontological category' i.e. the domain of quantification.) With this in mind, we can say at this stage that a significant restraint on Lowe's possible options for understanding these formal posits is his metaphysical realism. For another Quinean idea that Lowe wants to reject (and this rejection is shared by the mainstream properties and laws debate) is a thesis of ontological relativity, according to which there are equally legitimate ways of 'carving up' reality via different methods of representation (Lowe 2006, p.196). In this way, it is clear that the formal posits cannot be understood merely as conceptual (*qua* mental) tools for thinking about reality, since, although a given ontological system is first and foremost a human invention, a good ontology, for the realist, is also expected to compete as a contender for the true theory of the nature of reality, in the most abstract and general sense of the phrase 'nature of reality'.

Building the issue up in this manner, we can see the relevance of Lowe's adoption of Fine's notion of real essences. Given the overall aim of a connected plurality (i.e. Schaffer's ordered ontology), where we have different kinds of beings that stand to one another in various ways, we are 'burdened' with a number of ontological categories and formal ontological relationships. As we have discussed above, however, Lowe has argued that the construal of these formal posits as entities is multiply problematic. Hence there is a dilemma of sorts: the formal posits cannot be entities, or elements of being, but they are nevertheless central to the project of ontology, as conceived of by Lowe, Schaffer, and others. So the natural strategy is to understand ontological categories and formal ontological relationships not as entities, but nevertheless in terms of entities. And to do this, it seems, we need some notion of how entities can fall into different mind-independent types that constrain the different ways that they can stand to one another (such as instantiation and characterisation). This requirement is provided, I think, by Lowe's notion of a general essence, which is a type of essence that is shared by a number of distinct entities (Lowe 2013, p.98). So if we can have a number of distinct entities that can share a general essence, and, in addition, if we can postulate that there are different types of general essence, then we can capture

the idea that the world can have a certain structure *qua* ontological categories, since the (fundamental) ontological categories are the different (fundamental) types of general essences in the world. Hence, all objects share a general essence, and all kinds share a general essence, and so on. If this reading is correct, then to say that the world has a four-category structure is to say that there are four fundamentally different types of real essence. This would be an essence-based explanation for how a sorted ontology is possible, i.e. an essence-based understanding for how it is possible that the world can contain different types of entities: *viz*. entities have real essences and there can be general essences that are shared by multiple entities. To move on to the ordered ontology, however, we need to say, in addition, that these general essences are somehow constraining how different types of entities can stand to one another. But what understanding can we give of why, for example, kinds can be instantiated by objects but not by attributes or tropes? The answer that will be provided at this point, I think, is that the four fundamental types of general essence 'involve one another'. That is to say, when a proposition discloses what objects are, there will be some reference to modes, and perhaps also to kinds and attributes. (Note that objects stand in formal ontological relationships to each of these three types of entity).

I want to note a difficulty concerning real essences and formal ontological relationships (I am grateful to discussion with Sophie Gibb on this issue). At a number of places, Lowe says that real essences concern existence and identity conditions. For example, whilst discussing how modes depend for their identity upon the identity of the objects that they characterise, Lowe says: " ... it is a part of the essence of *m* [a mode] that it is the *very entity that it is—this* roundness mode as oppose to any other exactly resembling roundness mode—in virtue of being the roundness mode *that is possessed by this apple* (Lowe 2006, p.199: original italics; my square bracket). And relatedly, when discussing how we can take ontological categories to capture mind-independent distinctions (despite their lack of entity-status) he says: " ... we categorize correctly when we categorize by correctly apprehending the *existence and identity* conditions of the things concerned" (Lowe 2006, p.44: original italics). Citations such as these suggest to me that different entities are members of different ontological categories in virtue of their different general essences, and that, in addition, the possible ways that different entities can stand to one another are calculated, so to speak, via the asymmetric dependence relations that hold between kinds, objects, attributes, and modes. However, we can recall that Lowe also said that dependency relationships are less

fundamental than other formal ontological relationships. Specifically with regard to modes, we discussed how the identity and existential dependence relationships that modes bear to objects were thought to be constituted by the characterisation relationship. (We can recall, indeed, that Lowe said that the characterisation relationship was more fundamental than the dependency relationships.) I think that this complicates the idea that characterisation and instantiation etc. are straightforward reflections of the asymmetric ways in which different types of entities depend upon one another. I see this as a *prima facie* problem, since the attractive reading of Lowe's formal ontological relationships is that they are to be understood in terms of general essences; but given that real essence is often discussed in relation to existence and identity conditions, it is unclear to me how the 'fundamental' formal ontological relationships (such as characterisation) dovetail with the idea that formal posits arise from real essences. To put the matter one way, if characterisation constitutes dependence, and general essences concern dependence, then we might think that characterisation is responsible for the real essences of (at least) modes. But this looks to be a reversed understanding to the one ventured in the previous paragraph.

I should say at this point how I want to understand Lowe's formal ontological relationships. We can begin again with the move from a flat ontology to a sorted ontology. To secure this move, I have suggested, Lowe is drawing upon a notion of general essence, which is a type of essence that can be invariant across (numerically distinct) entities. And so we can secure the idea of multiple ontological categories (*pace* Quine) without having to reify ontological categories themselves. (The thought here, of course, is that this strategy is making sense of ontological categories in terms of entities, since real essences (and so general essences also) are understood to concern what entities are, or at least what entities could be.) If this is right, then we need to move on to think about how Lowe is understanding the ontological relationships that hold between the different kinds of being. For, as Schaffer has noted, the sorted ontology is not yet an ordered ontology, where kinds of beings stand to one another in various ways. What the observation of the previous paragraph shows, I take it, is that formal ontological relationships such as characterisation and instantiation cannot simply be shorthand locutions for different kinds of beings depending for their existence and/or identity upon other kinds of beings. As noted, this reading goes against Lowe's remark that characterisation constitutes dependency. Note also that Lowe suggests that modes existentially depend upon objects in virtue of the formal ontological relationship of

characterisation: "We want to say, perhaps, that it is *in virtue of* its characterizing the particular object that it does that the mode depends existentially upon that object" (Lowe 2006, p.51: original italics). Cutting to the chase, then, what I think is happening is that a certain number of Lowe's formal posits are being accepted as primitive. (Restricting ourselves to the scope of my outline, characterisation and instantiation would be primitive, and dependence (all varieties) would be non-basic.) To say that characterisation is primitive, I suggest, to just to say that we are taking the concept of a certain kind of being (a mode) standing to another kind of being (an object) as basic. That these kinds of beings can 'stand to one another' is not a concept that can be further explained, nor, as we might say, a theorem that can be deduced from a more basic axiom. At this point it might be objected that saying that two kinds of beings can stand to one another is trivial, since, the objector might say, even in Quine's domain entities 'stand to one another' *qua* their co-membership in this domain. But this objection would miss the mark if different types of primitive formal ontological relationship (such as characterisation and instantiation) were linked up to specific types of dependence relationships via the notion of constitution. Hence, we can point to significant differences between characterisation and instantiation by examining the different dependency relationships that they are deemed to constitute. As a last point of detail, it will be useful to note that Lowe's states of affairs are thought to be 'no additions of being'. Given our current reading, we can say that 'all that is happening' when two entities stand in a fundamental formal ontological relationship is that these entities thereby stand in the required dependency relationships.

> When beings do 'combine' in the ways to which they are suited by their ontological forms, these 'ways of combining' are the various formal ontological relationships—instantiation, characterization, and the rest. Such 'combinings' are 'no addition of being', just as there is, as it were, 'no addition of substance' when, in virtue of their valencies, an oxygen ion and two hydrogen ions combine to form a water molecule (Lowe 2006, p.48).

Finally, then, how should we understand Lowe's form–content distinction? It seems to me that the distinction is capturing the invariant aspects of a given ontological system. There are some exceptions (e.g. Spinoza), but for the most part a system of ontology will allow that we can keep the same type of ontology whilst allowing the entities within that ontology to vary. There appear to be two 'dimensions' in which this could occur. Firstly, we could say that there are different

entities at different times, but that the type of ontology remains fixed. Tooley's system is a clear example. In his actualist framework, there is a different totality of actual states of affairs at different times, but at each of these times the type of ontology remains fixed: *viz* we have his two-category object–universal ontology. And secondly, we could have a modal notion of variation, such that it is possible (in various non-temporal senses) for there to have been different entities. Armstrong's combinatorialism is a good example of this idea, perhaps, since he holds an eternalistic theory of time but allows that there are 'metaphysically possible worlds' that can be constructed via recombination from the actual world (1997, p.173). But we can note that all of these possible worlds will be factualist worlds, which follow the 'rules' of Armstrong's ontology (hence we will have no uninstantiated universals, and so on). Lowe's form–content distinction is a nice tool to capture what is happening in these two dimensions of variation, I think, since we can say that the form of the ontology is invariant, but that the content of the ontology is variable (either temporally or modally). Thinking about Lowe's ontology more specifically, we can say that the formal aspects of the ontology (i.e. ontological categories, formal ontological relationships, and formal predicates) are the invariant aspects of his theory. In other words, these aspects are closed under any temporal or modal variation. (We have not discussed formal predicates in this chapter, but I should say that Lowe accepts a number of formal ontological predicates, such as 'exists' and 'is a mode'. Along with his other formal posits, they are not entities or elements of being.) With this in mind, I take Lowe's form–content distinction to entail that, whatever the 'stocking' of the four fundamental ontological categories, i.e. whatever temporal or modal possibilities are actual, it will remain the case that there are four fundamental types of general essence: *viz*. those of kinds, attributes, objects, and modes. (Lowe appears to confirm this idea (2006, p.44) when he says that it is "necessary" that the four fundamental ontological categories are actually occupied). All in all, then, different (fundamental) ontological categories reflect different types of (fundamental) general essence. In addition, there are a number of fundamental and primitive ways that these different kinds of beings can stand to one another, such as characterisation and instantiation. These formal posits do not refer to entities, but they nevertheless capture distinctions and connections that concern types of entities (or kinds of beings) in virtue of their real essences.

10.4 Formal ontological operations and the active ontology

Temporal essentialism requires a different ontological 'blueprint' to those that we have discussed so far in this chapter. In a sense, the ontology of temporal essentialism is 'stronger' than Schaffer's flat, sorted, and ordered conceptions, since it includes all of the resources of these systems and adds a new ingredient. This ingredient, of course, is the performable operation of the ontology. One way to introduce this notion is to consider how Lowe's 'ordered ontology' handles synchronic and diachronic 'combinations of entities'. We can think of Lowe's formal posits as setting out the possible ways that entities can stand to one another. As noted, Lowe terms the coming together of entities 'combinations' or 'states of affairs' (2006, p.48; 2013, p.40). In general, the restrictions that the form of his ontology places upon the possible states of affairs will be non-trivial. Indeed, they will be fixed by the fundamental formal ontological relationships. Hence, we can say that it is metaphysically possible for a kind can be instantiated by an object, but that it is metaphysically impossible for a kind to be instantiated by a mode. (In addition, given his notion of non-rigid existential dependence, Lowe will want to say that it is metaphysically necessary that all actual kinds are instantiated by at least one object.) As we have discussed, all of these metaphysical modalities will be understood, ultimately, in terms of real essences, since, as we have noted, Lowe seeks to understand modality in terms of essence, following Fine. In this way, we can think of the fundamental formal ontological relationships (specifically characterisation and instantiation) as setting out the 'syntax' of Lowe's ontology; that is to say, these formal posits are setting out the allowable structures of states of affairs.

(i) Object *a* instantiating kind A
(ii) Mode F instantiating kind A

Above are two putative states of affairs. The first follows the syntax of Lowe formal posits, since it features the kinds of beings that can combine via instantiation. But the second is illegitimate. And this is because it features kinds of beings that cannot combine via instantiation. Importantly, we can say that this syntax is synchronic, since it will be held invariant over the temporal possibilities for the four-category ontology.

Let me consider this last remark in more detail. In his (2009b) essay *Serious Endurantism and the Strong Unity of Human Persons*, Lowe develops a presentist theory of time that is strongly Aristotelian. The basic line of thought is that we can understand temporal concepts in terms of concepts concerning change and existence (see also Coope 2005). For example, the present moment is understood in terms of the co-existence of entities. And likewise, temporal passage is understood in terms of existence changes. (More specifically, as I understand this essay, a single existence change (e.g. where a single substance gains a mode) is sufficient for the world to progress by one temporal unit, since the entities that co-exist have been modified. But this is a special case; we would expect there to be multiple ('simultaneous') existence changes in the actual world, such that the actual world moves forward in time via multiple new characterisations of modes, and so forth. As we suggested above, in this theory of time we have a notion of temporal variation in the content of Lowe's ontology. In other words, the entities that are members of the ontological categories and the states of affairs that obtain are varying across time. Nevertheless, the form of the ontology is fixed *qua* the syntax of its combinations, since all states of affairs (at any time or 'arrangement of co-existence') must follow the rules that are set out by the formal ontological relationships of characterisation and instantiation. In his essay, Lowe suggests that substance causation is the primary means by which existence changes occur.

> ... all causation is fundamentally *substance-causation*, which is a matter of individual substances exercising or manifesting their various causal powers and liabilities ... when a substance exercises its causal powers, the *immediate* effect is simultaneous with that exercise and consists in an existence change in that or one or more other substances—either a substantial change or else and more commonly a qualitative or relational one (Lowe 2009b, p.77).

With this in mind, Lowe's four-category ontology has been combined with a dynamic theory of time (or at least with a dynamic theory of existence). I think there is a significant overlap between Tooley and Lowe, since they will both want to maintain that a single world (i.e. the actual world) can feature different totalities of actual entities (although the way that they would go about explaining this would be different, of course; in particular, Lowe will not accept Tooley's concept of actual at a time as primitive). So when I said above that Lowe's formal posits are enforcing a

synchronic syntax upon his states of affairs, what I had in mind was the following point. Given that the actual world is undergoing existence changes, the content of Lowe's ontology is variable, but its form is remaining the same. More specifically, we can say that the form of the ontology is invariant across time (or across existence changes) such that, at each time (or arrangement of co-existence), we have the same ontological form *qua* metaphysically possible states of affairs. There is therefore an asymmetry with regard to form and content: the form is diachronically invariant, but the content is diachronically variant. Because the form of Lowe's ontology is diachronically invariant, I think it is sensible to say that it primarily concerns the synchronic syntax of states of affairs. My thought here is that as we move from each time or arrangement of co-existence to the next, we are drawing upon the same restrictions for states of affairs.

More specifically, the formal apparatus of Lowe's ontology is placing a restriction upon the allowable combinations of entities at two levels. First of all, we have the general idea that certain kinds of beings can only combine with certain other kinds of beings. This is the level of the ontological categories, or, looking at the matter from the perspective of essence, the level of general essence. Hence, we will want to say, for example, that only objects can be characterised by modes, and so on. But the same formal ontological relationships are also enforcing restrictions upon types of entities at a more fine-grained level. In this case we are thinking about the specific members of ontological categories. For example, we will need to say in this case that the specific kind 'gold' is only ever instantiated by particular pieces of gold, and that, in addition, the kind 'gold' is always characterised by the attribute 'soft metal', and so on (here I assume that pieces of gold qualify as substances). This is Lowe's essentialism for natural kinds entering into our discussion (2006, pp.141–55). We can note that this theory is also set out in terms of the apparatus of real essences and formal ontological relations.

Let us return now to temporal essentialism and its performable operations. Below I have presented Schaffer's (2009, pp.354–6) three conceptions of ontology, together with what I take to be their distinguishing features in the context of Lowe's form–content distinction.

Flat ontology:

A domain of entities.

Sorted ontology:

A domain of entities that includes the notion of different kinds of being.

Ordered ontology:

A domain of entities that includes the notion of different kinds of being together with the notion of formal ontological relationships, generally construed, that hold between these different kinds of being.

I think that all of these conceptions of ontology are 'list-like'. Needless to say, both Schaffer (2009, pp.656–73) and Lowe criticise the Quinean ontology for being list-like. Here, for example, is a part of Lowe's attack.

> It would miss the point of ontology altogether to suppose that its tasks were simply to enumerate all the entities that there putatively are ... Many nominalists, it seems to me, implicitly suppose that, in the last analysis, this *is* all that we may hope to do by way of characterizing the elements of being. They fundamentally agree with Quine when he said that the basic question of ontology is 'What is there?', but that it could be answered by the one-word English sentence: 'Everything' (Lowe 2006, p.195: original italics)

It is clear that Lowe is not presenting his four-category ontology as a list. In contrast, his methodology for ontology is thoroughly non-Quinean. But, I suggest, the sorted ontology and the ordered ontology are still list-like conceptions of ontology—all that we have done is to move from a simple list to a more complex list. What I have in mind here is a contrast thesis. There is another type of ontology.

Active ontology:

> A domain of entities that includes the notion of different kinds of being together with the notion of formal ontological relationships, generally construed, that hold between these different kinds of being. In addition, a formal ontological operation performs modifications to the variable aspects of the active ontology, i.e. to its content.

There are a number of points to make at this stage. Firstly, in terming this ontology blueprint 'active' I should not be taken to say that all ordered ontologies (to take the most pertinent case) are 'inactive' in the sense of rejecting a dynamic conception of reality. Indeed, both Tooley and Lowe, as we have discussed, maintain dynamic theories of reality within the ordered ontology paradigm. In Tooley's case, we have the primitive concept of actuality at a time, which he takes to be distinctive of any dynamic theory of time. And in Lowe's case, we have a dynamic theory of existence, which Lowe articulates in terms of co-existence and existence changes. But the point is that, so long as these philosophers are working with an ordered ontology, they are working with a blueprint for ontology that is not, it itself, specifically dynamic. In this connection we can observe that the same basic blueprint can be used to articulate completely static theories of time and existence, as is the case in Schaffer's (2009) essay *Spacetime the One Substance*. In this essay Schaffer sets out a 'super-substantivalist' conception of spacetime, according to which material objects are identical to spacetime regions. This model is explicitly eternalistic. In addition, it features grounding relationships that hold between the substance (spacetime itself) and, for example, its mereological parts. So the idea is this. If we want to set out a dynamic theory of reality, generally construed, then staying with the ordered ontology will force us to use formal apparatus that is not specifically dynamic. For there is nothing specifically dynamic about ontological categories, formal ontological relationships, or formal predicates. How could there be, if this same inventory of notions is used to build eternalistic theories?

A second point is as follows. In thinking about the general idea of an active ontology, I originally thought we could model an ontology upon a finite/discrete state machine, such as a Turing machine or cellular automaton. This would be a sense in which we could construe Schaffer's three conceptions of ontology as list-like. The thought here was that, intuitively at least, a Turing machine 'does something', whereas a domain, or a domain with 'subdivisions', or a domain with

subdivisions and relationships between its entities, does not 'do anything'. But with further consideration I have come to think that this suggestion is quite misleading. The problem, ironically, is that the formal description of a Turing machine (and finite state machines in general) centres around set theory. In particular, the transition function of a Turing machine, which we can think of as the 'rule book' for its performable operation, is understood as a functional mapping from, in the basic case, the combination of a state that the machine is in and the currently read symbol, to the combination of some specific operation (such as 'erase symbol') and a state transition (such as 'enter state S'). But set theory gets us back into thinking about 'relations holding between entities' (this being the most natural ontological analysis of a functional mapping *qua* ordered set). And, as I shall attempt to explain below, I want to distance the notion of a formal ontological operation from both formal ontological relationships and formal ontological predicates (not to mention material relations). What this means, if I have understood the computational models correctly, is that the notion of a performable operation within the computation/mathematics literature primarily concerns the notion of sequence, as oppose to 'dynamic modifications' (see below). (I am grateful for discussion with Mark Bishop on this point).

So I do not think that there is a straightforward connection between the active ontology and computational models. With this in mind, what I shall do at this stage is to simply say what I take a formal ontological operation to be. In a nutshell, a formal ontological operation is a type of modification to a given ontology's variable content, which is performed in accordance with a rule. That a given system of ontology is able to modify its variable content in a rule-following way is a concept that I take to be theoretically primitive, just as the ontologist who endorses an ordered ontology will have to take the concept of different kinds of beings standing in certain ontological relationships to be theoretically primitive. By the term 'theoretically primitive' I mean to say that, whilst these concepts may not be simple, in terms of theory construction they are taken as basic. I hope that the reader will join me in thinking that there is indeed something 'list-like' about Schaffer's three conceptions of ontology, at least when they are compared to the active ontology and its formal ontological operation.

In general, I suggest that there can be different types of formal ontological operation, just as there can be different types of formal ontological relationship from one ontology to the next. But there

are some restrictions that we can place upon all formal ontological operations as they might be postulated across different active ontologies. Firstly, the operation that can be performed must concern the variable content of the ontology. In the case of temporal essentialism, for example, I said that the temporal imperative adds new entities to the ontological category of objects and constructs states of affairs concerning first-order Platonic universals. I want to make this connection between modification and content an analytic one. So we are going to build into the concept of a performable operation the notion of variable content. In this way, the formal ontological operation is a fixed 'part' of the form of the ontological system, but its performance leads to modifications to the content of the ontology. This leads us to a second restriction, which is that a formal ontological operation must concern the temporal dimension. The line of thought here is that an active ontology is a model of a single world (a 'unified reality', or, more simply, a single time-indexed domain) that can modify its variable content in line with a rule. And the only way for this notion to make any sense, I suggest, is if the entities and states of affairs of a single world can be different at different 'indices'. In addition, then, the concept of a formal ontological operation should be analytically connected to a dynamic theory of time. In a dynamic theory of time we are saying that the content of the ontology can vary without moving from the actual world to alternative possible worlds. In other words, in one and the same world, the actual world, there is the possibility of modifying the variable content of the ontology. And this is just the idea of the formal ontological operation: we require that the content of the ontology can be 'open' along some index, such that we can have a population of entities and states of affairs at one value of the index being modified such that this population is different at the next value of the index. This is why, in the previous chapter, I required the temporal imperative to modify the value of Tooley's temporally-indexed domain of actual entities and states of affairs.

Such is the overall idea of a formal ontological operation. But whilst I take this posit to be theoretically primitive, it will have to earn its keep via some explanatory role. Given what I have said so far in this chapter, I think that the most natural application for a formal ontological operation (and therefore also for active ontologies in general) is a form-based understanding of time. In short, a given formal ontological operation will model a given structure of time. There are three ideas here that are coming together.

The first is that we can think of the dynamic aspect of time that philosophers like Tooley have stressed in terms of formal posits. With this in mind, it is distinctive to active ontologies that we are going to model temporality as a formal aspect of the ontology. (So when I said above that the ordered ontology is not specifically dynamic, we can see that the case is reversed for the active ontology: *viz*. the active ontology is specifically designed for a dynamic theory of time.) Here I should note that Lowe will also draw upon formal posits to understand the dynamic aspects of his theory. In particular, he will want to say that the content of his ontology can change from one arrangement of co-existence to another. Because 'existence' is a formal predicate, this is drawing upon the 'form side' of his form–content distinction. And other formal notions will also be brought into the discussion. Hence, as we have discussed above, Lowe will maintain that the members of the ontological category of modes (to take one case) will be different at different times; and correspondingly, he will maintain that states of affairs concerning the characterisation of objects by modes will differ from one time to another. In addition to all of this, Lowe will want to say that his essentialism over natural kinds and his conception of powers as manifesting in existence changes will provide a metaphysical explanation for why the world 'moves' from one arrangement of co-existence to another. In short, Lowe will draw upon his formal posits to understand both what the dynamic aspect of his ontology amounts to (basically: a modification to the content of the four-category ontology) as well as to provide an anti-Humean means by which the world can move from one time to another (basically: the powers essentially possessed by objects manifest in existence changes). With this in mind, what is distinctive about the active ontology is not that formal posits are merely involved in a metaphysical understanding of dynamic time, but rather that we are drawing upon a single dedicated posit (the formal ontological operation) to understand how a given system of ontology moves through its different content. We can safely say, I think, that a formal ontological operation is a distinctive type of formal ontological posit *re* Lowe's ontological categories, formal ontological relationships, and formal predicates. None of Lowe's formal posits involve, in themselves, the notion of a performable modification to content of the ontology that is rule-following.

This leads on to the second idea in my remark that a given formal ontological operation will model a given structure of time. This is the idea that we can think of the dynamic aspect of time, whereby, for example, successive entities and states of affairs are actualised, as a 'way' that kinds of beings

can 'stand to one another' in a diachronic sense. The thought at hand is that, just as Lowe's fundamental formal ontological relationships set out restrictions for the 'syntax' of states of affairs at a time, a formal ontological operation will set out the 'syntax' for how these states of affairs can combine across times. We can recall that I wanted to build into the concept of a formal ontological operation the modification of variable content. In simple terms, we are saying that a given ontology has both fixed and changeable aspects. The fixed aspects are the (fundamental) general essences of the ontological system, which are used to set out the ontological categories and formal ontological relationships. In turn, these (fundamental) general essences determine the allowable states of affairs of the system. Within this structure, the changeable aspects of the ontology concern those entities and states of affairs that obtain at different times (restricting ourselves to the temporal variation and ignoring the modal dimension). Now, in Lowe's case, we have a view that powers manifest existences changes such that the four-category ontology moves through different configurations of content. But an alternative view is that this temporal variation directly draws upon a dedicated formal posit. So construed, I take any active ontology to be committed to the idea that a dynamic notion of time is a completely rock-bottom feature of the world. Indeed, it is as basic as instantiation or characterisation in Lowe's system.

The sense in which a formal ontological operation is setting out the diachronic syntax of an active ontology will depend upon the third idea in my proposal that we can use this posit to model a given structure of time. This is, of course, the idea that time can have a certain structure. This issue is encroaching upon what I take to be the most interesting aspect of our investigation, which is that there is a connection between the active ontology and physical modality.

10.5 Structures of time and physical modality

By moving between different formal ontological operations we can model different structures of time. I suggest that there are two central structures of time in this context. The first is neo-Humean. It can be understood as a formal ontological operation whose modification is not sensitive to the content of its system. Whilst there are a number of ways in which a formal ontological operation can be insensitive to its content, I shall restrict myself to one set up. Let us think about a neo-Humean growing block model, in which we remove the necessitation relations from Tooley's

framework whilst keeping the remaining key ingredients of his theory intact (such as his concept of actual at a time and his two-category ontology of objects and Platonic universals). Given that we are interested in neo-Humeanism, we can investigate the idea of a world that builds itself up in stages, but where the content of these stages is metaphysically accidental. That is to say, we can picture a dynamic neo-Humeanism, where there are no necessary connections between distinct existences, but where there is, nevertheless, a continual increase in those objects and states of affairs that are actual (in line with the general notion of a growing block model). A candidate formal ontological operation for this envisaged ontology is shown below.

Looping operation

(i) Modify! the temporal index for objects and first-order states of affairs such that $t^n = t^{n+1}$.
(ii) Add! a 'metaphysically accidental' number of token entities to the ontological category of objects.
(iii) For each entity that is added in (ii), construct! a first-order state of affairs, where this state of affairs has as its constituents the new object in question and a 'metaphysically accidental' Platonic universal.
(iv) Return to (i).

The thought here is that we have a looping formal ontological operation. Its modification is to add 'random' states of affairs to the world at each successive time. In this thesis I shall not pursue the question of how we should understand the concept of 'metaphysically accidental' within the context of active ontologies. But it is tempting to say that the concept of fair probability would be applicable to both the number of objects that are added to the world at each stage and to the Platonic universal that is 'selected' for each of these objects to instantiate. In any case, the important point for our discussion is that this formal ontological operation has a different structure to the temporal imperative. More specifically, we can see that the looping operation at hand does not make use of a condition–operation structure; indeed, it has no condition. This is a first sense in which a formal ontological operation can be sensitive to the content of its system: *viz*. whether or not it performs its operation might depend upon the satisfaction of a specified condition. In this connection, let us

recall that the temporal imperative's condition requires that a 'cause' object is present. As such, if there are no present objects that instantiate the first place of the selection relation, then the temporal imperative will not perform its operation and so there will be no modification to the content of its system. A second sense in which a formal ontological operation can be sensitive to the content of its system is if the modification is different for different contents. The temporal imperative is also sensitive in this sense. This is because the states of affairs that are actualised as time passes are a function of present states of affairs in tandem with laws. But the looping operation in the neo-Humean growing block model is completely blind to its past and present states of affairs. I should note that these two senses appear to be independent, despite their close connection in the temporal imperative. For example, we could set out a formal ontological operation that has a condition–operation structure, but whose modification is 'metaphysically accidental'. One example would be a formal ontological operation that is triggered by the ontological category of objects having an even number of members, but whose modification is analogous to the looping operation above (i.e. where 'random' objects and states of affairs are actualised).

Let us return to temporal essentialism. How does this position fit into our present discussion concerning formal ontological operations and the neo-Humean growing block model? What I shall suggest at this stage is that there is a possible metaphysical explanation for physical modal facts that trades upon the understanding of dynamic time that we have just set out. It is therefore a time-based metaphysical explanation of physical modality. This line of thought can be broken down into the following steps. Firstly, let us construe Barker and Smart's governing role, which involves the necessitation of some entity (i.e. a property or a state of affairs), as the necessitation *qua* actualisation of some entity. We have already discussed that Tooley is using this idea when he says that laws control (i.e. govern, or necessitate) what states of affairs are to be actualised. What this move is doing, I suggest, is supplementing the idea of necessitation with a certain type of change in existential status, generally construed. So, we might say that a dispositional property necessitates its manifestation *simpliciter*, such that the cause and effect cannot come apart across metaphysically possible worlds, or we might say that the cause necessitates its effect in a more specific way, such that we have the above constraint on metaphysically possible worlds, but where this constraint is understood in terms of causes necessitating the actualisation of their effects. This is the 'old fashioned' idea of a cause bringing its effect into existence. So forced actualisation is a

specific type of necessitation. Likewise, Bird's (2007, p.114) 'concretisation' might be read as a different type of necessitation, relative to his modal metaphysics; in this case, the co-instantiation of the disposition and stimulus are subjunctively sufficient for the concretisation of the manifestation. In general, there might be many different types of necessitation that the anti-Humean could draw upon.

There is a difficult issue here that I should mention. It might be thought that the above distinction between necessitation *simpliciter* and necessitation *qua* actualisation is trivial, and this for the following reason. Let us note that we can have different general modal frameworks, such as actualism or Bird's 'possibilism'. Actualism is the standard view for dispositional essentialism (Bird aside). We can gloss it briefly as the view that all existing entities are actual, such that there is a single world: the actual world. But we also have in actualism the idea that things could have been different, such that there are mere metaphysical possibilities that are non-actual and that do not exist. Bird's possibilism is different: on this view, all metaphysical possibilities exist (so unicorns exist), but some things are concrete and the rest are abstract. Here I can imagine someone saying that they are happy to accept necessitation *simpliciter*, since they want the idea that dispositional properties, when suitably related to their triggers, force the instantiation of their manifestations. But then they might say that these causes necessitate *qua* actualise for the simple reason that they are working within the actualist framework and that, accordingly, when D and S are actual M is actual as well. In short, it might be objected that once we fix upon a given modal framework, such as actualism or possibilism, we automatically get necessitation *qua* actualisation or actualisation *qua* concretisation upon accepting the putatively more basic idea of necessitation *simpliciter*. I should note that Orilia (2012) sets out a dynamic theory of time within the possibilist framework. I can see this point, but what I have in mind in speaking of actualisation or concretisation in this context is a dynamic change in the existential status of the effect. This is getting back to Tooley's discussion of the key difference between static and dynamic theories of time, and how the dynamic conception of time facilitates an understanding of change that is 'stronger' than its static alternatives. Let us recall this citation.

> [T]he difference between a static conception of the world and a dynamic one comes to this. According to a static conception, what states of affairs there are does not depend upon what

> time it is. Change, consequently, cannot be a matter of a change, over time, in what states of affairs exist. It must be a matter simply of the possession, by an object, or by the world as a whole, of different intrinsic properties at different times. According to a dynamic conception of the world, by contrast, what states of affairs exist does depend upon what time it is. As a consequence, the totality of monadic states of affairs which exist as of one time, and which involve a given object, may differ from the totality that exists of some other time, and it is precisely such a difference that constitutes change in an object, rather than merely the possession by an object of different properties at different times. Similarly, change in the world as a whole is a matter of a difference in the totality of states of affairs that exist as of different times, and not merely a matter of the possession of different properties by different temporal slices of the world (Tooley 1997, p.16).

So the point that I am motivating is that we can think about a static notion of necessitation, where we 'simply' say that across metaphysically possible worlds, if it is the case that *x* is D&S, then it is the case that *x* is M (to give Bird's primary scheme). This is necessitation *simpliciter*. But this 'static' conception can be contrasted with necessitation *qua* actualisation, which, as I say, is a concept of necessitation wherein we force a given property or state of affairs to become actual. The assumption that I am making here, of course, is that we simply cannot have necessitation *qua* actualisation without accepting a dynamic theory of time. And the reason why I think this is that, given Tooley's idea of a static theory of time, a static actualism would not allow there to be existential changes in what is actual. (I am grateful to discussion with Matthew Tugby and Sophie Gibb on this matter.)

With this idea in hand, let us return to the main line of thought. There is something crucial about the general concept of a dynamic theory of time that has, I believe, been thus far excluded from the debate. This is the observation that in a dynamic theory of time a given type of change in existential status is occurring, as we might say, *en masse*. So in the actualist setting we have some change in what is actual at each time; and in the possibilist setting, a dyanmic theory of time would have different states of affairs being concrete at different times. In the case of Tooley's and Lowe's dynamic theories of time, this does not get us any further towards solving the puzzle of the governing role, since both Tooley and Lowe employ anti-Humean entities (laws and powers,

respectively) to explain why there is a progressive actualisation of entities. (Given that Lowe's theory of time/existence is presentist, we also have powers accounting for the destruction of modes and substances.) In the case of these philosophers, we have an entity-driven metaphysical explanation of both (i) the lawful development of the world and (ii) the temporal development of the world. Given that I am accepting Barker's (2013) point that there is a problem in retrieving such a governing role from the anti-Humean apparatus of properties, however, I think that both Tooley's and Lowe's metaphysical explanation of physical modality (which is bound up with actualisation) will be subject to an explanatory gap. That said, I shall not argue the particulars of the issue. But this is not the case with our neo-Humean growing block. Here we have suggested that time passes and that the world grows quite independently of traditional anti-Humean apparatus; in particular, there are no governing laws or essentially dispositional properties. And to motivate this point we explored the idea of using a formal ontological operation. So construed, we have a form-driven metaphysical explanation of (i) the temporal development of the world. By hypothesis, however, there is no metaphysical explanation for (ii) the lawful development of the world, since, of course, we want the actualisation of states of affairs to be 'metaphysically accidental'. We can note, therefore, that the neo-Humean growing block model would be rule out both governing laws and powers, since these entities would conflict with the looping operation. For it is the latter that is responsible for adding entities to the world, not the Platonic universals *qua* governing entities.

To summarise the last couple of paragraphs. First, there can be a specific notion of necessitation that trades upon Tooley's idea of a dynamic conception of time. In particular, we can think of some effect being necessitated in the sense that we are forcing its actualisation. In this way, Barker and Smart's governing role would be saying that, somehow, anti-Humean entities can 'make' other entities join the actual world, and in doing so we have a restriction upon what we find across metaphysically possible worlds. And secondly, as the above paragraph describes, there is something related happening in the general notion of a dynamic theory of time. More specifically, if the dynamic theory of time is anti-Humean, in the sense that laws or powers are thought to govern the process of 'temporal becoming', then we have our dynamic notion of necessitation by actualisation. This is the entity-driven explanation for why a dynamic theory of time is dynamic. Tooley says, for example, that causes bring their effects into existence. And the world leaps forward in stages because of this necessitation theory of laws. By the same token, I suggest that

Tooley and his necessitation *qua* actualisation will be open to Barker and Smart's explanatory gap. (And the same would be the case for Lowe's presentist model, let us assume.) But the neo-Humean growing block model is form-driven. Although there are no metaphysically necessary connections between states of affairs, there is something curiously close: *viz*. our discussion suggested that we could model the actualisation of 'random' states of affairs with a looping operation.

With this in mind, temporal essentialism is trying to gain a grip on Barker and Smart's governing role by dividing it into two sub-roles. The first is the role of actualisation. As we have discussed, there is an understanding of necessitation that involves the forcing of actualisation. Note here something of importance. The anti-Humean entities in play for Tooley and Lowe (i.e. the laws or powers) are both (i) responsible for the actualisation and (ii) responsible for selecting what is to become actual. We can see this clearly in Tooley's laws. Using Armstrong's scheme, N(F,G), Tooley is saying that N is response for the actualisation and that the new state of affairs in question (i.e. *x*'s being G) is a function of *x*'s being F via N. So Tooley's necessitation relations are both responsible for existential changes (mere possibility moves to actuality) and for deciding what is to be changed. Given this observation, the dialectical purpose of the neo-Humean growing block is that it provides the first sub-role, i.e. (i) above. Even though this model does not use traditional anti-Humean entities, the looping operation provides a rule-following modification to the content of this system. And this is so via the overall structure of the ontology, since we have added the appropriate formal ontological operation. As things stand, however, this formal ontological operation is 'directionless': it is simply generating 'random' states of affairs. Temporal essentialism proceeds by adapting the formal ontological operation of the neo-Humean growing block so that it is sensitive to the content of the ontology in the two senses that we discussed above. More specifically, we can recall that the temporal imperative is a formal ontological operation that is checking for present objects that instantiate the first place of the selection relation. And the selection relation is providing the second sub-role, that of selecting what is to be actualised, i.e. (ii) above. We can therefore say, as I originally said, that the temporal imperative is a formal ontological operation that is 'sensitive to physical modality'. I hope to have clarified this description since its introduction in Chapter 9.

Let us consider the connection between formal ontological operations and real essences. We can

recall that Lowe understands his fundamental formal ontological relationships in terms of general essences. Or so I proposed. This raises the question of how formal ontological operations are to be understood in terms of real essences. This is a pressing issue, since I cannot make use of Lowe's form–content distinction if formal ontological operations *qua* formal posits are not ultimately understood in terms of the real essences of entities. With regard to this issue, I suggest that it is a fair strategy to separate out two sides of the question: what are objects and Platonic universals within the context of a dynamic theory of time? The first side to this question concerns the synchronic nature of these types entities. On this matter we can think about the allowable states of affairs at a time. For example, let us recall that in Chapter 9 we set out the basic ontology for temporal essentialism and included a restriction for objects and their instantiation of Platonic universals. The restriction was that a given object has to instantiate at least one Platonic universal so as to have an intrinsic nature. I see this as an essentialist claim that concerns what kinds of beings objects and Platonic universals are, since we are drawing upon the ideas that objects are types of entities that can instantiate Platonic universals, that Platonic universals are types of entities that have intrinsic natures, and that, relatedly, objects are existentially dependent (in Lowe's non-rigid sense) upon Platonic universals. This synchronic formal aspect will be temporally-invariant; hence, as we modify the content of the system from time to time we will always have propertied objects—there will be no bare objects. But consider now the proposal of the active ontology, *viz*. that we can model the dynamic aspect of world, whereby the content of the actual world changes from time to time under a performable operation that is rule-following. What does this have to do with the essences of objects and Platonic universals? Simply this, I suggest. If the formal ontological operation is sensitive to the content of the system, in such a way that what is actualised is (in a non-trivial sense) a function of what is already actual, then the conditions for objects being actual and the conditions for states of affairs being actual are different to the opposing case of the insensitive formal operation (exhibited by the looping operation of the neo-Humean growing block model). In short, what it takes for objects and first-order states of affairs to be actual is significantly different when comparing temporal essentialism to the neo-Humean growing block. I see this as a good candidate for a part of the real definition of temporal entities, i.e. objects, in temporal essentialism and the neo-Humean growing block model, since the conditions upon a type of entity becoming actual and instantiating first-order Platonic universals so as to aquire different intrinsic natures are, quite plausibly, fundamental issues in understanding these kinds of being. I have drawn

upon Lowe's (2012, p.935) notion of a "generating principle" (what it takes for an entity to come into being) in seeing this connection. Ultimately, then, I suggest that it is not properties or laws that are powerful, but rather the structure of time, which reflects the temporal essences of objects. In addition, I do not think that we should say that Platonic universals have temporal essences, since these entities are not temporal. Hence, if this line of thought is a good one, then what a Platonic universal is, diachronically speaking, will not alter as we move between the different structures of time in temporal essentialism and the neo-Humean growing block model. But what an object is will so vary. And this is because, to recapitulate, the conditions for this kind of being becoming actual and for instantiating first-order Platonic universals will be different within different structures of time.

References

Anscombe, G.E.M., 'Causality and Determination', *Metaphysics and the Philosophy of Mind* (Oxford: Blackwell, 1981), pp.113–47.

Armstrong, D. M., *A World of States of Affairs* (Cambridge: Cambridge University Press, 1997).

Armstrong, D. M., *A Combinatorial Theory of Possibility* (Cambridge: Cambridge University Press, 1989).

Armstrong, D. M., *What is a Law of Nature?* (Cambridge: Cambridge University Press, 1983).

Armstrong, D. M., *A Theory of Universals* (Cambridge: Cambridge University Press, 1978).

Barker, S., 'Dispositional monism, relational constitution and quiddities', *Analysis* 69 (2009), pp.242–50.

Barker, S., 'The Emperor's New Metaphysics of Powers', *Mind* 122 (2013), pp.605–53.

Barker, S. and Smart, B., 'The ultimate argument against dispositional monist accounts of laws ', *Analysis* 72 (2012), pp.714–22.

Beebee, H., 'The non-Governing Conception of Laws of Nature', *Philosophy and Phenomenological Research* 61 (2000), pp.571–94.

Beere, J., *Doing and Being: An Interpretation of Aristotle's Metaphysics Theta.* (Oxford: Oxford University Press, 2009).

Bird, A., *Nature's Metaphysics* (Oxford: Oxford University Press, 2007).

Bird, A., 'The regress of pure powers?' *The Philosophical Quarterly* 57 (2006), pp.513–34.

Bird, A., 'Laws and Essences', *Ratio* 18 (2005a), pp.437–61.

Bird, A., 'The dispositionalist conception of laws', *Foundations of Science* 10 (2005b), pp.353–70.

Bird, A., 'The ultimate argument against Armstrong's contingent necessitation view of laws, Analysis 65 (2005c), pp.147–65.

Bird, A., 'Antidotes all the way down?' *Theoria* 51 (2004), pp.259–69.

Bird, A, 'Dispositions and Antidotes', *Philosophical Quarterly* 48 (1998), pp.227–34.

Broad, C.D., *Scientific Thought* (London: Routledge & Kegan Paul, 1923).

Cartwright, N. *The Dappled World* (Cambridge: Cambridge University Press, 1999).

Choi, S., 'The simple conditional analysis of dispositions', *unpublished essay* (2003).

Choi, S., 'The Simple vs. Reformed Conditional Analysis of Dispositions', *Synthese* 148 (2006),

pp.369–379.

Coope, E., *Time for Aristotle: Physics IV.10–14* (Oxford: Oxford University Press, 2005).

Corry, R., 'Can Dispositional Essences Ground the Laws of Nature', *Australasian Journal of Philosophy* 89 (2011), pp.263–75.

Cross, T., Recent Work on Dispositions, *Analysis* 72 (2012), pp.115–24.

Dummett, M., *Truth and the Past* (Columbia: Columbia University Press, 2003).

Dretske, F., Laws of Nature, *Philosophy of Science* 44 (1977), pp.248–68.

Eagle, A. 'Causal Structuralism, Dispositional Actualism, and Counterfactual Conditionals' in Handfield, T. (eds.) *Dispositions and Causes* (Oxford: Oxford University Press, 2009), pp.65–99.

Ellis, B., *The Metaphysics of Scientific Realism* (Durham: Acumen, 2009).

Ellis, B., *Scientific Essentialism* (Cambridge: Cambridge University Press, 2001).

Fine, K., 'Essence and Modality' in Tomberlain, J. (eds.) *Philosophical Perspectives 8: Logic and Language* (Atascadero: Ridgeview, 1994), pp.1–16.

Goodman, N., *Fact, Fiction and Forecast* (Cambridge, Massachusetts: Harvard University Press, 1954).

Grenon, P. and Smith, B., 'SNAP and SPAN: Towards a Dynamic Spatial Ontology', *Spatial Cognition and Computation* 4 (2004), pp.69–103.

Gunderssen, L.B., 'Outline of a New Semantics for Counterfactuals', *Philosophical Quarterly* 85 (2004), pp.1–20.

Gunderssen, L.B., 'In defence of the conditional account of dispositions', *Synthese* 130 (2002), pp.389–411.

Harré, R., and Madden, E.H., *Causal Powers* (Oxford: Oxford University Press, 1975).

Hawthorne, J., 'Causal Structuralism' in Tomberlin, J. (eds.) *Metaphysics* (Oxford: Blackwell, 2002), pp.361–78.

Heil, J., *From an ontological point of view* (Oxford: Clarendon Press, 2003).

Hobbes, T., 'Elements of Philosophy Concerning Body' in Molesworth, W. (ed.) *The English Works of Thomas Hobbes of Malmesbury* (London: Bohn, 1985 [1655]).

Jacobs, J.D., 'Powerful Qualities, Not Pure Powers', *The Monist* 94 (2011), pp.81–102.

Jacobs, J.D., 'A powers theory of modality—or, how I learned to stop worrying and reject possible worlds', *Philosophical Studies* 151 (2010), pp.227–48.

Johnston, M., 'How to speak of the colors, *Philosophical Studies* 68 (1992), pp.221–63.

Lewis, D.K., 'Finkish Dispositions', *Philosophical Quarterly* 47 (1997), pp.143–58.

Lewis, D.K., *On the Plularity of Worlds* (Oxford: Blackwell, 1986).

Lewis, D.K., 'Causation', *The Journal of Philosophy* 70 (1973), pp.556–67.

Linsky, B. and Zalta, E.N., 'In defence of the simplest quantified modal logic' in Tomberlain, J. (ed.) *Philosophical Perspectives 8: Logic and Language* (Atascadero: Ridgeview, 1994), pp.431–58.

Lombard, L.B., *Events: A Metaphysical Study* (London: Routledge & Kegan Paul, 1986).

Lowe, E.J., *Forms of Thought* (Cambridge: Cambridge University Press, 2013).

Lowe, E.J., 'What is the Source of Our Knowledge of Modal Truths', *Mind* 121 (2013), pp.919–50.

Lowe, E.J., *More Kinds of Being: A further Study of Individuation, Identity, And the Logic of Sortal Terms* (Oxford: Wiley-Blackwell, 2009a).

Lowe, E.J., 'Serious Endurantism and the Strong Unity of Persons', in Honnefelder, L. *et al* (eds.) *Unity and Time in Metaphysics* (Berlin: Walter de Gruyter, 2009b), pp.67–82.

Lowe, E.J., *The Four-Category Ontology* (Oxford: Oxford University Press, 2006).

Lowe, E.J., Time and Persistence' in Le Poidevin, R. (eds.) *Questions of Time and Tense* (Oxford: Oxford University Press, 1998), pp.43–60.

Lower, B., 'Humean Supervenience', *Philosophical Topics* 24 (1996), pp.101–27.

Makin, S., *Aristotle Metaphysics Book Θ* (Oxford: Oxford University Press, 2006).

Manley, D. and Waserman, R., '*Dispositions, conditionals, and counterexamples*', *Mind* 120 (2011), pp.1191–227.

Martin, C.B., *The Mind in Nature* (Oxford: Oxford University Press, 2007).

Martin, C.B., 'Dispositions and Conditionals' *Philosophical Quarterly* 44 (1994), pp.1–8.

Maudlin, T., *The Metaphysics Within Physics* (Oxford: Oxford University Press, 2007).

McCall, S., 'Tooley on Time' in Oaklander, N.L. (ed.) *The Importance of Time: Proceedings of the Philosophy of Time Society, 1995–2000* (Dordrecht: Kluwer Academic Publishers, 2001), pp.13–20.

McCall, S., *A Model of the Universe* (Oxford: Clarendon, 1994).

McCall, S., 'Time and the Physical Modalities', *The Monist* 53 (1969), pp.426–46.

Mellor, D.H., 'In Defence of Dispositions' *The Philosophical Review* 83 (1974), pp.157–81.

Mill, J.S, *A System of Logic* (London: Parker, 1843).

Molnar, G., *Powers A Study in Metaphysics* (Oxford: Oxford University Press, 2003).

Mumford, S., 'Reply to Bird', in *Looking for Laws: Review Symposium on Mumford's Laws in Nature*, *Metascience* 15 (2006), pp.437–69.

Mumford, S., *Laws in Nature* (Abingdon: Routledge, 2004).

Mumford, S., *Dispositions* (Oxford: Oxford University Press, 1998).

Mumford, S. and Anjum, R., *Getting Causes from Powers* (Oxford: Oxford University Press, 2011).

Mumford, S. and Anjum, R., 'Double Prevention and Powers', *Journal of Critical Realism* 8 (2009), pp.227–93.

Oaklander, N.L., 'Tooley on Time and Tense' in Oaklander, N.L. (ed.) *The Importance of Time: Proceedings of the Philosophy of Time Society, 1995–2000* (Dordrecht: Kluwer Academic Publishers, 2001), pp.3–12.

Orilia, F., 'Dynamic events and presentism', *Philosophical studies* 160 (2004), pp.407–14.

Popper, K., *The Logic of Scientific Discovery* (London: Hutchinson, 1959).

Pruss, A., *Actuality, Possibility, and Worlds* (New York: Continuum, 2011).

Psillos, S., 'Salt Does Dissolve in Water, but not Necessarily', *Analysis* 62 (2002), pp.255–7.

Quentin, S., 'Time and Degrees of Persistence: A Theory of Degree Presentism' in Callender, C. (ed.) *Time, Reality, and Experience* (Cambridge: Cambridge University Press, 2002), pp.119–36.

Quentin, S., 'Actuality and Actuality as of a Time' in Oaklander, N.L. (ed.) *The Importance of Time: Proceedings of the Philosophy of Time Society, 1995–2000* (Dordrecht: Kluwer Academic Publishers, 2001), pp.21–30.

Quine, W.V., *From a Logical Point of View*, 2nd ed. (Cambridge MA: Harvard University Press, 1961).

Reichenbach, H., *The Direction of Time* (Berkeley: University of California Press, 1956).

Ryle, G., *The Concept of Mind* (London: Penguin, 1949).

Sider, T., *Four-Dimensionalism: An Ontology of Persistence and Time* (Oxford: Clarendon Press, 2001).

Schaffer, J., 'On What Ground What' in Chalmers, D. et al (eds.) *Metametaphysics: New Essays on the Foundations of Ontology* (Oxford: Oxford University Press, 2009).

Schaffer, J., 'Spacetime the one substance', *Philosophical Studies* 145 (2009), pp.131–48.

Schaffer, J., 'Two conceptions of sparse properties', *Pacific Philosophical Quarterly* 85 (2004), pp.92–101.

Schneider, L., 'Whatever Binds the World's Innermost Core Together: Outline of a General Theory of Ontic Predication', *Axiomathes* 23 (2013), pp.419–42.

Schrenk, M., 'Interfering with Nomonological Necessity', *Philosophical Quarterly* 61 (2011), pp.577–97.

Schrenk, M., 'The Powerlessness of Necessity', *Nôus* 44 (2010), pp.725–39.

Shoemaker, S., 'Causality and Properties', in van Inwagen, P. (eds.), *Time and Cause: Essays Presented to Richard Taylor* (Dordrecht: Reidel, 1980), pp.109–135.

Tooley, M., *Time, Tense, and Causation* (Oxford: Oxford University Press, 1997).

Tooley, M., 'Response to Comments on *Time, Tense, and Causation* by Storrs McCall, Nathan Oaklander, and Quentin Smith' in Oaklander, N.L. (ed.) *The Importance of Time: Proceedings of the Philosophy of Time Society, 1995–2000* (Dordrecht: Kluwer Academic Publishers, 2001), pp.31–58.

Tooley, M., *Causation: A Realist Approach* (Oxford: Oxford University Press, 1987).

Tooley, M., 'The Nature of Laws', *Canadian Journal of Philosophy* 7/4 (1977), pp.677–98.

Tugby, M., 'Graph-theoretic models of dispositional structures', *International Studies in the Philosophy of Science* 27 (2013a) pp.23–9.

Tugby, M., 'Platonic Dispositionalism', *Mind* 122 (2013b), pp.451–80.

van Fraassen, B., *Laws and Symmetry* (Oxford, Oxford University Press, 1989).

Vetter, B., *Potentiality and Possibility* (Oxford: Dissertation, 2010).

Vetter, B., 'Nature's Metaphysics: Laws and Properties', *Logical Analysis and History of Philosophy* 12 (2009), pp.320–28.

Williams, N.E. and Borghini, A., 'A Dispositional Theory of Possibility', *Dialectica* 62 (2008), pp.21–41.

Williamson, T., 'Bare Possibilia', *Erkenntnis* 48 (1998), pp.257–73.

Yates, D. 'The Essence of Dispositional Essentialism', *Philosophy and Phenomenological Research* 87 (2013), pp.93–128.