Difference and Structure

Deleuze and Ontic Structural Realism

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How else can one write but of those things which one doesn't know, or knows badly? It is precisely there that we imagine having something to say.

(Gilles Deleuze)

And all this science I don't understand.

(Elton John)

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Abstract

A branch of the interpretative literature on the work of the philosopher Gilles Deleuze is more or less dedicated to emphasizing his engagements with mathematics and the sciences and to presenting his thought to an audience of philosophers of science working in the analytic tradition. Such scholarship, however, generally fails to connect Deleuze to the ideas and problems that motivate contemporary philosophers of science. Still, an emerging interest in Deleuze is observable within the philosophy of science literature. This thesis aims to encourage and cultivate this interest by presenting a direct, comparative study of Deleuze's philosophy of difference in relation to ontic structural realism. I claim that identifying and examining the various affinities (and differences) between these two positions, which I take to be a worthwhile task in and of itself (i), allows us: (ii) to force Deleuze's philosophical position into greater exegetical clarity, (iii) to critically reappraise (and reject) the way in which numerous commentators understand the role of science within Deleuze's philosophical writings, and (iv) to propose some interesting challenges and adjustments to the ontic structural realist view.

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Table of Figures

All figures are my own. Figure 4.1 is based on the illustration found in Leibniz's 'Justification of the Infinitesimal Calculus by that of Ordinary Algebra' (see Leibniz 1989: 545–46). Figures 4.2 and 4.6 are based on those found in Duffy's *Deleuze and the History of Mathematics* (2013: 17, 28).

Abbreviations and Citation Conventions

When adopting refencing conventions commonly used in the philosophical literature (for example when referring to the works of Aristotle, Hume, or Kant), I include an explanatory footnote in the first instance. When referring to specific sections of this thesis, I use parentheses emphasized in bold—for example: **(3.2)**. When referring to the seminars Deleuze taught at the Université de Paris VIII–Vincennes à St. Denis in the period 1971–87, and which are the focus of an ongoing translation project, co-directed by Daniel W. Smith and Charles J. Stivale, I refer to the relevant date in parentheses—for example: (29 Apr 1980). The link to 'The Deleuze Seminars' project is as follows: https://deleuze.cla.purdue.edu/.

References to the works below are given using the following abbreviations, followed by page number(s).

Works by Gilles Deleuze

B	*Bergsonism*, trans. H. Tomlinson and B. Habberjam (New York: Zone, 1988).
DR	*Difference and Repetition*, trans. P. Patton (London: Athlone, 1994).
ES	*Empiricism and Subjectivity: An Essay on Hume's Theory of Human Nature*, trans. C. V. Boundas (New York: Columbia University Press, 1991).

FLB *The Fold: Leibniz and the Baroque*, trans. T. Conley (London: Athlone, 1993).

Works by Gilles Deleuze and Félix Guattari

AO *Anti-Oedipus*, trans. R. Hurley, M. Seem and H. R. Lane (New York: Viking Press, 1977)

ATP *A Thousand Plateaus*, trans. B. Massumi (Minneapolis: University of Minnesota Press, 1987).

WP *What is Philosophy?*, trans. H. Tomlinson and G. Burchell. New York: Columbia University Press, 1994).

Other works

ETMG Ladyman, J., Ross, D., et al. *Every Thing Must Go: Metaphysics Naturalized* (Oxford: Oxford University Press, 2007).

SotW French, S. *The Structure of the World: Metaphysics and Representation* (Oxford: Oxford University Press, 2014).

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Introduction

A branch of the interpretative literature on the work of the philosopher Gilles Deleuze is more or less dedicated to emphasizing his engagements with mathematics and the sciences and to presenting his thought to an audience of philosophers of science working within the analytic tradition.[1] Such scholarship, however, generally fails to connect Deleuze to the ideas and problems that motivate contemporary philosophers of science.[2] Still, an emerging interest in Deleuze is observable within the recent philosophy of science literature. Calamari (2021), for instance, asks whether Deleuze might provide the appropriate metaphysics for loop quantum gravity, and Dewar (2022) speculates as to whether he affords the conceptual resources that might help to formulate a category-theoretical account of the representation of scientific theories. Even van Fraassen and Pesghard (2008) reference Deleuze in their paper on identity over time.[3] One of the motivations of this thesis, then, is to encourage this interest by presenting a (hopefully) more accessible Deleuze, one who connects with many of the issues that animate contemporary philosophy of science.

I do this by means of a direct, comparative study of Deleuze's philosophy of difference in relation to 'ontic structural realism'. This seems to me an especially appropriate point of comparison because these two positions exhibit various affinities with one another:

[1] DeLanda's aim in his *Intensive Science and Virtual Philosophy*—'one of the great classics of Deleuze scholarship' (Harman 2016: viii)—is to 'present […] Deleuze to an audience of analytical philosophers of science' (2002: 1). See also Protevi, who seeks to 'show how Deleuze's conceptual framework enables us to bring scientifically minded philosophers and philosophically minded scientists—as well as analytic and continental philosophers—into dialogue' (2013: 14). See **(3.3)** for a more thorough account of the scholarship.
[2] This claim receives justification in **(3.3, 5.1)**.
[3] See also Ludwig (2017).

- Both critique identity- or individual-based metaphysics, along with the attendant notion that the world is mereologically composed of little things or otherwise organized into a hierarchy of 'levels'.
- Both describe ontologies in which relations are fundamental.
- Both can be described as modified versions of empiricism.
- Both endorse a metaphysically primitive form of objective modality.
- And both are naturalistically motivated—and, in particular, are influenced by the work of Henri Poincaré.

This in itself is not an obvious claim. It is an unfortunate sociological fact—one concerning the organization of institutional philosophy over the last century or so—that philosophers with expertise in the philosophies of science and physics will likely not be familiar enough with Deleuze's thought to acknowledge such affinities, and vice versa for those with expertise in Deleuze. Overcoming this obstacle is part of the work that this thesis must do. Accordingly, much of the early chapters are dedicated to providing the exegesis necessary in order to make each philosophical domain accessible to those who specialize in the other.

An ever-present difficulty for bridge-building projects, such as this one, is that they often run up against differing local standards for what counts as a legitimate or worthwhile philosophical project. It is therefore worth taking a moment to establish precisely what I understand the principal contributions of this thesis to be.

First, I take it that examining hitherto unrecognized parallels between lines of thought, and determining the ways in which they complement or contrast with one another, is a worthwhile pursuit in and of itself—and especially so when those lines of

thought have never before (or have only very rarely) been associated.[4] It is simply peculiar that a philosopher so regularly affiliated with those putative 'postmodernist forces of darkness' (Sider 2011: 65) appears to have made so many near-identical claims to a piece of contemporary philosophy of science and physics—and to have done so decades before the emergence of the latter (in its current form, at least) while drawing on largely independent sources.[5] This peculiarity demands further investigation, in my view—and this is something my thesis aims to provide.

Second, note that Deleuze is an extremely difficult philosopher to understand and that his texts are open to many differing interpretations:

> We still don't quite know what the name 'Deleuze' stands for, or the place we ought to give it in the history of thought. His is a thought that is in the process of being canonised, yet there seems to be little agreement as to what exactly is entering the canon. (de Beistegui 2010: 1)

Making sense of Deleuze's philosophical position is therefore a project unto itself. Using ontic structural realism as a foil, I hope to force Deleuze's thought into greater exegetical clarity.

Doing so has a number of upshots. For instance, updating our understanding of the relevant contemporary philosophy of science allows us to critically reappraise the way in which numerous commentators understand the role of science in Deleuze's

[4] There appears to be no mention of Deleuze in the core ontic structural realism literature. In the Deleuze literature, the ontic structural realism of Ladyman and Ross is examined by Bell (2016: 172–79). But his examination is only very brief. And indeed, he appears to misrepresent Ladyman and Ross's position. For instance, he claims that, on their view, the practice of 'reading entrails' did at one point track real patterns (2016: 178–79). When we examine their account of real patterns, we will see that such a claim cannot be true **(2.2)**. Ladyman and Ross are also briefly mentioned by Harman to DeLanda in their conversational book (2017: 82), but this thread is not developed.

[5] I take the 'current' form of ontic structural realism to have emerged, roughly, with Worrall (1989) and Ladyman (1998).

philosophical writings **(5.1)**. Making more accessible sense of Deleuze's thought might also yield fresh conceptual resources for the ontic structural realist's metaphysical toolbox. That is, French highlights the realist obligation to provide one's interlocuters with a reasonably clear picture of what exactly they are a realist about, and he regards the metaphysical tradition as a 'toolbox' that offers resources for the construction of such a picture.[6] That Deleuze's philosophical position already bears some resemblance to ontic structural realism suggests that his concepts (or at least some of them) might be ready made for this purpose.

Relatedly, both French and Ladyman (2003a) and Ladyman and Ross (*ETMG*) admit to finding themselves 'hamstrung by the descriptive inadequacies of modern logic and set theory' (2003a: 41):

> Certainly, the structuralist faces a challenge in articulating her views to contemporary philosophers schooled in modern logic and set theory, which retains the classical framework of individual objects represented by variables subject to predication or membership respectively.[7] (*ETMG*: 155)

Ontic structural realists may lament their inheritance of this most basic descriptive and conceptual machinery from the analytic tradition,[8] then, but Deleuze is free from these limitations. As Smith observes:

[6] French draws on Chakravartty (2007) here (see *SotW*: 48). I flesh this out in **(2.2)**.
[7] A paradigm case of such a contemporary philosopher would be Sider, who insists that 'modern logic's quantificational apparatus mirrors the structure of reality' (2001: xvi).
[8] As Smith (a Deleuze scholar) remarks: 'The limitation of so-called "analytic metaphysics" is its reliance on a logicist, formalist, and set theoretical metaphysics inherited from the nineteenth century' (2012: 83, n.15).

> Deleuze […] approaches the problem of existence not through logic, which takes identity as its model, but through mathematics, which—in certain of its domains—developed a symbolism capable of thinking difference.[9] (2012: 83)

Though ontic structural realists have developed strategies for circumventing their analytic inheritance, Deleuze may still provide useful ways for articulating the structuralist view.[10] In fact, I argue that Deleuze not only develops his own analogue of one of these structuralist strategies—namely, the so-called 'Poincaré Manoeuvre'—but that he does so *also* by drawing on the work of Poincaré **(4.3)**! These ontic structural realism-specific upshots notwithstanding, producing a philosophy of science-informed statement of Deleuze's philosophical position will also help in our aforementioned aim of promoting that emerging interest in Deleuze within the philosophy of science more broadly.

The third and final principal contribution made by this thesis is that of articulating a potential challenge and alternative to current versions of ontic structural realism. In particular, and as part of my investigation of Deleuze's naturalist status, I advance some challenges to Ladyman and Ross's Primacy of Physics Constraint **(5.2)**. I argue that their Principle of Naturalistic Closure might be more serviceable *without* this constraint and I suggest that Deleuze's philosophy represents precisely this kind of alternative **(5.3)**.

These parameters in hand, the structure of the thesis is as follows. Chapter 1 establishes the relevant philosophical backdrop and motivations for the ontic structural realist view. I introduce the realism and anti-realism debate in the philosophy of science

[9] On the difficulty of conceiving of difference as primary within the logical machinery of the analytic tradition, see Moore (2012: 399–400, 419–20).
[10] Indeed, compare Deleuze's aforementioned emphasis on *mathematics* with Wallace's recent articulation of a 'math-first' approach to physical theories (2021).

(1.1, 1.2) and show how, according to the ontic structural realist, a structuralist metaphysics proves to be the most advantageous and reconciliatory position available—or the 'best of both worlds' **(1.3)**. I then examine the main positive evidence for ontic structural realism—namely, quantum mechanics **(1.4)**—before then acknowledging Ladyman and Ross's critique of 'neo-scholastic' metaphysics in the analytic tradition **(1.5)**.

Chapter 2 establishes a more positive understanding of the two main versions of ontic structural realism—that belonging to Ladyman and Ross (*ETMG*) and that belonging to French (*SotW*). I distinguish their respective metametaphysical accounts of *what counts* as appropriately naturalistic metaphysics **(2.1)** and I distinguish Ladyman and Ross's 'Rainforest Realism' from French's 'eliminative' structuralist ontology **(2.2)**. I also express a semantic qualm concerning the supposedly distinctively 'eliminative' character of French's metaphysics.

Chapter 3 turns to Deleuze. I start by introducing his general philosophical project and by attempting to account for his weird and esoteric rhetorical style **(3.0)**. I then present his critique of 'representation', or at least one aspect of it, by examining his engagements with Aristotle and Scholastic philosophy **(3.1)**. I then elucidate Deleuze's identification of his thought as a form of 'transcendental empiricism' **(3.2)**. This will involve examining and explicating the ways in which he takes up and radicalizes the critical projects of Hume and Kant. Crucially, it also involves introducing Deleuze's novel account of objective modality—or his concept of the 'virtual'. Let me be clear: this is the site of one my main original and interpretative claims concerning how best to make sense of Deleuze's philosophical position. He is rarely associated with the contemporary metaphysics of modality in the analytic tradition—or at least in the philosophy of science. And yet, I claim that by reading him

in conjunction with philosophers such as Ismael (2017) and Vetter (2009), as well as alongside ontic structural realists, we can helpfully parse him as defending a radical form of objective modality that is both 'immanent' (in the sense that it encodes the relevant modal features *within* the actual world) and 'primitive' (in the sense that it makes these modal features ontologically basic). Finally, I introduce the question of Deleuze's naturalist status **(3.3)**. I show that, despite the extensive literature emphasizing Deleuze's engagements with the sciences, and despite claims of wanting to introduce his thought to philosophers working in the analytic tradition, *and despite claims to have shown Deleuze's philosophy to be naturalistic*, the question of his naturalism is almost never explicitly thematized.

Chapter 4 develops a more positive sense of Deleuze's philosophy of difference by elaborating upon two of his (many) descriptive machineries—namely, intensity and the calculus (and other related mathematical notions). Drawing on the work of Mader (2014), I situate Deleuze's thinking of intensity in relation to Aristotle and his medieval commentators before then elaborating upon his own ontology of intensive difference—specifically in relation to his engagements with embryology **(4.1)**. I then turn to (some of) his engagements with mathematics **(4.2)**. Drawing upon the helpful historical and interpretative work done by Duffy (2004, 2013), and upon transcripts of Deleuze's seminars, I elucidate Deleuze's interpretation of Leibniz's infinitesimal calculus, according to which we ought to take the 'differential relation' as fundamental. Noting his idiosyncratic use of the term, I then detail some episodes in the history of mathematics from which Deleuze extracts his concept of 'singularity'—a core notion in his differential ontology. These episodes range over Leibniz, Weierstrass's theory of analytic continuity, and Poincaré's qualitative approach to differential equations. Finally, I attempt to relate this mathematical descriptive machinery back to his

transcendental empirical account of the virtual and the actual **(4.3)**. And it is here that I propose that Deleuze enacts his own 'Poincaré Manouevre'. Though the structuralist manoeuvre draws primarily on Poincaré's work 'On the Foundations of Geometry' (1898), or on his contributions to group theory, however, what I see as the Deleuzean manoeuvre draws on Poincaré's qualitative approach to differential equations (1881, 1882).

Chapter 5, which is the final chapter of the thesis, revisits the topic of naturalism—and in particular the question of Deleuze's naturalist status. Drawing on work done in **(1.5, 2.1, 2.2, 3.3)**, I argue that what little discussion of Deleuze's naturalist status *does* exist—namely, that belonging to Patton (2016) and Ansell Pearson and Protevi (2016)—fails to accurately reflect the commitments of the sciences and otherwise suffers from a lack of engagement with contemporary philosophy of science **(5.1)**. Picking up from **(2.1, 2.2)**, I then interrogate Ladyman and Ross's Primacy of Physics Constraint and present some arguments for why we might want to abandon it **(5.2)**. Armed with a new positive conception of naturalistic metaphysics, I then present an account of the role of the sciences in Deleuze's philosophical writings that appears to fit with such a conception **(5.3)**. Along the way, I critique further attempts by commentators—namely May (2005) and Mader (2017)—to make sense of Deleuze's philosophical relationship to the sciences.

I conclude the thesis with some speculative remarks on other potential points of comparison. These include recent attempts to think about inferences to the best explanation, or abductive reasoning, as a kind of transcendental inquiry, some reflections on a Deleuzean account of the representation of scientific theories, and some final thoughts on the potential relevance of Deleuze's broader system—in particular his aesthetics.

Chapter One

Why Structure?

1.0 Introduction

The purpose of this chapter is to provide a sense of why we might want to adopt a structuralist ontology. After all, the idea that the world is entirely relational is not an intuitive one. We tend to think of relations as states of affairs that obtain *between* things. That is to say, the very idea of a relation seems to presuppose the existence of entities upon which relations depend—or without which they could not obtain. Paul cannot be taller than Peter, for instance, if neither Peter nor Paul exist. Or, rather, there can be no relation between them if they do not first have some comparable basic features or intrinsic properties (such as their respective heights). Why, then, ought we to abandon the much more familiar and intuitive notion that the world consists of things *between which relations of various kinds obtain* in favour of the much less familiar and more bizarre-seeming notion that relations are all that exist? In what follows, we attempt to answer this question.

Doing so requires that we establish some understanding of the dialectical space in which structuralism operates. Ontic structural realism *is*, after all, a version of realism about science. That is to say, we can regard it as an attempt to modify and bolster realism in light of the various challenges faced by its standard formulation. If we are to understand the motivations for structuralism properly, then, we ought first to establish

an understanding of the standard conception of scientific realism, along with some of its limitations **(1.1)**. We ought then to consider the leading alternative (that is to say, *anti*-realist) position—namely, Bas van Fraassen's constructive empiricism **(1.2)**. Only then will we be able to recognize how the conjunction of these positions and their respective limitations results in the structuralist attempt to reconcile the advantages of both while retaining none of their weaknesses **(1.3)**. Upon this recognition, however, we ought then to provide some independent, positive justification for adopting a structuralist ontology. Otherwise, structuralism remains vulnerable to the charge that it is 'ad hoc'. Structuralism may well be pitched as an extremely reconciliatory position, but what actual *evidence* do we have for the view? Such evidence can be found in our most successful scientific theory to date—namely, quantum mechanics **(1.4)**. After detailing these quantum mechanical motivations, I return to the issue of structuralism's counter-intuitiveness. I detail Ladyman and Ross's critique of what they refer to as 'neo-scholastic metaphysics', and the resultant claim that intuitions ought not to have currency when it comes to metaphysical deliberation **(1.5)**.

1.1 Realism

Following van Fraassen (1980), the realism debate in the philosophy of science can be cast in terms of the *aims* of scientific theories. Consider, then, the following question: what is the aim of science? A common (and perhaps the most intuitive) response would be to say something like: 'science is supposed to tell us what the world is really like'. This, approximately speaking, is scientific realism. And, though precisely how realism about science ought to be characterized remains a matter of contention, we can formulate it a bit more precisely as follows: science aims at producing true descriptions

of the world, and so accepting a scientific theory involves a metaphysical commitment to whatever the content of that theory represents.[11] Thus, if you are a scientific realist, you think that our best science refers to things that *actually exist*.

The reader will most likely find this claim uninteresting and uncontroversial when it comes to things we can observe. After all, few would deny the existence of planets, tigers, and bridges.[12] But the realist position becomes a little more controversial once we acknowledge that it also applies to things we *cannot* observe—at least not directly or without the help of technical instruments. These include things like viruses, most electromagnetic waves, atoms, and electrons. Thus, despite the fact that no one has ever observed any such entities (again, *with their own unaided senses*), nor *could* anyone do so (that is, given the particularities of human physiology), the realist insists that our best science commits us to their existence nonetheless.[13]

This is not to say that the distinction between observable and unobservable is significant for the realist position. On the contrary, the point is that realism *does not* discriminate between what can and cannot be observed—at least when it comes to the aims of science or what is involved in accepting a scientific theory. It is, rather, the *anti*-realist who thinks observability matters. The introduction of this distinction, then, serves not to elucidate some important feature of the realist view, but to anticipate a point of contention exploited by its opponents—namely, realist claims to knowledge about unobservable entities. Before examining the difficulties surrounding these claims, however, let us consider their principal defence.

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[11] This is a version of van Fraassen's own definition of scientific realism: '*Science aims to give us, in its theories, a literally true story of what the world is like; and acceptance of a scientific theory involves the belief that it is true*' (1980: 8).
[12] That being said, we will see in Chapter 2 that French does in fact deny that such entities exist.
[13] We return to the notion of observability below **(1.2)**.

1.1.1 No Miracles

We have observed that realism might be the most intuitive position regarding the aims of scientific theories, but it is also supported by one of the most powerful arguments in the philosophy of science—namely, the 'no miracles' argument. Originally formulated (in these terms) by Putnam, it claims that 'realism […] is the only philosophy that doesn't make the success of science a miracle' (1975: 73). Different things can be meant by the 'success' of science here, but perhaps its most obvious markers are reliability and predictive success. Medicine, for instance, regularly preserves and prolongs life. That is to say, medical treatments such as antibiotics and vaccines tend to work precisely as expected, having contributed to increased life expectancy and the near-elimination of various diseases (including polio, measles, mumps, and rubella). So what explains such widespread success? According to the no miracles argument, the best (and indeed *only*) explanation is that realism is true. In other words, medicine works because microbiologists and biochemists have figured out that *there are* such things as cells, bacteria, and viruses whose behaviour can be manipulated in various ways in order to combat disease. If this were *not* the case, or if we refused to accept that the relevant theories involved in the development of these kinds of medical treatments accurately represent what the world is really like, then we would have no way of explaining their effectiveness. Indeed, so the argument goes, we would have to conclude the successful medical application of such theories to be little more than happenstance—or a '*cosmic coincidence*', as Smart puts it (1963: 39). Thus, assuming that we find appeals to miraculous happenstance wildly unsatisfactory, we should regard realism as true.

Following Ladyman (2002: Ch.7), we can conceptualize this argument more precisely by acknowledging that it is an example of 'inference to the best explanation', a mode of reasoning (also known as 'abduction') that is used in both everyday life and, according to the realist, in scientific practice. Say, for example, that I arrive downstairs to find my research notes torn to shreds and strewn across the living room floor, plus an extremely guilty-looking Yorkshire Terrier – Pomeranian cross cowering in the corner. At this point, I can form one of several possible beliefs, such as:

(1) The notes spontaneously destroyed themselves and Bertie (the dog), having witnessed this strange event, is concerned that he will wrongfully get the blame.

(2) A burglar broke into the house. Bertie valiantly fought them off, but the notes (and only the notes) were damaged collaterally, and he is now concerned that he will wrongfully get the blame.

(3) Bertie ate the notes.

Naturally, I infer (3)—and I do so because it appears to be *the best explanation* given the available information.

What makes one explanation better than another? This in itself is a subject of debate, but candidate factors include properties like simplicity and coherence with other background beliefs. That Bertie ate the notes, for instance, is the simplest explanation, requiring no further account of how a burglar entered the house without leaving any signs of forced entry. Similarly, this same account fits nicely with my other beliefs concerning the likelihood of a burglar-Bertie brawl resulting *only* in some torn papers, as well as the ability of inanimate objects to spontaneously self-destruct.

That we do in fact use this kind of reasoning in everyday life seems incontrovertible. As Ladyman notes, 'it is hard to see how we could get by without such inferences' (2002: 210). But, as already mentioned, some argue that abduction also plays a significant role in scientific practice—for instance, when deciding between competing candidate theories. Consider, for example, Wolfgang Pauli's postulation of the neutrino in 1930. At the time, a type of radioactive decay called β-decay (or 'beta decay') was thought to violate the principle of conservation of energy. Niels Bohr, for instance, claimed that such a phenomenon 'may force us to renounce the very idea of energy balance' (1932: 383). In a public letter to a group of physicists, however, Pauli hypothesized the existence of a hitherto undetected type of subatomic particle that would account for any apparent discrepancy in energy conservation. Thus, on Pauli's account, the decay of a neutron into a proton and an emitted electron (as was the picture at the time) also resulted in an emitted antineutrino, which would have sufficient mass to balance the relevant equation and conserve energy across the decay.[14]

Now, Pauli's hypothesis is a clear instance of abduction because he advances an alternative to Bohr's explanation that he believes to be simpler and more consistent with the prevailing views of the time. That is, rather than stick only with the detected configuration of particles, thereby forcing us to abandon the already well-established and successful law of conservation of energy, Pauli suggests, in an explicitly acknowledged effort 'to save […] the law of conservation of energy' (Pauli 1991: 4), that there might be another, albeit more difficult to detect, particle at play. If postulating the existence of another kind of subatomic particle precludes the need to rewrite one of

[14] I am using some anachronistic terminology here. Pauli himself did not refer to 'antineutrinos', for instance. Indeed, his original term for the neutrino was 'neutron'; it was Enrico Fermi who coined the term 'neutrino' (literally: 'little neutral one') in 1933. For an overview of the history of the neutrino, see Johnson and Tegen (1999). In addition, the kind of β-decay described here is actually β^--decay (or 'beta *minus* decay'). Again, these contemporary nuances and terms of reference had yet to be introduced at the time of Pauli's original hypothesis.

our most celebrated laws of physics, then surely that seems a better explanation for any alleged discrepancy. And indeed, despite his initial humility and refusal to publish on this suggestion, Pauli's hypothesis was vindicated by the eventual detection of the neutrino in 1956.[15]

It would certainly seem, then, that examples of abduction can be found in scientific practice. But what does this have to do with the defence of scientific realism? Well, according to Ladyman, the sheer fact that scientists appear to be interested in *explaining* phenomena suggests that realism must be true: 'the practice of IBE [inference to the best explanation] in science commits us to realism' (2002: 211). That is to say, if *explanatory* considerations inform theory choice (as they do for Pauli), then accepting a theory involves a commitment to the existence of whatever unobservable entities might be referred to by that theory. After all, only the *existence* of neutrinos *explains* β-decay (in light of the law of conservation of energy). Another theory, one that claims merely that the world behaves *as though there were* neutrinos, might predict and describe β-decay correctly, but would fail to explain *why* it occurs in the way that it does.

Ladyman refers to this particular argument as the 'local' defence of realism by means of inference to the best explanation (2002: 210). Notice, however, that the local defence can be articulated *without* any appeal to actual scientific practice. That is, without depending upon the premise that 'many scientists think that to regard a theory as the most explanatory successful is therefore to have a good reason for choosing that theory over its rivals' (2002: 211). And indeed, this is precisely how Ladyman and Ross express the argument in *Every Thing Must Go*: 'A local defence of scientific realism appeals to a particular set of experimental facts and their explanation in terms of some

[15] See Cowan, Reines, et al (1956).

particular unobservable entities' (*ETMG*: 69). Thus, regardless of whether scientists do in fact reason abductively, scientific realism can still be motivated by pointing to a particular theory (be it the biochemical theories mentioned above, or Pauli's neutrino-based account of β-decay) and by attributing its predictive success to the existence of whatever unobservable entities it postulates (cells, viruses, and antibodies in the former case; neutrinos in the latter).

Van Fraassen, however, argues that any of these local explanations can in fact be understood as a *pragmatic* commitment simply to retain the successful theory in question. As he writes, 'acceptance [of a theory] involves a commitment to confront any future phenomena by means of the conceptual resources of this theory' (1980: 12). Thus, on van Fraassen's account, Pauli's postulation of the neutrino expresses not a commitment to its existence but a commitment simply to retain the (hitherto predictively successful) law of conservation of energy.

We will focus more on van Fraassen's arguments in the following section. For now, it is worth acknowledging that enough pressure can be applied by the anti-realist to the 'local' defence of realism to warrant a shift to what Ladyman refers to as the 'global' defence of realism by means of inference to the best explanation (2002: 213–19). Here the argument appeals not to *some particular* set of experimental facts or theoretic successes, but to the success of science *as a whole*. That is, to *all* current and historic theoretic success. It is this more comprehensive appeal to the success of science that, on Ladyman's view, properly deserves to be called the 'no miracles' or the 'ultimate' argument for scientific realism (2002: 213; *ETMG*: 69).

More can be said about the no miracles argument and the need to explain the success of science. Below, for instance, we examine van Fraassen's particular misgivings regarding the supposed need to explain theory success. For now, though, it

is enough to recognize that the argument, in its fullest and most comprehensive form, insists that there must be some connection between the general success of science in predicting and describing phenomena and *the way the world is*. Science must have somehow latched onto the truth of the world in order to be as successful as it in fact is.

1.1.2 Theory Change

On a certain formulation, then, the no miracles argument can be understood as appealing to the history of scientific success in order to claim that realism is true.[16] There is, however, another argument that draws on the history of science in order to *reject* realism. This is the argument from theory change—or the 'pessimistic meta-induction'. Now, this argument (or rather this *type* of argument) has been advanced in a variety of forms and for a variety ends.[17] But its most famous and seminal contemporary formulation can be attributed to Laudan (1981), who appeals to the history of theory change in the sciences in order to undermine the realist attempt to associate scientific success with the successful reference of theoretical terms to real unobservable features of the world.

In Laudan's vocabulary, the realist claims that the only explanation for the success of scientific theories is that their terms *genuinely refer* to entities in the world. Thus, the microbiologist's theories work because the terms employed by those theories ('cell', 'virus', 'antibody', and so on) refer to cells, viruses, and antibodies—that is, *to*

[16] See, for example, Boyd, who demands an explanation for the cumulative success of the sciences, or for how 'scientific methodology acts dialectically so as to produce in the long run an increasingly accurate theoretical picture of the world' (1984: 65).
[17] I qualify 'type' of argument here because so-called 'pessimistic inductions' have been used in various ways and to various (including realist) ends. For an overview of how this kind of argument has been mobilized, see Wray (2015).

things that actually exist. Laudan, however, points to numerous past cases in which a predictively or empirically successful theory has subsequently been rejected and replaced by a theory *with different terms*. That is to say, we can point to a number of discarded theories in the history of science that were initially considered successful in the relevant ways, but whose terms have since proven *not* to have referred to anything at all.

Laudan provides a list of examples, including the phlogiston theory of chemistry, the caloric theory of heat, and the positing of the luminiferous ether as the medium through which light waves travel (1981: 33). Indeed, Laudan claims that the history of science is riddled with such examples:

> for every highly successful theory in the past of science which we now believe to be a genuinely referring theory, one could find half a dozen once successful theories which we now regard as substantially non-referring. (1981: 35)

On his account, then, the history of theory change, and specifically the history of the redundancy of theoretical terms, provides a sufficient inductive base for the claim that we ought to expect the terms of our current theories to suffer the same fate. The pessimistic meta-induction therefore takes the following form:

(P1) Throughout the history of science, many theoretical terms of successful theories have been replaced by different terms in more successful theories (and so have proven not to refer).

(P2) We have no reason to expect that our current theories will be any different in this respect.

(C) Therefore, we ought not to believe that any of the terms used by our current theories genuinely refer to real features of the world—and so realism is false.

Notice, then, how Laudan has driven a wedge between the success of a theory and the successful reference of that theory's terms. This would appear to be a devastating blow to the realist, whose position (as per the no miracles argument) depends upon an appeal to genuine reference in order to explain scientific success.[18] If we have no reason to think that a successful theory accurately represents the world, then the principal justification for realism evaporates.

Now, the realist can attempt to undermine the force of Laudan's conclusion by introducing greater restrictions on what counts as a successful theory. The idea here is that, if such restrictions are introduced, then the realist might be able to reduce the inductive force of Laudan's argument. Examples of such constraints might include the maturity of a theory or the ability of a theory to make novel predictions. Though, of course, the realist then needs to explain precisely what counts as 'maturity' and 'novel prediction' on this account.[19]

Still, we might wonder whether merely *reducing* the pool of successful non-referring theories is enough to ward off the concerns posed by theory change. For even if just *one* past theory, which we now know to be false, achieves this more restrictive standard of success, then, as Psillos writes, 'the intended explanatory connection between empirical success and truth-likeness is still undermined' (1999: 103). The caloric theory of heat is argued to be just such an example, having been incredibly

[18] Hardin and Rosenberg (1982) argue that the realist *can* recover a notion of approximate truth without reference.
[19] Stathis Psillos (1999: 99–103) speaks to these issues.

empirically successful—and, arguably, having even facilitated novel prediction.[20] It would seem, then, that the realist needs to revise their view beyond the simple version presented by the no miracles argument if they are to accommodate the phenomenon of theory change and of success without reference (of the kind just described).

1.1.3 Underdetermination

Another problem for the realist position, though one that does not appeal to the history of science, is the so-called 'underdetermination' of theory by the evidence. The realist claims that successful theories are so because they accurately represent the world. But suppose that, for some body of evidence, there could be multiple theories that are not only empirically successful in their own right, but are so *equally*. That is, suppose that we have some set of theories, each of which puts forward an account of the world that is incompatible with the others, but is nonetheless equally capable of describing and predicting the relevant phenomena—or is 'empirically equivalent' to those other theories in the set. Such a prospect would prove extremely problematic for the realist, as they could not explain such success by suggesting that the world *is* as represented by each of those theories. The world, after all, can only be one way or another.

Just how seriously the realist takes this challenge depends upon how willing they are to admit that such cases of underdetermination actually do arise. For instance, the realist can claim that, while we might very well encounter empirically equivalent theories as part of the scientific enterprise, further evidence inevitably arises that breaks any underdetermination in favour of one particular theory or another. Consider once

[20] For more on the success of the caloric theory, see Chang (2003).

again Bohr's and Pauli's competing accounts of β-decay. At the time, we might have considered each account to fit equally well with the available evidence. That is, with the detected decay of a neutron into a proton and an emitted electron. One theory, however, suggested that such decay results in the emission of another particle that had not yet been detected, whereas the other claimed that there were no further particles to detect. And so, *at the time* (and ignoring those explanatory considerations discussed above), the realist would have faced a problem. But, as we have seen, new evidence eventually arose that broke the underdetermination—namely, the detection of the neutrino. That is to say, Pauli was vindicated because evidence arose that supported *his* hypothesis and discounted Bohr's account.

So the realist can simply argue that all apparent cases of underdetermination are of this kind. In other words, they can claim that all empirical equivalence is merely 'weak' empirical equivalence, which can be characterized as empirical equivalence with respect to the evidence accrued *so far*.[21] In the event of underdetermination, then, the realist simply postpones judgement, treating any and all empirically equivalent candidate theories as equally promising hypotheses until new phenomena or experimental data that can break such equivalences are found.

But might there in fact be instances in which not only any evidence gathered *so far* but any possible evidence whatsoever underdetermines theory choice? That is to say, might there be cases in which no further evidence can or will ever break the underdetermination in question? Such supposed cases are described in terms of the 'strong' empirical equivalence between theories.[22] One candidate example of such strong equivalence can be found amongst some cosmological theories regarding the

[21] See *ETMG*: 79–80.
[22] See *ETMG*: 80–81.

state of the universe before the big bang. Consider, for instance, the hypothesis that *nothing* preceded the big bang. Consider also the hypothesis that the big bang was preceded by a 'big crunch', and that the universe oscillates between periods of expansion and contraction, creating and annihilating itself periodically. Now, both hypotheses fit perfectly well with observations or measurements of our 'post-bang' universe. That is, both are commensurate with the currently observed expansion of the universe and with the prevailing theory that such expansion originated with a 'big bang'. It would also seem, however, that no measurements can be taken *outside* of our 'post-bang' universe. If this is indeed the case, then these competing theories would appear to exhibit *strong* empirical equivalence—that is, empirical equivalence with respect to all possible observation and measurement.

There are a number of ways in which the realist might respond to the prospect of underdetermination due to strong empirical equivalence. They might, for instance, argue that the very notion of empirical equivalence is itself ill-defined, depending as it does on some principled distinction between the observable and the unobservable features of a theory. They might also argue that *empirical* equivalence does not equal *evidential* equivalence.[23] This is where our non-empirical virtues of explanatory power, simplicity, and consistency with other beliefs come back into play. Any empirically equivalent theory that exhibits more of these virtues, the realist might claim, gives us more reason to believe in it than its competitors, and so such virtues may break this kind of underdetermination.

Of course, the realist must then provide an account of what precisely these non-empirical virtues are and of what counts as more or less virtuous. For example, is the hypothesis that *nothing* preceded the big bang simpler because it requires no further

[23] For more on these critiques, see *ETMG*: 81.

account of an oscillating universe? Or is the oscillating universe hypothesis simpler because it avoids the implied claim that something came from nothing? Further, how ought we to rank these various virtues? Should a simpler hypothesis be accepted over one that is more commensurable with our current beliefs?

We have only scratched the surface of these issues, but we have at least shown that realism about science is certainly not as obviously unproblematic as it might appear to be. We might, therefore, consider adopting some form of anti-realism.

1.2 Constructive Empiricism

There are various forms of anti-realism about science. Generally speaking, though, anti-realism can be characterized by a more conservative attitude towards one's ontological commitments. That is to say, and as indicated above, anti-realists can be understood as relinquishing their claims to knowledge about unobservable entities in order to accommodate theory change and underdetermination.

'Instrumentalism', for instance, holds that scientific theories (or at least the parts of them that refer to unobservable entities) do not say anything about the world. Instead, they are mere tools, or *instruments*, for predicting observable phenomena—or for systematizing our observations of such phenomena. The defining feature of instrumentalism, then, is that it refuses to interpret talk of unobservables literally. Rather, theoretical terms (that refer to unobservables) refer elliptically or indirectly to associated observable phenomena. Thus, according to the instrumentalist, 'electron' has no meaning in and of itself, but instead stands in for observational statements

concerning vapour trails (in the context of cloud chamber experiments) and interference patterns (in the context of double slit-experiments).[24]

By understanding the semantics of theoretical terms in this way, the instrumentalist avoids the concerns raised by theory change and underdetermination (at least insofar as they concern the realist). In other words, that claims about unobservables frequently prove to be false (as revealed by theory change), and that incompatible claims about unobservables might be empirically equivalent, and thus have equal claim to truth (as threatened by underdetermination), poses no problem for the instrumentalist because they simply abandon the assumption that such claims are truth-apt in the first place (at least with respect to putative unobservables). As Rowbottom remarks, however: 'Instrumentalism is no longer a popular position and is rarely discussed in serious depth' (2011: 1200).

The current leading anti-realist position is van Fraassen's 'constructive empiricism', which he defines as follows: '*Science aims to give us theories which are empirically adequate; and acceptance of a theory involves as belief only that it is empirically adequate*' (1980: 12). The notion of 'empirical adequacy', which is obviously core to the position, must be carefully spelled out. Van Fraassen claims that 'a theory is empirically adequate exactly if what it says about the observable things and events in this world, is true' (1980: 12). On the face of it, then, empirical adequacy might seem just like the notion of straightforward empirical or predictive success employed above insofar as it describes the ability of a theory to correctly predict the phenomena we observe. Importantly, however, mere empirical success can be understood as describing the fact that a particular theory has accurately described

[24] A key figure in the development of instrumentalism was Pierre Duhem (1954). For a contemporary defence, see Darrell Rowbottom (2011).

whatever phenomena *have in fact been observed*. Empirical *adequacy*, on the other hand, must be understood as describing a theory's ability to accurately describe any (actual) phenomena whatsoever—that is, any phenomena that are *observable*, or that *would be* observed *were* an observer present. As van Fraassen himself qualifies:

> I must emphasize that this [empirical adequacy] refers to *all* the phenomena; these are not exhausted by those actually observed, nor even by those observed at some time, whether past, present, or future. (1980: 12)

That constructive empiricism involves a modal claim about what *would* be observed under certain circumstances requires further examination, especially insofar as it conflicts with another of van Fraassen's explicitly empiricist commitments—namely, that he 'recognize no objective modality in nature' (1980: 202). For now, though, consider the (related) slippery issue of what is meant by 'observable'. Again, we have already noted that the notion of observability is important for the anti-realist (more so than it is for the realist). And it is especially important for van Fraassen, as empirical adequacy is defined in terms of it. So how, then, ought we to understand observability? What counts as observable—and why?

First off, we need to distinguish between *observing* and *detecting* on van Fraassen's account. To observe something is to witness it *directly* with one's senses. 'Seeing with the unaided eye', he writes, 'is a clear case of observation' (1980: 16). To *detect* something, however, is to register it through some indirect means, or only by having one's senses *aided* in some important way. So, for example, though I might hear (and thus observe) the ring of the doorbell, in doing so I merely detect a visitor at the

door, for I do not observe them directly.[25] Similarly, when I observe a momentary streak of condensation in a cloud chamber, I merely detect the charged particle that caused it (according to our current theories).

The crucial difference between the visitor at the door and the charged particle, however, is that the former is *observable* on van Fraassen's account—all I have to do is open the door. The latter, on the other hand, is *only* merely detectable—that is to say, *un*observable. Regardless of whether I concentrate my gaze within or slightly ahead of the trail of condensation, I will never *see* the particle; it remains *beyond* my gaze. And it does so, importantly, not because my line of sight is blocked or hindered in some way (as in the case of the visitor behind the door), but just because I am not equipped to see it. Observability, then, describes a feature not of entities *in themselves* but of *our relation* to those entities—specifically, our capacity to observe them given our physiological limitations. 'It is these limitations to which the "able" in "observable" refers—our limitations, *qua* human beings' (1980: 17). Van Fraassen therefore defines observability as follows: 'X is observable if there are circumstances which are such that, if X is present to us under those circumstances, then we observe it' (1980: 16). Since there are *no* circumstances in which I might perceive a subatomic particle directly, they are unobservable on van Fraassen's account.

Van Fraassen's qualification 'to *us*' is particularly important here, as it blocks the objection that he makes observability a matter of *individual* circumstance—that is, a matter of the physiological capabilities of some particular observer. Obviously, this

[25] As we shall see, the distinction between observable and unobservable has become a focal point for criticism. But it is worth noting that the distinction between observation and detection is also not entirely straightforward. For example, if my visitor were to knock on the door, then presumably this would for van Fraassen count as observation. After all, I *directly* experience the noise generated by *their hand* on the door. But what is the significant difference between generating these waves by means of one's hand rapping against wood and one's finger pressing a button? Is it the intermediary of an electronic circuit? In that case, do I only merely detect my visitor if my doorbell has a camera function? Are phone calls mere avenues for detection? For a related query, see Hacking (1981).

would be strange—and not to mention incompatible with the constructive empiricist's need to circumscribe what is observable in some general principled way, lest they render the notion of empirical adequacy unhelpfully relativistic. Crucially, then, van Fraassen's definition of observability refers not to some given individual, but 'to *us*'. That is, to a collective epistemic community. Thus, even if some entity cannot be observed by a particularly disadvantaged member of our community, it can still be considered observable so long as it *would* be observed by anyone who enjoyed the average physiological capabilities of a member of the human species.[26] As van Fraassen writes, 'what counts as an observable phenomenon is a function of what the epistemic community is' (1980: 19).

Accordingly, van Fraassen does admit that, even though observability is not a matter of *individual* circumstance, it *is* subject to the broad capabilities of a collective or community and is thus subject to change as a result of some transformation in that community:

> At present, we count the human race as the epistemic community to which we belong; but this race may mutate, or that community may be increased by adding other animals (terrestrial or extra-terrestrial) through relevant ideological or moral decisions ("to count them as persons"). (1980: 18)

So does the same objection not resurface here? Is this conception of observability, empirical adequacy, and thus the aims of scientific theories not still too relativistic? Here van Fraassen would remind us that science itself 'is a biological phenomenon, an

[26] Or even if it *would* be observed by that same individual if they were not disadvantaged in that particular way.

activity by one kind of organism which facilitates its interaction with the environment' (1980: 39). That is to say, if science is but a way of informing *our* epistemic attitude towards the world, then, on van Fraassen's account, it is entirely appropriate that our account of the aims of science be tied to our particular capacities. In other words, van Fraassen wants his account of the aims science to be neither so narrow as to be unduly relativistic, nor so broad or absolute as to become disconnected from its characteristically *human* provenance.

So, is constructive empiricism able to accommodate theory change and underdetermination? It would seem so (at least, on the face of it).[27] Just like the instrumentalist, the constructive empiricist makes no claims to knowledge about unobservables. The purpose of a scientific theory, on van Fraassen's view, is to generate true descriptions about what is observable *only*—that is, to be empirically adequate. He can therefore accommodate theory change and underdetermination, as the fallibility of claims concerning unobservables, as well as the empirical equivalence of incompatible claims concerning unobservables, appear to present no problem for the claim that science aims at empirical adequacy.

Importantly, van Fraassen's strategy does differ from the instrumentalist's insofar as it does not depend on a change in semantics—or a change in how one understands or interprets the meaning or content of scientific theories.[28] That is to say, the constructive empiricist retains the same basic semantic approach as the realist, which is to interpret theories *literally*. As van Fraassen writes: 'the language of science should be literally construed' (1980: 10). Thus, when a physical theory refers to

[27] We see shortly how underdetermination also affects constructive empiricism.
[28] Another way of putting this is in accordance with Psillos's distinctions between the metaphysical, epistemic, and semantic components of scientific realism (1999). Instrumentalists (in the sense described here) refuse the semantic component; constructive empiricists accept the semantic component but refuse the epistemic component.

subatomic particles, the constrictive empiricist interprets this as reference *to subatomic particles* rather than as some kind of shorthand for blips on a computer screen (as the instrumentalist would have it). The constructive empiricist therefore differs from the instrumentalist insofar as they, like the realist, treat statements about unobservables as truth-apt. Theoretical statements concerning electrons say something *about electrons* and can thus be true or false.

Crucially, though, van Fraassen merely claims that scientific statements concerning unobservables are '*capable of* being true or false' (1980: 10). He makes no claim about whether they are *in fact* true or false. Again, he thinks that '*acceptance of a theory involves as belief only that it is empirically adequate*' (1980: 12). He therefore differs from the realist insofar as he denies that adopting a particular theory involves an ontological commitment to *everything* it represents. This is a sign of his dedication to *empiricism*, which (he writes at the beginning of his book) 'requires theories only to give a true account *of what is observable*' (1980: 3). Thus, though the constructive empiricist demands that the parts of scientific theories that describe observables be true, they remain agnostic about the truth or falsity of the parts that describe unobservables. And it is this agnosticism that allows van Fraassen to avoid the problems posed to the realist by theory change and underdetermination.

1.2.1 Theory Success

One significant challenge for the constructive empiricist is that they appear unable to accommodate the no miracles argument—or to *explain* the success of scientific theories. After all, recall that, where a theory refers to unobservable entities as part of its account of phenomena, only the *existence* of such entities *explains* those

phenomena.[29] If, on the other hand, we interpret that theory as merely claiming that the world behaves *as though* such entities exist, then we have no such explanation. The constructive empiricist interprets theories in this second way, since they construe the language of science *literally* but nonetheless refuse to commit themselves ontologically to unobservables (or to any particular unobservable). Hence, the constructive empiricist cannot explain theory success.

Van Fraassen's response here is twofold. First, he questions the suitability of the no miracles argument as a *scientific* explanation for the success of science. He claims that its basic structure, according to which how we think about or represent the world corresponds to, or is 'adequate' to, the ways things are, is overtly Scholastic. 'Aquinas', he remarks, 'would have felt quite at home with it' (1980: 39). He then offers his own, alternative form of explanation for scientific success. Drawing an analogy between scientific theories and the evolution of animal species, he claims that it ought not to be surprising at all that our current theories are so successful—born as they are 'into a life of fierce competition, a jungle red in tooth and claw' (1980: 40). Just as we ought not to marvel at how a mouse recognizes the cat as an enemy, then, so too we ought not to marvel at the empirical success of our best science. Mice would not be around if they did not flee from predators, just as our current theories would not have won out against their competitors if they did not reliably describe and predict phenomena.[30]

There are a couple of ways in which the realist might be dissatisfied with van Fraassen's response. First, the realist can argue that the no miracles argument is in fact a perfectly appropriate form of scientific explanation insofar as it is an exercise in

[29] Van Fraassen challenges this idea in the final chapter of *The Scientific Image* (1980).
[30] The mouse example comes from van Fraassen (1980: 39–40).

abductive reasoning. Scientists use inference to the best explanation in order to decide between theories, and so the no miracles argument for scientific realism merely exercises such inference in a way consistent with scientific practice.

Second, the realist can point out that van Fraassen's supposed explanation of scientific success misses the point. That is, van Fraassen may indeed give a decent account of how successful theories emerge, or of the sheer fact that our current theories are successful, but he fails to explain what makes a theory successful in the first place. In keeping with van Fraassen's allusion to the natural selection of some kinds of biological organism over others, the realist can argue that van Fraassen provides a 'phenotypic', but not a 'genotypic', explanation.[31] That is to say, van Fraassen gestures towards a selection mechanism that explains why all selected theories are empirically successful, but he does not explain *why* each selected theory enjoys empirical success. As Lipton puts it: 'a selection mechanism may explain why all the selected objects have a certain feature without explaining why each of them does' (1991: 170). And it is this latter form of explanation that the no miracles argument demands.

But van Fraassen will simply point out that he quite purposefully reconstrues the question of scientific success as 'the question why we have successful scientific theories at all' (1980: 39). That is, he insists that the realist somehow betrays the spirit of scientific inquiry when they demand a genotypic explanation. Rather, 'a very different kind of scientific explanation is required' on his account (1980: 39). Similarly, van Fraassen would not be impressed by the appeal to inference to the best explanation in order to justify the realist's concern. Why? Well, because van Fraassen rejects this mode of reasoning. That is, he simply 'denies that IBE [inference to the best explanation] is compelling' (Ladyman 2002: 213).

[31] See *ETMG*: 73–74.

Van Fraassen's suspicions about the realist use of abduction are numerous, but one notable objection is his 'best of a bad lot' (1989: 143) argument, according to which, given the vast range of the set of possible empirically equivalent theories, the realist simply cannot know whether *the* true theory is in fact included in the subset currently under consideration. Some 'claim of privilege for our genius' (1989: 143), as van Fraassen puts it, would be required to assure the realist that the correct theory was in fact under consideration. As Ladyman observes: 'Realists tend to bite this bullet and argue that scientists do have privilege, which issues from background knowledge' (2002: 220)—that is, the host of other background theories that narrow the subset of theories under consideration. Unwilling to bite this particular bullet, van Fraassen argues instead that such abductive inferences can be reinterpreted *not* as inferences to the truth of a particular theory but merely as inferences to the *empirical adequacy* of that theory:

> Here is a rival hypothesis: we are always willing to believe that the theory which best explains the evidence, is empirically adequate (that all observable phenomena are as the theory says they are). (1980: 20)

Thus, the use of abductive reasoning to justify selecting Pauli's neutrino theory, for instance, is for van Fraassen simply a testament to its ability to correctly predict and describe observable phenomena (the relevant β-decay and subsequent neutrino detections); it says nothing about the truth of its claims about neutrinos nor any other unobservable entities.

Given van Fraassen's differing views with respect to the demand for an explanation for theory success, as well as the basic structure of inference to the best

explanation, it might well seem as though we have reached a stalemate. Still, we have at least acknowledged that constructive empiricism is not quite a straightforwardly compelling alternative to realism.

1.2.2 Underdetermination, again

At this point we ought to note that underdetermination does in fact pose a challenge to constructive empiricism—that is, underdetermination is not a distinctively *realist* problem. Above we acknowledged the prospect that different theories might be *weakly* empirically equivalent, which is to say that it might not be possible to select one theory over another by appealing only to the body of evidence *accrued so far*. Now consider this kind of underdetermination in light of constructive empiricism. Is it not the case that weak empirical equivalence poses a similar problem for the selection of *empirically adequate* theories?

Recall that, for van Fraassen, an empirically adequate theory accurately describes all the phenomena—observed and unobserved; past, present, and (importantly) future. It would therefore seem that, for any empirically adequate theory, we can easily generate some other theory that is empirically equivalent with respect to the phenomena *so far*, but nonetheless involves some change in the phenomena at some future time.[32] Consider our current theory of gravity, for example: general relativity. Now consider another theory that predicts precisely the same phenomena as general relativity, though with the caveat that gravitational effects will reverse in the year 3000. According to 'general relativity 2.0', then, on some unfortunate day in the future

[32] It will perhaps be clear by now that, as Ladyman and Ross observe: 'The weak underdetermination argument is a form of the problem of induction' (*ETMG*: 80).

massive bodies will no longer attract but repel one another, causing galaxies, solar systems, and planets to explode and fly apart from themselves and from one another.

Obviously, this example is a little wild. But its wildness serves to underline the point: van Fraassen lacks the conceptual resources to deny the empirical adequacy of the latter theory. 'Of course "general relativity 2.0" is nonsense!', we might say, 'why think that the laws of nature would suddenly reverse in this way?'. Van Fraassen, however, cannot avail himself of this response because it involves a realist commitment to laws of nature—that is, to some form of objective modality. And, as we have already indicated (and as we explore in more depth below), van Fraassen's empiricism allows him to 'recognize no objective modality in nature' (1980: 202).

Fair enough, but surely van Fraassen can appeal to other features of these theories? The latter, for example, presumably fits incredibly uneasily with many other theories and background beliefs. These are, however, *non-empirical* virtues to which we are appealing. In other words, we are using inference to the best explanation to justify our choice of theory—a form of reasoning which (again, as we have just seen) van Fraassen rejects. General relativity certainly appears to be the most promising candidate for an empirically adequate theory of gravity, then, but van Fraassen lacks a principled way of selecting this theory among other weakly empirically equivalent candidates. As Ladyman puts it: 'The problem for van Fraassen is that he seems to be left with no grounds even for believing a theory to be empirically adequate' (2002: 220). Thus, underdetermination is not a distinctively realist problem. As Ladyman and Ross observe:

> The underdetermination argument cannot be ignored by the scientific realist, but, since it also threatens any positive form of antirealism such as constructive

> empiricism, it does not give us compelling grounds to abandon standard scientific realism. (*ETMG*: 83)

What underdetermination also reveals when directed towards constructive empiricism, however, is that van Fraassen is forced into a dilemma. Either he accepts the underdetermination of empirical adequacy by the evidence, and so theory selection for him becomes impossible, rendering him 'an out and out sceptic' (Ladyman 2002: 221), or he insists that theory selection *is* possible, retaining some form of abductive reasoning, but only for observables. As Ladyman puts it, van Fraassen:

> must adopt an arbitrary scepticism about IBE for unobservables while endorsing IBE for theories about observables and for inferences to the empirical adequacy of theories about unobservables… (2002: 221)

Neither horn of this dilemma seems particularly attractive, and so given this dilemma, along with the problem of explanation (examined above), as well as the problem of objective modality (examined below), we might want to consider an alternative account.

1.2.3 Objective Modality

We have already indicated that, despite van Fraassen's refusal to accept any kind of objective modality in nature, constructive empiricism depends upon some account of objective modality. The constructive empiricist claims that scientific theories aim to be empirically adequate. And, as we have seen, empirical adequacy means providing true

descriptions of actual and observable phenomena. But recall that by 'observable' we must not understand only those phenomena that are in fact observed. Again, van Fraassen insists that empirical adequacy 'refers to *all* the phenomena' and that such phenomena 'are not exhausted by those actually observed, nor even by those observed at some time, whether past, present, or future' (1980: 12). Thus, he claims that some phenomenon is observable if it is the case that, *were* that phenomenon present to us under suitable conditions, then we *would* observe it (again, see 1980: 16). This is a counterfactual claim, and therefore suggests that the constructive empiricist is in fact committed to belief in some form of objective modality in order make sense of their account of observability.

Note that the constructive empiricist appears to be committed to a form of *objective* modality—that is, to the idea that there are some objective facts of the matter regarding what is and is not observable—because van Fraassen himself stresses the theory-independence of such facts: 'I regard what is observable as a theory-independent question' (1980: 57). And indeed we have already seen that observability is circumscribed by facts about *us*—that is, biological facts about our perceptual capacities. If the constructive empiricist endorsed some account of *subjective* modality, according to which what is and is not observable depends (in this instance) upon what theories we use, then 'observability' would be an arbitrary distinction and could not enjoy the epistemic significance bestowed upon it by constructive empiricism. Thus, as Ladyman argues, 'in order to circumscribe the observable in a principled way, as constructive empiricism requires, it is necessary to believe some modal facts that are theory-independent' (2000: 849). Van Fraassen, on Ladyman's account, must either accept some commitment to objective modality, and thus relinquish to some extent his

extremely literal and uncompromising adherence to the tenets of empiricism, or he must abandon constructive empiricism altogether.[33]

1.3 Structural Realism

We are now, finally, in a position to recognize how reorienting our metaphysical commitments to structure might be the best way to address and reconcile the various challenges facing both scientific realism (standardly conceived) and constructive empiricism.

1.3.1 The Best of Both Worlds

First and foremost, structuralism appears to be a way of appeasing *both* the need to explain scientific success *and* the argument from theory change. This is the basic thesis of John Worrall's seminal paper 'Structural Realism: The Best of Both Worlds?' (1989), which engages previous work by Poincaré with these issues.[34]

Recall that the realist accounts for the empirical success of scientific theories by claiming that such theories are (at least approximately) true. Thus, to borrow one of Worrall's preferred examples (1989: 107–8), Maxwell's electromagnetic theory of light is empirically successful because its description of light as waves in an electromagnetic field is basically correct. Also recall, however, that the history of theory change casts doubt on this view. Fresnel's own prior account of light as vibrational or mechanical

[33] This debate, admittedly, rages on with Monton and van Fraassen (2003) and Muller (2005).
[34] See Poincaré (1905).

(and so *not* electromagnetic) waves within an all-pervading luminiferous ether, for example, was also empirically successful (albeit less so than Maxwell's theory). But now, after the famously failed experiments of Michelson and Morley, along with the developments of Maxwell, we know that there is no such ether. Similarly, the previous reigning hypothesis that light is corpuscular (consisting of tiny particles) enjoyed some empirical success, but was itself rejected in favour of Fresnel's ether-based theory. The history of science, then, appears to be littered with discarded theoretical posits. And this history, so the argument goes, suggests that our current prevailing theoretical posits will likely face the same fate. (The currently (additionally) accepted photon theory of light, for instance, at least weakens our commitment to the idea that the nature of light can be described *exhaustively* by Maxwell's theory.)

We therefore appear to be pulled, as Worrall remarks, 'in opposite directions' (1989: 101). We need to account for theory success (which, as we have already seen, inclines us towards realism), but we also need to accommodate theory change (which inclines us towards anti-realism). More precisely, and perhaps more troublingly, we need to explain how it can be that the *content* of successive theories is so often *discontinuous*, with specific terms permanently dropping out of our theoretical lexicon, while empirical success *continuously* or steadily increases. As Worrall observes: the corpuscular theory 'dealt satisfactorily with simple reflection and refraction'; Fresnel's theory 'added interference and diffraction and eventually polarisation effects'; Maxwell's theory 'added various results connecting light with electrical and magnetic effects'; and the addition of photon theory (and wave-particle duality) 'added the photoelectric effect and much else besides' (1989: 108). And yet light cannot *be* all of the above—it cannot be a particular kind of particle *and* a vibrational wave in a

luminiferous ether *and* a wave in a primitive electromagnetic field *and* a different kind of particle.[35] As Worrall himself summarizes:

> The picture of the development of science certainly seems, then, to be one of essential cumulativity at the empirical level, accompanied by sharp changes of an entirely non-cumulative kind at the top theoretical levels. (1989: 109)

The proposed realist solution to this problem, which Worrall draws from Poincaré, is to identify some aspect of our successive theories (in addition to their empirical successes) that *is* in fact cumulative. In other words, if we can identify *some* feature of the descriptive and conceptual machinery of successive theories that *survives* theory change, and is *incorporated into* what follows, then the realist still has something upon which they can hang their ontological commitments and thus *explain* the cumulative empirical success of such theories. For Poincaré, this feature is the mathematical formalism (the equations) in which these theories are couched. He writes: 'these equations express relations, and if the equations remain true, it is because the relations preserve their reality' (1905: 161). And indeed, Worrall confirms that, with respect to the relevant mathematical formalism of Fresnel and Maxwell's respective theories, such equations *do* remain true—or 'there is in fact complete continuity between Fresnel's and Maxwell's theories' (1989: 119).

Though Worrall does go on to demonstrate this continuity in mathematical detail (1989: 119–20), we can for our purposes consider a simpler illustration. Fresnel's theory *correctly* described the relevant relations that underpin reflection, refraction,

[35] One might be tempted to argue that these different theoretical posits are merely increasingly accurate approximations *of the same thing*. Worrall, however, rejects this argument, claiming that 'waves in a mechanical medium and particles travelling through empty space seem more like chalk and cheese than do chalk and cheese themselves' (1989: 107–08).

interference, and diffraction; it was just mistaken in describing such relations as occurring within a luminiferous ether. Maxwell's theory, on the other hand, describes *the same relations*, or waves that 'obey *formally* similar laws' (Worrall 1989: 118); it just attributes them to disturbances in an electromagnetic field instead. In other words, the relevant equations of Fresnel's theory (those that pick out the relevant relations) survived and were incorporated into Maxwell's theory; it was merely the posited theoretical medium in which the relations were said to hold that was abandoned. As Poincaré writes, these equations:

> teach us now, as they did then, that there is such and such a relation between this thing and that; only the something which we then called *motion* [within a luminiferous ether], we now call *electric current* [within an electromagnetic field]. (1905: 161)

Thus, as Worrall points out, there *is* 'continuity or accumulation in the shift [between theories], but the continuity is one of *form* or *structure*, not of content' (1989: 117). On his view, then, the realist should abandon their ontological commitment to whatever is represented by the *terms* of our theories (as recommended by the pessimistic meta-induction), but nonetheless retain a commitment to the *relations* or *structure* described by successful theories. That is, the (standard) scientific realist should become a *structural* realist.

Of course, the isolated case study of theory change in the field of optics is not by itself enough to justify structuralism. Others have, however, demonstrated the same kind of mathematical continuity in cases of theory succession elsewhere. For example: Worrall does so with respect to Newton's theory of gravitation and Einstein's theory of

general relativity (1989: 120–21); Simon Saunders does so with respect to Ptolemaic and Copernican astronomy, and indeed between classical and quantum mechanics (1993); and Ladyman does so with respect to the old phlogiston theory of combustion (2011). There therefore appear to be plenty of examples of the conservation of mathematical structure through theory change—enough, it seems, to warrant taking structural realism seriously as a genuine alternative to both standard realism (which cannot accommodate theory change) and anti-realism (which cannot explain theory success).

We should note, though, that both Poincaré and Worrall predate the advent of the explicitly *ontic* or *ontological* version of structural realism examined in this thesis. The distinction between *ontic* structural realism (or 'OSR', according to which *all there is* is structure) and *epistemic* structural realism (or 'ESR', according to which *all we can know* is structure) was first articulated by Ladyman (1998). And it certainly seems as though Poincaré adopted the latter view without adopting the former.[36] That is, Poincaré accepts that we will never have theoretical terms that successfully refer, but he nonetheless maintains that *there are* such entities to which our terms attempt to refer:

> these are merely names of the images we substituted for the real objects which Nature will hide for ever from our eyes. The true relations between these real objects are the only reality we can attain… (1905: 161)

As already indicated, I do not dwell on epistemic structural realism in this thesis. Ladyman and Ross present a number of reasons for rejecting the view (*ETMG*: 124–28), focussing primarily on its association with outdated ways of representing scientific

[36] Worrall's own position, as Ladyman observes, 'is ambiguous in this respect' (1998: 410).

theories. Epistemic structural realism, they claim, 'is thoroughly embedded in the syntactic view of theories and adopts first-order quantificational logic as the appropriate form for the representation of physical theories' (*ETMG*: 128).[37] It therefore ignores the central role of *mathematics* in theory representation. French, however, provides an even more concise and damning indictment of this epistemic form of structuralism. Insofar as epistemic structural realism posits 'hidden' natures or objects that are beyond our grasp, we can argue that it fails to properly heed the metaphysical implications of our best science and thus fails to qualify as appropriately naturalistic. For, as French points out, and as we shall see below **(1.4)**, the implications of quantum mechanics 'lead us to abandon the notion of object, hidden or otherwise' (*SotW*: 19). Thus:

> if structural realism is to broaden its grasp and seize the kinds of structures that modern physics actually presents to us, then it is going to have to shift from ESR to OSR. (*SotW*: 19)

1.3.2 Ontic Structural Realism as Modal Structural Empiricism

Before we examine the quantum mechanical motivations for ontic structural realism, recall the above objection to constructive empiricism concerning objective modality. Despite van Fraassen's claims to the contrary, the constructive empiricist is committed to a form of objective modality insofar as they are committed to belief in some counterfactual or modal facts—concerning what would be observable under given

[37] For an alternative, 'math-first' approach, see Wallace (2021).

circumstances—if they are to account for the distinction between what is observable and unobservable in a way that does not render this distinction arbitrary. As Ladyman summarizes nicely, the constructive empiricist 'is committed to belief in more than just what theories say about what is observable and actual, in order to discern what they do say about what is observable and actual' (2000: 851–52). Thus, constructive empiricism, on his view at least, is only tenable when combined with some form of realism about objective modality—at least on Ladyman's account.[38] And indeed, in a subsequent article, Ladyman claims that this kind of position—that is, constructive empiricism plus some commitment to objective modality—just *is* ontic structural realism. Constructive empiricism, he writes, 'could only make sense of science in conjunction with modal realism. Such a view may well make the best sense of science […] and is a form of structural realism' (2004: 764). This claim is reaffirmed by Ladyman and Ross, who argue that 'ontic structural realism ought to be understood as modal structural empiricism' (*ETMG*: 99).

The term 'structural empiricism' originates with Bueno (1999) and denotes nothing more than a formulation of constructive empiricism that, in response to the problem of theory change, wears its structural commitments on its sleeve. Or, as Bueno puts it: '*structural empiricism* […] is nothing but constructive empiricism brought to self-consciousness' (1999: 79). Like the structural realist, then, the structural empiricist accounts for increased empirical success across theory change in terms of the accumulation of structure. Unlike (ontic) structural realists, however, the structural empiricist insists that the only structures that matter here are the '*empirical*

[38] Again, it is worth reminding ourselves that there is further debate to be had. See, again, Monton and van Fraassen (2003) and Muller (2005).

substructures and partial models of the *phenomena*' (1999: 80; my emphasis). As van Fraassen later writes:

> The empirical successes of the older theories were partial successes of a very distinct sort: their representations of nature, the models they made available for representation of the observed phenomena, were partially accurate. […] There was something they got right: the structure, at some level of approximation, of those phenomena. (2006: 303)

As always, the motivation here is one of refusing to overcommit oneself ontologically. The constructive empiricist *qua* structural empiricist argues that 'we don't need to stick our necks out so much' (Bueno 1999: 79) and that we can avoid 'sinking into [a] metaphysical morass' (van Fraassen 2006: 303) by simply reorienting our account of the aims of science towards the phenomena and towards the empirical adequacy of our theories. Once again, though, we strike upon the problems of explaining theory success and of circumscribing observability (and thus empirical adequacy) in a non-arbitrary way.

With respect to theory explanation, for instance, van Fraassen essentially repeats the same approach examined above:

> The success of science *is not a miracle*, because in any theoretical change both the past empirical success retained and new empirical successes *were needed as credentials* for acceptance. (2006: 298–99)

We can therefore repeat Lipton's (1991) complaint—namely, that simply identifying those qualities shared by successful theories is not the same as explaining why each such theory enjoys those qualities.

With respect to circumscribing observability, we can once again point out (along with Ladyman 2000, 2004) that the structural empiricist, just like the constructive empiricist, appears to be implicitly committed to some form of objective modality if they are to make sense of their own position. That is to say, precisely in so far as structural empiricism 'is nothing but [some reformulation of] constructive empiricism' (Bueno 1999: 79), our previous objections to the latter seem to extend over the former. And indeed, it is precisely this kind of objective modality that constitutes the basic metaphysical commitment of ontic structural realism. For, as we have already seen, and as we are about to see again **(1.4, 1.5)**, the ontic structural realist relinquishes any commitment to individuals or objects. They therefore admit of objective modality in the form of law-like behaviours or relations in the world, but they do not attribute these behaviours or relations to any basic constituents, articulating instead a metaphysics in which such relations are fundamental or primary. As Ladyman and Ross elaborate:

> there is a minimal metaphysical commitment that we think structural realism must entail. This is that there are mind-independent modal relations between phenomena (both possible and actual), but these relations are not supervenient on the properties of unobservable objects and the external relations between them. Rather, this structure is ontologically basic. (*ETMG*: 128)

To recapitulate: on Ladyman and Ross's account, ontic structural realism provides the most reconciliatory response to the current realism and anti-realism debate in the philosophy of science. Ontic structural realism, on their view, 'can claim all the advantages of constructive empiricism and scientific realism [standardly conceived] without being prone to the problems that those views respectively face' (*EMTG*: 99). The structuralist can explain theory success through commitment to a counterfactual generalization-supporting modal structure represented by the relevant continuities in mathematical structure (and thereby satisfy the no miracles argument), and the structuralist avoids the pessimistic meta-induction by withholding their ontological commitment to that structure alone. Underdetermination may still pose a problem for the structuralist, though (we have seen) no more so than it does for the constructive empiricist. And indeed, as we see in the next section, contemporary versions of ontic structural realism are in fact crucially motivated by their ability to handle a particularly significant instance of underdetermination in quantum mechanics.

1.4 Quantum Mechanics

We have so far considered how something resembling a structuralist ontology might be able to accommodate various issues in the realism debate in the philosophy of science that no other single position is able to accommodate. Standard scientific realism, for instance, appears unable to account for theory change (where such change involves the loss of theoretical terms). Constructive empiricism, on the other hand, seems unable to explain what makes scientific theories successful. It also appears to involve a commitment to objective modality that is incompatible with its required agnosticism towards the unobservable. Ontic structural realism, however, can explain scientific

success: the mathematical formalism in which our theories are couched accurately represents the structure of the world, which is all there is. Structuralism can also accommodate theory change: theoretical terms may be lost, but mathematical structure is conserved across theories—so theory change poses no problem, since we are committed only to the existence of what that structure represents. Lastly, a commitment to objective modality is obviously unproblematic for the structural realist, who readily admits that 'there are mind-independent modal relations between phenomena (both possible and actual)' (*ETMG*: 128).

Notice, however, that we have so far given no positive, independent reason for believing that structuralism is true. It is one thing to sketch the parameters for what the ideal philosophy of science in this context might look like, but it is another to provide good empirical evidence for that position. In other words, we might accuse the realist, who has so far tweaked their position into a structuralist form in order to accommodate the relevant issues, of being 'ad hoc'. That is, of doctoring their position in the face of opposition in such a way that provides no further reason to adopt that position. Ladyman and Ross acknowledge this kind of objection:

> If structural realism […] is just a response to theory change it is vulnerable to the charge that it is ad hoc. The view advocated here escapes this concern by having multiple motivations, and by appeal to the virtue of consilience in relation to a variety of problems in philosophy of science. (*ETMG*: 67)

Notice, however, that they admit that structuralism is susceptible to the charge that it is ad hoc *only* if it is 'just a response to theory change'. And indeed, they claim that structuralism can avoid this charge if it is able to speak to more of the issues—that is,

'by appeal to the virtue of consilience in relation to a variety of problems'. But mere consilience, we can argue, is insufficient. Conspiracy theories, for example, can be extremely conciliatory—indeed, this is their hallmark characteristic. Suppose I deny that we landed on the moon in 1969 (or at anytime). You object: 'but what about the footage?'; I counter: 'it was faked'. You object: 'but what about the astronaut's first-hand accounts?'; I counter: 'they are in on it'. You object: 'but what about the astronaut's families, and the scientists and engineers, and everyone else involved in the Apollo missions or otherwise associated with NASA and its partner organizations?'; I counter: 'they're *all* in on it!'. I may be able to respond to each and every one of these challenges, but I have yet to provide any positive evidence for my account—such as some official record documenting John F. Kennedy's, Lyndon B. Johnson's, and Richard Nixon's collective intention to deceive the world in the relevant way.

We ought, then, to revise Ladyman and Ross's acknowledgement of the 'ad hoc' objection in order to distinguish them from the conspiracy theorist. So: structural realism is vulnerable to the charge that it is ad hoc not only if it is a mere response to theory change, but also if it is a mere conciliatory response to the issues discussed above. The true *positive* evidence for ontic structural realism comes from 'contemporary fundamental physics' (*ETMG*: 130)—specifically, quantum mechanics. That is, ontic structural realism appears to be the best way of interpreting what quantum mechanics suggests the world is really like. Or, in other words, the results of quantum mechanics encourage us *not* to interpret the fundamental constituents of reality as objects with discrete identity or individuality profiles. In what follows, we will develop some idea as to why this is the case.

For starters, consider two *classical* objects. That is to say, two objects that obey classical or Newtonian mechanics. More specifically, consider two objects of the same

kind. Billiard balls, for example—red ones. Now, we might regard these objects as 'indistinguishable' in the sense that they share the same basic properties. They have the same shape, size, colour, mass, and so on. So, were I to hold one in each hand in front of you, and then hide my hands behind my back before revealing them to you again, you could not be sure if they had been exchanged.

That being said, they obviously *are* distinguishable in a very important sense. They might share the same basic properties, and so it might be difficult to tell whether they have been exchanged, but it clearly *makes a difference* whether they have in fact been exchanged or not: *either* one is in my left hand and the other is in my right, *or* they are the other way around. To state the obvious: they may be of the same kind, but they are different *individuals*.

So how do we explain this individuality? What exactly is it that makes an individual the individual it is? Locke's answer to these questions would be to propose some kind of underlying substance in which the properties mentioned above inhere. What is distinctive about *this* billiard ball cannot be its shape, size, colour, or mass because every other ball of the same kind is precisely the same in these respects, so there must be some underlying substratum that serves the dual function of holding these properties together and of conferring individuality upon the object in question. *This* individual billiard ball is different from *that* individual billiard ball because they are, ultimately, different substances.

Although this kind of explanation (of which Locke's is but one example) has received renewed attention in recent decades,[39] it is not typically favoured by those of a naturalistic persuasion because it involves positing substances (in the case of Locke) or haecceities (in the case of Duns Scotus) that *transcend* all the properties of a given

[39] See, for example: Post (1971) and Adams (1979).

object. That is, such substances and similar metaphysical posits are not merely *unobservable* but are also in principle *undetectable* in the senses discussed above. As Locke admits, they are 'only a supposition of [one] knows not what' (1836: 193).[40]

Another way of accounting for the individuality of objects, then, could be to reorient our attention back towards their properties—and especially those properties we have not yet considered. We noted that our two billiard balls have the same shape, size, colour, and mass. But each also has the property of being in a particular spatiotemporal location. And, importantly, this property can never be shared. This is because objects, conceived classically, are assumed to be 'impenetrable'—that is to say, they cannot occupy the same space at the same time.[41]

Our two billiard balls can therefore be distinguished by their trajectories in spacetime, which can in turn account for the difference between my exchanging them and not exchanging them behind my back. If they are exchanged, their spacetime trajectories crossover (or near enough); if they are not exchanged, then this does not happen. In other words, classical objects obey Leibniz's famous 'principle of the identity of indiscernibles', which (on its weakest formulation, at least) states that no two individuals can have *all* of their properties in common.[42]

Now consider two objects whose behaviour is *quantum* mechanical. Electrons, for instance. As with our billiard balls above, we can regard any electron as

[40] Locke's *Essay Concerning Human Understanding* was first published in 1689. The cited passage occurs in Book II, Chapter XXIII, Section 2.

[41] As French and Krause put it: on this assumption, 'points of spacetime are either monogamous or virginal' (2006: 8)—which is to say that they only host *one* extended thing or none at all.

[42] According to Leibniz's principle, then, individuality amounts to qualitative distinguishability (or discernability). That said, we should at least recognize that individuality and distinguishability are importantly different notions. The former is metaphysical; the latter epistemological. As Ladyman and Ross observe, whereas the latter 'concerns what enables us to tell that one thing is different from another', the former 'concerns whatever it is in virtue of that two things are different from one another' (*ETMG*: 134). We ought also to note that this principle can be formulated in a number of different ways: the weakest formulation (as we have just seen) including *all* properties; the strongest version including only 'monadic' or intrinsic properties. Different versions of this principles are exploited to try to make sense of individuality in quantum physics.

'indistinguishable' from all other electrons insofar as they are the same kind of subatomic particle. Importantly, however, they are also 'indistinguishable' in a much stronger sense—one described by the so-called 'indistinguishability postulate' in contemporary physics.[43] And it is this kind of indistinguishability that poses a challenge to the idea that quantum objects are individuals. In order to illustrate this indistinguishability, then, let us return to, and modify, our above example.

Suppose I repeatedly conceal and reveal our classical billiard balls. And each time I either move one, both, or neither such that in each instance I reveal to you either one ball in each hand or both balls in one hand. Assuming that I do so randomly,[44] classical statistics dictates that you are just as likely to witness either of these cases. That is, you will see *either* one of the two possible arrangements of both balls in one hand, *or* one of the two possible arrangements of one ball in each hand—and you could flip a coin as to the likelihood of seeing one or the other. If these were *quantum* objects, however, and if an analogous situation were described by *quantum* statistics, then you would be twice as likely to see one of the two possible arrangements of both particles 'in one hand' than you would one particle 'in each hand' (where 'hands' here represent quantum states). That is to say, although we might intuitively think that there are still *four* possible arrangements here, in the quantum case there are only *three*.

As a matter of fact, this configuration of *three* possible arrangements refers only to bosons—that is, particles that obey 'Bose-Einstein' statistics (so photons, gluons, and other so-called 'force-carrying' particles). Fermions, or particles that obey 'Fermi-Dirac' statistics (so electrons, quarks, neutrinos, and other so-called 'matter' particles), have only *one* possible arrangement available to them—namely, the 'one in each hand'

[43] See Messiah and Greenberg (1964).
[44] And assuming that I have precisely two hands.

arrangement.[45] Still, regardless of whether we talk about bosons or fermions, the point remains: when it comes to quantum statistical mechanics, there is simply no difference between the two (classically) possible arrangements of 'one particle in each hand'—they are *indistinguishable* in this much stronger sense.

Such indistinguishability can also be expressed in terms of 'permutation invariance', which is to say that 'permuting' (or exchanging) particles of the same kind within some quantum system makes no difference to that system. To be clear: it is *not* the case, as it is with our billiard balls above, that we merely *cannot tell* the difference between these permutations; the indistinguishability postulate does not express a fact about *our ability* to distinguish. The point, rather, is that *there is* no difference between permuted states. As French and Rickles observe:

> if such an ensemble is invariant under a permutation of its constituent particles (i.e., permutation symmetric) then one doesn't "count" those permutations which merely "exchange" indistinguishable particles; rather, the exchanged state is identified with the original state. (French and Rickles 2003: 212)

And it is precisely this identification of permuted states, and thus of the permuted particles therein, that led physicists during the so-called 'quantum revolution' to conclude that subatomic particles ought not to be regarded as individuals. Dirac, for instance, claimed that:

[45] This is due to the 'Pauli exclusion principle', which states that indistinguishable fermions cannot occupy the same quantum state. Thus, as Ladyman and Ross point out, two electrons in a helium atom may have the same energy and (non-localized) position values, but they must have opposite spins (*ETMG*: 135). Simon Saunders exploits this fact in order to recover a version of Leibniz's principle of the identity of indiscernibles for fermions (*ETMG*: 137; Saunders 2003a, 2003b, 2006).

> A satisfactory theory ought, of course, to count any two observationally indistinguishable states as the same state and to deny that any transition does occur when two similar particles exchange places. (1958: 207)

Similarly, Weyl claims that, were electrons identical twins, then it would be:

> impossible for either of these individuals to retain his identity so that one of them will always be able to say "I'm Mike" and the other "I'm Ike." Even in principle one cannot demand an alibi of an electron! (1931: 241)

One should not make the mistake of thinking that these particles can still be individuated by means of their respective spacetime trajectories—as with our billiard balls above. It is simply an unfortunate fact of quantum mechanics that, as Ladyman and Ross observe, 'particles are not always assigned well-defined trajectories in spacetime' (*ETMG*: 135). Indeed, entangled particles are often assigned 'the same position state (which is not localized)' and thus 'quantum particles [bosons, in particular] appear sometimes to possess all the same intrinsic and extrinsic properties' (*ETMG*: 135). Subatomic particles, in other words, appear to violate the principle of the identity of indiscernibles (and should therefore be considered non-individuals).

Off the back of these conclusions about the non-individuality of subatomic particles, or what French and Krause call the 'received view' (2006),[46] a first wave of structuralism emerged. That is to say, the immediate reaction of physicists to the statistical experimental results depicted above was interpreted by early structuralists

[46] Not to be confused with the 'syntactic' approach to the representation of scientific theories, sometimes also referred to as the 'received' view.

(such as Cassirer and Eddington) to motivate the elimination of objects from our conceptual lexicon. As French observes:

> As far as many commentators (such as Cassirer and Eddington) were concerned, the most significant impact these consequences had was on the notion of object and they saw quantum statistics in particular as implying the elimination of objects, at least in so far as this notion was intimately tied to that of the object as an individual. (*SotW*: vi)

But the story does not end here, however, as French (1989) later demonstrated that subatomic particles can indeed be conceptualized as individuals—albeit as individuals subject to 'a dynamical restriction on the accessibility of certain states' (1989: 444). In other words, permutation invariance can be understood not as resulting from the fact that subatomic particles lack individuality, but in terms of a restriction imposed upon quantum systems that limits the kinds of arrangements available to the individual particles therein. The details here are extremely technical, but the point can be illustrated by appealing to a representational device called 'Hilbert space'. Roughly speaking, such a space can be used to represent the arrangements available to certain kinds of particles under certain operations (permutation, for example), and those particles that obey a certain kind of statistics are excluded from occupying certain subdomains within that space. So, bosons are restricted to one particular subdomain (specifically, that in which permutations are symmetric), fermions are restricted to another subdomain (that in which permutations are anti-symmetric), and both bosons and fermions are excluded from those subdomains in which permutations are nonsymmetric. Thus, subatomic particles can be considered individuals, but individuals

with a different set of options available to them than their classical counterparts. As French puts it:

> they can still be regarded as individuals but subject to certain constraints on their behaviour as characterized by these restrictions to certain sub-spaces of Hilbert space, given by the action of PI [permutation invariance]. (*SotW*: 37)

This account is obviously schematic, but the relevant point here is that the physics is *not* incompatible with a kind of individuality and so does not *directly* motivate a structuralist ontology. Rather, according to French, the physics supports *two* 'metaphysical packages': one according to which particles are non-individuals (as suggested above), and another according to which particles are individuals (subject to 'state accessibility restrictions' (1989: 445)). There is, then, an *underdetermination* of the metaphysics by the physics. And it is *this* underdetermination that motivates contemporary structuralist ontologies. That is, according to contemporary structuralists, rather than deliberating upon whether subatomic particles are individual objects or non-individual objects of some kind or another, we should simply abandon the idea that they are objects in the first place. As French and Ladyman claim:

> The locus of this metaphysical underdetermination is the notion of an object so one way of avoiding it would be to reconceptualise this notion entirely in structural terms. (French and Ladyman 2003a: 37)

Thus, the physics does not motivate structuralism *directly* (as the so-called 'received view' would have it) but does so *indirectly* by means of this underdetermination. Ontic

structural realism, in addition to being able to navigate the principal challenges facing standard realism and constructive empiricism, is therefore billed as our best way of making sense of our most successful science to date.

1.5 Neo-Scholastic Metaphysics

We have so far examined various motivations for ontic structural realism. Despite these considerations, however, the staunch opponent might still baulk at the notion of a structuralist ontology, insisting once again upon just how counterintuitive this view appears when compared to the much more familiar image we have of the world as consisting primarily of individuals or objects. Chakravartty, for instance, remarks that: 'This much must seem obvious—one cannot intelligibly subscribe to the *reality* of relations unless one is also committed to the fact that *some things* are related' (1998: 399).

Ladyman and Ross, however, quickly dispatch these kinds of objections. For we are on their account under the influence of a powerful folk-ontological worldview, one derived from our everyday experience in which we track the world in terms of individuals interacting with one another in various causal and compositional ways. This way of modelling the world has no doubt been extremely evolutionarily useful, enabling us to successfully navigate our immediate ancestral milieux.[47] And it is no doubt because of its success that some of the most basic categories of Western metaphysics have been derived from this mode of representation. As Ladyman and Ross observe:

[47] For Ladyman and Ross's appeals to empirical evidence for these claims, see *ETMG*: 2–4.

> We have been equipped with a conception of the nature of physical objects which has been transformed into a foundational metaphysics of individuals, and a combinatorial and compositional conception of reality that is so deeply embedded in philosophy that it is shared as a system of 'obvious' presuppositions by metaphysicians who otherwise disagree profoundly. (*ETMG*: 11)

It is this constellation of presuppositions that Ladyman and Ross call 'neo-scholastic' metaphysics—a basic way of thinking about the world that can be found throughout the Western philosophical tradition, and that continues to influence much analytic metaphysics to this day—including, for example, Chakravartty's above objection.

A key reason for the continued persistence of neo-scholasticism in both ordinary and philosophical thought is the fact that a (relatively) recent and incredibly successful (though now outdated) paradigm in science—namely, the corpuscular mechanics of classical or Newtonian physics—is so easily appropriable in its terms. Indeed, and as Ladyman and Ross point out, despite the fact that 'contemporary physics is hugely more complicated and less intuitively comprehensible than […] classical physics' (*ETMG*: 26), the subatomic particles with which many of our scientists are currently occupied are 'still often conceived in popular imagination as sub-microscopic solar systems' (*ETMG*: 3)—that is, as collections of tiny billiard balls orbiting and colliding with one another, thereby generating all other phenomena. This is why, on Ladyman and Ross's account, so much contemporary philosophy that bears the label 'naturalism' is merely *pseudo*-naturalism.[48] An appreciation of the sciences might regularly be exalted in

[48] Perpetrators of pseudo-naturalism, on Ladyman and Ross's account, include Armstrong (1983), Elder (2004), Kim (1998), Lewis (1986) and Merricks (2001).

recent analytic philosophy, but such exaltations rarely go beyond deference to the neo-scholastic image informed by outdated physics.

The ultimate mistake made by such putatively naturalistic philosophers, then, is the assumption that science and metaphysics will reflect some of our most basic intuitions about what the world is really like. As Ladyman and Ross point out, however, we simply have no good reason to maintain such expectations:

> proficiency in inferring the large-scale and small-scale structure of our immediate environment, or any features of parts of the universe distant from our ancestral stomping grounds, was of no relevance to our ancestors' reproductive fitness. Hence, there is no reason to imagine that our habitual intuitions and inferential responses are well designed for science or for metaphysics. (*ETMG*: 2)

In fact, not only do we lack good reason to expect science and metaphysics to reflect our basic intuitions, we have good reason to expect them *not* to do so. We now accept, for example, and despite appearances to the contrary, that we are living on a globe that hurtles through space at approximately 67,000 miles per hour while its equatorial surface rotates at approximately 1,000 miles per hour about a tilted axis. And we know, again despite appearances, that there are almost as many atoms in a grain of sand as there are stars in the observable universe. Time and again the sciences reveal to us a world that is *in fact* much stranger than it seems,[49] and so why not expect them to challenge our most inveterate assumptions about the ultimate nature of reality—such as

[49] Ladyman and Ross cite further examples from Wolpert (1992) (see *ETMG*: 11–12). And Wolpert himself goes so far as to claim: 'I would almost contend that if something fits with common sense it almost certainly isn't science' (1992: 11; cited in *ETMG*: 12).

those about the primacy of individuals? Such intuitions have no currency in scientific or metaphysical deliberation, and thus the claim that ontic structural realism remains counterintuitive provides no reason to abandon the view. As Ladyman and Ross point out:

> as naturalists we are not concerned with preserving intuitions at all, and argue for the wholescale abandonment of those associated with the image of the world as composed of little things, and indeed of the more basic intuition that there must be something of which the world is made. (*ETMG*: 12)

1.6 Conclusion

We should now have a good sense of the motivations for a metaphysics of structure. Ontic structural realism, its advocates claim, provides the maximally reconciliatory response to various canonical issues in the philosophy of science. It also just appears to be the most appropriate form of naturalistic metaphysics—it being the best way to make sense of quantum mechanics. Though, we have seen, we should not be discouraged by the counter-intuitiveness of their view, the structuralist *does* owe us a reasonably clear picture of what they mean by 'structure'. It is towards this picture that we now turn our attention.

Chapter Two

Structure

2.0 Introduction

The aim of this chapter is to provide a more positive picture of the ontic structural realist claim that structure is all there is, and to distinguish those versions of structuralism defended by its main proponents—namely, Ladyman and Ross (*ETMG*) and French (*SotW*). First, we examine how, according to the structuralist, the enterprise of metaphysics should be conceived and practised **(2.1)**. We then examine what a structuralist metaphysics looks like on Ladyman and Ross and French's respective accounts. I also highlight an ambiguity in the relevant literature, taking issue with repeated (but either ambiguous or straightforwardly false) descriptions of French's view as a *distinctively* 'eliminative' version of ontic structural realism **(2.2)**.

2.1 Naturalistic Metametaphysics

In the previous chapter we examined Ladyman and Ross's critique of neo-scholastic metaphysics within the analytic tradition **(1.5)**. Ontic structural realism may be counterintuitive, but we have little reason to suppose that intuitions are good guides to the ultimate nature of the world. Moreover, placing stock in such intuitions leads even

putatively 'naturalistic' philosophers to generate metaphysical accounts that are neither connected to, nor reflected by, contemporary science. In what follows, we examine Ladyman and Ross and French's respective *meta*metaphysical accounts of *what counts* as appropriately naturalistic metaphysics.

2.1.1 Metaphysics Naturalized

Ladyman and Ross insist that 'naturalistic metametaphysics', just like naturalistic metaphysics itself, 'should […] be based on science' (*ETMG*: 6).[50] That is, if metaphysics ought to be naturalized such that it reflects the commitments of the sciences, then our account of what counts as doing this kind of metaphysics ought itself to be naturalized in the same way. For this reason, Ladyman and Ross propose their Principle of Naturalistic Closure as precisely just such an account:

> Any new metaphysical claim that is to be taken seriously at time *t* should be motivated by, and only by, the service it would perform, if true, in showing how two or more specific scientific hypotheses, at least one of which is drawn from fundamental physics, jointly explain more than the sum of what is explained by the two hypotheses taken separately… (*ETMG*: 37)

The claim that metaphysics seeks to 'jointly explain' scientific hypotheses, or to carve out some unificatory ontological framework in order to make collective sense of various scientific hypotheses, supposes that the world is in fact unified in the first place. As

[50] Note that the full passage here reads: 'naturalistic metametaphysics, we hold, should be based on naturalistic metaphysics, which should in turn be based on science' (*ETMG*: 6). Later in this thesis I argue that Ladyman and Ross fail to adhere to this implied order of explanation **(5.2)**.

Ladyman Ross argue, the sciences do in fact support this supposition. Contra disunity theorists such as Cartwright (1999) and Dupré (1993), Ladyman and Ross claim that science tends towards increasingly unified and generalized explanations of things. This is evidenced by the history of science, which includes episodes wherein phenomena previously thought to be independent, or independently explicable, (electricity and magnetism; different gaseous behaviours) were ultimately given unified treatment in some succeeding theory (Maxwell's electromagnetic theory; the kinetic theory of gases).[51] It is also evidenced by scientific practice. As Ladyman and Ross observe:

> Scientists are reluctant to pose or to accept hypotheses that are stranded from the otherwise connected body of scientific beliefs. This is rational, reflecting the fact that a stranded hypothesis represents a mystery, and therefore calls out for scientific work aimed at eliminating it. It also reflects the fact that an important source of justification for a hypothesis is its standing in reciprocal explanatory relationships—networked consilience relationships—with other hypotheses. (*ETMG*: 27)

That both the history and practice of scientific inquiry exhibit this integrability of scientific theories and hypotheses into more unified explanations for phenomena, then, suggests that the world *is* unified and thus *is* amenable to some maximal—that is, metaphysical—description. Thus, for Ladyman and Ross, the task of metaphysics is that of providing this description—or of 'critically elucidating consilience networks across the sciences' (*ETMG*: 28).

[51] See Friedman (1974) and Kitcher (1981).

Note, however, that it is not sufficient, on Ladyman and Ross's account, for metaphysics to aim merely at elucidating consilience networks across *any* scientific theories or hypotheses. For at least one such theory or hypothesis must *always* come from fundamental physics. Ladyman and Ross further clarify and justify this qualification by means of their Primacy of Physics Constraint:

> Special science hypotheses that conflict with fundamental physics, or such consensus as there is in fundamental physics, should be rejected for that reason alone. Fundamental physical hypotheses are not symmetrically hostage to the conclusions of the special sciences. (*ETMG*: 44)

Ladyman and Ross therefore attribute to what they describe as 'fundamental physics' a form of 'epistemic priority' over the rest of the sciences (*ETMG*: 37).[52] And they justify this priority by, again, appealing to the practice and history of science. In the first instance, they claim simply that the primacy of physics has indeed emerged as a 'methodological rule' (*ETMG*: 38), or 'regulative principle' (*ETMG*: 44), for recent and current scientific theory construction. Second, they argue that such a regulative principle is justified by recent historical developments in the sciences. Two arguments from this history are put forward: first, that no non-physical posits or explanations for putatively non-physical phenomena have ever been discovered or proven successful; and second, that such putatively non-physical phenomena have in fact been explained in purely physical terms. Thus:

[52] I interrogate this notion of 'fundamental physics', along with the Primacy of Physics Constraint itself, in a later chapter **(5.2)**.

> it is not merely that anti-primacy-of-physics hypotheses have been rejected in the history of science, but that specifically physical hypotheses and explanations *have* been successful in their place. (*ETMG*: 43)

A helpful example here is that of historical attempts to posit a supposedly (non-physical) 'vital' force to explain organic or biological processes. As should be apparent, no such force was ever discovered. Moreover, purely physical explanations have proven successful in lieu. As Ladyman and Ross themselves observe:

> the electrochemical functioning of neurons is understood partly in the language of insulators, resistors, and charge and density gradients, as is the operation of the ion pumps and ATP transport molecules that build the charge gradients, and supply the (physical) energy for the operation of the pumps. (*ETMG*: 43)

Given this history, and given the existence of such a regulative principle, Ladyman and Ross argue that the primacy of physics ought to be reflected within a properly naturalistic metaphysics:

> This, we claim, is a regulative principle in current science, and it should be respected by naturalistic metaphysicians. The first, descriptive, claim is reason for the second, normative, one. (*ETMG*: 44)

Again, note that it is the sheer existence of such a regulative practice or norm within scientific theory construction that requires, on Ladyman and Ross's view, its representation as a constraint upon metaphysical theory construction. That is, Ladyman

and Ross *do not* promote this constraint based on some *ontological* thesis of physicalism or reductionism;[53] their claim is merely that naturalistic metaphysics should emulate scientific practice. (I exploit this aim of emulating scientific practice when subjecting the Primacy of Physics Constraint to critical scrutiny in a later chapter **(5.2)**.)

2.1.2 The Toolbox (née Viking) Approach

French's approach differs from Ladyman and Ross's primarily with respect to their respective attitudes towards metaphysics. As we saw in the previous chapter, Ladyman and Ross level a notably, and indeed self-proclaimed, 'polemical' critique against neo-scholastic metaphysics in the analytic tradition—insisting, as a consequence, that such an enterprise ought to be 'discontinued' (*ETMG*: vii). French, however, is more charitable on this point:

> even divorced from modern science as Ladyman and Ross feel it is, metaphysics might still offer an array of tools, moves, and manoeuvres of which the realist could avail herself. (*SotW*: 50)

This is the basic spirit behind what French refers to as the 'Viking' or (with McKenzie) the 'Toolbox' approach to metaphysics.[54] Such an approach is required, on French's account, because a commitment to naturalism, or a commitment to 'reading off' one's metaphysical theories from the sciences, generates a problem: namely, that of stripping

[53] I expand on their rejection of physicalism as an ontological thesis shortly and, more so, in a later chapter **(5.1)**.
[54] See French and McKenzie (2012).

down one's metaphysical commitments in order to avoid undue instances of 'humility' while also providing a reasonably clear picture of such commitments.

This problem is what French calls 'Chakravartty's Challenge', and it is worth unpacking. Chakravartty claims that: 'One cannot fully appreciate what it might mean to be a realist until one has a clear picture of what one is being invited to be a realist about' (Chakravartty 2007: 27; cited in *SotW*: 48). That is, and in the context of the philosophy of science, it is simply not enough to identify the appropriate (i.e. *not* outdated and *not* domesticated by neo-scholastic metaphysics) scientific theories, before then identifying the relevant features of those appropriate theories, before then simply declaring that those relevant features represent what the world is really like. Doing so, French claims, would be 'to simply wave one's hands at the relevant theoretical posits or equations and declaim "that is what I'm a realist about"!' (*SotW*: vi). The naturalistic metaphysician should rather be able to point towards those equations (or other mathematical devices) and provide some clear picture as to *what* they represent, not least because doing so would be immeasurably pedagogically helpful, but also because such equations, or the theories to which they belong, often *underdetermine* what that clear picture might be—as in the case of individuality or non-individuality in quantum mechanics, for instance **(1.4)**.[55] Those who fail to respond to this need for a clear picture, on French's account, 'are either closet empiricists or "ersatz" realists' (*SotW*: 48).[56]

[55] Note that, without such a clear picture, the ontic structural realist is also open to the charge that they endorse a kind of mathematical Platonism. See French and Ladyman (2003b).

[56] 'Ersatz' realism is here a reference to Ladyman (1998). Referring to the aforementioned case of individuality and non-individuality, along with other instances of underdetermination in quantum mechanics, he writes: 'We need to recognise the failure of our best theories to determine even the most fundamental ontological characteristic of the purported entities they feature. It is an *ersatz* form of realism that recommends belief in the existence of entities that have such ambiguous metaphysical status' (1998: 419–20).

The reintroduction of metaphysics into the mix here is precisely what helps to articulate this clear picture. Crucially, though, we need to be careful *not* to reflect this aforementioned underdetermination within this metaphysical picture. Say, for example, that we adopt the domesticated metaphysics criticized in the previous chapter **(1.5)**. The sciences, on this account, depict a world ultimately composed of objects. Now, given the underdetermination just mentioned—namely, that between the individuality and non-individuality of putative quantum objects—we face various difficult questions concerning whichever particular interpretative package we decide to adopt. And such underdetermination, French points out, 'prevents us from giving a definitive answer […], at least on the basis of the physics itself' (*SotW*: 61). In other words, we may adopt a metaphysics of objects either as individuals or non-individuals, but either way we open ourselves up to instances in which we simply have to shrug, throw our hands up in the air, and declare our inability to adjudicate on questions concerning the ultimate natures of such objects. That is, we have to admit a certain degree of ignorance—or what French calls 'humility': 'Here we have way too much humility!' (*SotW*: 61). *This*, then, is the manner of Chakravartty's Challenge: again, to provide sufficient clarity of understanding while avoiding humility as far as possible.

'Humility' is, I think, an unfortunate choice of nomenclature here. Given that humility is often considered a virtue, and thus as something *worth aiming at*, the suggestion that we might want to *avoid* humility as far as possible strikes one as odd and risks impeding the easy grasping of French's position. His meaning, though, is clear: when conducting metaphysical inquiry, we ought to restrict ourselves to making claims, or asserting the existence of things, about which we are reasonably certain.[57]

[57] I qualify 'reasonably' here because, when it comes to naturalistic metaphysics and its abductive machinery, unqualified or *absolute* certainty is not the most appropriate standard at which to aim. Naturalistic metaphysicians, just like scientists themselves, are in the business of seeking *best* explanations, not *necessary* explanations.

We seek to avoid humility, then, only in so far as we seek to avoid those instances in which our expression of it is made necessary by having been too metaphysically ambitious and having committed ourselves to claims that we cannot sufficiently support or with respect to which there are no discernible criteria for adjudication. In an important sense, then, it is humility that *motivates* French's concern, or his not wanting to 'overstep the mark', metaphysically speaking. For this reason, 'uncertainty'—or perhaps 'hesitance' or 'unsurety'—might be more suitable descriptors for what French seeks to avoid.[58]

Semantics aside, how does French propose we go about minimizing such humility or uncertainty? His answer is simple: 'I suggest we deal with it by elimination' (*SotW*: 59). Drawing upon the likes of Faraday (1844) and Cassirer (1956), French proposes that we simply eject any metaphysical posit that proves to be subject to the kind of underdetermination just examined. French encapsulates this idea in what he calls 'Cassirer's Condition': 'Take the "conditions of accessibility" to be "conditions of the objects of experience"', where 'conditions of accessibility' means 'those conditions encoded in our best theories that give us *access* to the way the world is (on a realist construal)' and 'conditions of the objects of experience' means 'those conditions that lay down *how* the world is' (*SotW*: 59).[59] Thus, we get a kind of identification—or at least very close situating—of epistemology and metaphysics.[60] Playing a role in successful theoretical access to the world appears to be, on French's view, a necessary and sufficient condition for metaphysical commitment.[61] Take our

[58] Admittedly, 'humility' has a better ring to it than 'hesitance' or 'unsurety', and 'uncertainty' brings with it concerns of the kind mentioned in the above footnote.
[59] An extremely interesting question arises here: how close is this to Deleuze's transcendental empiricism (as described in **(3.2)**)? I explore this question briefly in the Conclusion to this thesis.
[60] See *SotW*: 60, n.16.
[61] This sentence is meant as a (hopefully) useful summary. 'Playing a role' and 'successful' here require qualification.

domesticated or object-oriented metaphysics as example once again. That *different* accounts of objecthood (that is, individual and non-individual) are supported by the relevant science, and indeed that *non*-objecthood accounts are supported, suggests that the notion of 'object' does not count among those Cassirerian 'conditions of accessibility'. Such a notion is superfluous, it does not appear to be doing any *work* in the relevant theoretical machinery, or it appears to be explanatorily redundant, and so ought to be metaphysically eliminated.

As French observes, Chakravartty himself expresses a similar idea:

> we must turn to the equations with which we attempt to capture phenomenal regularities, and ask: what do these mathematical relations minimally demand? We must consider not what possible metaphysical pictures are consistent with these equations, but rather what kinds of property attributions are essential to their satisfaction—i.e. to consider not what is possible, but what is required. (Chakravartty 1998: 396; cited in *SotW*: 61)

The question, then, is not whether this or that object-oriented metaphysical package fits best with the relevant science, but whether the notion 'object' is required at all. The metaphysician, on Chakravartty and French's view,[62] ought simply to be in the business of presenting candidate metaphysical concepts and then letting the science filter out whatever is unnecessary or superfluous. As French puts it, the relation between metaphysics and science is 'akin to that between theory and disconfirming evidence as

[62] I do not mean here to suggest that Chakravartty and French share the same metaphysical views, only that their *meta*metaphysical views exhibit some similarity. Chakravartty's 'semi-realism' (1998), for French, describes a 'dispositional framework in which properties are understood in terms of causal powers', but 'retains objects as the "seat" of these causal powers and thus still falls prey to the metaphysical underdetermination regarding individuality' (*SotW*: 62).

quantum mechanics is being used as "evidence" to rule out this particular item of metaphysics' (*SotW*: 53)—namely, objects.

Such a metametaphysical approach may lead us to a structuralist metaphysics, then, in the sense that it recommends the elimination of objects from our conceptual vocabulary. Nonetheless, Chakravartty's Challenge remains for our structuralist Viking, who now faces the task of digging around in the conceptual toolbox of the metaphysical tradition in order to provide a clear and illuminating response to the question: 'So just *what* do you mean by "structure" anyway?'. It is to this question that we also now turn our attention.

2.2 What is Structure?

In what follows we develop a positive sense of Ladyman and Ross's 'rainforest realist' account of real patterns and French's so-called 'eliminative' version of ontic structural realism. I then interrogate the supposedly distinctively *eliminative* character of French's structuralist metaphysics, arguing that the kind of supposedly distinctive eliminativism usually attributed to him fails to distinguish his view from Ladyman and Ross's position.

2.2.1 Real Patterns

Ladyman and Ross advocate what they call a 'Rainforest Realism'.[63] The label, they explain, renders explicit their rejection of the Quinean preference for reduced, austere ontologies:

> Quine frequently expressed […] a preference for deserts over jungles. […] Ours is […] a realism of lush and leafy spaces rather than deserts, with science regularly revealing new thickets of canopy. Anyone is welcome to go on sharing Quine's aesthetic appreciation of deserts, but we think the facts now suggest that we must reconcile ourselves to life in the rainforest. (*ETMG*: 234)

As Ladyman and Ross observe, the traditional preference for minimalist ontologies arises in part from the principle of Ockham's razor, which, on their recounting, restricts one's ontological commitments to 'what is *required* for a maximally empirically adequate science' (*ETMG*: 234). They claim, however, that Ockham's razor 'has sometimes been interpreted in a stronger way, as suggesting that ontologies should be not just restricted but *small*' (*ETMG*: 234)—the intuition here being that reduced ontologies better reflect the simplicity-aspiring spirit of the razor. Thus, if it seems as though the world is made up of objects standing in various causal and compositional relations to one another, the razor (on such a stronger reading) suggests the reduction of all the more complex, composite objects to the simplest and most fundamental objects so that only the latter—namely, subatomic particles—need be included in our ontological inventory.

Ladyman and Ross deny that this conclusion is supported by the sciences. That is, they provide various scientifically informed arguments *against* this reductionist

[63] The label comes from Ross (2000).

thesis, or against a strong *ontological* version of physicalism. We examine these arguments in greater detail later in this thesis, where they are employed against recent attempts by Deleuze commentators to determine his naturalist status **(5.1)**. For now, we can simply gesture to them as follows: there is nothing *in* the articulation of scientific theories or laws that implies the kind of asymmetry required for ontological physicalism (here Ladyman and Ross (*ETMG*: 41) draw on Hüttemann and Papineau (2005)); the sciences themselves imply the 'scale relativity of ontology' (*ETMG*: 200); and, simply, if naturalistic metaphysics is in principal motivated by the epistemic success of the sciences, then we should commit ourselves metaphysically wherever we see such success, which we do in the special sciences as well as in fundamental physics. This latter 'epistemic success' argument is perhaps Ladyman and Ross's simplest and most powerful argument *against* physicalism as an ontological thesis and *for* an egalitarian attitude towards one's ontological commitments:

> Thus understood physicalism is in tension with the naturalism that supposedly motivates all forms of physicalism. That is, a responsible naturalist who defers to science as it stands in matters of belief formation will find herself ontologically committed to all sorts of entities and properties that aren't straightforwardly physical, in the sense of being studied as such by physicists. (*ETMG*: 40)

Ladyman and Ross therefore find themselves committed to all kinds of entities, those described by the special sciences and those described by fundamental physics, as well as to an *egalitarian* attitude towards such commitments. 'Prices, neurons, peptides, gold, and Napoleon' all exist, on Ladyman and Ross's account, and they do so 'in the

same unqualified sense as quarks, bosons, and the weak force' (*ETMG*: 300). I question the compatibility of this egalitarian attitude with their Primacy of Physics Constraint in a later chapter **(5.2)**. For now, let us restrict our attention merely to Ladyman and Ross's commitment to the existence of all kinds of entities—or to fundamental physical *and* to special science ontologies. For the following problem emerges in light of this claim: 'It is easier to give up on self-subsistent individuals in physics than it is in the special sciences' (*ETMG*: 191). That is to say, the *physics* may recommend a structuralist metaphysics and the elimination of objects from our conceptual vocabularies, but (given the epistemic success and other arguments just mentioned) we remain committed to all kinds of special scientific entities that are not obviously describable in structuralist terms. How are we to make sense of the idea that plants and people are *not* objects or individuals of some kind or another but are in fact *relations* or *structure*? It is in response to this problem that Ladyman and Ross articulate their Rainforest Realism—or an ontology of so-called 'real patterns'.

Their formal definition of a real pattern is as follows:

> To be is to be a real pattern; and a pattern $x \rightarrow y$ is real iff
>
> (i) it is projectible; and
>
> (ii) it has a model that carries information about at least one pattern P in an encoding that has logical depth less than the bit-map encoding of P, and where P is not projectible by a physically possible device computing information about another real pattern of lower logical depth than $x \rightarrow y$.[64] (*ETMG*: 233)

[64] Much like the label 'Rainforest Realism', this definition of real patterns—along with the focus on real patterns itself, drawn from Dennett (1991)—is drawn from Ross (2000) (though Ladyman and Ross's is a slightly more nuanced expression).

Obviously, this definition is quite technical—especially clause (ii). The technicalities arise from Ladyman and Ross's engagement with information theory, from which they borrow concepts in order to articulate the most precisely and formally defined version of their Rainforest Realism—namely, their 'Information-Theoretic Structural Realism' (*ETMG*: 238). Rather than delving into information theory, though, we can parse both (i) and (ii) (the conjunction of which represents the necessary and sufficient condition for being a real pattern) in plainer language.

First, note that a pattern for Ladyman and Ross 'is just any relations among data' (*ETMG*: 228). Also note that, owing to their structuralist or fundamentally relational metaphysics, real patterns are always patterns *of*, or rather *in*, other real patterns: 'it's real patterns all the way down' (*ETMG*: 228). Now, what distinguishes real patterns from 'mere' patterns is their ability to support generalizations or predictions. For note that, if patterns are simply 'relations among data', then any posited relations between data points whatsoever can be said to constitute a pattern.[65] Ladyman and Ross's example here is the 'many curves that can be drawn through the past price data on a stock market' (*ETMG*: 228). Assuming that such data points are accurate, any curves drawn through them constitute patterns on Ladyman and Ross's view. But only *some* of the curves will accurately represent the relevant trends and thus support predictions regarding future data points. And this ability to support generalizations is just what it means to be 'projectible' on Ladyman and Ross's account:

[65] Here Ladyman and Ross's notion of 'pattern' diverges from our intuitions, for 'pattern' *simpliciter* is often taken as shorthand for what they count as 'real pattern'.

> What the financial economist or stock analyst wants to know […] is which of these curves can be reliably projected forward—which ones generalize to the unobserved cases. (*ETMG*: 228)

Thus, when two friends learn of their mutual intolerance to lactose and one of them remarks 'oh yeah, of course, we're both pisces', then that friend posits a pattern between being born during a particular period of time and being lactose intolerant. This is a *mere* pattern, however, because investigation will yield no greater incidence of lactose intolerance in those born between late-February and late-March than it will for the same time period at any other point in the year.[66] In other words, this pattern does not support the implied generalization that the next person you meet who is lactose intolerant is more likely to be pisces than they are any other star sign.[67]

Sheer projectibility is not enough, however, to make a pattern real. The second condition—that expressed by clause (ii) above—is that *real* patterns must be 'informationally non-redundant', which is to say that they 'must be *required* if some counterfactual-generalization-supporting information is not to be lost' (*ETMG*: 231). Were projectibility enough to make a pattern real, in other words, then we could simply conjoin projectible patterns willy-nilly, needlessly proliferating our already densely packed rainforest ontology. Ladyman and Ross provide the following example, taken from Ross (2000: 162):

[66] One might observe a spike in lactose intolerance in late-September to early-October births, but this would simply be because more babies are born on average during this period in the year. (As reported by the Office for National Statistics: https://bit.ly/2M1IwU8.)

[67] Here we come across the reason for why Bell's claim, mentioned in the Introduction to this thesis, that 'reading entrails' might have at some previous time been a real pattern (2016: 178–79), simply cannot be true. Unless we are willing to accept that this practice did at one point support counterfactual or generalizing claims (which is extremely difficult to believe!), then we ought to dismiss this claim as false.

> the object named by ‘my left nostril and the capital of Namibia and Miles Davis’s last trumpet solo’ is not a real pattern, because identification of it supports no generalizations not supported by identification of the three conjuncts considered separately. (*ETMG*: 231)

This further condition therefore helps the rainforest realist to respect Ockham’s razor, as it excludes those patterns that are not *required* by one’s ontology. No new data or phenomena are tracked by such an arbitrarily conjoined pattern; nothing is gained from tracking *it* alongside its constituent patterns independently. It is therefore not real and should be eliminated.

Note also that this informational non-redundancy condition also serves the same function as Ladyman and Ross’s ‘epistemic success’ argument mentioned above—or that it works ‘in the other direction’, so to speak, *excluding* what ought not to be included in one’s ontology but *including* what ought to be included. Thus, the pattern ‘that tiger’ ought to be recognized as real because it supports generalizations and predictions not supported by ‘these carbon molecules’ or ‘this jungle’, for example. This is similar, if not equivalent, to the observation that, were we to reduce biology to chemistry, or even biology to microbiology, then information or insight would be lost.

According to Ladyman and Ross’s Rainforest Realism, then, all putative objects studied by the special sciences just *are* real patterns. This is not to say that ‘object-talk’ should be eliminated from our everyday and special scientific vocabulary. Indeed, such talk is necessary for prudence considerations on Ladyman and Ross’s account. Such talk, however, should *not* be construed as referring to putative objects or individuals *qua objects or individuals*, for there *are* no such things according to our structuralist metaphysics. Instead:

> the special sciences track real patterns, necessarily using individuals as constructed epistemic book-keeping devices, but without identifying the real patterns in question with the individuals. (*ETMG*: 245)

2.2.2 Laws and Symmetries

French avoids the problem to which Rainforest Realism responds altogether by adopting a much more austere ontology. Simply put, 'the laws and symmetries of our theories of contemporary physics' are all that exists on French's account (*SotW*: ix). That is to say, and unlike Ladyman and Ross, French endorses no other ontological commitments than that structure described by fundamental physics. Hence his view is often described, by both himself and commentators, as an 'eliminativist' version of ontic structural realism:

> Not for nothing is the view I defend characterised as eliminativist ontic structural realism! I press for the elimination of not only objects at the fundamental level, but at all 'derivative' levels, adopting a form of nihilism towards tables, dogs, people and so on. On my view, all there is in the world is structure, understood as that fundamental structure presented to us by modern physics. (2019: 24)

Fittingly, then, our account of his position can be brief. Recall our discussion of the quantum mechanical motivations for ontic structural realism in the previous chapter

(1.4). There we saw how certain experimental results cast doubt upon the assumption that subatomic particles are individual objects, thereby motivating an initial wave of structuralism—in the work of Cassirer and Eddington, for example. We then saw how the relevant physics does in fact support, though *underdetermines*, two metaphysical packages—those of individual and 'non-individual' objects respectively.[68] This underdetermination itself is then taken to motivate ontic structural realism.

Now, a crucial aspect of French's approach is his emphasis on the role of group theory as a representational device in quantum mechanics.[69] Very simply put, group theory studies transformations and seeks invariances—otherwise known as 'symmetries'. In geometry, for example, group theory studies the behaviour of figures, such as squares or equilateral triangles, under different kinds of transformations—rotation being a simple example. Note that no change is exhibited when a square undergoes rotations of 90, 180, 270, or 360 degrees, or that it remains 'invariant' under such transformations. And the same can be said of our triangle for rotations of 120, 240, and 360 degrees. We might therefore say that the square is 'symmetric' under four of its rotational transformations, and the triangle under three. Important information about the natures of these figures can therefore be encoded in this way. For suppose that I tell you that I am thinking of a two-dimensional geometrical figure that is symmetric or invariant under *all* rotation transformations; you will immediately know that the figure I have in mind is a circle. The details are technical, but these kinds of group-theoretical analyses can also be used to study solutions to complex mathematical equations—for instance, those involved in quantum mechanics. And indeed, Weyl—a leading figure in the development of group theory—claims that: 'The theory of groups is the appropriate

[68] Again, see French (1989).
[69] See French (*SotW*: 74–79). Wigner and Weyl are central figures in the development of group theory and its relation to quantum mechanics. A key work for French, one in which 'both the "Wigner" and "Weyl" programmes are represented', is Weyl (1931) (*SotW*: 77).

language for the expression of the general qualitative laws which obtain in the atomic world' (1968: 291; cited in *SotW*: 78).

We have already seen an example of this appropriateness at work. Recall, for instance, the representation of permutation *invariance* in Hilbert Space **(1.4)**. Such a space, we observed can be used to represent the arrangements available to certain kinds of particles under certain operations, such as permutation. Bosons are restricted to one particular subdomain of that space (in which permutations are *symmetric*) and fermions are restricted to another subdomain (in which permutations are anti-*symmetric*). In other words, this space itself represents group-theoretical describable invariances or symmetries in the behaviour of certain kinds of particle—that is, permutation symmetry (or invariance). As French himself remarks (in a little more detail):

> This use of group theory hinges on the fundamental relationship between the irreducible representations of the group and the sub-spaces of the Hilbert space representing the states of the system. Under the action of the permutation group that Hilbert space decomposes into mutually orthogonal sub-spaces corresponding to the irreducible representations of this group. The symmetric and anti-symmetric representations are the most well known, corresponding to Bose–Einstein and Fermi–Dirac statistics respectively…[70] (*SotW*: 76)

French therefore fastens onto this group-theoretical language—the idea being that, if 'the fundamentals of quantum mechanics appear to simply drop out of the group-theoretic approach' (*SotW*: 77), then we are best off embracing this descriptive

[70] I omit French's qualification concerning so-called 'paraparticles' and 'parastatistics' for the sake of simplicity, but also because such particles do not, French observes, appear to be 'exemplified in nature' (*SotW*: 76).

machinery in our metaphysics. Hence his ultimate claim that the structure of the world is just symmetries (and their associated laws) of the kind just described:

> the status of PI, from this perspective, is that of one of the fundamental symmetry principles which effectively binds the 'web of relations' constituting the structure of the world... (French and Rickles 2003: 233)

We return to this emphasis on symmetry, and to French's Poincaré-inspired mechanism for defending the ontological basicness of a symmetry of a group in relation to its putative elements, later in the thesis **(4.3)**.

2.2.3 What is *Eliminative* Ontic Structural Realism?

French's version of ontic structural realism, then, can be understood as distinctively eliminative. But there is ambiguity in the literature as to precisely which of his claims such eliminativism tracks. See, for instance, the following—all taken from a special issue, dedicated to French's book, of *Studies in History and Philosophy of Science*:

> Ontic structural realism argues that structure is all there is. In (French, 2014) I argued for an 'eliminativist' version of this view, according to which the world should be conceived, metaphysically, as structure, and objects, at both the fundamental and 'everyday' levels, should be eliminated. (French 2019: 22)

> French accepts that […] everyday and special science ontology do not exist. Hence, for him, OSR in the philosophy of physics requires eliminativism about

> both everyday objects and the entities of the special sciences, in favour of the structures of fundamental physics. (Ladyman 2019: 2)

> This is the position for which French is antecedently famous […]: it is intended as a form of scientific realism, it is ontic insofar as it describes structure as comprising the furniture of the world, and it is eliminative in denying the existence of objects. Reflecting all of this, I will refer to the position henceforth as 'eliminative ontic structural realism' (EOSR). (Chakravartty 2019: 10)

Each passage distinguishes French's view as a *distinctively* eliminative version of ontic structural realism. And yet, each passage either straightforwardly fails to distinguish French's position from that of Ladyman and Ross, or otherwise harbours some ambiguity that makes the distinctiveness of his view unclear.

In the first passage, for example, French describes his view as 'eliminativist' in the sense that he claims that 'objects, at both the fundamental and "everyday" levels, should be eliminated' (2019: 22). But this is just straightforward ontic structural realism! That is to say, in *this* sense of 'eliminativist', Ladyman and Ross are equally deserving of the title. Indeed, Ladyman and Ross do in fact claim that the labels 'ontic structural realism' and 'eliminative structural realism' are interchangeable, and thus imply that the latter can just as well be attributed to them (*ETMG*: 67, n.1). They also explicitly argue for 'eliminativism about self-subsistent individuals' (*ETMG*: 130). There is thus nothing so far to distinguish French's view from that of Ladyman and Ross. Chakravartty makes the same mistake, attributing to French 'eliminativism' in the sense merely of 'denying the existence of objects' (2019: 10).

Ladyman's passage is more ambiguous, meaning that it *does* admit of a reading that tracks French's *genuinely* distinctive eliminative claim, but nonetheless still suffers from a lack of clarity and so can be very easily misinterpreted. Note the initial proposition—namely, that French accepts that 'everyday and special science ontology do not exist' (Ladyman 2019: 2). This claim does not by itself distinguish French from Ladyman and Ross. Our everyday ontology, according to the structuralist, is one of objects or self-subsistent individuals. And so too is special science ontology, ordinarily conceived. 'We of course acknowledge that special sciences are richly populated with individual objects' (*ETMG*: 130). Recall that *this* fact, along with their willingness to take seriously the commitments of the special sciences, is what generates a problem for Ladyman and Ross, thereby motivating their Rainforest Realism. That this claim can be attributed to French, then, is not enough to distinguish his view.

Now consider the second proposition—namely, that for French 'OSR in the philosophy of physics requires eliminativism about both everyday objects and the entities of the special sciences, in favour of the structures of fundamental physics' (Ladyman 2019: 2). Only on a very broad construal of the word 'entity' does this claim accurately reflect what is truly distinctive about French's view—namely, that he endorses eliminativism about both objects and the entities (*be they objects, real patterns, or structures*) of the special sciences. Not only is he an eliminativist about objects (standard ontic structural realism), then, but he is also an eliminativist about *what we ordinarily take to be objects*.

Even if Ladyman's passage supports an accurate assessment of what distinguishes French's view from the Rainforest Realist, though, an unfortunate ambiguity remains. French's view is essentially described as 'double eliminativism', so to speak. That is, eliminativism about objects and eliminativism about any putatively

non-fundamental physical structure. A semantic shift in one of these labels (ideally the latter) might avoid confusion, though an obvious candidate does not present itself.[71]

2.3 Conclusion

We have developed a sense of Ladyman and Ross and French's respective metametaphysical approaches, as well as their positive metaphysical views. Ladyman and Ross are stricter with respect to their criticism of analytic metaphysics, arguing that the enterprise 'should be discontinued' (*ETMG*: vii) and thus, presumably, that its attendant metaphysical resources should be abandoned. French, however, adopts a more liberal 'toolbox' approach, particularly in response to Chakravartty's Challenge. He recommends digging around in the metaphysician's toolbox and tinkering with their concepts in order to provide an appropriately illuminating (though not too humility-inducing) picture of the ontic structural realist view. Conversely, it is Ladyman and Ross who adopt the more liberal approach when it comes to ontology, endorsing a Rainforest Realism of real patterns, each of which supposedly enjoys *the same* ontological status. We invoke this claim to ontological parity in a later chapter in order to challenge Ladyman and Ross's view **(5.2)**. We also examined French's basic ontological claim—namely, that the relevant group-theoretically informed symmetries described by fundamental physics, such as permutation symmetry, represent the structure of the world. This prepares the way for our exploration of the ontic structural realist and Deleuze's respective engagements with Poincaré later in the thesis **(4.3)**.

[71] 'Fundamentalism' is, admittedly, not a particularly attractive label.

Chapter Three

Why Difference?

3.0 Introduction

The purpose of this chapter is to introduce and motivate Deleuze's metaphysics of difference. Deleuze's philosophical writings, however, are extremely diffuse and various, so here I focus on the three motivating and contextualizing threads that seem most relevant to the project of this thesis. Before forecasting these threads, though, I want to say something about the diffuseness of Deleuze's work, his messy and sporadic rhetorical style, and the frustrating reading experience that accompanies such unfortunate quirks.

Consider, for instance, the following snapshot of his philosophical writings. His early 'historical' period includes monographs dedicated to Hume (1953), Nietzsche (1962), Kant (1963), Proust (1964), Bergson (1966), and Spinoza (1968).[72] These are followed by his middle texts: *Difference and Repetition* (1968) and *Logic of Sense* (1969). Here Deleuze brings together a plethora of figures, including those just mentioned, and puts them into conversation with ideas from literature and the arts, psychoanalysis and linguistics, mathematics and science, as well as the philosophies of logic and language. Then comes his later period, which is largely defined by his collaborations with the psychoanalyst Félix Guattari—most notably *Anti-Oedipus*

[72] I am using original publication dates here to give a sense of the chronology of Deleuze's career.

(1972), *A Thousand Plateaus* (1980), and *What is Philosophy?* (1991). As their titles suggest, *Anti-Oedipus* is broadly psychoanalytic in scope, while *A Thousand Plateaus* enjoys a much wider purview, containing references to cosmology and geology, evolutionary and developmental biology, history, anthropology, and politics, and literature and music. *What is Philosophy?*, on the other hand, is strictly metaphilosophical, examining the natures of philosophy, science, and art (along with their respective relations to one another). Though this later period is generally identified with these collaborative works, Deleuze also published independently during this time, including a further book on Spinoza (1970), a book on the twentieth-century artist Francis Bacon (1981), a two-volume text on cinema (1983, 1985), and a book on Leibniz (already a prominent figure in his earlier writings) (1988).

With such an assorted body of work, then, it can be difficult to know where to begin with Deleuze. It is not as though the above exhibits the same kind of systematic organization found in, say, the works of Aristotle, Spinoza, Kant, or Hegel. There is therefore no obviously 'fundamental' text with which to start and in terms of which we might be able to parse the rest. Indeed, many of the individual texts mentioned above fail to exhibit this kind of systematicity within their own pages. Instead, they are presented in an often difficult and disorientating rhetorical style, one that does not allow for the easy identification of a single argumentative thread, a thread that could in turn be traced back to some privileged explanatory source or starting point.

The most egregious examples of this obfuscating style can be found in *A Thousand Plateaus*. Whereas the more traditional book consists of chapters that progressively build an argument towards some conclusory claim, this text consists of 'plateaus', whose relations to one another are manifold and so do not form a linear sequence. They can thus 'be read independently of one another' (*ATP*: xx), or in

whatever order one desires, thereby resisting any attempt to discern some prescribed explanatory structure.

Such difficulties persist even within the plateaus themselves, riddled as they are with references that are both highly allusive and disjunctive. That is to say, Deleuze's many mentions of other authors and subject matters often lack explanation, development, or even proper referencing. Moreover, they frequently appear alongside other references of a completely different sort, thereby rendering the precise content of his philosophical claims incredibly difficult to track. We are, after all, talking about a book that refers to 'Joycean tachyons' (*ATP*: 53), and according to which

> a semiotic fragment rubs shoulders with a chemical interaction, an electron crashes into a language, a black hole captures a genetic message, a crystallization produces a passion, [and] the wasp and the orchid cross a letter… (*ATP*: 69)

As I have already indicated, these are some of the more extreme examples of Deleuze's difficult style. This is because *A Thousand Plateaus* is a particularly experimental book, itself beginning with a reconceptualization of the very idea of a philosophical text and of how best to communicate philosophical claims.[73] We should emphasize, though, that this same style can be found across most (if not all) of Deleuze's philosophical writings. Even *Difference and Repetition*, which is regularly cited as one of his more sober or straightforward works, confronts us with each of the difficulties mentioned above.[74]

[73] See the introduction to *A Thousand Plateaus* (*ATP*: 3–25).

[74] Somers-Hall, Bell, and Williams comment on the 'classical structure' of *Difference and Repetition*, claiming that 'while [it] recognises the need to move away from traditional approaches to philosophising, it does not itself institute this movement' (2018: 2). See also de Beistegui, who refers to the book's 'doctoral and academic nature' (*Difference and Repetition* was Deleuze's principal thesis for his Doctorat D'Etat) as an explanation for why it, in his view, conforms to 'the classical model of the book' (2018:

For instance, though it *does* consist of chapters, Bryant observes that those chapters 'fit uneasily' with one another (2020: 6). Indeed, he claims that *Difference and Repetition* 'reads like two books', its first, third, and fourth chapters comprising 'a book of metaphysics on the one hand', with the second, third, and fifth presenting 'a book of critical philosophy in the transcendental mode on the other' (2020: 7).

Within the body of the text, Deleuze's penchant for allusion and disjunction is also evident. Bryant cites a brief mention of French linguist Gustave Guillaume (2020: 7; *DR*: 205), remarking that:

> there are countless places where Deleuze refers to something in the history of philosophy, literature or science in a way that seems to be of crucial importance, nonetheless failing to fully develop the idea or even tell the reader what he is explicitly referring to. (Bryant 2020: 7)

He then draws our attention to the disjointedness of such allusions, noting how Deleuze 'fluidly moves' from more naturalistic or metaphysical talk of the 'dynamic processes through which cell division takes place' (as in *DR*: 222) to discussions of a more phenomenological or transcendental sort, referring to 'the formation of the right and left, high and low, and figure and ground' (as in *DR*: 229) (Bryant 2020: 7).

For an example that captures both obfuscating elements, consider Deleuze's mention of the *Critique of Pure Reason* in one and the same breath as Niels Henrik Abel's and Évariste Galois's respective attempts to determine the conditions for the possibility (or impossibility) of solving polynomials by means of radicals (*DR*: 180). If

12). See also Deleuze's own claim that *Difference and Repetition* 'aspired […] toward a sort of classical height' (2006: 65).

you find yourself craving some contextual explanation of Abel's and Galois's respective mathematical theories, and of how those theories relate to Kant's Copernican revolution, then you have some idea as to what it is like to pick up and read *Difference and Repetition*—or indeed any of Deleuze's works—for the first time.

A Thousand Plateaus might be the book in which his peculiar rhetorical style is at its most pronounced, then, but it is not the only place where Deleuze's trademark mode of philosophical expression, along with its accompanying interpretative difficulties, can be encountered. It would seem, then, that wherever we look—whether it be at his body of work as a whole, at this or that particular text, or even within this or that particular chapter or plateau—we find it difficult to attribute some unifying explanatory structure to Deleuze's philosophical thought, or to ascribe to Deleuze a single philosophical mission. *This* is what makes him such a difficult philosopher to read (and to introduce!).

And yet Deleuze *does* advocate a systematic approach to philosophizing. 'I believe in philosophy as a system' (2010: vii), he states in a letter preface written towards the end of his career, thereby suggesting that he does in fact regard his thought as enjoying *some kind* of unity or consistency. Why, then, does this unity or consistency prove so elusive?

The answer has to do with his principal philosophical claim—namely, that difference is fundamental—and its implications for the nature of philosophical thought. That is to say, if Deleuze thinks that the world is irreducibly differential or multiple, and if any account of the world must itself be a part of the world it describes, then his own philosophical description of the world must itself reflect this fundamentally differential structure. The explanatory composition of his system, then, cannot simply

refer back to some easily identifiable fundamental text, or to some first principle or set of axioms (again, like those of Aristotle, Spinoza, Kant, or Hegel).

To use the botanical imagery frequently adopted by Deleuze and Guattari in *A Thousand Plateaus*, the structure of Deleuze's system cannot be 'arborescent' or 'tree-like', according to which its more diverse and determinate claims (the branches) are unified by some more general explanatory base (the roots). For if it did conform to this image, then each and every one of its claims would be explained by their relation to some common ground or shared identity, thereby violating its commitment to the fundamentality of difference. Hence his immediate qualification:

> I believe in philosophy as a system, but I dislike the notion of system when people relate it to the coordinates of the Identical, the Similar and the Analogous. […] The system must not only be in perpetual heterogeneity, it must be in *heterogenesis*, and it seems to me this has never been tried before. (2010: vii).

The assorted and eclectic composition of his philosophical writings, then, along with the messy and sporadic rhetorical style in which they are wrought, do not signal Deleuze's failure to organize his thoughts effectively, nor do they betray a deliberate attempt at obfuscation (as is so often suspected of those who are labelled 'postmodern'). Rather, this peculiar mode of philosophical expression reflects the demands of his substantive claims, along with the extent to which those claims go against our more familiar ways of thinking about both the world and about thought as such. Deleuze's system must be heterogenous, or differentially-structured, and it must be 'in heterogenesis' in so far as a system *based on difference* can never be 'closed' or

completely circumscribed. Rather, it must be an 'open' system—open, that is, to new ways of articulating itself.

Returning to Deleuze and Guattari's botanical imagery, a system of difference must not be arborescent but 'rhizomatic'—rhizomes being root systems characterized by horizontal growth and the lack of a privileged centre (think grass, ginger, or bamboo). Rhizomes are described by Deleuze and Guattari as 'flat' (*ATP*: 9) and as 'always in the middle' (*ATP*: 25). Connections, or 'lines', can be drawn between any point of a rhizome and any other (*ATP*: 21). Or, rather, rhizomes have no absolute points of articulation, consisting instead of nothing other than these lines or connections themselves. 'There are no points or positions in a rhizome, such as those found in a structure, tree, or root. There are only lines' (*ATP*: 8). Accordingly, and perhaps most significantly for our current purposes, a rhizome 'always has multiple entryways' (*ATP*: 12)—again, no privileged centre, base, or ground (that is, no fundamental text or guiding first principle).

With these brief preliminary remarks, I hope to have provided at least *some* justification for the organization of Deleuze's body of work, and for the formidable and frustrating writing style found therein. Deleuze does describe himself as a 'very classical' philosopher (2010: vii) and so we ought to approach him as such—even if his approach to classical philosophical questions remains incredibly unorthodox. Again, his work may be 'a mess', as Bryant remarks (2020: 6), but it is not a *mere* mess. Rather, it is a mess that is, I argue, carefully and purposefully constructed for some rather intriguing philosophical reasons—some of which I hope to showcase throughout the course of this thesis.[75]

[75] This exercise of the principle of charity, of course, has limits. Deleuze can often be accused of being unduly esoteric—and rightly so. Part of the project of this thesis is to attempt to present his work in a more accessible light.

With this in mind, we will proceed in this chapter to examine some of the 'ways in' to Deleuze's philosophical position. We start by considering his critique of 'representation', or of our folk-ontological way of representing the world, according to which the world consists primarily of objects, identities or individuals **(3.1)**. We will then examine Deleuze's self-identification as a 'transcendental empiricist' **(3.2)**, before briefly acknowledging—and indeed opening up the question of—the significance of mathematics and the sciences to his philosophical thought **(3.3)**.

3.1 Representation

In the previous chapters, we saw that ontic structural realists claim that the world is fundamentally relational—or that *structure is all there is*. We also recognized the counter intuitiveness of this view, but then in turn examined a structuralist response in the form of Ladyman and Ross's critique of 'neo-scholastic' metaphysics in the analytic tradition **(1.5)**. The idea that world is ultimately composed of individual objects may be extremely intuitive, but it is in fact challenged by our best contemporary science.

A similar story can be seen with respect to Deleuze's thought. Deleuze also claims that the world is fundamentally relational—or 'differential' in character. 'All identities are only simulated, produced as an optical "effect" by the more profound game of difference and repetition' (*DR*: xix); 'Every object, every thing, must see its own identity swallowed up in difference, each being no more than a difference between differences' (*DR*: 56); 'difference is behind everything, but behind difference there is nothing' (*DR*: 57). Again, though, this claim clashes with our intuitions. It seems as though, in order for there *to be* difference or differences, there must first be identity or identities or individuals *between which* such difference or differences obtain. Deleuze

describes this package of intuitions surrounding the relationship between identity and difference as 'representation' or as 'the image of thought': 'The primacy of identity, however conceived, defines the world of representation' (*DR*: xix). And, just as Ladyman and Ross provide a critique of neo-scholastic or 'individualist' metaphysics in the analytic tradition (*ETMG*: 189), so too does Deleuze provide a critique of various manifestations of representation throughout the entire Western tradition.

Now, though it is Plato who, for Deleuze, 'inaugurates and initiates' representation as the basic commonsensical and philosophical model for thinking about the world and about thought as such (*DR*: 265),[76] it is in fact Aristotle who is the paradigm figure of representation on Deleuze's account. That is to say, though in Plato we may identify the original canonical instances in which difference is subordinated to 'the Same, the Similar, the Analogous and the Opposed', 'these instances are not yet distributed [in Plato] as they will be in the deployed world of representation (from Aristotle onwards)' (*DR*: 265). In what follows, then, we will examine how representation manifests itself in Aristotle's thought, we will examine the problems that Deleuze identifies with this representationlist schema, and we will gesture towards Deleuze's proposed alternative to this problematic model.

3.1.1 Aristotle: Genera, Species, Individual

For Aristotle, things or individuals in the world are organized according to a hierarchy of species and genera. To adopt the canonical example: Socrates can be identified as a member of the genus 'animal', but he can be further specified as 'rational' and thus as

[76] For the authoritative study of Deleuze's account of Plato, see Smith (2012: 3–26). See also de Beistegui (2012) and Altamirano (2015).

a member of the species 'human': 'the individual man belongs in a species, man, and animal is a genus of the species' (*Categories* 2a13–2a18).[77] This hierarchy, however, is much more expansive than is let on by this example. The genus 'animal', for instance, is really a kind of sub-genera, acting as genus in relation to certain individuals but itself acting as species to the broadest category under which it is subsumed—in this case 'substance'. Thus:

> we […] have a hierarchy, reaching from the highest genera to the individual, through which the individual is specified by a process of division from the genus through the various species, gaining determinations as it goes, since each genus will determine the essence of that below it. (Somers-Hall 2012: 44)

A particular notion of difference is key to this picture. Indeed, Aristotle himself inserts this notion of difference into his definition of 'genus': 'A genus is what is predicated in what a thing is of a number of things exhibiting differences in kind' (*Topics* 102a31). Such 'differences in kind' are otherwise described as *specific* differences—that is, the difference *between* species within a given genus. This, for Aristotle, is the 'greatest' difference, which is to say that it is the only form of difference which for him relates to the *essences* of things, or *what it is* to be a particular kind of individual. Differences between individuals themselves, for instance, are merely trivial or accidental on his view, having nothing to do with their *being* or *essence*. As for putative differences between genera (meaning the broadest overarching categories), Aristotle claims that

[77] When referring to Aristotle's works, I use Barne's *The Complete Works of Aristotle* (1984) except for the *Categories*, in which case I refer to Aristotle (1963).

genera are incomparable and do not exhibit differences from one another. In Aristotle's words:

> For things which differ in *genus* have no way to one another, but are far too distant and not comparable; and for things that differ in *species* the extremes from which generation takes place are contraries; and the distance between extremes—and therefore that between the contraries—is the greatest. (*Metaphysics* 1055a)

And in Deleuze's own recounting:

> In short, contrariety in the genus is the perfect and maximal difference, and contrariety in the genus is specific difference. Above and below that, difference tends to become simple otherness and almost to escape the identity of the concept: generic difference is too large, being established between uncombinable objects which do not enter into relations of contrariety; while individual difference is too small, being between indivisible objects which have no contrariety either. (*DR*: 30–31)

Deleuze describes Aristotle's specific difference as 'conceptual difference' and argues that this basic way of conceiving difference—that is, as difference (between species) *within the identity of a concept* (or genus)—can be seen in one form or another throughout the Western tradition, 'from Aristotle to Hegel via Leibniz', preventing us from articulating a 'concept of difference' in its own right (*DR*: 27). This representationlist schema experiences what Deleuze calls 'catastrophes' of difference.

That is, moments at which the system organized by identity-subordinated specific difference breaks down, allowing us to glimpse a more profound notion of difference-*in-itself* that cannot be subordinated to identity: 'does not difference as catastrophe precisely bear witness to an irreducible ground which continues to act under the apparent equilibrium of […] representation?', Deleuze writes in *Difference and Repetition* (*DR*: 35).

3.1.2 Problems: the Small and the Large; Paronymy and Analogy

The Aristotelian system of specific difference experiences problems once attention is paid to its very highest and lowest levels. As Widder observes:

> The fragility of the schema just described becomes clear when one inquires beyond the level of genus and species, in one direction toward the individual and in the other toward the highest categories. (2001 : 440)

The problem of the lowest level (or of the 'small') is that the ultimate differences between individuals cannot be accounted for or explained by specific difference. Individuals *are* differentiated or individuated from one another in an important way. And yet, since there can be no intermediating species between individuals of the same basic kind, the difference between them can only be that of 'the irreducible "thisness" of each of them', as Widder puts it. 'Socrates, for example, might be understood as a man with certain characteristics and *who is made of this particular material* or *who is this particular man*' (Widder 2001: 440). This is the difference that renders each

individual irreducibly unique, and so cannot be accommodated by a conception of difference as subordinated to the identity of a concept or species.

The problem of the highest level (or of the 'large') is that of the differences between the highest genera or categories—substance, quantity, quality, and so on. We have already observed Aristotle's claim that such categories are incomparable, or that they are 'far too distant' from one another. Another way of putting this is that there can be no 'highest' genus or no single category that unifies the rest. 'Being' would be an obvious candidate for such a category—everything described by the Aristotelian system (presumably) *is*, after all. 'Being' would therefore appear to be the ultimate common category, under which the rest could be subsumed.[78] Nonetheless, Aristotle himself insists that being is not a genus:

> It is not possible that either unity or being should be a single genus of things; for the differentiae of any genus must each of them have both being and be one, but it is not possible for the genus to be predicated of the differentiae taken apart from the species (any more than for the species of the genus to be predicated of the proper differentiae of the genus); so that if unity or being is a genus, no differentia will either be one or have being. (*Metaphysics* 998b)

This is worth unpacking. Genera, recall, are differentiated within themselves. It is this differentiated character that is carved out by specific difference—or 'differentia'. Such differentia, however, must be *different kinds of things* from the species they differentiate. So, for example, within the genus 'animal' (taken as genus now, for the

[78] 'Unity' is itself another candidate common category here, for everything that *is* is, presumably, unified with itself. Aristotle discusses both options; we only discuss one.

sake of illustration), we can differentiate 'humans' as 'rational'. That is, humans (species) are animals (genus) who are rational (differentiae). Note, then, that while we *can* say that *humans* are animals, or that the genus 'animal' can be predicated of the species 'human', it makes no sense to say that 'rational' is an animal. Hence, 'it is not possible for the genus to be predicated of the differentiae taken apart from the species' (*Metaphysics* 998b). Now, suppose that 'being' were the highest category or genus. This genus would then itself be differentiated into the Aristotelian categories—again, substance, quality, quantity, and so forth. But notice, in this case we *would* be able to predicate the differentiae of the genus. In other words: just as we can say that substances *are*, so too can we say that *differences* (whatever specific differences they might be) *are*. Thus, being *cannot* be a genus because differences evidently *do* exist, or 'have being', and their relation to being *cannot* be that of genus predicated of differentia. As Somers-Hall helpfully summarizes: 'if being is a genus, then […] all difference would lack being' (2013: 27). Or, in Deleuze's own words:

> Remember the reason why Being itself is not a genus: it is, Aristotle says, because differences *are* (the genus must therefore be able to attribute itself to its differences in themselves: as if animal was said at one time of the human species, but at another of the difference 'rational' in constituting another species …). (*DR*: 32)

Two unfortunate consequences arise here. One result is that there can be no highest genus, or that such a putative genus must remain undefined while the aforementioned categories are left irreducibly multiple. Again, here a 'catastrophic' difference (to appropriate Deleuze's phrase) spills out, threatening the consistency of Aristotle's

system. On the one hand, we have the intermediate area of the hierarchy (between genera, species and sub-species) in which the system of specific difference works just fine; on the other hand, we have the upper reaches of the hierarchy, where this system breaks down and difference is let loose. As Somers-Hall elaborates:

> the terms in the hierarchy are now to be characterized in two divergent ways. In the intermediate terms, difference will descend from the identity of the genus, whereas for the highest genus, difference itself will reign, as it does not itself partake in a higher identity. (2012: 49)

And, in Deleuze's words:

> It is as though there were two 'Logoi', differing in nature but intermingled with one another: the logos of Species, […] which rests upon the condition of the identity […] of concepts in general taken as genera; and the logos of Genera, […] which is free of that condition and operates […] in the diversity of the most general concepts. (*DR*: 32–33)

The other result has to do with Aristotle's understanding of metaphysics, or of the possibility of a science of being. He commits himself to the following three claims regarding the nature and possibility of metaphysics:[79]

> (A) There is a science which investigates being as being and the attributes which belong to this in virtue of its own nature. (*Metaphysics* 1003a)

[79] These three claims are helpfully collected and cited by Somers-Hall (2012: 50).

(B) For every single class of things, as there is one perception, so there is one science, as for instance grammar, being one science, investigates all articulate sounds. Therefore to investigate all species of being *qua* being, is the work of a science which is generically one… (*Metaphysics* 1003)

(C) There are many senses in which a thing can be said to 'be'. (*Metaphysics* 1003b)

This latter claim appears to be our aforementioned first consequence—namely, that the ultimate categories are left irreducibly multiple, or that 'there are different classes of being' (Somers-Hall 2013: 28). And notice that it cannot be held in conjunction with (A) and (B) without contradiction. Thus, a knock-on effect of our above consideration of the fact that being cannot be a genus is that Aristotle faces a significant problem: namely, that of reconciling these three claims such that metaphysics *can* be made possible on his view (something he evidently thinks *can* be done).

Here Aristotle attempts to have his cake and eat it too, so to speak. That is, he attempts to conceive of being *both* as admitting of many senses, as per (C), *and* as a unifying concept, thereby allowing for (A) and (B). He does this by claiming that the aforementioned many senses in which something can be said 'to be' are 'paronymous', as opposed to 'synonymous' or 'homonymous'. As Somers-Hall observes, Aristotle opens his *Categories* with a discussion of these three terms:

> When things have only a name in common and the definition of being which corresponds to the name is different, they are called *homonymous*. Thus, for example, both a man and a picture [of an animal] are animals.
>
> When things have the name in common and the definition of being which corresponds to the name is the same, they are called *synonymous*. Thus, for example, both a man and an ox are animals.
>
> When things get their name from something, with a difference of ending, they are called *paronymous*. Thus, for example, the grammarian gets his name from grammar, the brave get theirs from bravery. (*Categories* 1a1–1a15; cited in Somers-Hall 2012: 45)

Now, our above consideration of the fact that being cannot be a genus has shown that, for Aristotle, the different senses in which things are said 'to be' cannot be synonymous. They also cannot be homonymous, on Aristotle's account, because mere homonymity does not sufficiently recover the kind of unity required for claims (A) and (B) above. Though we might group together a man and a picture of an animal, for instance, that grouping would not itself reflect any interesting, important, or essential way in which the world is organized. Such a group would instead be a mere 'heap'.[80] Thus, for Aristotle, the only remaining option is that being is paronymous, thereby allowing for the different senses of 'being' to all be genuinely different, and yet allowing for them all to remain connected to some unifying concept—as, for example, we do when we

[80] 'In the case of all things which have several parts and in which the whole is not, as it were, as mere heap, but the totality is something besides the parts, there is a cause of unity' (*Metaphysics* 1045a).

describe both the clamour of an amateur high school jazz band and random fluctuations in experimental data as ‘noise’. Thus:

> Aristotle will claim that what is really at issue in the definition of a science is not the identity of the sense through which the class is spoken, but rather the identity of the focal meaning that underlies the differing senses. (Somers-Hall 2012: 50)

Aristotle’s solution here is imperfect. With any attempt to clarify the nature of this ‘focal meaning’ or unifying concept of being, he faces the danger of just repeating the above-observed mistake of situating being as a highest genus. Consequently, as Somers-Hall argues, he must therefore place being ‘outside of the world as described by the hierarchy’ of specific difference (2012: 51), thereby invoking a kind of metaphysical transcendence.[81]

This project of making sense of the paronymy of being was inherited by Aristotle’s medieval commentators—and in particular by Aquinas, for whom paronymy takes the form of ‘analogy’. Here Aquinas is concerned with appropriately describing the relation between God and the world, especially when it appears as though the same terms can describe both. God is wise, for instance, and yet there are also (some) wise human beings. What, then, is the relation between these senses of the word ‘wise’ here? Aquinas rejects the suggestion that such sense might be synonymous (now ‘univocal’), as this would mean that human beings and God are wise *in the same sense*, which cannot be allowed: ‘it is clear that nothing can be predicated univocally of God and other things’ (1939: 148). Similarly, Aquinas rejects the suggestion that such sense might be

[81] In this respect, Aristotle’s position ends up being closer to Plato’s than he would likely want to admit.

homonymous (now 'equivocal'), as this would be to eliminate any sense of likeness or similarity between human wisdom and God's wisdom: 'Where there is pure equivocation, we observe no likeness of things, but merely sameness of name'; there *is*, however, 'some kind of likeness of things to God' on Aquinas's account (1939: 151). Thus, Aquinas argues this sense to be *analogical*:

> those things which are said of God and other things are predicated neither univocally nor equivocally, but analogically, that is according to an order or relation to some one thing. (1939: 152)

He further makes sense of this idea with his notion of 'proportion'. Thus, God and human beings *are* wise *in the same sense*, but they are so with an important proportional difference—human beings enjoying infinitesimal wisdom compared to the infinite wisdom of God.

Now, we can export this Aquinian account of analogy away from its theological framework and back into its original problematic. That is, the concept of being: 'Aquinas maintains an analogical conception of being in which various senses are proportioned to one another' (Widder 2001: 442). As Somers-Hall points out, though, this new analogical and 'proportional' machinery does not do much to help Aristotle out of his original predicament:

> We should recognize […] that this is a clarification of the notion of analogy, and its reliance on the concept of an indeterminate identity, rather than a solution to the problem of the fracture of being itself. (2012: 56)

Similarly, Widder argues that none of this new analogical machinery helps with Aristotle's problem at the *lowest* level of his hierarchy—that of the differences between individuals:

> the analogical solution does nothing to answer the question of the diversity of individuals within a species, for these are related by simple commonality and not according to any proportion: what makes Socrates this particular man does not make him more of a man than Plato. (2001: 443)

Or, in Deleuze's own words:

> It is […] inevitable that analogy falls into an unresolvable difficulty: it must essentially relate being to particular existents, but at the same time it cannot say what constitutes their individuality. (*DR*: 38)

Deleuze introduces and tracks these historical developments partly in order to showcase the extension of representation throughout the history of Western thought,[82] but also partly to identify and appropriate conceptual resources from that same history in order to combat this representationalist schema and the problems in which it is enmeshed. To recapitulate: we encountered problems with the Aristotelian paradigm of representation, problems which manifest in its inability to account for the essential character of those individuals at its lowest level and its inability to adequately make sense of its highest level, namely 'being' as such, as well as the possibility of

[82] Granted, we have hitherto only explored a brief and initial episode in this history leading from Aristotle to his medieval commentators.

metaphysics. And again, these problems all originate with a particular notion of difference as conceptual or specific difference—that is, difference as subordinated to identity. This is where we end up, on Deleuze's view, if we understand difference as (ultimately) conceptualizable in terms 'of the Same, the Similar, the Analogous and the Opposed' (*DR*: 265).

3.1.3 Alternative: Univocity and Difference

Marshalling against these problems, Deleuze proposes an alternative, drawing on the Duns Scotian thesis of the univocity of being.[83] We do not need to go into great historical or exegetical detail here; what matters is the broad schematic of Deleuze's response. Instead of treating 'being' as some overarching (and, we saw, potentially transcendent) identity, unity, or genus by means of paronymy or analogy, and instead of conceiving of a hierarchy of specific difference as somehow conveying 'proportions' of this being down to the individual level, Deleuze proposes that we conceive of being not only as univocal but as *difference-in-itself*.

This account enjoys certain advantages over the Aristotelian representationalist schema, on Deleuze's view. For instance, we saw previously that, for Aristotle (as for Aquinas) being cannot be synonymous or univocal, or a common *identity* or sense shared by all things, because it cannot be the highest genus. And it cannot be the highest genus because being so conflicts with the existence of difference. On Deleuze's account, however, being *can* be univocal, or said in precisely the same sense for everything of which it is said, because being *is* difference. That is to say, there is no

[83] Deleuze refers to Duns Scotus's *Opus Oxoniense* as 'the greatest book of pure ontology' (*DR*: 39).

need to deny the univocity of being in order to preserve or save a conception of specific difference (as we did above): 'With univocity […] it is not the differences which are and must be: it is being which is Difference, in the sense that it is said of difference' (*DR*: 39).

Deleuze's univocal-differential account of being also allows us to make sense of *individual* difference (or the lowest level of the Aristotelian hierarchy). Before, we were required to reach an arbitrary 'stopping point', so to speak, when describing the differences between things. That is to say, Aristotle's specific or 'greatest' difference is incapable of describing those irreducible differences between the individual members of a given species (Plato and Socrates, for instance). This has to do with the nature of specific difference: such difference would require a further intermediating species or identity in order to differentiate such members, and we are unlikely to accept that Plato and Socrates are members of different species—or indeed species *unto themselves*. This also has to do with a practical consideration. As Somers-Hall observes, the whole point of Aristotle's hierarchy of specific difference is to provide a way for us to speak about and understand, by means of a limited vocabulary, what are for him those infinite individual things in the world around us: 'it provides the necessary linguistic economy to allow an infinite number of things to be described using a purely finite number of terms' (2012: 44). Unless we are willing to assign to each individual *its own* concept, then, we are simply required to 'stop' at some point in our conceptual analysis: 'how can one think things that are infinite in this way? […] if we do not make a stop'? (*Metaphysics* 994b22–25). To repeat Deleuze's complaint, however, it is for precisely these reasons that such a system lacks the ability to reflect or describe those individuating differences between, for example, Socrates and Plato: 'it must essentially

relate being to particular existents, but at the same time it cannot say what constitutes their individuality' (*DR*: 38).

Deleuze provides a way of recovering and accounting for individual difference. According to the Aristotelian system, it is *species*, or *specific* difference, that carves up the world into groups of individuals who themselves *lack* difference or must remain undifferentiable in this specific sense. It is *species* that 'carry the difference', so to speak, under the broad (and, we saw, somewhat ill-defined) analogical identity of being. In other words, the Aristotelian system differentiates 'univocal', or undifferentiable, individuals by means of differentiable, or 'equivocal' species (under an ultimately analogical conception of being). For Deleuze, however, because being is now conceptualized not in terms of *identity* but in terms of the more profound notion of *difference-in-itself*, specific differences are no longer required to do this differentiating work, and so *individuals* no longer need to be organized or defined according to some shared identity or commonality of species. Individuals, that is, can retain their individual difference, or their 'equivocity', precisely because a difference-based conception of being eliminates the need for the apparatus of specific difference. This is what Deleuze is getting at when he claims: 'it is not we who are univocal in a Being which is not; it is we and our individuality which remains equivocal in and for a univocal Being' (*DR*: 39). He elaborates:

> Univocity signifies that being itself is univocal, while that of which it is said is equivocal: precisely the opposite of analogy. Being is said according to forms which do not break the unity of its sense; it is said in a single same sense throughout all its forms […]. That of which it is said, however, differs; it is said of difference itself. (*DR*: 304)

Note that Deleuze's new differential-univocal conception of being entails the collapse of the Aristotelian hierarchical system. Because things no longer need to be ordered or differentiated according to categories, genera, and species of decreasing generality, this system of organization can be 'flattened out', so to speak, thereby placing everything that *is* 'on the same level'. Nothing 'participates more or less in being, nor receives it by analogy', Deleuze writes (*DR*: 37):

> The words 'everything is equal' may therefore resound joyfully, on condition that they are said *of* that which is not equal in this equal, univocal Being: equal being is immediately present in everything, without mediation or intermediary, even though things reside unequally in this equal being.[84] (*DR*: 37)

Deleuze thus circumvents any danger of invoking a form of metaphysical transcendence—or of having to place being 'outside of the world' (Somers-Hall 2012: 51), as we were worried Aristotle might—instead conceiving of the relationship between 'being' and beings in a much more immanent way. As Widder observes:

> The univocity of being makes available an alternative distribution of difference no longer tied to the proportion marking the relation between a transcendent One and a derivative multitude… (2001: 443)

Also note that this differential-univocal account of being involves a new relational or processual understanding of reality. Strictly speaking, we ought *not* to consider putative

[84] Compare with Ladyman and Ross's claim to ontological parity in **(2.2, 5.2)**.

'individuals' as ultimately characterizable in terms of identity. Because 'being' as such is now understood in terms of difference, thereby resulting in the collapse of the Aristotelian hierarchical system and a new, immanent model according to which (to repeat) 'equal being is immediately present in everything, without mediation or intermediary' (*DR*: 37), then we ought also to understand putative 'individuals' in terms of difference. Such individuals, in other words, just *are* differences *within* self-differentiating being as such—that is, momentarily stable elements within differentiating or *individuating* processes. (Hence Deleuze's above claim that: 'Every object, every thing, must see its own identity swallowed up in difference, each being no more than a difference between differences' (*DR*: 56).) As Deleuze himself qualifies:

> when we say univocal being is related immediately and essentially to individuating factors, we certainly do not mean by the latter individuals constituted in experience but that which acts in them as a transcendental principle: as a plastic, anarchic and nomadic principle, contemporaneous with the process of individuation, no less capable of dissolving and destroying individuals than of constituting them temporarily… (*DR*: 38)

Widder parses the same point in (thankfully) plainer language:

> It is necessary to situate an originary web of difference from which individual identities both appear and dissolve. Accomplishing this would […] affirm the differences by which individuals always exceed categorization according to similarity and sameness. (2001: 446)

We have here untangled just one of the threads that run through the first chapter of *Difference in Repetition*, which is where much (though not all) of Deleuze's critique of representation takes place.[85] We observed how one particular manifestation of representation (again: identity-based thinking), this one in Aristotle's philosophy, later reflected in Scholastic philosophy, ran into its own internal problems and inconsistencies as a result of its representationalist foundations. And we recognized how Deleuze mobilizes conceptual resources from Duns Scotus in order to provide an alternative, which *prima facie* avoids such problems. He repeats this critical procedure a number of times, subjecting manifestations of representational thinking in Plato, Leibniz, and Hegel to scrutiny while drawing alternative resources from Spinoza and Nietzsche (for example).[86]

Again, Deleuze claims that the scope of representation throughout the Western tradition is expansive and near-all-encompassing, owing to its nature not as a theoretically derived and defended set of propositions, but as a pre-theoretical set of inveterate intuitions which then manifest themselves implicitly in theoretical thought: 'conceptual philosophical thought has as its implicit presupposition a pre-philosophical and natural Image of thought, borrowed from the pure element of common sense' (*DR*: 131). And indeed, Somers-Hall claims that the same kinds of problems that plague representationlist systems 'also occur through the notion of systematic ambiguity employed by Russell and Whitehead within the *Principia Mathematica*' (2012: 56).

Though we lack the requisite space to enter into any greater exegetical account of these different episodes in the history of representation here, the point is simply to recognize a key part of Deleuze's negative or critical project. On his account, problems

[85] See also the third chapter of *Difference and Repetition*, entitled 'The Image of Thought'.
[86] Again, this is just the first chapter of *Difference and Repetition*.

or inconsistencies will always arise within representationalist systems, and it is on such occasions that a more fundamental and profound—that is, non-representationalist—concept of difference reveals itself. A crucial part of Deleuze's mission, then, is to identify such instances (as we saw in our case study of Aristotle) and to expose and cultivate this more profound concept of difference—that is, to attempt to 'think difference in itself' (*DR*: xv). He writes:

> Difference must leave its cave and cease to be a monster; or at least only that which escapes at the propitious moment must persist as a monster, that which constitutes only a bad encounter, a bad occasion. (*DR*:29)

In future chapters, we will examine Deleuze's more positive or constructive elaboration of his philosophy of difference.

3.2 Transcendental Empiricism

Deleuze famously describes his philosophical position as a 'transcendental empiricism' (*DR*: 56–57). In this respect he is indebted to both Hume and Kant—both of whom, we have already seen, he wrote books about. By examining his relation to each of these figures and their own projects, we can come to appreciate another motivating and contextualizing thread for his philosophy of difference.

3.2.1 Empiricism

As Moore remarks, Hume 'introduced a kind of self-consciousness into metaphysics' (2012: 87). That is, Hume lamented the fact that, contrary to the burgeoning natural sciences of his time, metaphysics showed no real signs of progress and was instead entrenched in circuitous and overtly speculative debates about (for example) God and substance, more often than not informed by mere intuition or superstition. He writes:

> Here indeed lies the justest and most plausible objection against a considerable part of metaphysics, that they are not properly a science; but arise either from the fruitless efforts of human vanity, which would penetrate into subjects utterly inaccessible to the understanding, or from the craft of popular superstitions, which, being unable to defend themselves on fair ground, raise these intangling brambles to cover and protect their weakness.[87] (1.6)

He therefore sought to reform philosophy, and thus lend it greater scientific legitimacy, by determining some principled way of distinguishing legitimate metaphysics from illegitimate metaphysics. In other words, he sought to turn the scrutinizing attitude of philosophical cognition back upon itself (hence Moore's claim about a form of self-consciousness) in order to ascertain precisely how we acquire the knowledge we have and to discover what, if any, the limits of our knowledge acquisition might be. As Hume himself put it, he sought to 'discover the proper province of human reason' (1.7):

> It becomes, therefore, no inconsiderable part of science barely to know the different operations of the mind, to separate them from each other, to class them

[87] I cite Hume's *Enquiry Concerning Human Understanding*, collected within the Nidditch-edited *Enquires Concerning Human Understanding and Concerning the Principles of Morals* (1975), by section and paragraph number.

> under their proper heads, and to correct all that seeming disorder, in which they lie involved, when made the object of reflexion and enquiry. (1.8)

So what is this province? What criterion, according to Hume, determines the scope of legitimate knowledge and metaphysics? The answer: sense experience.

Hume distinguishes two kinds of mental object. First, there are our immediate sense perceptions and feelings—the smell of that pie on the windowsill, the sting of that papercut, and so on. Hume calls these 'impressions' (2.12). Second, there are those marks left by these impressions: our recollections or invocations of them.[88] These might include my imaginary recreation or hypothetical construction of the pie smell in my mind, for example, or my memory of an old friend's face. Hume calls these thoughts or 'ideas' (2.12). He does acknowledge our supposedly 'unbounded' (2.13) capacity for fantasy or imagination—that is, our ability to conjure images that have never been, and perhaps could never be, objects of experience (goblins, ghouls, and Gods for instance). But he nonetheless insists that such ideas are mere chimeras, cobbled together out of more basic ideas or recollections of sensory impressions:

> this creative power of the mind amounts to no more than the faculty of compounding, transposing, augmenting, or diminishing the materials afforded us by the senses and experience. (2.13)

Ideas may lack the vivacity of impressions (as in the case of hypotheticals and recollections), and they may be more abstract and fantastical (as in the case of imagined fictions), then, but just like impressions they ultimately derive from sensory experience.

[88] Moore uses the term 'imaginative anticipation' (2012: 90).

Hence Hume's empiricism: the contents of our minds (both ideas and impressions) are furnished by experience and experience alone.

Hume delineates a further distinction between two kinds of knowledge. First, we can know about 'relations of ideas' (4.20). Hume provides 'Geometry, Algebra, and Arithmetic' as the more formal or scientific examples of this type of knowledge (4.20). But we can also group more basic or particular claims such as 'all bachelors are unmarried' under this heading. Such knowledge need not be corroborated by experience; it can be demonstrated *a priori* or by the exercise of pure thought (that is, once experience has appropriately furnished us with the requisite ideas). Such knowledge also enjoys a kind of certainty or necessity, for denying such knowledge involves contradiction. It is not possible that the sum of five and seven be anything other than twelve, for instance, and we could never come across a bachelor who is married.[89] 'Matters of fact' (4.20), on the other hand, do *not* enjoy this kind of certainty. They are demonstrable only *a posteriori* and thus require experiential corroboration. For knowledge claims concerning such matters are claims about how the world happens to be and, as Hume puts it, 'Whatever *is* may *not be*' (12.132). States of affairs can always be otherwise and so cannot be guaranteed or demonstrated by thought alone but must in each instance be confirmed by our senses. 'The existence, therefore, of any being can only be proved by arguments […] founded entirely on experience' (12.132).

Thus, for Hume, there are two kinds of knowledge and only two kinds of science or inquiry that legitimately produce such knowledge. Again, according to Hume the only formal science that produces knowledge concerning relations of ideas is mathematics. 'It seems to me, that the only objects of the abstract sciences or of

[89] Hume's example: 'That the cube root of 64 is equal to the half of 10, is a false proposition, and can never be distinctly conceived' (12.132).

demonstration are quantity and number' (12.131). With respect to matters of fact, there are of course those particular knowledge claims we infer or produce throughout daily life and experience. (I know, for example, that Jeremy is ambling around the quad talking to himself because I can see him from my window.) But there are also those more general and formal knowledge claims about matters of fact produced by the natural and social sciences, based as they are on systematic experiment and observation.[90] And metaphysics, it turns out, falls into neither such category.

Consider again the writings of Hume's rationalist opponents: Descartes, Spinoza, or Leibniz. Each deals in their own way with such speculative fare as substance or God, and they do so not merely as an exercise in the relations of ideas but in order to make claims about the ultimate nature of the world—that is, about matters of fact. As we have already seen, however, claims about matters of fact must be corroborated by experience—they are subject to the 'testimony of our senses' (4.21). But neither substance nor God (barring some kind of hallucination or confused misrepresentation of events) appear to be sensible entities or objects of possible experience. According to Hume, then, such metaphysical proclamations about the nature of substance or the existence of God violate those criteria established by philosophical cognition's self-critical self-consciousness—or our enquiry concerning human understanding—and must therefore be rejected or, as he famously puts it, 'committed to the flames':

> If we take in our hand any volume; of divinity or school metaphysics, for instance; let us ask, *Does it contain any abstract reasoning concerning quantity*

[90] In Hume's time the understanding and respective developments of the different scientific disciplines was obviously different. Hence he claims that 'history, chronology, geography, and astronomy' all concern particular matters of fact, akin to our everyday 'deliberations in life', and he considers those more formal or general sciences to be 'politics, natural philosophy, physic, chemistry, &c.' (12.132).

> *or number?* No. *Does it contain any experimental reasoning, concerning matter of fact and existence?* No. Commit it then to the flames: for it can contain nothing but sophistry and illusion. (12.132)

Hume's critical project, or his aim to discover criteria that delineate legitimate from illegitimate metaphysics, therefore results in an extremely constrained empirical scepticism about the kinds of knowledge that are possible. And according to this empirical scepticism, the metaphysical efforts of Hume's contemporaries, or what he refers to as those 'airy sciences' (1.7), attempt to adjudicate on matters that either cannot be known (Hume's 'epistemic' empiricism) or simply fail to make sense (Hume's 'semantic' empiricism).[91]

3.2.2 Transcendental Idealism

To say that Kant was impressed with Hume's ideas would be an understatement. As he famously remarks in his *Prolegomena*:

[91] It is worth noting that there is debate in Hume studies surrounding whether Hume's empiricism was ultimately semantic in nature (in which case it was also epistemic), or whether it was merely epistemic (and thus allowed that the claims of metaphysicians have meaning or make sense, even if our knowing them lies in principle beyond our epistemic reach). I do not contribute to this debate. That said, it is worth noting that many adherents of the (merely) epistemic view argue that it makes better sense of Hume's *Enquiry*, which Hume himself claims better represents his '*philosophical sentiments and principles*' than does his earlier *A Treatise of Human Nature* (see the 'Advertisement' to the former). Despite their claims, however, the following passage from the *Enquiry* clearly supports the semantic interpretation: 'When we entertain, therefore, any suspicion that a philosophical term is employed without any meaning or idea (as is but too frequent), we need but enquire, *from what impression is that supposed idea derived?* And if it be impossible to assign any, this will serve to confirm our suspicion' (2.17).

> the remembrance of *David Hume* was the very thing that many years ago first interrupted my dogmatic slumber and gave a completely different direction to my researches in the field of speculative philosophy.[92] (4:260)

Kant too was dissatisfied with the lack of progress and the disrepute of metaphysics relative to the natural sciences. 'If metaphysics is a science, why is it that it cannot, like other sciences, attain universal and lasting acclaim?' (4:255).[93] And, following Hume, he also sought to discover principled criteria for determining the legitimacy and scope of metaphysics. That is, he sought to 'pose the question: "whether such a thing as metaphysics is even possible at all"' (4:255), to correct the fact that 'there are […] still no reliable weights and measures with which to distinguish profundity from shallow babble' (4:256), and to do so by means of 'critical reason' (4:259), or by once again making philosophical cognition the subject of (its own) scrutiny.

But Kant did not uncritically endorse every aspect of Hume's thought. He accepted the need for a critical re-evaluation of the possibility and legitimacy of metaphysics, and that such an examination should take the form of a self-critique of our cognitive capacities, but he did not endorse Hume's own execution of this project—referring to his conclusions as 'premature and erroneous' (4:258). Thus, though Kant regarded his own critical philosophy as a continuation of the Humean project, he nonetheless claimed to 'take it further than could the sagacious man whom one has to

[92] When citing Kant's *Prolegomena*, I adopt the convention of referencing the standard marginal paginations from the German edition of Kant's works: *Kant's Gessamelte Schriften*, edited by the Royal Prussian (and later German) Academy of Sciences (Berlin: Georg Reimer, later Walter de Gruyter & Co., 1900–). The English version I use is collected in Kant (2002).

[93] See also the start of the first *Critique*, where Kant recalls 'a time when metaphysics was called the **queen** of all the sciences', but has since become a subject of 'despise' and a 'battlefield of […] endless controversies' (Aviii). I adopt the standard citation convention for Kant's first *Critique* (2007).

thank for the first spark of this light' (4:260) and to offer a more 'complete solution of the Humean problem' (4:313).

So how precisely does Kant go about providing this greater solution to Hume's problem? And in what respect does he think Hume's own execution of this critical project goes awry? These are of course huge questions, which are indeed still very much the subject of debate.[94] I do not contribute to this discussion here, nor can I do it justice by means of extended exegesis. I will, however, gesture towards the basic contours of Kant's critical evaluation of Hume, and to the basic conceptual apparatus introduced by Kant. This will serve us in our ultimate aim (in this section) of understanding the elements of Hume's and Kant's respective philosophies that Deleuze incorporates into his own position.

First of all, then, note the way in which Kant rearticulates and specifies our initial problem by introducing a new conceptual distinction. We are already familiar with the distinction between *a priori* and *a posteriori* truths, which roughly corresponds to Hume's distinction between relations of ideas and matters of fact. Whereas the former are demonstrable through thought alone and need not be verified by experience, the latter do indeed depend upon experiential verification. For Kant, however, this distinction alone does not sufficiently capture Hume's problem. He therefore introduces a further distinction between 'analytic' and 'synthetic' judgements (or truths).[95]

This distinction can be understood in terms of conceptual containment. As Kant himself puts it:

[94] See, for example, Kuehn (1983).
[95] Though Kant uses the term 'judgement', the term 'truth' is also acceptable. On this point, see Moore (2012: 113).

> Either the predicate B belongs to the subject A as something which is (covertly) contained in the concept A; or B lies outside the concept A, though connected with it. In the former case I call the judgement **analytic**, in the latter **synthetic**. (B10/A6)

A truth that is analytic, for example, refers to some concept that is contained within some other concept, and can thus be known by reflection upon those concepts alone. That all bachelors are unmarried is, for example, an analytic truth because the very notion of 'bachelorhood' contains the concept of 'being unmarried'. Not being married is part and parcel of what being a bachelor *is*—and to claim otherwise would be to contradict oneself. Synthetic judgements, on the other hand, do not involve these containment relations. That this or that bachelor has some nationality or another, or that they do or do not own a cat, are synthetic judgements because neither 'being British', for example, nor 'cat ownership' are part of the concept of being a bachelor.

Crucially, synthetic knowledge is *ampliative*. When I arrive at a truth that is synthetic, I learn something new about the subject of my inquiry—or about the way the world is. For example, that this particular bachelor is British or that they do not own a cat. Analytic knowledge, on the other hand, is merely *explicative*; it does not (strictly speaking) yield new information. When I reflect on the notion of 'bachelorhood' and determine that all bachelors are unmarried, I do not learn something new; I merely clarify *what it is* to be a bachelor and so consolidate my understanding of information I already possess.

For Kant, the question of whether there can be legitimate metaphysics becomes a question about how these two distinctions—that between *a priori* and *a posteriori* truths, and that between analytic and synthetic truths—relate to one another. More

specifically, it becomes the question of whether there can be synthetic truths that are known *a priori*. For recall that metaphysics, in the language of Hume, supposedly affords us knowledge about matters of fact—or about the state or nature of the world—by *a priori* means, or merely by relating ideas to one another. In the more precise technical vocabulary of Kant:

> **Metaphysics** […] is meant to **contain synthetic *a priori* knowledge**. Its main concern is not at all merely to analyse concepts which we form *a priori* of things, and thus to elucidate them analytically, but to expand our knowledge *a priori*. (B18)

Thus, for Kant, the guiding question of critical philosophy becomes: '**How are synthetic judgements *a priori* possible?**' (B19).

Now, if we were to anachronistically attribute this terminology to Hume, we might parse him as claiming that no such knowledge is possible. No truth can be known *a priori* that is not also analytic, on his account. And likewise all synthetic truths are known *a posteriori*. These being the only two classes of knowledge, any supposed science or form of inquiry that claimed to produce synthetic truths *a priori*—that is, without some suitable grounding in experience—ought to be committed to the flames.

Consider, for example, the canonical illustration of causation. That 'everything that happens has some cause' is a statement that cannot be derived from experience alone, since experience can merely tell us what *is* and not what *must be*. As Kant observes: 'It cannot be experience' that justifies this claim, because such a claim possesses a 'greater generality' and 'the character of necessity', and so is 'therefore entirely *a priori* and [derived] from mere concepts' (B13/A9). Similarly, though, such

a claim cannot be derived analytically, since there is no containment relation that obtains between the concept of a happening and the concept of a cause. 'But the concept of a cause is entirely outside that concept and indicates something different from that which happens; hence it is in no way contained in that representation' (B13/A9). Thus, metaphysical claims about the causal nature of the world are candidate claims concerning synthetic *a priori* knowledge.

In keeping with his empirical scepticism, Hume famously rejects the possibility of knowledge claims concerning causality. He explains that we naturally arrive at claims about causation by means merely of the 'association of ideas' (3.18–19) or by 'customary conjunction' (5.38). That is to say, when certain impressions appear in conjunction with one another with some degree of regularity, we infer patterns or causal connections between those impressions. Such inferences may be entirely natural, and indeed, as Hume remarks, our cognitive capacities may be structurally inclined towards such inferences: 'It is an operation of the soul, when we are so situated, as unavoidable as to feel the passion of love, when we receive benefits; or hatred, when we meet with injuries' (5.38). And yet, we must refrain from thinking that such inferences constitute anything greater than habitual or customary extrapolations—such as claims about the way the world is—precisely because they fail to qualify as one of our two possible classes of knowledge. We ought not to regard causation as something that is *in* the world, Hume argues, because claims to this effect either cannot be known (again, this is Hume's epistemic empiricism) or simply have no meaning (Hume's semantic empiricism). Kant summarizes Hume's position succinctly:

> he concluded that reason completely and fully deceives herself with this concept [causation], falsely taking it for her own child, when it is really nothing but a

> bastard of the imagination, which, impregnated by experience, and having brought certain representations under the law of association, passes off the resulting subjective necessity (i.e., habit) for an objective necessity (from insight).[96] (4:257–58)

So how (and why) does Kant recover the possibility of synthetic *a priori* knowledge? First, note that Kant does in fact think that there are clear instances of synthetic *a priori* knowledge. These include claims from mathematics, geometry, the natural sciences,[97] and indeed the domain of practical reason or ethics. Most would agree, for instance, that mathematical truths are known and justified *a priori*. That 7 + 5 = 12, to adopt Kant's own example, requires no experiential justification. And indeed, Kant admits, we might readily suppose this to be an analytic truth—especially since denying this sum seems to involve contradiction. Nonetheless, he insists that this is a synthetic truth, for the concept of the combination of '7' and '5' is *just that*, on his account, and so does not itself contain the further concept of '12':

> But if we look more closely we find that the concept of the sum of 7 and 5 contains nothing beyond the union of the two numbers into one, whereby nothing is being thought as to what this single number may be which combines both. (B15)

In the first instance, then, Kant simply denies Hume's claim that there are only two classes of knowledge. But how, then, is this third class of knowledge possible? This is

[96] See also (B127) of his first *Critique*.
[97] For Kant's examples from mathematics, geometry, and the natural sciences, see (B14–19).

where Kant makes perhaps his most significant contribution to the history of philosophy, for he supposes that the best way to make sense of this possibility is to completely reconceptualize the relationship between the objects of cognition and cognition itself:

> Hitherto it has been supposed that all our knowledge must conform to its objects. But all attempts to establish something about them *a priori* by means of concepts, and thus to expand our knowledge, have on this supposition come to nothing. We should therefore attempt to tackle the tasks of metaphysics more successfully by assuming that the objects must conform to our knowledge. (Bxvi)

This is Kant's transcendental idealism. Whereas Hume and others suppose that our cognition and experience of the world is direct, immediate and passive, Kant supposes that we, *in the very acts of experience and cognition*, mould or structure the objects of such acts in a particular way.[98] To adopt the canonical illustration, it is as though, for Kant, we were equipped with a pair of internal spectacles, which condition the world of our experience and the objects of our knowledge. These 'spectacles' thus afford us two kinds of synthetic knowledge. As Moore observes:

> We can look through them at the world and see how the world actually appears through them. Or we can reflect on the spectacles themselves and draw conclusions about how the world *must* appear through them. (2012: 125)

[98] Referring specifically to Hume, for instance, Kant claims that 'it never occurred to him that possibly the understanding itself might […] be the author of that experience in which its objects are found' (B127).

The former is an example of straightforward synthetic *a posteriori* knowledge. The latter, however, is derived from *a priori* reflection. Kant's 'transcendental' philosophy therefore becomes a kind of 'meta-knowledge', or an *a priori* synthetic study of the conditions and limits of experience or knowledge of this more straightforward synthetic *a posteriori* kind. 'I call all knowledge **transcendental** which deals not so much with objects as with our manner of knowing objects insofar as this manner is to be possible *a priori*' (B25/A11–12).

With respect to our candidate synthetic *a priori* statement concerning causation, then, Kant explains its possibility by arguing 'causation' itself to be one of the key conceptual features of our innate spectacles—otherwise referred to as 'categories' or 'pure concepts of the understanding'.[99] That is to say, we can know that each and every object of possible experience *must* have a cause precisely because *we* endow all of our experience with a casual structure. 'I therefore have quite good insight into the concept of cause, as a concept that necessarily belongs to the mere form of experience' (4:312). Transcendental philosophy therefore gives rise to the project of deriving and articulating each of these categories—of which Kant identifies twelve (B106/A80). This is how he claims to solve Hume's problem:

> This complete solution of the Humean problem, though coming out contrary to the surmise of the originator, thus restores to the pure concepts of the understanding their *a priori* origin… (4:313).

[99] In addition, that is, to the pure forms of intuition (namely space and time).

Whereas Hume denounces the possibility of legitimate metaphysics, instead embracing a wholesale scepticism towards any such metaphysical claims, Kant delineates a not-insignificant domain in which metaphysical—or synthetic *a priori*—claims *can* be advanced and known. Importantly, though, Kant does retain a degree of Humean scepticism. For, according to his transcendental *idealism*, we can know only about appearances (straightforward synthetic *a posteriori* knowledge) and their necessary structure (synthetic *a priori* knowledge).[100] We cannot, therefore, go *beyond* appearances and glean knowledge of the world as it is in itself—or we cannot remove our categorial spectacles. Thus, whereas knowledge for Hume is restricted, as Kant puts it, to the 'limits of experience' (B127), it is for Kant restricted, slightly less so, to the limits of *possible* experience.

Kant therefore rejects only what he refers to as 'transcendent' metaphysics—that is, metaphysics that goes beyond the limits of possible experience. He is happy to entertain claims about the causal nature of the world (of appearances), for instance, but he denies that we can legitimately extrapolate from these notions the idea of, say, an ultimate cause that is not itself caused (God, for example). Ideas of this sort are a 'transcendental illusion', on Kant's account, and a substantial part of his *Critique of Pure Reason*—namely, the 'transcendental dialectic'—is dedicated to identifying and exposing these illusions (see B88/A63–64). Note, however, that Kant does not set out to *eliminate* such illusions. Like Hume, then, he thinks that reason is structurally inclined to exert itself beyond its domain of legitimate application. As he remarks in the very first sentence of the *Critique of Pure Reason*:

[100] In addition, that is, to whatever we know analytically.

> Our reason has the peculiar fate that, with reference to one class of its knowledge, it is always troubled by questions which it cannot ignore because they are prescribed by the very nature of reason itself, and which it cannot answer because they transcend the powers of human reason. (Avii)

One of the points of transcendental philosophy, then, is to continually ward off such overextensions—for they cannot be eliminated altogether.

3.2.3 Transcendental Empiricism

The above examination was made necessary by Deleuze's intimate philosophical relationships with both Hume and Kant. We are now in a position to examine these relationships.

As already indicated, Deleuze's first book—*Empiricism and Subjectivity*, originally published in 1953—was a study of Hume. In the preface to its English translation, Deleuze provides a brief list of what he considers to be Hume's most significant contributions to the history of philosophy. Chief among them is the same turn toward philosophy's own (self-)critical self-consciousness described above:

> He asked about the conditions which legitimate belief […]. The consequences are important: […] thought has fewer reasons to defend itself against error than against *illusion*. Illegitimate beliefs perhaps inevitably surround thought like a cloud of illusions. In this respect, Hume anticipates Kant. An entire art and all sorts of rules will be required to distinguish between legitimate beliefs and the illusions which accompany them. (*ES*: ix)

Deleuze's own transcendental empiricism can be understood as a continuation of this Humean and Kantian critical project. Importantly, though, it is also a reconceptualization of it.

Deleuze embraces Hume's reorientation of philosophical cognition towards its origins in experience. He describes his own empiricism as a 'science of the sensible' that seeks to 'apprehend directly in the sensible that which can only be sensed' (*DR*: 56–57). Nonetheless, he refuses to constrain himself to the more conventional or traditional definition of empiricism with which we may be more familiar. For instance, he does not endorse the claim that 'all knowledge is derived from experience' exhausts or adequately reflects the spirit of the empiricist project. To be clear: this is not to say that he *denies* that all knowledge derives ultimately from experience; it *is* to say that he thinks this claim leaves something out. And this something is the *extent* of the critical attitude exhibited by Hume's empiricism, on Deleuze's account.

Ordinarily, we might think of experience as the experience *of* a subject—or as given *to* an experiencing subject. And indeed, it certainly *feels* or *seems* as though each and every one of my experiences is precisely that—*my* experience. Deleuze, however, regards an understanding of empiricism based on this kind of intuition as simple or crude. 'Empiricism is by no means a […] simple appeal to lived experience' (*DR*: xx), he writes in the preface to *Difference and Repetition*. And indeed, in his final essay, 'Immanence: A Life…', Deleuze contrasts his own transcendental empiricism with a 'simple empiricism' based entirely on 'the element of sensation' (1997: 3)—based, that is, entirely on lived experience, or experience *as experienced*.

Why does Deleuze take issue with this 'simple' empiricism? Well, precisely because the intuition on which it is based presupposes the experiencing subject. And, as Moore remarks:

> no position that deserves the title 'empiricism' can acknowledge a sense-maker that is not just as much within 'the given', or the immanent, as the data of sense experience themselves. (2012: 551–52)

A properly critical empiricism, according to Deleuze (himself inspired by Hume),[101] must encompass and explain not only the limits and scope of one's knowledge and experience, but the very subject of such knowledge and experience itself. As Deleuze himself writes:

> This subject who invents and believes is constituted inside the given in such a way that it makes the given itself a synthesis and a system. This is what we must explain. In this formulation, we discover the absolute essence of empiricism. (*ES*: 87)

Empiricism, in other words, must explain the subject as something not external to given experience but as generated or produced *within* the given, or by the machinery of experience itself. It is therefore this more primordial—or this more immediate and subject-generating—form of experience that Deleuze insists must be the focus of empiricism proper:

[101] For Hume on this issue, see his *Treatise* (I.IV.§VI).

> We must begin with *this* experience because it is *the* experience. It does not presuppose anything else and nothing else precedes it. It is not the affection of an implicated subject, nor the modification or mode of a substance. (*ES*: 88)

Another way in which Deleuze expresses this reconceptualization of ordinary or simple empiricism is by insisting that we investigate the *conditions* of experience—that is, those conditions of the kind of experience that is the subject of 'simple' empiricism. In his book on Bergson, for example, he argues that we must 'go **beyond** experience, toward the conditions of experience' (*B*: 23) in order to constitute a 'superior empiricism' (*B*: 30).

Now, with this talk of 'conditions of experience', Deleuze has in mind a 'transcendental analysis' (*B*: 23) of the kind exhibited by Kant above. He does not endorse Kant's transcendental *idealism*, however, for precisely the same reason that he does not endorse 'simple' empiricism. That is, Deleuze refuses to locate the conditions of experience within the pure concepts and forms of intuition of a transcendental *subject*. As Voss elaborates (and alluding to another critique of representation):

> While Kant locates the ground of our represented world in universal reason or the transcendental subject, Deleuze admits no transcendental subject that would represent the world but seeks a point of view *beyond* representation, that is an a-subjective and unconscious transcendental field. (2013: 2)

Indeed, and on this very point, Deleuze criticizes Kant for not going far enough in his own critical mission to reject 'transcendent' metaphysics. Recall that, for Kant, legitimate metaphysics (or any legitimate claim to synthetic *a priori* knowledge) is

constrained by the limits of possible experience. Once we entertain claims that *transcend* what can be experienced, or that have nothing to do with the necessary structure of experience itself, then we have entered into a domain of which we can have no knowledge whatsoever. Thus, when it comes to adjudicating between illegitimate and legitimate metaphysics, Kant is concerned with rejecting transcendence and with preserving immanence (where 'immanence', for Kant, refers to the domain of possible experience):

> All principles the application of which is entirely confined within the limits of possible experience we shall call **immanent** principles; those, on the contrary, which tend to transgress these limits, **transcendent** principles. (B352/A295–96)

Deleuze inherits his own career-long preoccupation with immanence and transcendence from Kant.[102] Nonetheless, he (with Guattari) claims that, by rendering immanence immanent *to* a transcendental subject, or the so-called 'transcendental unity of apperception',[103] Kant in fact preserves the very kind of transcendence he aimed to eliminate:

> Kant discovers the modern way of saving transcendence: this is no longer the transcendence of a Something, or of a One higher than everything (contemplation), but that of a Subject to which the field of immanence is only

[102] Immanence is a prominent theme in *Empiricism and Subjectivity*, just as it is in Deleuze's very last essay, 'Immanence: A Life…'.
[103] 'It must be **possible** for the **I think** to accompany all my representations: for otherwise something would be represented within me that could not be thought at all, in other words, the representation would either be impossible, or at least would be nothing to me' (B131–32).

> attributed by belonging to a self that necessarily represents such a subject to itself (reflection). (*WP*: 46)

And, as Deleuze and Guattari insist:

> Immanence is immanent only to itself and consequently captures everything, absorbs All-One, and leaves nothing remaining to which it could be immanent. In any case, whenever immanence is interpreted as immanent *to* Something, we can be sure that this Something reintroduces the transcendent. (*WP*: 45)

Thus, in order to reject transcendence, not only do we need to reorient philosophical cognition towards immanence or experience, but we must also bracket our more commonsensical notion of experience as the experience *of* a subject. Experience may be structurally inclined towards alluding to such a subject, but Deleuze insists that a properly critical philosophy must undercut, accommodate, and explain this allusion according to some more basic principles. This is the meaning of a properly critical empiricism, and indeed of a properly empirical critique, on Deleuze's view: 'The critique is empirical when, having situated ourselves in a purely immanent point of view, […] we ask: how is the subject constituted in the given?' (*ES*: 87). This, in other words, is the meaning behind Deleuze's *transcendental* empiricism.

Note that it is Deleuze's commitment to immanence, and his consequent dissociation of the transcendental from a putative transcendental subject, that allows him to retain his self-proclaimed status as 'pure metaphysician' (2007: 42). Though he embraces Hume's critical call to derive knowledge from experience alone, and though he takes up Kant's call to investigate the transcendental conditions for such experience,

he nonetheless refuses to locate either within an experiencing subject—instead locating them, as we saw from Voss, within an 'a-subjective and unconscious transcendental field' (2013: 2). The conditions of experience, then, no longer describe the structuring influence *of* a transcendental subject (by means of pure concepts of the understanding and forms of intuition, on Kant's view), thereby resulting in the relevant anti-realist or constructivist restrictions upon one's metaphysics. Instead, the transcendental conditions of experience—themselves belonging 'neither […] to an object nor […] to a subject' (Deleuze 1997: 3)—describe those underlying processes through which both objects and subjects of experience arise, thereby accounting not merely for the world *of* experience but for the *experienceable* world as such.[104]

That Deleuze does in fact aim to recover a kind of metaphysics beyond the limits of that restricted anti-realist or constructivist domain described by Kant is evidenced by his claim, purposefully articulated in Kantian language, that: 'Difference is not phenomenon but the noumenon closest to the phenomenon' (*DR*: 222). See also his approving citation of Bergson, who also seeks to 'unmake' the Kantian fracture between the world of our experience and the experienceable world as such in an effort, he writes, to 'recover contact with the real' (Bergson 2004: 216):

> there is a last enterprise that might be undertaken. It would be to seek experience at its source, or rather above that decisive *turn* where […] it becomes properly *human* experience. (Bergson 2004: 216; cited in *B*: 27)

[104] See Bell (2011) for an account—which takes a slightly different line than the one presented here—of Deleuze in relation to realism and anti-realism.

Note that Kant, like Aristotle before him, is for Deleuze caught up in a representationalist schema.[105] 'It is impossible to maintain the Kantian distribution, which amounts to a supreme effort to save the world of representation' (*DR*: 87). And we have already seen why, broadly speaking, this is the case. Kant 'discovers the modern way of saving transcendence', recall, by attributing immanence or experience *to* a transcendental subject (*WP*: 46). In other words, he means to make sense of experience by appealing to an ultimate *identity*—namely, the transcendental unity of apperception, which ensures the 'thoroughgoing identity' of my experience, or its attributability '**to me**' (B133–34). And, in so doing, he invokes the kind of transcendence that should be rejected by a properly immanent (and indeed transcendental) philosophy on Deleuze's account.

Now, the details of this particular critique of representation in Kant have to do with his notion of 'synthesis'. As Deleuze intimates: 'here, synthesis is understood as active and as giving rise to a new form of identity in the I, while passivity is understood as simple receptivity without synthesis' (*DR*: 87). In essence, and again broadly speaking, Deleuze's claim is that Kant assumes that the kinds of syntheses that unify and structure experience must be 'active'—that is, attributable to the *activity* of a subject. In short: my experience seems to be unified (because it is *my* experience), and so there must be *something* (the transcendental unity of apperception) *outside* of experience that does this unifying work. In the second chapter of *Difference and Repetition*, however, Deleuze aims to show that 'passive' syntheses are possible and that such syntheses are responsible for the constitution of the subject (and the world as such). As Somers-Hall renders explicit:

[105] 'Kant's transcendental philosophy […] is liable to repeat the mistakes Deleuze finds in traditional metaphysics' (Somers-Hall 2013: 56).

> By explaining how subjects come into being, Deleuze also aims to show why it is that philosophers have been misled into believing in something like a Kantian account of the constitution of the world that presupposes rather than explains the existence of subjects. (2013: 57)

In doing so, Somers-Hall points out, Deleuze provides 'a "Humean" deduction of how the world is constituted that does not rely on a subject' (2013: 57)—hence, again, Deleuze's status as 'pure metaphysician' (2007: 42).

It is not, however, *this* particular critique of representation in Kant's philosophy that we will examine next. Deleuze makes another complaint about Kant's transcendental project, and in particular regarding his notion of a transcendental 'condition'. Examining *this* complaint will help us to introduce the important Deleuzean notion of the 'virtual'.

3.2.4 Possibility and Virtuality

We saw above how, for Hume, legitimate knowledge claims are restricted, in Kant's words, to the 'limits of experience' (B127). We then saw how, for Kant, such claims enjoy (slightly) wider purview within the limits of *possible* experience, thereby allowing some (albeit modest) latitude for metaphysics. In essence, Deleuze rejects Kant's emphasis on the conditions for the *possibility* of experience.[106] When, in his

[106] For the sake of space and accessibility, I reconstruct Deleuze's arguments here largely independently of any of his engagements with other figures. Note, though, that Deleuze critiques Kant on several fronts and by appeal to many figures. One such figure, for instance, is the lesser-known Kant critic Solomon Maimon. Regarding his influence on Deleuze, see Jones (2009) and Smith (2012: 59–71).

book on Bergson, he insists that a 'superior empiricism' (*B*: 30) must go *beyond* experience in favour of a 'transcendental analysis' (*B*: 23) of its conditions, he immediately rejects the (quite natural) supposition that what interests him are conditions of possibility:

> We go **beyond** experience, toward the conditions of experience (but these are not, in the Kantian manner, the conditions of all possible experience: They are the conditions of real experience). (*B*: 23)

The Kantian emphasis on conditions of 'possibility', and indeed the modal notion of possibility itself, Deleuze argues, is once again rooted in a representationalist schema that invokes a form of transcendence and ought thus to be rejected by a properly critical (and therefore necessarily immanent) philosophy.

Before we examine the reasons for this claim, it is necessary to recognize two important terminological distinctions that operate in Deleuze's philosophy: that between the 'possible' and the 'real', and that between the 'virtual' and the 'actual'. Deleuze inherits these distinctions from Bergson, writing that

> We must take this terminology seriously: The possible has no reality (although it may have an actuality); conversely, the virtual is not actual, but ***as such possesses a reality***. (*B*: 96)

We can begin to understand these distinctions by contrasting them with the perhaps more conventional distinction between the 'possible' and the 'actual' in the analytic tradition. According to the analytic metaphysician of modality, the actual denotes what

is whereas the (merely) possible denotes only what *could be*.[107] In the more precise vocabulary of possible worlds, the actual picks out *our* world whereas the (merely) possible picks out the rest.[108] Thus, there is a possible world in which there is a retired racing greyhound spread out across my floor, but (alas) *that* world is not *this* world, and so Merlin remains a mere possibility; he is *not* an actuality. For Deleuze, however, the term 'actual' has no modal significance. It simply denotes individuated objects or states of affairs—that is, individuals with discrete identity profiles. Thus, for Deleuze both the possible dog *and* the actual dog (in the contemporary analytic senses of these terms) are actual (in Deleuze's sense).[109] Hence his above claim that the possible 'may have an actuality' (*B*: 96). (And indeed, we will see that it is for precisely this reason that Deleuze eliminates the notion of the possible from his conceptual lexicon.)

What analytic metaphysicians of modality mean by 'actual' is included in, though does not necessarily exhaust, what Deleuze means by 'real'. The real for Deleuze is just what actually (in the analytic sense) and unequivocally *is*—namely, the sensible world or immanence as such. The real excludes for Deleuze anything that is not part of this domain, including putative transcendent entities such as God, Platonic Forms, and Lewisian possible worlds.[110]

I qualify 'does not necessarily exhaust' here because some analytic philosophers, including ontic structural realists, attempt to incorporate accounts of modality—that is, accounts of that in virtue of which things could be otherwise—*into* their accounts of the actual (in the analytic sense) world. As Ismael observes (within a philosophy of science context):

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[107] The qualification 'mere' is necessary as what is actual is also necessarily possible.
[108] Lewis is a paradigm figure of possible worlds (1986).
[109] Rather than simply cast one idiom in terms of the other, I simply qualify these terms when necessary. This seems the most appropriate way to avoid both confusion and falsification.
[110] For more (and slightly different) encounters between Deleuze and Lewis, see Moore (2012: 414–19), who studies this encounter through Bergson, and Williams (2005: Ch.6).

> there is among many a desire to reject metaphysical commitment to non-actual, possible worlds. To satisfy that desire while preserving scientific practice, one needs an account of modality that makes modality *immanent* in the actual world…[111] (2017: 109; my emphasis)

See also Vetter (this time in a more general context):

> Anyone who does not either deny modally loaded facts about the world, or outsource them to real other worlds—anyone, that is, who thinks that counterfactual or law-like, counterfactual-supporting statements are true in virtue of something in the actual world—has to include unrealized possibilities *in* actuality. (2009: 6; my emphasis)

Deleuze is sympathetic to this mission, which is precisely why he introduces his concept of the 'virtual' and why he describes it as '*fully real*' (*DR*: 208) (or 'actual' in Ismael and Vetter's sense). That is, in virtue of his twofold concern with articulating a philosophy *of immanence* and a metaphysics *of difference*, he (much like the contemporary philosopher of science) seeks to articulate a form of immanent objective modality that explains both the regularities we observe in the world as well as how things could be otherwise.[112] And yet, and as we indicated at the start of this subsection, he thinks that such an account requires that we abandon the notion of the 'possible'

[111] Ismael's choice of the word 'immanent' here is, for by now hopefully obvious reasons, extremely fortuitous.
[112] I revisit and further emphasize this point in my critique of Patton **(5.1)**.

altogether and instead replace it with his notion of the 'virtual'. We are now in a position to see why this is the case.

Recall the isomorphism observed by Deleuze between the possible and the actual. Just as the actual is (typically) experienced and conceived as a domain of individual entities, so too is the possible. And indeed such isomorphism just seems to be a prerequisite for our making sense of the possibility of things. How else, after all, would I be able to tell that *this* particular (initially mere) possibility had now become a reality if the (mere) possibility and the actuality or reality were not identical or did not resemble one another in some important respect? As Kant himself puts the point in his canonical example, one hundred 'actual' thalers 'does not contain the slightest bit more' than, or can be no different from, the 'mere concept' or *possibility* of one hundred thalers, for otherwise 'what exists would not be the same as was thought in the concept' (B627–28/A599–600). On Deleuze's account, however, such isomorphism serves to condemn the possible. For consider the following question:

> What difference can there be between the existent and the non-existent if the non-existent is already possible, already included in the concept and having all the characteristics that the concept confers upon it as a possibility? (*DR*: 211)

That is, assuming such isomorphism, what difference can there be between a thing and its mere possibility? There evidently *is* such a difference, because I do not currently feel the joy and contentment that would follow from an actual retired greyhound lounging in my vicinity. Or, as Kant famously quips: 'In my financial position, no doubt, there exists more in the case of one hundred actual *Talers* than in the case of their mere concept (that is, their possibility)…' (B627/A599). So how do we account for this

difference? Only by positing a difference in ontological or existential status, on Deleuze's account.[113] The merely possible must be understood as the actual or real 'minus' its actuality or reality, so to speak—or the possible must be conceived as 'open to "realisation"', in Deleuze's words (*DR*: 212). And thus, in so far as we might be concerned with articulating an account of objective modality, we are forced to conceive of an unbridgeable gap between the possible and the actual or the real—in other words, transcendence. Whether it be through some putatively real (though transcendent) Platonic or logical space, some Lewisian possible world, or some encoding of all possible experience within some experience-structuring cognitive framework, any conceptual machinery developed to make sense of the obvious *difference* between (mere) possibility and actuality or reality, while also assuming their isomorphism or *resemblance* to one another, will inevitably result, for Deleuze, in some commitment to transcendence.

Again, note that the ultimate problem here is the *representationalist* assumption that the possible—or otherwise our appropriate modally informed description of the *conditions* of experience or of things—*resembles* or inherits its basic structure from the actual (in both its analytic and Deleuzean senses). That is, the actual world of ordinary experience is one of individual entities and states of affairs, and so we naturally model the possible in these same terms, thereby running into the difficulties just encountered: 'Such is the defect of the possible: a defect which serves to condemn it as produced after the fact, as retroactively fabricated in the image of what resembles it' (*DR*: 212). Accordingly, Deleuze accuses Kant of 'tracing […] the transcendental from the empirical' (*DR*: 143):

[113] 'Possibility is therefore distinguished from actuality in terms of existence' (Somers-Hall 2013: 152–53).

> Contrary to Kant's belief, it [the transcendental] cannot be induced from the ordinary empirical forms in the manner in which these appear under the determination of common sense. (*DR*: 143)

Another problem with this representationalist schematic of transcendental conditions as conditions *for possibility*, on Deleuze's view, is that it leaves us unable to account for transformation or change. On this schema, the modal or counterfactual 'potency', so to speak, of the actual or the real is stripped away, having been outsourced to some other transcendent domain. Thus, a thing's *coming to be*, or its shift from mere possibility to actuality or reality, can only be conceived as some instantaneous 'flip' in existential status. A thing, in other words, can only ever *obtain* or *not*, the representationalist schema allowing no latitude for becoming or difference:

> Every time we pose the question in terms of possible and real, we are forced to conceive of existence as a brute eruption, a pure act or leap which always occurs behind our backs and is subject to a law of all or nothing. (*DR*: 211)

Once the possible is 'arbitrarily extracted from the real like a sterile double', in other words, 'we no longer understand anything either of the mechanism of difference or of the mechanism of creation' on Deleuze's account (*B*: 98).

Deleuze's solution to both representationlist problems—that is, the invocation of transcendence and the inability to adequately describe change—is to abandon the assumption that conditions ought to *resemble* that which they condition and, importantly, to reconceive of conditions as playing an immanent, *genetic* role or as

literally *producing* that which they condition: 'In fact, the condition must be a condition of real experience, not of possible experience. It forms an intrinsic genesis, not an extrinsic conditioning' (*DR*: 154). Deleuze does this precisely by introducing a new, difference-based modal concept called 'virtuality'.

Thus, for Deleuze, it is no longer *possibilities* that are 'realized' but *virtualities* that are 'actualized'. The virtual is *different in kind* from the actual on Deleuze's account: it 'breaks with resemblance as a process no less than it does with identity as a principle' (*DR*: 212). It is thus *this* difference in kind that accounts for that previously acknowledged difference between some actuality and its mere potential, rather than any representation-influenced and transcendence-invoking difference in existential or ontological status.[114] This is why Deleuze claims above that 'the virtual is not actual, but ***as such possesses a reality***' (*B*: 96), or that '*The virtual is fully real in so far as it is virtual*' (*DR*: 208). Both the virtual and the actual count as real (or actual, in the analytic sense), and so virtuality is Deleuze's way of immanentizing his account of transcendental conditions or objective modality—or his way of 'bringing the condition back to the conditioned so that no distance remains between them' (*B*: 30).

Consequently, Deleuze is able to attribute to the world genuine modal or counterfactual potency, which is to say that he can describe change or transformation without appealing to the mere and mysterious 'brute eruption' or 'realisation' of the possible (*DR*: 211). Actualities arise *out of* virtual processes of actualization, and actual change is ultimately explicable, for Deleuze, in terms of the vicissitudes of the virtual.

Obviously, a positive account of this modal metaphysics of difference remains to be sketched—this will be done in the next chapter **(4.2)**. To anticipate, though,

[114] I use the word 'potential' here because, as we have already observed, 'possibilities' are for Deleuze ineliminably conceived as individual entities or states of affairs, and so thus entail all the problems just surveyed.

Deleuze recruits various mathematical resources in order to make sense of (i) the fundamentally differential nature of the world, and (ii) the way in which fundamental or virtual difference determines or actualizes itself into the familiar and actual world of our experience. He adopts many vocabularies, but in some instances (again, drawing on resources from mathematics) he describes the specification or articulation of the virtual in terms of 'differentiation' and the actualization of the actual *out of* the virtual as 'differenciation'. Thus:

> We call the determination of the virtual content […] differen*t*iation; we call the actualisation of that virtuality into species and distinguished parts differen*c*iation. (*DR*: 207)

The emergence of the actual, as well as change or transformation within the actual, can therefore be tracked and described in terms of these differentiating and differenciating processes on Deleuze's account. 'The actualisation of the virtual […] always takes place by difference, divergence or differenciation. […] In this sense, actualisation or differenciation is always a genuine creation' (*DR*: 212). It is 'genuine creation' because we are no longer committed to a resemblance-based model of the abrupt appearances or flips in existential status of qualitatively identical copies. There are no actual or individual 'possibilities', however one makes sense of this notion, pre-existing their realization. Rather, since there is a difference in kind between the virtual and the actual, processes of actualization always create genuinely new forms or kinds of things: 'Evolution takes place from the virtual to actuals. Evolution is actualization, actualization is creation' (*B*: 98).

Again, we examine a more positive account of Deleuze's metaphysics of difference in the next chapter. Here, the point has been to recognize the ways in which Deleuze is influenced by the critical projects of Hume and Kant, as well as those ways in which he diverges from and integrates their respective positions. Deleuze is a 'transcendental empiricist' in so far as he seeks to determine and describe the immanent, virtual conditions for the actual world of experience—and reading him in conjunction with philosophers such as Ismael and Vetter, or with ontic structural realism in mind, helps us to parse his metaphysics of modality in this more helpful way. He advocates an *immanent* objective modality (one encoded within the actual world), and this modality is *primitive* on his account (in so far as it is essentially differential and difference is for him fundamental). (These are claims that we revisit in **(5.1)**.)

3.3 The Metaphysics Science Needs

Deleuze refers to himself as a 'very classical' philosopher (2010: vii) and a 'pure metaphysician' (2007: 42). In this respect, he distances himself from many of his 'continental' influences and 'postmodern' contemporaries. Unlike Heidegger or Derrida, for instance, Deleuze refuses to see metaphysics as something that needs to be eliminated or overcome. As Deleuze and Guattari make clear in their *What is Philosophy?*: 'the death of metaphysics or the overcoming of philosophy has never been a problem for us: it is just tiresome, idle chatter' (*WP*: 9). Indeed, not only does Deleuze think that metaphysics remains a viable and worthwhile pursuit (albeit somewhat reconceptualized with a new notion of fundamental difference at its core), but he also ties philosophy and metaphysics to science in a way that further distinguishes him from

the perceived science-sceptic or science-critical attitudes of his 'continental' and 'postmodern' contemporaries.

We have already observed, for instance, that many of Deleuze's philosophical writings are riddled with references to mathematics and the sciences **(3.0)**. And, in the preface to the English translation of *Difference and Repetition*, he claims explicitly that 'Philosophy cannot be undertaken independently of science' (*DR*: xvi).[115] 'It is very difficult', he elaborates, 'since philosophy obviously cannot claim the least superiority, but also creates and expounds its own concepts only in relation to what it can grasp of scientific functions' (*DR*: xvi). Philosophy 'is not obliged to advance […] science', he continues, 'but it can advance itself only by forming properly philosophical concepts from a given [scientific] function' (*DR*: xvi).

Note also Deleuze's oft-cited statement of interest in 'the metaphysics science needs'. In an exchange with Villani, he claims:

> I feel that I am Bergsonian—when Bergson says that modern science has not found its metaphysics, the metaphysics it needs. It is that metaphysics that interests me.[116] (2007: 41)

Now, we can see why those who emphasize Deleuze's scientific engagements might appeal to this claim in order to support their interpretive approach—as, for example,

[115] Note that the unabridged sentence here reads: 'Philosophy cannot be undertaken independently of science or art' (*DR*: xvi). That is, Deleuze also insists upon a key relationship between philosophy and art—and each of the subsequently cited passages from this preface include allusions to this relationship. Though Deleuze's aesthetics is a relevant and related issue here, I do not address it directly. Instead, I focus on explicating the interpretative issues surrounding his account of the relationship between philosophy and science. It seems to me that this explicative work is necessary in order to *then* investigate how Deleuze's metaphysics and philosophy of science relates to his aesthetics. I say more about this in the Conclusion to the thesis.

[116] This exchange, which took place in 1981, was originally published in Villani's *La guêpe et l'orchidée* (1999: 129–31). Here I cite the translation available in *Collapse*.

Bonta and Protevi do towards the start of their book (2004: 12). But this statement of interest is also extremely under-scrutinized, for it has not yet been recognized that it radically *underdetermines* Deleuze's view regarding the precise nature of the relationship between philosophy and science.

What, after all, does it mean for a philosopher to be interested in 'the metaphysics science needs'? What is the implied relationship between philosophy, metaphysics, and science here? In the first instance, we could suggest that science presupposes a metaphysics that is mistaken or problematic in some way, and so philosophy is required to provide a more appropriate metaphysics—or *the* metaphysics that science needs. In the second instance, science might lack either the resources or the prerogative to articulate its own ontology, and so the task of the philosopher is to interpret the science properly in order to express what it says the world is really like. On the first reading, Deleuze is science-critical; on the second, he is science-deferring—or more naturalistic.

An obvious way to attempt to break this underdetermination would be to follow the reference to Bergson. Bergson was critical of science for its failure to grasp and represent what is, on his view, the essentially mobile or 'durational' character of reality. As he writes in *Time and Free Will*:

> science cannot deal with time and motion except on condition of first eliminating the essential and qualitative element—of time, duration, and of motion, mobility. (2012: 126)

He therefore sought to provide science with a proper metaphysics of duration that could ground and accommodate its misrepresentative claims. In his words, 'philosophy ought

[…] to follow science, in order to superpose on scientific truth a knowledge of another kind, which may be called metaphysical' (2001: 192).

It would appear, then, that Deleuze endorses the first of our proposed views: science presupposes a metaphysics that is problematic in some way, and so he is interested in providing it with proper metaphysical grounding. But a closer reading of his exchange with Villani complicates this suggestion. Consider Villani's initial prompt, in which he asks whether the philosophy elaborated within *A Thousand Plateaus* (recently published at the time of interview) might be 'transposable' into mathematics or biology.[117] Deleuze prefaces his 'Bergsonian' reply with the following remark: 'You ask if a mathematical or biological transposition is possible. No doubt it is the other way around' (2007: 41).

What is the significance of this prefatory remark and how does it challenge Deleuze's Bergsonian status? Well, Villani's question concerns a particular order of explanation. He is asking whether the concepts articulated in *A Thousand Plateaus* might be applicable to, help us make sense of, or explain certain mathematical or biological theories. In this respect, it is *Villani* who is Bergsonian in the sense that he regards the order of explanation here as running *from* philosophy or metaphysics *to* science. Deleuze, however, suggests the reverse. He is concerned not with the transposability of philosophical concepts into mathematics and biology but with the transposability of mathematical and biological theories into philosophy. 'How might mathematics and biology help us to make sense of the world on a broader philosophical or metaphysical register?', we can imagine Deleuze asking. Far from endorsing the first,

[117] Villani's prompt in full: 'The conclusion of *A Thousand Plateaus* consists in a topological model which is radically original in philosophy. Is it transposable into mathematics, biology?' (Deleuze 2007: 41).

Bergsonian view proposed above, then, Deleuze in fact appears to be adopting the second, more naturalistic position.

Such a suggestion fits with what we have already seen from Deleuze's explicit statements in the English preface to *Difference and Repetition*. Indeed, and as we saw in the previous section, 'differentiation' and 'differenciation' are key concepts in Deleuze's metaphysics, and in this preface he states that he derives these notions *from* mathematics and biology respectively: that is, he 'tried to constitute a philosophical concept *from* the mathematical function of differen*t*iation and the biological function of differen*c*iation' (*DR*: xvi).[118] Once again, science appears to provide valuable *input* for metaphysical theorizing and is not something erroneous to be underpinned or explained away by philosophy.

At the very least, then, there remains an underdetermination of Deleuze's philosophical relationship to science within his above statement of interest in 'the metaphysics science needs'. We can interpret this interest in one of two directions: one science-critical à la Bergson; the other science-deferring or more naturalistic. And indeed, within Deleuze studies itself the question of his naturalist status remains something of an open question. As Paul Patton remarks (in one of the few essays dedicated to this topic):

> The question whether or not Deleuze can be considered a naturalistic philosopher and if so in what sense of the term 'naturalist' is not one that has been widely discussed in the secondary literature. (2016: 348)

This is not to say that Deleuze's references to the sciences have gone unacknowledged.

[118] I have emphasized the word 'from' in this quotation.

A wing of the interpretative scholarship is more or less dedicated to emphasizing these engagements, giving rise to what Gaffney labels the 'scienticity' polemic in Deleuze studies (2010: 7). And yet, despite such scholarship, and despite the claims of some of its proponents, Deleuze's status as a naturalist is almost never explicitly thematized. Consider, for example, the following from Protevi:

> Since the early 1990s, a number of works (among others, Massumi 1992; DeLanda 2002; Bonta and Protevi 2004; Beistegui 2004; Bell 2006) have claimed that Deleuze offers a naturalist ontology that maps well onto wide-ranging current research projects that use nonlinear dynamic systems modeling. (2013: 1)

Protevi's claim notwithstanding, not one of the mentioned authors dwells on the question of Deleuze's naturalism. Not one of the cited works, for example, includes an index entry for 'naturalism'. Neither Massumi (1992) nor DeLanda (2002) nor Bell (2006) use the word at all. Beistegui uses the word in conjunction with Deleuze's name only once, at the end of his book, at which point he claims to have 'shown that ontology can and must be as open to naturalism as to phenomenological intuitionism' (2004: 338). And Bonta and Protevi allude to naturalism twice, describing it as the desire to 'analyze social systems with the same basic concepts' used to 'analyze organic and inorganic systems' (2004: 4, 92). Protevi himself does briefly acknowledge the slipperiness of the term, though he ultimately just reiterates his and Bonta's position that 'Deleuze is a naturalist qua anti-humanist' (2013: 1, n.2). As we can see, and to reiterate Patton's point, the question of Deleuze's naturalism, and of how precisely we ought to understand the term 'naturalism' in this context, is severely under-addressed—

even amongst those who place Deleuze's scientific engagements at the centre of their interpretive projects. One of the primary tasks of this thesis, then, is to pursue an answer to this question and to shed light on Deleuze's naturalist status.

3.4 Conclusion

We have introduced some of the basic motivations for Deleuze's philosophical project. He is engaged in a constant critique of an identity-prioritizing folk ontology called 'representation'. He can be understood as a 'critical' philosopher in the spirit of Hume and Kant, but he is also a 'pure metaphysician', one who articulates an immanent account of primitive objective modality. Finally, he clearly regards the sciences as bearing *some* significant and motivating relationship to philosophy—though it is still a matter of debate as to what this relationship is. In the proceeding chapters, I examine more closely some of Deleuze's references to mathematics and the sciences **(4.1, 4.2)**. I will then argue that many of his commentators have misunderstood what naturalism *is* and so fail to adjudicate on the question of Deleuze's naturalist status **(5.1)**. I then attempt to suggest an answer to this question **(5.3)**.

Chapter Four

Difference

4.0 Introduction

This chapter aims to provide a more positive account of Deleuze's metaphysics of difference—and to help make Deleuze's philosophical position seem a little less speculative. We saw in the previous chapter his interest in and engagement with the history of philosophy. This was useful for contextualizing his philosophical mission. And though a little of this historical engagement remains in this chapter, we are now in a position to attempt to make sense of his philosophical mission with his numerous engagements with the sciences and mathematics. We do so first by examining what Mader describes as 'the kind of becoming that Deleuze deems foundational to his ontology of difference' (2017: 261)—namely, 'intensity' **(4.1)**. I then examine Deleuze's engagement with the history of mathematics—and in particular his engagement with the calculus and his notion of 'singularity' **(4.2)**.

4.1 Difference as Intensity

The locution 'difference-in-itself' is unintuitive and difficult to visualize. But throughout his philosophical writings Deleuze provides us with various descriptive

vocabularies that enable a clearer understanding of his ontology of fundamental difference. One such idiom is that of 'intensity': 'Every intensity is differential, by itself a difference', he writes in *Difference and Repetition* (*DR*: 222). This may not be the most prominent concept in contemporary analytic philosophy (and perhaps less so in the philosophy of science), but thinking about intensity goes back to medieval and ancient Greek thought. As Mader remarks, there exists something of a 'minor' or a 'lesser' tradition of thinking about intensity, and it is this tradition that Deleuze 'revives, enriches, and centralizes' within his own philosophy of difference (2014: 225).[119] In what follows, we will introduce the concept of intensity and understand something about its philosophical lineage before then examining the use Deleuze makes of it in his own writings.

4.1.1 From Aristotle to Medieval Thought

In the *Categories*, Aristotle writes that there are

> Qualifications [that] admit of a more and a less: for one thing is called more pale or less pale than another, and more just than another. Moreover, it itself sustains increase (for what is pale can still become paler)—not in all cases though, but in most. It might be questioned whether one justice is called more a justice than another, and similarly for the other conditions. For some people dispute about such cases. They utterly deny that one justice is called more or less a justice than another, or one health more or less a health, though they say that one person

[119] Mader observes that 'references to the concept of intensity, even central ones, appear in almost all of Deleuze's texts' (2014: 226).

> has health less than another, justice less than another, and similarly with grammar and the other conditions. At any rate things spoken of in virtue of these unquestionably admit of a more and a less: one man is called more grammatical than another, juster, healthier, and so on. (*Categories* 8.10b26–11a4; cited in Mader 2014: 228)

It is this observation—namely, the observation that there exist certain qualities that can become more or less of themselves—that generates 'a problem for which the concept of intensity became the main solution' on Mader's account (2014: 228). Qualities such as '(i) states and dispositions (e.g., virtue); (ii) affects of bodies (e.g., sweetness, heat); and (iii) affections of the soul (e.g., anger)' (Mader 2014: 229; see *Categories* 8.8b26, 8.9a14, 8.9a28), in other words, are susceptible to a kind of change that is significantly different from others identified by Aristotle.

On his view: 'There are six kinds of change: generation, destruction, increase, diminution, alteration, change of place' (*Categories* 14.15a13; cited in Mader 2014: 229). And 'alteration' is the name he gives to the kind of change in which a given quality becomes *more or less of itself*. On the face of it, such change might seem extremely similar to 'increase' or 'diminution' (decrease), but increases and decreases denote *quantitative* change for Aristotle: 'Motion in respect of Quantity has no name that includes both contraries, but it is called increase or decrease according as one or the other is designated' (*Physics* 5.2.226a30; cited in Mader 2014: 229). That is to say, this kind of change involves a subject or quality that is in some sense divisible into discrete units or parts, which can then be added (as in the case of increase) or subtracted (as in the case of decrease) accordingly. Thus, my bank balance is subject to increase and (more likely) decrease, as is the size of a piece of paper or the population of a town.

Alteration, on the other hand, is a *purely qualitative* kind of change for Aristotle. Such qualities do not obviously admit of parts or division: there are no discrete units of charity, health, anger, or sweetness, for example. Aristotle was insistent upon this point and took pains, Mader observes, to argue that alteration is 'distinct from all other five sorts of change', and especially to separate 'analytically alteration from increase and decrease' (2014: 229): 'there is a question about alteration—whether it is not perhaps necessary for what is altering to be altering in virtue of one of the other changes. However, this is not true' (*Categories* 14.15a13; cited in Mader 2014: 229).

Thus, Aristotle presents a philosophical and ontological problem. How do we make sense of the idea that some kinds of qualities 'admit of a more and a less', though *not* in quantitative terms? And it is in response to this problem that the notion of 'intensity' is first developed by Aristotle's medieval commentators. Mader notes:

> An extremely fertile debate over the ontology of intensity develops in the medieval period, set off by problems with the ontology of Aristotle's purely qualitative notion of "more" and "less" of a quality. (2014: 231)

As Mader continues to observe, though:

> the medieval solutions that come to prevail actually challenge and abandon this qualitative construal of "the more and the less". In fact, this allegedly purely qualitative version of alteration is treated to increasingly quantitative explanation… (2014: 231)

Part of the motivation for the gradual abandonment of a purely qualitative account of alteration or intensive change in medieval philosophy comes from the question of whether or not the relevant kinds of qualities 'are species in themselves' (Mader 2014: 232).[120] In order to permit such qualities species-hood, but also to allow that they may admit of a more and a less and thus be subject to change without themselves transforming into different species, some Aristotle commentators in the medieval period took to attributing such qualities with a kind of 'latitude'. Such 'latitude', however, meant the attribution of a divisible or partitive nature such that intensive change could then be understood in quantitative terms, thereby forgoing the purely qualitative account that Aristotle had in mind. As Mader makes clear:

> On this view, such qualities could undergo additions and subtractions without changing in kind. In this way, a thoroughly qualitative theory of intensive change begins to be moved in the direction of a quantitative explication. For with such theories of qualitative latitude, the additions of parts—for Aristotle, a characteristic feature of increase—is employed to understand alteration, a process of change in quality that is allegedly independent of quantitative change, as Aristotle had argued in *Categories*. (2014: 232)

As we will now see, Deleuze can be seen as attempting to recover the purely qualitative nature of intensive change as first envisioned by Aristotle.

4.1.2 Deleuze on Intensity

[120] Here Mader has in mind Aquinas, along with 'fourteenth century […] Franciscans' and the so-called 'Oxford Calculators' (2014: 235).

Again, Deleuze sees in intensity a model for thinking about difference-in-itself, or the fundamental kind of difference upon which his metaphysics is based:

> Every phenomenon refers to an inequality by which it is conditioned. Every diversity and every change refers to a difference which is its sufficient reason. Everything which happens and everything which appears is correlated with orders of differences: differences of level, temperature, pressure, tension, potential, *difference of intensity*. (*DR*: 222; original emphasis)

Though Deleuze accepts that what Aristotle calls 'affections of the soul' remain apt illustrations for intensive changes, we can see that he prefers to use physical phenomena as examples: temperature, pressure, tension, potential, and so on. The example of temperature in particular provides a perfect illustration of Deleuze's concern with recovering the essentially qualitative and differential character of intensity—or at least with eliminating the kind of quantitative explanation introduced in the scholastic period.

Intensive differences in temperature, for Deleuze, should not be parsed as (ultimately) *extensive* differences. As the name suggests, extensive difference can be measured extensionally by means of spatially represented units or parts. It is also a purely *quantitative* kind of difference in so far as it consists in a change in the *number* of such parts. We therefore regularly mispresent changes in temperature when we treat them as changes in a number of degrees (themselves often represented extensively by a particular volume of mercury in a thermometer). This is a *misrepresentation* because temperatures *themselves* do not admit of parts—or are 'not composed of other

temperatures', Deleuze argues (*DR*: 237). That is to say, qualitative intensities are not susceptible to the same mereological operations of composition and decomposition, or addition and subtraction (increase and decrease, in Aristotle's language), as quantitative extensities. Spilling half of my cup of tea does not reduce its temperature, for instance; nor will 'combining' it with more of the same make it boil over.

More importantly, for Deleuze, the quantitative misrepresentation of intensity (in this and other cases) obscures its fundamentally differential character—or, as Mader puts it, 'its necessarily ineliminable structuring difference' (2014: 225). That is to say, when we conceive of difference extensively, as the difference in number between sums of otherwise identical, equivalent, or homogenous units or parts, then we once again conceive of difference *representationally* as the *nonidentity* of those sums. A significant part of Deleuze's metaphysical project, then, consists in his attempting to preserve and think the fundamentally qualitative and differential character of intensity, as well as his attempting to think the fundamentality of intensity itself in relation to extensity. That is to say, not only does Deleuze claim that intensity can and should be understood independently of extensity or extensive quantity, or that 'the fiction of a homogeneous quantity vanishes with intensity', he also claims that it is only in virtue of these more fundamental intensive relations that extensity emerges in the first place: 'intensity is an implicated, enveloped or "embryonised" quantity' (*DR*: 237).

Consider, for example, Deleuze's appeals to the gradient-based embryological theories of the 1930s–40s.[121] Of particular interest to him are accounts of 'morphogenesis', or of the process through which the three-dimensional structure of an

[121] Deleuze makes an oblique reference to 'Child and Weiss' (*DR*: 250), who are most likely Charles Manning Child and Paul Alfred Weiss. See, for instance, Child (1914, 1915, 1941) and Weiss (1939). (I am grateful to Charles Stivale—and, by extension, Gary Genosko and Daniel Smith—for their correspondence and help in determining these identities.) Deleuze's more overt references, though, are to Albert Dalcq's *L'œuf et son dynamisme organisateur* (1941) (see *DR*: 251, *ATP*: 531–32). For more on the gradient-based embryology of this time, see Thieffry (2001).

animal's body is generated by means of 'morphogenetic' motions (layerings and foldings of cellular material) within an egg.[122] Importantly, the theories upon which Deleuze fastens claim these motions to be induced and determined by *gradients*—that is, differentials in temperature and chemical concentration. This provides him with a genuine empirical example of how extensities (the animal body and its individual parts) can be generated out of more fundamental intensive relations (the relevant gradients within the egg). As he writes:

> the organic parts are induced only on the basis of the gradients of their intensive environment […]. Throughout, intensity is primary in relation to organic extensions […]. Notions such as 'morphogenetic potential', 'field-gradient-threshold' put forward by Dalcq, which essentially concern the relations of intensity as such, account for this complex ensemble. (*DR*: 251)

In essence, what Deleuze discovers here—as well as in various other scientific fields—is an ontology of intensity which he then extends to the world at large. Hence his famous (and admittedly bizarre) statement: 'The world is an egg' (*DR*: 251). Again, as Mader nicely puts it, intensities enjoy a 'necessarily ineliminable structuring difference' (2014: 225)—which is to say that there is no such thing as a 'static' or 'stationary' intensity (all intensities are intensive *relations* or intensive *differences* or *processes*). As we can see in the case of temperature, all such temperatures are in the process of mixing with or averaging out one another—our atmosphere being a perfect example, a tumultuous sea of temperature gradients driven by the sun, and which are themselves responsible

[122] Blastulation, gastrulation and neurulation (each of which are referenced in *DR*: 250–51) are examples of morphogenetic processes. See Wolpert (2011: Ch.4) for a helpful gloss.

for the development of extensive arrangements such as clouds and storm formations. Deleuze's claim is that all phenomena are driven by such intensive processes, including (as we have seen) the formation of organic life. Again:

> Everything which happens and everything which appears is correlated with orders of differences: differences of level, temperature, pressure, tension, potential, *difference of intensity*. (*DR*: 222; original emphasis)

Deleuze's prioritization of intensity and his critique of the 'extensive' or 'quantitative' treatment of intensity reflects Ladyman and Ross's own critique of the idea that the world is mereologically composed of little objects. For it is precisely the kinds of mereological compositional relationships to which *extensities* are amenable, on Deleuze's account, but *intensities* are not.

4.2 Calculus, Differentials, and Singularity

As we have already observed, and will continue to observe throughout the course of this thesis, Deleuze's philosophical writings contain many scientific and mathematical references. But perhaps no such references are as important for understanding his philosophy of difference than his appeals to the calculus—or his uptake of Leibniz's original notion of an 'infinitesimal' calculus, to be exact. He writes of a 'metaphysics […] strictly immanent to the techniques of the calculus itself' (*DR*: 176) and claims that 'there is a treasure buried within the old so-called barbaric or pre-scientific interpretations of the differential calculus' (*DR*: 170). In particular, Deleuze embraces a philosophical interpretation of the calculus according to which the differential or

differential relations are fundamental—or what Duffy (2004) describes as the infinitesimal calculus 'from the differential point of view'.

Deleuze also develops an important notion of 'singularity' from his engagements with various episodes in the history of mathematics. In what follows, then, we will first examine Deleuze's interpretation of the calculus 'from the differential point of view', before then looking at some of these episodes from which he derives his metaphysical notion of singularity.

4.2.1 Calculus, from the Differential Point of View

Calculus, roughly speaking, is a mathematical and conceptual tool used to determine instantaneous rates of change. Now, before anything else, let us consider for a moment the seemingly oxymoronic ring of the phrase 'instantaneous rate of change'. Imagine a projectile (an arrow shot from a bow, for instance) arcing its way through the air. Given some measurement for the time it takes our projectile to hit the ground, along with the distance it managed to travel before doing so, we can calculate its average speed for the duration of its flight.[123] But suppose our projectile failed to travel at a constant speed for the duration of this flight. Suppose, for instance, that for some stretches of its journey it was accelerated by the wind. And suppose also, the wind being highly erratic, that for some other stretches our projectile's progress was hindered by that same wind. We might therefore wonder at what speed our projectile was travelling at any given point on its journey. And it is here that we strike upon the apparently oxymoronic character of the phrase 'instantaneous rate of change'. For speed is determined by

[123] For the sake of simplicity, let us suppose that here we are dealing only with the horizontal component of our projectile's velocity.

dividing distance travelled by the time taken to do so. And yet, for any single *point* or at any particular *instant* on its journey, both the distance travelled by our projectile and the time taken for it to do so are equal to zero, and so asking for the *instantaneous* speed of our projectile seems to be tantamount to dividing zero by itself, which is an extremely (conceptually and mathematically) problematic notion.[124]

Calculus helps us to avoid this problem and to determine the instantaneous speed of our projectile (or the instantaneous rate of any continuous change). This is perhaps best illustrated geometrically. Suppose that the journey of our projectile is plotted on a graph: distance travelled represented on the *y* axis; time represented on the *x* axis. Now, if our projectile's speed was constant, then its plotted journey would be a simple straight diagonal line. But, as already stipulated, our projectile's speed varies as it is battered by harsh winds. And so our plotted journey forms a winding curve, described by a so-called 'primitive function' (an equation detailing the changing value of *y* relative to *x*). What the calculus effectively does is find the tangent to this curve (otherwise called the 'derivative' or 'differential relation') at any given point—the geometrical intuition being that the tangent to the curve at any point represents the speed of our projectile *at that given point*.

We will examine how this works in a little more detail in a moment. For now, though, let us simply acknowledge the basic lesson Deleuze draws from calculus. Ordinarily, we take the primitive function to be *primitive* in a logical and ontological sense. After all, in order for there *to be* rates of change (the projectile's speed) there must first be something (the projectile), or some things (its position, along with the passage of time), that are changing. Hence, we are often taught calculus in accordance

[124] Division by zero, let alone dividing zero by itself, is a problematic notion. For instance: consider any non-zero number and divide it by zero. Whatever the result, we are now committed to the claim that this result, multiplied by zero, is our initial non-zero number. Not only have we just contradicted ourselves, but it would seem that division by zero would render any number in the numerator position equal to zero.

with this intuition. Primitive functions are taken as given, and we are asked to determine their derivatives or the rates at which their given values change. Indeed, we are sometimes asked to determine their *second* derivatives, at which point we *differentiate the differential* in order to discover the rate at which the differential itself changes (in the case of our projectile, the second derivative describes its *acceleration*). Deleuze, however, reverses this ordinary interpretation. On his view, it is the *differential relation* that is logically and ontologically primary and the so-called 'primitive' function that is in fact derivative. As Evens summarizes nicely:

> In calculus class we are presented with a function and told to differentiate it, to take the derivative or produce the differential relation. In Deleuze's rereading of the calculus, the primitive function does not precede the differential relation, but is only the ultimate result or byproduct of the progressive determination of that relation. The differential is a problem, and its solution leads to the primitive function. (2000: 111)

We will come to understand precisely what Evens means by 'the progressive determination of that relation' later. For now, let us examine *why* Deleuze adopts this perhaps-unconventional interpretation of the calculus by taking a look at his engagements with its history.

Deleuze's first point of contact with the calculus is through its creator: Leibniz.[125] As already mentioned, Deleuze discusses Leibniz in many of his works. But for our purposes we can focus on his close reading of Leibniz's 1701 essay,[126] entitled

[125] Leibniz is, more precisely, *one of* the creators of calculus given that both he and Isaac Newton appear to have, quite independently, invented it at the same time (though using slightly different methods and terminologies). For a succinct and helpful history of the calculus, see Moore (2019: 61–68).
[126] Cited in Leibniz (1989).

‘Justification of the Infinitesimal Calculus by That of Ordinary Algebra’, in the seminars he taught at the Université de Paris VIII–Vincennes à St. Denis.

In this essay, Leibniz invites us to consider a diagram displaying two right-angled triangles, whose hypotenuses and adjacent sides each fall on the same lines respectively. Given these shared lines, the triangles have similar proportions and thus each triangle exhibits the same ratio between its adjacent and opposite sides.[127] Having established these properties, Leibniz then invites us to imagine the shared hypotenuse line moving, all while ‘preserving the same angle’ (1989: 545), in a direction parallel to each respective triangle’s opposite side, such that one triangle grows in size while the other gradually diminishes (see Fig. 4.1).

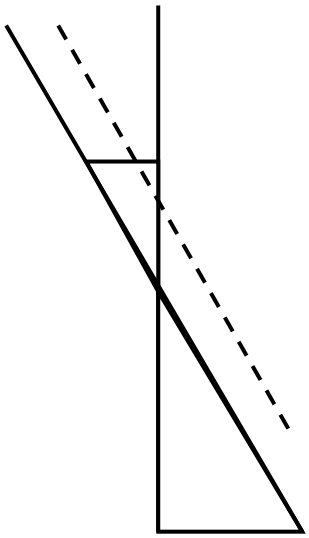

Fig. 4.1.

Now, Leibniz’s point is that, even once the diminishing triangle has disappeared entirely, the ratio between its adjacent and opposite sides remains the same as the ratio

[127] A reproduction of this diagram, along with a brief treatment of Leibniz’s essay, can be found in Smith (2012: 52–55) and in Deleuze’s book on Leibniz (*FLB*: 18).

between the adjacent and opposite sides of the remaining triangle. That is to say, though the diminished sides may themselves appear equal to zero, they are not 'absolutely nothing, since they still preserve the ratio' of these remaining sides (1989: 545). Leibniz, then, effectively demonstrates how a differential relation (in this case, the relevant ratio of the diminished triangle) can survive its relata, thereby showing that such relations can exist independently of, and thus enjoy priority over, their terms. Smith renders this point explicit: 'The differential relation is thus not only a relation that is *external* to its terms, but a relation that in a certain sense *constitutes* its terms' (2012: 53; original emphasis). And it is precisely this point that Deleuze takes up in his seminar discussion:

> Like he [Leibniz] says in his language, these are nothings, but they are not absolute nothings; they are nothings respectively; specifically, these are nothings, but that conserve the relational difference.[128] (22 April 1980)

Now, for a long time Leibniz's own version of the calculus was treated with suspicion precisely because it depended on the concept of an 'infinitesimal'—that is, an infinitely small quantity. *This* is how he got around the problem, posed above, of dividing zero by itself. For instead of doing so he postulated, in the words of Duffy, 'a quantity smaller than any given or givable quantity' (2004: 200) such that two infinitesimal differences, though strictly speaking nothing or equal to zero *with respect to whatever value each is infinitesimally different from*, still have a non-zero relation to one another when expressed in quotient form. As Deleuze puts it: '*dx* is nothing in relation to *x*'

[128] See also Deleuze's book on Leibniz: 'the differential quotient […] retains the relation […] when these two magnitudes vanish' (*FLB*: 18).

(*DR*: 47) or 'In relation to *x*, *dx* is completely undetermined, as *dy* is to *y*, but they are perfectly determinable in relation to one another' (*DR*: 172). See again Leibniz's essay, in which he claims that the elements of the diminished or vanished triangle are not themselves '*absolutely* nothing' and are thus 'treated as infinitesimals, exactly as are the elements which our differential calculus recognizes in the ordinates of curves for momentary increments and decrements' (1989: 545; my emphasis).

Why treat infinitesimals with suspicion? Well, for one they (at the time) lacked rigorous mathematical or arithmetical foundation. Infinitesimals were a new and as yet insufficiently defined concept. Duffy, for example, refers to 'the vagaries of the infinitesimal, which made many mathematicians wary' (2004: 202). Not to mention the fact that Leibniz, in employing infinitesimals as not merely very small but *infinitely small* numbers, was effectively invoking a new *kind* of number. Infinitesimals, in other words, are not 'real' numbers (in the technical mathematical sense). Another reason for treating infinitesimals with suspicion is their seeming incoherence. As Moore remarks, it seems as though an infinitesimal is 'equal to 0 when it suits us', for example when describing an infinitely small difference from some variable (*dx*), 'and not when it does not', for example when describing differential relations (*dy*/*dx*) in such a way as to avoid dividing zero by itself (2019: 60). He continues:

> For all its depth and beauty, the reasoning here is […] fundamentally flawed. It rests on a certain notion of an infinitesimal difference (as not quite nothing, but not quite something either), and this notion is ultimately incoherent. (Moore 2019: 61)

It is for such reasons, then, that Deleuze observes that Leibniz's own version of the calculus might be regarded as 'barbaric or pre-scientific' (*DR*: 270). Leibniz clearly regarded infinitesimals as core to his understanding of calculus—hence the original title of 'the infinitesimal calculus' (since replaced by 'the differential calculus' or simply 'calculus'). That said, Leibniz *was* aware of these problems, offering something of a remedy himself. As Moore notes:

> His [Leibniz's] reaction was to urge us not to take talk of infinitesimal quantities literally. We could think of it as just a *façon de parler*, or as a 'useful fiction', to be justified by appeal to its enormous utility.[129] (2019: 62)

Even Leibniz, it would seem, did not take the infinitesimal basis for his approach to calculus as seriously as Deleuze does in his own seminars and philosophical writings.

So dissatisfied with the notion of infinitesimals were eighteenth- and nineteenth-century mathematicians that many attempts were made at providing calculus with a more rigorous arithmetical foundation—that is, one based on neither Leibniz's conceptually challenging infinitesimals nor Newton's own geometrically informed method. This is what Klein referred to as the 'arithmetization of analysis' or what Smith calls the '"discretization" program' in mathematics (see Smith 2012: 293). And, towards the end of the nineteenth century, Weierstrass (building on the work of Cauchy

[129] Claims Leibniz in a 1702 letter to Pierre Varignon: '[one must say] I am not so persuaded myself that one must consider our infinites and infinitely small other than as ideal things and as well founded fictions'. This letter does not appear to be available in translation. Here it is cited from (and within) Deleuze's seminars on Leibniz (see 27 Jan 1987). Deleuze also alludes to this letter in his book on Leibniz (*FLB*: 96, n.27), and the relevant passage is cited at length (in the original French) by Robinson in his *Non-Standard Analysis* (1966: 262–63). For the letter itself, see Leibniz (1859).

before him) successfully provided just that foundation in the form of the 'epsilon delta' approach to calculus.[130] As Duffy observes:

> The Weierstrassian program determined that the fate of calculus need not be tied to infinitesimals, and could rather be given a rigorous status from the point of view of finite representations. (2013: 14)

And yet, Deleuze complains that the epsilon delta approach misses something crucial: namely, the sense of continuous change or dynamism that the original mission of calculus was to capture. (Hence Smith's description of Weierstrass's contribution as a 'discretization' effect.) As Deleuze himself remarks in one of his seminars:

> Weierstrass […] creates an axiomatic of calculus, but at what price? He transforms it completely. To the point that, today, when we do differential calculus, there is no reference to the notions of infinity, of limit and of tendency of approaching the limit, no longer any reference to those things. There is a static interpretation. There is no longer any dynamism in differential calculus, but a static and ordinal interpretation of calculus. (29 Apr 1980)

It is fortunate for Deleuze, then, that a mathematician in the twentieth century, Abraham Robinson, managed to provide a form of infinitesimal calculus with its own rigorous foundation through an approach known as 'non-standard analysis'. In Robinson's own words: 'It is shown […] that Leibniz' ideas can be fully vindicated and that they lead

[130] For an account of this history with a great degree of mathematical detail, see Duffy (2013: 8–15).

to a novel and fruitful approach to classical Analysis and to many other branches of mathematics' (1966: 2).

Deleuze himself reflects on these developments in his book on Leibniz (*FLB*: 129–30). And, in his seminars, one of his colleagues from the mathematics department reports:

> What has Robinson proven? Quite simply that […] we can have a language including these objects [infinitesimals], these 'well founded fictions' as Leibniz says, and that causes absolutely no contradiction. (27 Jan 1987)

Just as Leibniz is vindicated, then, so too does Deleuze's interpretation of the calculus appear to be. Although we should be careful not to attribute contemporary mathematical approaches to Leibniz and other seventeenth-century thinkers of the calculus. As Moore points out, Robinson 'used logical methods and techniques that went far beyond what would have been recognizable to seventeenth-century mathematicians. It would be anachronistic to see his work as a vindication of what they had been doing. It did not show that the notion of an infinitesimal as understood by *them* had been coherent' (2019: 68).[131] Still, we can see Deleuze's engagements with the history of mathematics as concerned not so much with providing some vindication of Leibniz's infinitesimal calculus *precisely as presented by Leibniz*, but with lending some credence to the basic conceptual heart of Leibniz's account—which, we have seen, for Deleuze has to do with the dynamism and fundamentality of continuous change (or difference). Indeed, and as Duffy notes, Deleuze also means simply to reorient our attention back to the

[131] See also Duffy (2013: 15).

metaphysical implications of this incredibly successful—and indeed ubiquitous—piece of mathematics:

> In response to these protracted historical developments, Deleuze brings renewed scrutiny to the relationship between the developments in the history of mathematics and the metaphysics associated with these developments, which were marginalized as a result of efforts to determine the rigorous foundations of the calculus. (Duffy 2013: 15)

4.2.2 Singularity

A question that remains of Deleuze's understanding of the calculus is precisely how he makes sense of the idea that differential relations—which, we have seen, he views as fundamental—constitute their terms. In other words, how do we make sense of the idea that, contrary to popular belief, it is in fact the differential or so-called 'derivative' that determines a so-called 'primitive' function?

Here we need to introduce the concept of a 'singular point', or what Deleuze refers to frequently throughout his work as 'singularities'. For not only does Deleuze claim that differential relations enjoy a determining role in relation to their primitive functions; he also claims that this determining role can be attributed specifically to such singularities. We will look at these claims in the context of three episodes in the history of mathematics: Leibniz, Weierstrass, and Poincaré.

First, though, we should acknowledge the idiosyncrasy of Deleuze's terminology. Deleuze readily admits that, in using mathematics- and science-inspired

terms, he may not adhere to the precise usages of mathematicians and scientists. 'We are well aware, unfortunately, that we have spoken about science in a manner which was not scientific', he writes in the preface to *Difference and Repetition* (*DR*: xxi).[132] And his adoption of the term 'singularity' is a good example of just such an instance. For a mathematician, for instance, the term 'singularity' denotes a point at which the value for a given function cannot be defined. An example of such a singularity would be a 'pole', or a point asymptotically approached by some function; 'maxima' and 'minima', otherwise known as 'stationary points', however, do *not* count as singularities in this sense—despite the fact that Deleuze still refers to them as such. It would seem, then, that Deleuze simply uses the word 'singularity' as an umbrella term for various mathematical objects, which may or may not *actually* be called 'singularities' in mathematical practice, that on his view embody certain features that he deems important or interesting. In what follows, we will develop a sense of what these features are.

i. Leibniz: maxima, minima, points of inflection.

Deleuze's initial interest in the mathematical notion of singularity is sparked by the way in which the mathematical understanding of 'singular' is distinguished from our classical logical way of understanding such a notion. In logic, Deleuze claims, the 'singular' is understood in relation to the 'universal'. In mathematics, however, the 'singular' is understood in relation to the 'regular' or the 'ordinary':

[132] See also: 'Here, we are making a childish inquiry; I insist on this: we are talking mathematics, but we don't know a word of it' (29 Apr 1980). Do note, though, that in both instances Deleuze appears to lament this fact.

> What interest does this have for us? You have to understand this: it's that mathematics already represents a turning point in relation to logic. The mathematical use of the concept 'singularity' orients singularity in relation to the ordinary or the regular, and no longer in relation to the universal. (29 Apr 1980)

(Thus, for Deleuze, a key benefit of modelling his philosophical thought upon such mathematical notions is that he manages to avoid those metaphysical puzzles generated by talk of 'universals'—or of some kind of supplementary, transcendent dimension to the world.)

So how, more precisely, do we understand this mathematical relation between singularity and regularity? Well, simply put, and in contrast to regular or ordinary points, singular points are those points at which something remarkable or interesting happens. Thus, an extremely simple example would be that of a geometrical figure, such as a square. While its sides enjoy an infinite number of ordinary points, the points at each of its four corners are singular: 'on the level of a simple square, of a rectilinear figure, singularities were *extremum*' (29 Apr 1980). Another instance would be that of the singular points of a curve representing a particular mathematical function. Examples here include 'maxima', 'minima' and 'points of inflection'.[133] Points, that is, at which the behaviour of the curve changes in some significant way (see Fig. 4.2):

[133] Maxima and minima are known as 'stationary points'. The inflection point in Fig. 4.2 is 'non-stationary'. Stationary inflection points are those which, like maxima and minima, have an initial derivative value of zero.

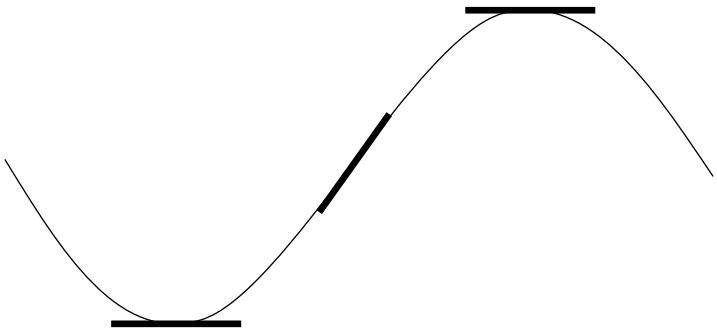

Fig. 4.2.

Maximum and minimum points are those at which a curve changes direction, or at which the differential or derivative of the function equals zero; a point of inflection occurs when the concavity of the curve changes. As Duffy observes, 'it was Leibniz who developed the first theory of singularities in mathematics' on Deleuze's account (2013: 16). That is, in so far as Leibniz provided a way of identifying these kinds of singular point.[134]

Now, part of what makes singularities so distinctive and interesting, for Deleuze, is that they have a special determining relation to the rest of the curve. After all, if all we knew of the above function (see Fig. 4.2) was its value at its singular points (along with the respective natures of those singular points), then we could sketch out the rest of the function or curve quite easily, informally speaking. *Prima facie* this does not appear to be the case for its ordinary points. Similarly, with our first example of the square, its four singular corner points are sufficient to reflect its squareness. As Smith

[134] Deleuze discusses Leibniz's contribution in his 1980 seminars on 'Leibniz: Philosophy and the Creation of Concepts'. In particular, he refers to Leibniz's 1684 essay—indeed, his very first presentation of the calculus—entitled 'Nova methodus pro maximis et minimis, itemque tangentibus, quae nec fractas, nec irrationales quantitates moratur, & singulare pro illis calculi genus' or 'A new method for maxima and minima as well as tangents, which is impeded neither by fractional nor by irrational quantities, and a remarkable type of calculus for this'. Translation available in Struik (1986: 271–80).

expands: ‘Geometrical figures, for instance, can be classified by the types of singular points that determine them’ (2012: 55).[135]

And indeed, speaking more formally now, Deleuze goes further, claiming that such singularities do in fact encode information about the function as a whole and that we can, mathematically, determine or generate the rest of the function from these points. We can do this by taking successive derivatives at these singular points, which yields more and more information about the successive rates at which the value of the function is changing, and so in turn yields greater and greater approximations of where the surrounding points on the so-called primitive function are likely to be. *This* is what Evens means when he describes the primitive function as ‘the ultimate result or byproduct of the progressive determination’ of the differential relation (2001: 111). And so it is in *this* respect that Deleuze maintains that the differential relation is fundamental and determines the primitive function; *not* the other way around.

As Duffy observes, ‘Leibniz [himself] even provided a formula for the nth order differential relation, as n approaches infinity’ (2013: 17)—referring to the so-called ‘General Leibniz Rule’.[136] That said, it is in the form of ‘power’ or ‘Taylor’ series expansions that this iterative procedure of taking successive differentials in order to approximate a given function is properly formalized. Thus, for Deleuze, it is in virtue of such Taylor or power series expansions that singular points or singularities ‘extend’ across the entirety of their functions in so far as the behaviour of that function, or the behaviour of its ordinary or regular points, in some sense inheres or is encoded within such points. As he remarks in one of his seminars:

[135] Note the apparent connection to group theory.
[136] I am grateful to Simon Duffy for clarifying this point in personal correspondence.

> the singular point's characteristic is to extend itself (*se prolonger*) over the whole series of ordinary points that depend on it all the way to the neighborhood of the subsequent singularity. So, I maintain that the theory of singularities is inseparable from a theory or an activity or a technique of extension. (29 Apr 1980)

And as Duffy writes (perhaps more plainly):

> The power series determines not only the specific qualitative nature of the function at the distinctive point in question but also the specific qualitative nature of all of the regular points in the neighbourhood of that distinctive point, such that the specific qualitative nature of a function in the neighbourhood of a distinctive point insists in that one point. (2004: 204–205)

Note, however, that Deleuze's (implicit) claim that Taylor series expansions can *only* take place at the above-identified singular points is false. Such expansions can in fact be implemented at *every* point on a curve or function—be it singular *or* ordinary. And so, in an important respect, and *contra* Deleuze, it would appear that *every* point 'extends' itself or encodes information within itself regarding the rest of its function. This throws into doubt the special significance that Deleuze attributes to those singular points just mentioned.

There are three ways in which we might respond, on behalf of Deleuze, to this complaint. The first would be to claim that Deleuze is merely exercising some form of philosophical licence and is not too concerned about fidelity to the mathematics. For reasons to be detailed in the next chapter **(5.3)**, this seems an implausible explanation.

The second response would be to claim that such singular points *do* still in fact retain some special status of the kind Deleuze argues is significant—though informally so. After all, though these singular points (maxima, minima, points of inflection) may not appear to enjoy any special status when it comes to the formal mathematical procedure of Taylor series expansions, we *did* observe that they enjoy a less formal kind of priority. Again, if we were provided with the maximum and minimum point of a function, along with its point of inflection, then we could sketch out a good approximation of the rest of the curve ourselves; this could not be done if we were given three random *ordinary* points (again, informally speaking). And so we might admit that singular points *do*, in a sense, deserve the special status attributed to them by Deleuze—even if it has nothing to do with Taylor series expansions. The third response maintains that such singular points *do* enjoy a mathematically justified kind of determining priority over the rest of the function, though just not in virtue of their role in Taylor series expansions. Note, for instance, that one can still identify these kinds of singular point by means of only one or two derivatives of a given function: maxima and minima can be found where the derivative equals zero; and points of inflection where the second derivative equals zero. Thus, there *is* some formally mathematically recognizable and justified sense in which these kinds of singular point play a determining role over the rest of the function.

As already mentioned, Deleuze fastens onto numerous other instances of singularity in the history of mathematics. As he himself remarks, referring again to our the very simple cases just described of simple geometrical figures and functions:

> in the simplest cases, the singular is the extremity, in other simple cases, it's the maximum or the minimum or even both at once. Singularities there [*sic*] develop

> more and more complex relations on the level of more and more complex curves. (29 Apr 1980)

We will now briefly examine two of these more complex cases.

ii. Weierstrass: analytic continuity.

Deleuze also engages with another mathematical method from which approximations of functions can be derived. This method, developed by Weierstrass, also uses Taylor series expansions and is called 'the approximation of analytic functions' or 'analytic continuation' (see Duffy 2013: 20–23). It is used in 'complex analysis', meaning that it involves functions of complex numbers—such numbers themselves having the 'imaginary' number √-1 (the square root of minus-one), or some multiple thereof, as a component.[137]

The details here are technical, but there are instances in which functions can only be approximated within a particular domain called a 'circle of convergence'. In such instances, we can Taylor expand the function up to the edge of this domain, then take a point towards the edge (though still within) that domain as the centre for our *next* domain. Such domains, or their circles, will overlap slightly or 'converge' (hence the term), and this process can be repeated for the entirety of this broader converging domain in which the function remains analytic:

[137] The square of any real number is always positive. Thus, both one and minus-one squared equals one. This imaginary number, *i*, is posited as that such as *i* squared equals minus-one.

> The domain of the function is extended by the successive adjunction of more and more circles of convergence. […] In this way, […] by analytic continuation one can obtain the entire analytic function over an extended domain. (Duffy 2013: 21)

Now, an important detail about these circles of convergence is that they can only be so large. Indeed, their radii can extend only as far as the nearest *singular point* or *singularity*. (Note that here the term 'singularity' *is* being used appropriately.) Thus, in Deleuze's own summary:

> you trace a circle that stops in the neighborhood of the singularity A and you trace another circle that stops in the neighborhood of singularity C. You see, these circles intersect. […] So, you go on like that constructing, from one singularity to the next, what you will be able to call a continuity.[138] (29 Apr 1980)

Thus, the method just described can be visualized as successive, overlapping circles whose size is limited by the presence of singularities (see Fig. 4.3):

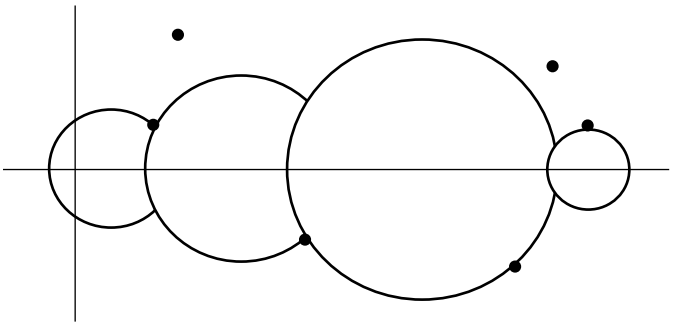

Fig. 4.3.

[138] In this seminar, Deleuze has drawn a diagram on the board (to which 'A' and 'C' refer).

In some cases, such singularities are ‘poles’, which are points that the function approaches asymptotically and at which the gradient of the function becomes infinite. In other words, the function becomes *discontinuous*, meaning we encounter a *break* in the curve describing the function. An example of such a case would be the function of tan(*x*), for which a singularity or pole occurs periodically, at multiples of $\pi/2$ (see Fig. 4.4):

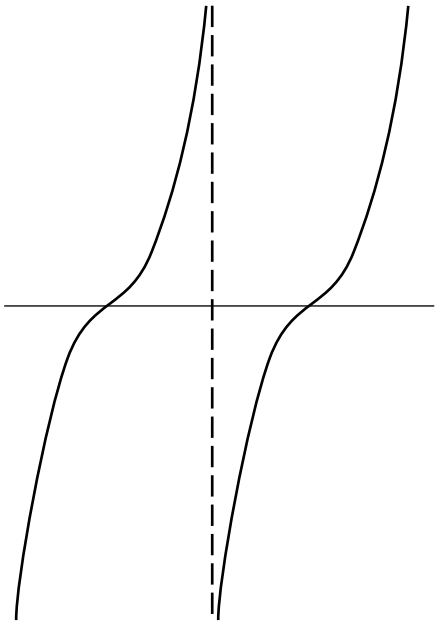

Fig. 4.4.

The method of analytic continuation for the approximation of such a function (or equivalent) might therefore look something like this (see Fig. 4.5):

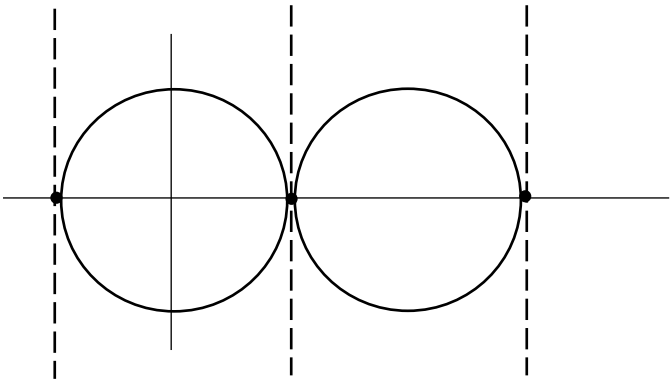

Fig. 4.5.

In cases such as those just mentioned, then, the singularity retains its special, determining role over the function being approximated. It may not itself be a point on the curve, but it nonetheless exerts an influence over the behaviour of the function—that is, by restricting and determining those domains in which the function is analytic, and by dictating that function's behaviour within its vicinity.

iii. Poincaré: nodes, saddles, foci, and centres.

Another example of a form of singularity with which Deleuze engages in the history of mathematics can be attributed to Poincaré—and in particular to Poincaré's 'qualitative approach' to differential equations.[139] As Strogatz remarks in an undergraduate textbook on nonlinear dynamics, Poincaré

[139] Deleuze does not cite his sources, but it is clear, in his seminars on 'Leibniz: Philosophy and the Creation of Concepts' for example, that he draws upon two of Poincaré's essays in particular. That is, parts one and two of his 'Mémoire sur les courbes définies par une equation différentielle' (1881, 1882). For an example of Deleuze's close reading of these essays, see (29 Apr 1980).

> introduced a new point of view that emphasized qualitative rather than quantitative questions. For example, instead of asking for the exact positions of the planets at all times, he asked 'Is the solar system stable forever, or will some planets eventually fly off to infinity?' Poincaré developed a powerful *geometric* approach to analyzing such questions. (2015: 2; original emphasis)

In other words, and in the face of the fact that many of the differential equations that describe physical systems either resist or simply do not admit of straightforward analytic solution, Poincaré turned his attention toward the geometrical representation of such systems in order to discover whether such representations might themselves yield information about the long-term behaviours of those systems. And it is precisely this kind of information that he discovers in the form of four new classifications of singular points—namely: nodes (*les nœuds*), saddles (*les cols*), foci (*les foyers*) and centres (*les centres*) (see Poincaré 1881: 392).[140]

Again, we are now in the domain of the representation of dynamical systems. Such singularities are exhibited within something called a 'state space'—an *n*-dimensional logical space, each point of which represents a possible state of the dynamical system it represents, and where *n* represents the number of 'degrees of freedom' or relevant variables changing in the system. Different observed evolutions of the system will generate different trajectories running through the space. And this space, once populated with observed trajectories, is called a 'phase portrait'. In two-dimensional phase portraits, nodes occur when an infinite number of trajectories pass through a single point; saddles when only two trajectories pass through a point and the

[140] For mentions of these kinds of points (though sometimes by slightly different names) in a contemporary textbook on nonlinear dynamics, see Hilborn (2000: 80, 94–96, 283).

other approaching trajectories veer away; foci when surrounding trajectories spiral in towards a single point; and centres when trajectories form closed (perhaps concentric) loops around a point (see Fig. 4.6):[141]

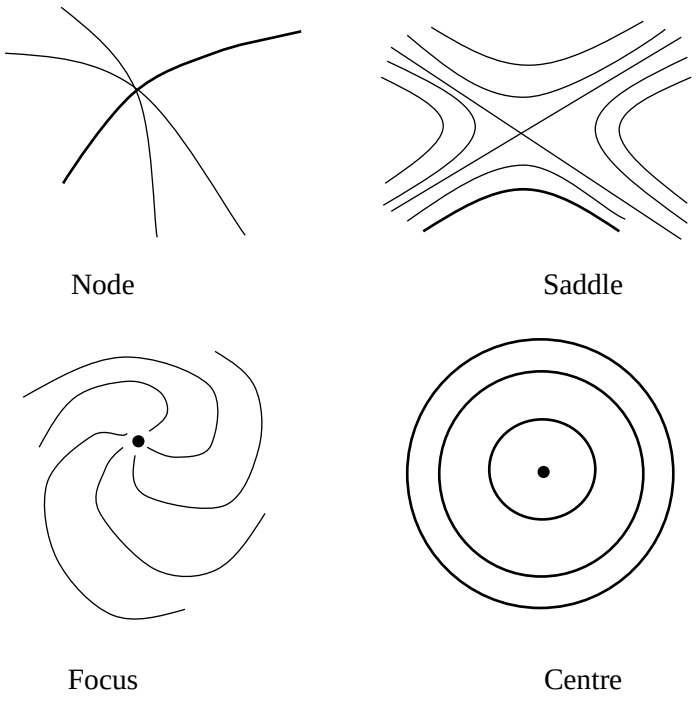

Fig. 4.6.

These singular features are described as ‘attractors’ and ‘repellors’, or as combinations thereof, in contemporary dynamics.[142] That is, and as with those singularities identified within the context of analytic continuity, such singularities can be said to *influence* or *determine* the behaviour of those curves, trajectories, or functions that occupy the state space. In other words, the nature and distribution of such singularities *structures* the

[141] For a succinct and helpful description, and geometrical representation, of these kinds of points, see Stewart (1989: 95–104). See also Duffy (2013: 27–31).
[142] See Abraham and Shaw (2016: 42–46), Lorenz (1993: 39–49), Hilborn (2000: 80–83, 126–27) and Strogatz (2015: 17).

state space of physical systems in particular ways, punctuating them with 'basins of attraction' and so on, such that the movement of trajectories around that space is constrained or guided in particular ways. As Duffy writes (referring to these sorts of singular features as 'essential singularities'):

> The essential singularity determines the behaviour of the composite function, or the appearance of the solution curve, in its immediate neighbourhood by acting as an *attractor* for the trajectory of the variable across its domain. (2004: 211)

Or, as DeLanda elaborates, these

> singularities are said to represent the inherent or intrinsic *long-term tendencies* of a system, the states which the system will spontaneously tend to adopt in the long run as long as it is not constrained by other forces. (2002: 15)

A concrete example of such a system, then, would be a swinging pendulum. Frictionless, its state space would exhibit a centre; dampened by friction, however, its state space exhibits a focal point toward which any potential trajectory approaches (see Abraham and Shaw 2016: 55–64).[143] Similarly, a predator-prey system, described by the 'Lotka-Volterra' model, exhibits a centre, thereby showing a periodic cycle of an increase in predator population, due to an increase in prey population, leading to a decrease in prey population and, subsequently, a decrease in predator population, and so on and so forth.[144] (Interestingly, French also discusses the Lotka-Volterra model as

[143] This system also has a saddle point, representing the state of the completely inverted pendulum.
[144] See Abraham and Shaw (2016: 82–85).

an example from biology which, despite lacking in the sorts of laws one finds in physics, nonetheless exhibits 'the sorts of features that the structuralist can get her teeth into' (*SotW*: 334).)

4.3 Conclusion: A Virtual Poincaré Manoeuvre

Having recognized and examined some of the salient mathematics, we can now showcase how Deleuze extrapolates from these engagements a logic for his metaphysical system. Consider the following claim: 'The reality of the virtual consists of the differential elements and relations along with the singular points which correspond to them' (*DR*: 209). Deleuze's account of his immanent, objective modality (the virtual), then, can therefore be parsed in terms of those fundamental differential relations examined in this chapter. And those differential relations, on his account, are themselves encoded within and determined by a particular distribution of singularities—just as we saw in the case of analytic continuity and with Poincaré's qualitative approach to differential equations. In the context of dynamic systems, for instance, these 'singularities' (and, again, we ought to be wary of Deleuze's potentially idiosyncratic use of this term) can be said to 'structure' the state space of some physical system. Accordingly, Deleuze claims that: 'The reality of the virtual is structure' (*DR*: 209).

We saw in a previous chapter **(3.2)** that Deleuze also describes a *difference in kind* between the virtual and its contrast class—namely, the actual. His strategy here was to avoid the transcendence he saw as being implicated by the modal category of possibility and its resemblance relation to the actual. This likely seemed fairly speculative and abstract at the time. But now we have the descriptive and conceptual

mathematical machinery that might be able to help us make more sense of this idea. 'Actual terms never resemble the singularities they incarnate', writes Deleuze (*DR*: 212). This idea makes sense in the context of dynamic systems. After all, neither the predators nor the prey studied by our 'Lotka-Volterra' model *resembles* the singularity (the Poincaréan centre) around which their state space trajectories travel. Similarly, water may boil or freeze, but it never 'resembles' its boiling or freezing points—and it is unclear precisely what such a 'resemblance' would look like. Deleuze appears to be claiming that the behavioural tendencies of these systems (the fish eating one another, the water molecules agitating in particular ways) are encoded within and determined by these singular points.

Deleuze also, drawing on different conceptual resources, describes constellations of these singularities as 'Ideas'. He writes: 'An Idea […] is […] but a multiplicity constituted of differential elements, differential relations between those elements, and singularities corresponding to those relations' (*DR*: 278). Delving into the conceptual provenance of this term 'Idea' is not important here.[145] What *is* important is Deleuze's endorsement of 'an empiricism of the Idea' (*DR*: 278). He writes:

> In the most diverse cases, we must ask whether we are indeed confronted by ideal elements—in other words, elements without figure or function, but reciprocally determined within a network of differential relations (ideal non-localisable connections). For example, we must ask whether any physical particles are elements of this kind and, if so, which ones? Are biological genes such elements? Are phonemes? We must also ask what distribution of

[145] See Smith (2012: 106–121).

> singularities, what repartitioning of singular and regular, distinctive and ordinary points, corresponds to the values of the given relations. (*DR*: 278)

What are we to make of this? Deleuze is, I think, simply describing a particular philosophical method: an 'empiricism' that is able to get to grips with these 'transcendental' or 'virtual', and thus imperceptible, differential relations and singular features—the transcendental, modal, conditions of experience. He is, I think, proposing that philosophers, or rather metaphysicians, be in the business of attempting to identify the relevant singular features implicit in actual (in the Deleuzean sense) phenomena, or to 'ask what distribution of singularities, what repartitioning of singular and regular, distinctive and ordinary points, corresponds' to them. Of course, mathematics and the sciences will be our principle way of doing this—and I think this parsing connects nicely with the account of minor science introduced in the next chapter. But here I just want to recognise the resemblance of this procedure to the 'Poincaré Manouevre' described by French (*SotW*: 66–68), French and Ladyman (2003a: 41–42), and Ladyman and Ross (*ETMG*: 155).

This manoeuvre is essentially a strategy for reorienting one's ontological commitments. Recall our (extremely) simple example of group theory in a geometrical context—that is, with our simple two-dimensional shapes **(2.2)**. We observed that, under certain rotation transformations, different figures were left invariant, or 'had symmetry'. And we also observed that these symmetries encode important information about the natures of those figures. (If this particular two-dimensional figure has rotational symmetry of 'four', say, then you know it is a square.) Now, things become odd when we start to suggest, as French does, that *the symmetries are ontologically primary*. After all, do we not need things, or elements, of a group *in the first place*

before we can then subject them to transformations in order to discover their symmetry properties? Poincaré famously responds to this kind of objection by claiming that the elements or figures in our groups, those objects we subject to various transformations, may be 'the gross matter which is furnished us by our sensations', but they are nonetheless 'a crutch for our infirmity' (1898).

In essence, then, the argument is simply that our reliance on figures or elements to discover group symmetries expresses *a fact about us*, and not a fact about the ontological significance of those figures. As Ladyman and Ross make clear, now referring to structure generally: 'We may not be able to think about structure without hypostatizing individuals as the bearers of structure, but it does not follow that the latter are ontologically fundamental' (*ETMG*: 155).

I think something very similar appears to be going on in Deleuze's thought, albeit this time referring to different mathematical resources. First, we observed Deleuze's interpretation of the calculus 'from the differential point of view'. That is, Deleuze takes differential relations to enjoy ontological priority over their so-called 'primitive' functions. And yet, we *need* the primitive functions in order to access those differentials. Recall our earlier observation that surely there need to be *things* undergoing change for there to be *rates of* change. Yes, we might say, but once those things have done their job we can cast them aside. And indeed, Deleuze's appeals to different procedures of successive differentiation (either with only a couple of iterations at stationary points on a curve, or more formally in the form of power series expansions) show, on his account, that it *is* in fact the differential relations that enjoy priority—just as, for French, it is the symmetries upon which we ought to hang our ontological commitments.

Now, the main difference with Deleuze's analogue of this manoeuvre is that it seems to involve two stages. The first stage remains at the level of fairly simple calculus, with Leibniz. The aim of this stage appears to be simply to get one ontologically focussed on differential relations. It is only at the second stage, the one that seeks to compress this commitment down to *singularities*, that Deleuze's engagement with Poincaré comes into play. And, as we have already seen, here he draws on Poincaré's essays describing a qualitative approach to differential equations and in which he identifies four new kinds of singular point, each of which plays an especial determining role in the possible solutions to a function, or in structuring the representative spaces in which dynamical systems are studied.

Chapter Five

Naturalism Revisited

5.0 Introduction

The purpose of this chapter is to reflect a bit more critically on the question of naturalism as it relates to both ontic structural realism and Deleuze's philosophy of difference. First, I want to show that what little discussion of Deleuze's naturalist status *does* exist fails to accurately reflect the commitments of the sciences and otherwise suffers from a lack of engagement with contemporary philosophy of science **(5.1)**. I do this, for the most part, by extending Ladyman and Ross's critique of neo-scholastic metaphysics in the analytic tradition to the relevant accounts in Deleuze studies—the most prominent of which belong to Patton (2016) and Ansell Pearson and Protevi (2016). I then examine Ladyman and Ross's own positive account of what counts as naturalistic metaphysics **(5.2)**. Here I subject their so-called 'primacy of physics' constraint to particular scrutiny and explore whether a pared-down version of their 'principle of naturalistic closure', according to which naturalistic metaphysics is simply the enterprise of articulating networked consilience relationships across scientific hypotheses, might be preferable to the version they endorse. This arguably neater account of naturalistic metaphysics in hand, I then turn to the question of whether we might in fact read Deleuze as a naturalistic philosopher **(5.3)**. I examine how the question of naturalism manifests itself in Deleuze's writings, I critique some further

attempts by commentators to conceive of Deleuze as straightforwardly non-naturalist, and I draw upon Deleuze and Guattari's distinction between 'major' and 'minor' science (a distinction that has been neglected in this context in Deleuze studies) in order to carve out a revised understanding of the role of science in Deleuze's thought—one that might, I suggest, be considered naturalistic.

5.1 Naturalism in Deleuze Studies

We have already observed that Deleuze references the sciences and mathematics frequently in his philosophical writings. We have also observed that, although there is scholarship that emphasizes Deleuze's engagements with the sciences, the question of his naturalism is almost never explicitly thematized **(3.3)**. To repeat a claim from Patton:

> The question whether or not Deleuze can be considered a naturalistic philosopher and if so in what sense of the term 'naturalist' is not one that has been widely discussed in the secondary literature. (2016: 348)

In this section, I argue that what little discussion of Deleuze's naturalist status *does* take place employs a conception of naturalism that is inadequate. In other words, I want to extend Ladyman and Ross's critique of pseudo-naturalistic metaphysics and neo-scholasticism in the analytic tradition to some of the more prominent attempts to judge Deleuze's naturalist status within the Deleuze literature.

These attempts belong to Patton (2016) and Ansell Pearson and Protevi (2016). In each instance, they start with the well-known and long-established distinction

between naturalism of an 'ontological' and a 'methodological' sort. Broadly speaking, ontological naturalism concerns our metaphysical commitments: there is what the sciences say there is, and the metaphysician is constrained by this ontology in some important way. They cannot, for instance, accept the existence of God, the soul, ghosts, or any other supernatural or otherwise 'spooky' entities. Methodological naturalism, on the other hand, concerns *how we arrive* at these ontological commitments: science is our best (and perhaps only) way of knowing the world, and so it ought to serve as the primary source of information for metaphysical deliberation. Now, for reasons explained below, Ladyman and Ross do not endorse this distinction. Still, since this is how Patton and Ansell Pearson and Protevi frame their own discussions, it is worth structuring what follows in these same terms—even if these terms themselves come under critical scrutiny.

5.1.1 Patton on Ontological Naturalism

Drawing on the work of Papineau and Armstrong, Patton defines ontological naturalism in terms of the well-known notion of 'causal closure', 'whereby physical states or events are caused only by physical states or events' (2016: 351). This idea is also described in terms of the 'completeness' of the physical realm.[146] That is to say, once a description of a particular physical effect contains all its physical causes, then that description is *complete*: 'we never need to look beyond the realm of the physical in order to identify a set of antecedents which fixes the chances of any subsequent physical occurrence' (Papineau 1993: 16).

[146] See Papineau (1993: 16–17), Crane (1995) and Papineau and Spurrett (1999).

As Patton observes, naturalism in this sense admits of strong and weak versions. The former insists, à la Armstong, that 'the world contains nothing but the entities recognized by physics' (Armstrong 1980: 156; cited in Patton 2016: 351); the latter allows, à la Papineau, for 'the existence of non-physical states or events' (Patton 2016: 351)—though only on condition that they 'are identical with or realized by physical states' (Papineau 1993: 103). Thus, there might exist non-physical entities such as mental states, but whatever *does* exist must be entirely explicable only in terms of *physical* cause and effect. As soon as one accepts the causal influence of the non-physical over the physical, then one no longer qualifies as naturalist in the ontological sense.

Patton therefore concludes that Deleuze's philosophy cannot possibly be ontologically naturalistic because, though much of his project is defined by a relentless critique of metaphysical transcendence, Deleuze nonetheless 'endorsed the existence of some decidedly "spooky" entities such as pure events, abstract machines and other kinds of virtual reality' (2016: 352). And such entities, Patton rightly notes, *do* for Deleuze have some bearing on how things go in physical nature. Indeed, much of Deleuze's philosophical project consists in detailing the 'virtual origins of particular domains of thought and empirical reality' and articulating the 'complex processes by means of which virtual structures are actualized in spatio-temporal form' (2016: 352). Deleuze's philosophy, Patton claims, therefore seems to be 'inconsistent with the modern scientific image of the world as a single, closed causally interconnected system' (2016: 352).

But Patton is mistaken—as are those whose work he draws upon to articulate his view—about the basic character of 'the modern scientific image of the world', and thus about what qualifies as conforming to that image. As Ladyman and Ross point out,

it is highly likely that 'causation does not figure in fundamental physics' (*ETMG*: 275).[147,148] The details here are technical, but they have to do with the search for a theory of quantum gravity—that is, a theory that reconciles the conceptual tensions between quantum mechanics and general relativity. Though a successful such theory remains to be found (candidates include string theory, M-theory, and loop quantum gravity), it is generally agreed that the successful theory will show spacetime to be nonfundamental. As Ladyman and Ross observe: 'in all the non-perturbative approaches to quantum gravity familiar macroscopic four-dimensional spacetime is dynamically emergent rather than fundamental' (*ETMG*: 172). Or, in a slightly less technical idiom:

> None of the existing contenders for a theory of quantum gravity is consistent with the idea of the world as a spatio-temporal manifold with classical particles interacting locally.[149] (*ETMG*: 174)

Absent such a manifold, or without this spatiotemporal frame of reference, causation drops out of the picture—at least on the register of fundamental physics. And, given that one of our scientific disciplines—let alone our most celebrated and predicatively successful scientific discipline—promises to exclude causal and other spatiotemporal relations from its descriptive and conceptual machinery, Ladyman and Ross insist that properly naturalistic metaphysics, and thus our conception of *what counts* as properly naturalistic metaphysics, 'cannot go on making causation fundamental' (*ETMG*: 259).

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[147] Here I elaborate an argument against the inclusion of causation in fundamental physics from quantum gravity. We should note, though, that Russell (1913) famously argued against causation in physics over a century ago.

[148] Note that this argument is pitched against the commonsensical or neo-scholastic notion of causation, which is akin to Aristotelian 'efficient' causation for Ladyman and Ross (*ETMG*: 3). Other, more subtle, accounts of causation—for example, a counterfactual account of causation—might yet prove compatible with fundamental physics.

[149] For more on the philosophical implications of the search for a theory of quantum gravity, see Callender and Huggett (2001).

This is a complaint that they level directly against Papineau and others who endorse a principle of causal closure: 'one might deny that there are causes in physics […] and so deny the causal closure of the physical' (*ETMG*: 44, n.43).[150]

As indicated in a previous chapter **(1.5)**, sheer ignorance of the relevant science is not the sole reason for this conceptual misstep. Again, Ladyman and Ross attribute to us a powerful folk-ontological worldview, one derived from our everyday experience in which we track the world in terms of individuals interacting with one another in various causal and compositional ways. And it is from this folk-ontological worldview, otherwise referred to as 'neo-scholastic metaphysics', that we derive much of our thinking about what the world is really like and about what the sciences say the world is really like—our neo-scholastic intuitions being bolstered in this respect by outdated and easily domesticable classical physics. In other words: causal relations seem to be ubiquitous, and so we assume that causation has something to do with how the world ultimately *is*. But, and again as already observed in **(1.5)**, we simply have no good reason to suppose that we can make legitimate inferences about the ultimate nature of reality based on the character of our particularly pinched perspective on that reality. And, as our allusion to the search for a theory of quantum gravity confirms, the sciences do in fact show our pinched perspective to be misrepresentative of what the world is really like. Patton, then, can be grouped alongside the other targets of Ladyman and Ross's opening salvo in *Every Thing Must Go*. He lacks an adequate conception of the naturalistic worldview—and he therefore also lacks an appropriate standard with which to judge Deleuze's naturalist status.

[150] See also their complaint against Armstrong: where Armstrong defines ontological naturalism as 'the doctrine that everything that exists is in space and time', Ladyman and Ross point out once again that 'contemporary physics takes very seriously the idea that spacetime itself is emergent from some more fundamental structure' (*ETMG*: 23; see Armstrong 1983: 1).

Now, before we extend Ladyman and Ross's critique of neo-scholasticism to Ansell Pearson and Protevi's account of naturalistic metaphysics, I want to examine another limitation of Patton's argument for Deleuze's non-naturalism. This limitation stems partly from an underappreciation of Deleuze's overarching philosophical project, as well as from a lack of engagement with contemporary philosophy of science. It has to do with his claim that Deleuze 'endorsed the existence of some decidedly "spooky" entities' (2016: 352).

Here I think Patton conflates 'spookiness' with objective modality—that is, with the idea that there are features of the world that determine not only what *is*, but what *might* be or *could* otherwise have been.[151] This distinction is an important one because it has implications for whether a piece of metaphysics qualifies as naturalistic. 'Spookiness', as we have seen, describes entities or properties that are not recognized by the sciences and are thus immediately and invariably objectionable to the naturalist. Objective modality, on the other hand, is by no means objectionable in this way. The sciences *do* recognize modality, which is to say that scientific theories go *beyond* mere descriptions of the *actual* course of natural events. As Ladyman puts it:

> Scientists never bother to formulate theories that only refer to what actually happens in the world; instead theories are always modalized in the sense that they allow for a variety of different initial conditions or background assumptions rather than just the actual ones, and so describe counterfactual states of affairs. (2000: 852)

[151] Here we pick up on a thread from **(3.2)**.

Whereas no science recognizes the existence of divine intervention or extra-sensory perception, then, 'there is a near-universal recognition that modality is central to science' (Ismael 2017: 109).[152] That one endorses a commitment to objective modality does not therefore provide sufficient reason to revoke one's naturalist credentials. And indeed, for many such a commitment follows directly from their commitment to naturalism. Ladyman and Ross, for example, argue that the modalized nature of scientific theories remains 'utterly mysterious' to constructive empiricists and other anti-realists who take science as a guide to ontology but nonetheless refuse to accept a commitment to objective modality (*ETMG*: 110).

Granted, there *are* forms of objective modality that sit uncomfortably with a commitment to naturalism. Take the semantics of modal claims (or the semantics of contemporary philosophical claims about modality) literally, for example, and we appear to commit ourselves to a massively inflationary ontology of infinite *real* possible worlds.[153] As Ismael remarks, however, 'it has never been clear what these [possible worlds] are, or how we could know about them' (2017: 109). And indeed, such worlds might very well qualify as 'spooky' in the sense outlined above.[154] Accordingly, those who endorse objective modality on naturalist grounds typically seek to describe modality as somehow encoded *within* the actual world. To repeat a claim from Ismael from earlier in this thesis **(3.2)**:

[152] Note that while constructive empiricists such as Bas van Fraassen *do* reject objective modality, they do so in virtue of their commitment to *empiricism*, *not* their naturalism. Even van Fraassen acknowledges the modalized construction and expression of scientific theories (1980: 158–203); he merely advises that we commit ourselves ontologically only to those parts of our theories that concern actual and observable phenomena. 'To be an empiricist', he writes, 'is to withhold belief in anything that goes beyond the actual, observable phenomena and to recognize no objective modality in nature' (1980: 202).
[153] Again, as in **(3.2)**, Lewis (1986) is the canonical representative of this position.
[154] Wüthrich (2020), for example, argues that since the ultimate nature of the world is most likely non-spatiotemporal, then our actual world cannot even be considered possible in Lewis's terms, since a possible world *is* for him fundamentally spatiotemporal: 'Lewis's […] pluriverse, for all its ontological abundance, does not contain our world' (2020: 233). Lewis's modal realism is therefore non-naturalistic.

> there is among many a desire to reject metaphysical commitment to non-actual, possible worlds. To satisfy that desire while preserving scientific practice, one needs an account of modality that makes modality *immanent* in the actual world, i.e., one that does not take the semantics of modal belief at face value.[155] (2017: 109; my emphasis)

The infinitely inflationary metaphysics of modal realism notwithstanding, then, the twofold point remains: not only is recognition of modality perfectly compatible with naturalism, but commitment to an *immanent* form of objective modality seems (to many) to follow directly from a commitment to naturalism.

So why think that those conceptual innovations of Deleuze's identified by Patton—namely, 'pure events, abstract machines and other kinds of virtual reality'—refer to this kind of modality and *not*, as Patton himself claims, to 'some decidedly "spooky" entities' (2016: 352)? Well, and to elaborate further on some claims made earlier in this thesis **(3.2)**, Deleuze's entire philosophical project can be characterized as an exercise in the metaphysics of modality. He might not approach the subject in the same way and with the same vocabulary as the analytic metaphysician, but it is not for nought that one commentator describes his philosophical vision as that of a 'purely modal […] universe' (Smith 2012: 37). Throughout his writings, Deleuze remains obsessed with *novelty* and *creativity*, with expressions of *power*, with *capacities* to affect and be affected, and with what bodies *can* do—in a word, with *difference*.[156] And

[155] Again, see also Vetter: 'Anyone who does not either deny modally loaded facts about the world, or outsource them to real other worlds—anyone, that is, who thinks that counterfactual or law-like, counterfactual-supporting statements are true in virtue of something in the actual world—has to include unrealized possibilities *in* actuality' (2009: 6; my emphasis).

[156] The language of 'novelty' and 'creativity' can be found, for example, in Deleuze's work on and references to Bergson; 'power' and 'with what bodies can do' his appreciation of Spinoza and Nietzsche; and 'capacities to affect and be affected' in, for example, *A Thousand Plateaus*.

any philosophy of difference—that is, any philosophy that attributes to difference a logically and metaphysically fundamental or primary status, and according to which the world, on its most basic description, can and does continuously prove to be otherwise—just *is* an account of a radical and metaphysically primitive form of objective modality.

More to the point, and as indicated above **(3.2)**, Deleuze assigns to philosophy the task of rejecting 'transcendence'. He admits of no purely intelligible domain of Platonic forms, nor of any other substance or mode of being external to or beyond that of the sensible—or nature.[157] And of course, the pursuit of 'immanence' is itself a constant and explicit theme within Deleuze's philosophical writings.[158] Not only is Deleuze committed to a form of objective modality, then, but he shares in the contemporary philosopher of science's commitment to an *immanent* form of objective modality—that is, a form of modality that is *part of* the real (in Deleuze's sense) or the actual (in the analytic sense) world.[159]

It is precisely this kind of objective modality, then, that I argue Deleuze articulates with his talk of 'pure events, abstract machines and other kinds of virtual reality'. For example, Patton himself observes that Deleuze—adopting resources from the respective histories of mathematics and philosophy—describes the virtual in terms of 'the differentials of virtual Ideas' (2016: 352). What he fails to observe, however, is that such descriptions are invariably *modal* in nature. 'Not only is the differential

[157] Designating transcendence as 'the poisoned gift of Platonism', Deleuze insists that 'Every reaction against Platonism is a restoration of immanence in its full extension and in its purity, which forbids the return of any transcendence' (1997b: 137; see also *DR*: 59). For more on Deleuze's philosophical relationship to Plato, see Smith (2012: 3–26) and de Beistegui (2012). For a more recent reappraisal of this relationship, see Altamirano (2015). For the connection between immanence and nature, or the project of articulating an immanent ontology and a (Lucretian) form of naturalism, see de Beistegui (2012) and Johnson (2017). For example: 'Lucretian atomism is a naturalism because it affirms the full immanence and productive power of nature from within; it takes nature alone as the object of speculative and practical philosophy, and it does so as a part of nature itself' (2016: 5).

[158] The notion of 'immanence' features prominently in Deleuze's first major book publication, *Empiricism and Subjectivity*, through to his final essay, 'Immanence: A Life…' (1997a).

[159] Again, for my account of Deleuze's distinctions between actuality and virtuality and between possibility and reality, see **(3.2)**.

relation the pure element of *potentiality*' (*DR*: 47; my emphasis), for Deleuze, but virtuality and potentiality are frequently and explicitly identified with one another: 'the potentiality of the Idea, its determinable virtuality' (*DR*: 201), 'a virtuality, a potentiality' (*DR*: 185), 'a potential or virtual object' (*DR*: 212), and so on.[160]

The same is true of those other concepts identified by Patton. With respect to the 'machinic' ontology of *A Thousand Plateaus,* for instance, Patton himself once again observes (at least implicitly) that Deleuze and Guattari present a radical and sophisticated account of immanent objective modality. He describes their related notion of 'absolute deterritorialization', for instance, as 'the immanent source of transformation, the reserve of freedom or movement in reality' (2016: 354). Again, however, he fails to observe that such an account is perfectly compatible with—and perhaps indeed entailed by—a commitment to naturalism in the ontological sense.

One final example. Patton cites Deleuze's interpretation and use of the 'Lucretian *clinamen*' as another one of those 'other kinds of virtual reality' (2016: 352). Originally postulated to accommodate free will, and to explain the collisions between Epicurean atoms in the void, 'the *clinamen*', Deleuze insists, 'is by no means a change of direction in the movement of an atom, much less an indetermination testifying to the existence of a physical freedom'. 'It is', rather, 'the *original* determination of the direction of movement, the synthesis of movement and its direction which relates one atom to another' (*DR*: 184; my emphasis). Deleuze, in other words, criticizes the Epicurean conception of the atom for retaining 'too much independence, a shape and an actuality' (*DR*: 184). That is, he rejects the idea that atoms are individuals with

[160] The modal nature of virtuality is evident even through Deleuze's collaborative work with Guattari. In *A Thousand Plateaus*, for instance, the terms 'potential' and 'virtual' are once again identified with one another (*ATP*: 99). And in *What is Philosophy?*, Deleuze and Guattari describe the virtual as 'containing all possible particles and drawing out all possible forms' (*WP*: 118). (An admittedly curious instance, given Deleuze's critique of the concept of possibility.)

intrinsic identity profiles, claiming instead that they are ultimately *relationally* constituted: 'it is indeed *essential* that atoms be related to other atoms' (*DR*: 184; my emphasis).[161] And the *clinamen*, on his view, reflects this fact, expressing 'a relation between the differentials of atoms in movement' or the '"multiple and non-localisable connections" established between particles' (*DR*: 184). Though he retains the idea that the *clinamen* reflects a certain indeterminacy or 'potentiality' (*DR*: 184), then, and is thus a *modal* notion, he nonetheless departs from any intended meaning or more conventional interpretation by regarding it not merely as some modification to the behaviour of already-constituted atoms in the Epicurean void, but as constitutive (and *differentially* so) of those atoms themselves—or as a key feature in those (virtual) 'structures which are actualised in sensible composites' (*DR*: 184). Once again, then, though this time appropriating alternative resources from the history of philosophy, Deleuze is describing an objective and metaphysically primitive (and thus immanent) form of objective modality. And, once again, Patton appears to be mistaken in interpreting otherwise.

5.1.2 Ansell Pearson and Protevi on Ontological Naturalism

Ansell Pearson and Protevi distinguish three versions of ontological naturalism. Their 'weak' version 'merely denies the existence and explanatory power of supernatural entities', thereby allowing 'entities and states emergent from and irreducible to the physical' (2016: 34). We can refer to this as a form of 'emergentism'.[162] Their 'strong'

[161] Compare with those lessons learnt from French and others concerning identity and individuality in quantum mechanics **(1.4)**.

[162] An important terminological note. Ansell Pearson and Protevi's identification of emergence with irreducibility to the physical suggests that their concept of emergence is comparable to the concept critiqued by Ladyman and Ross, which they draw from the early British Emergentist C. D. Broad.

version is 'nonreductive physicalism', which on their view allows for 'vital, social, or mental properties of physical events, but not vital, social, or mental states, […] thereby asserting a property dualism linked to a substance monism' (2016: 34).[163] Their 'superstrong' version is just '(reductive) physicalism', according to which 'only physical entities exist' (2016: 34).[164]

Contrary to Ansell Pearson and Protevi's claims, however, Ladyman and Ross point out that neither emergentism nor physicalism (of any of the varieties mentioned above) accurately reflect the metaphysical commitments of the sciences. For instance, not only do they claim that most arguments for physicalism 'are striking for the near total absence of reference to current scientific theories or results' (*ETMG*: 39), but they also provide several scientifically informed arguments for why almost all forms of physicalism fail to qualify as naturalistic.

Consider, for example, their 'epistemic success argument' (*ETMG*: 41)—which is also serves as an argument *against* conceptualizing 'naturalism' as distinguishable

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Emergentism, on Broad's account, claims that the behaviour of an emergent whole '*could* not, even in theory, be deduced from the most complete knowledge of the behaviour of its components, taken separately or in other combinations, and of their proportions and arrangements in this whole' (1925: 59). Though I attribute this notion of emergence to Ansell Pearson and Protevi going forward, note that Protevi elsewhere provides a different and more specific definition of emergence as 'the (diachronic) construction of functional structures in complex systems that achieve a (synchronic) focus of systematic behaviour as they constrain the behaviour of individual components' (2006: 19; see also Bonta and Protevi 2004: 32). It is possible that Ladyman and Ross might be more accepting of this description, as they are with those of Kauffman (1995) and Forrest (1991) (see *ETMG*: 45)—in particular because Protevi also claims to dispense with the 'levels' metaphor and 'the false problem of "downward causation"' (2006: 20), and to deemphasize 'the part/whole relation of synchronic emergence' (2006: 24), with which notions of emergence are often associated. An investigation of this possibility must be the subject of future work. Here I focus on Ansell Pearson and Protevi (2016) because they, and neither Protevi (2006) nor Bonta and Protevi (2004), explicitly claim to deal with Deleuze's naturalism.

[163] Two remarks on Ansell Pearson and Protevi's use of 'nonreductive physicalism'. First, no contemporary naturalist accepts the existence of 'vital' forces or vital properties (see Brown and Ladyman 2009: 37; see also *ETMG*: 42). Second, though they distinguish nonreductive physicalism from (what we are calling) emergentism at the start of their essay, they appear to conflate the two when discussing Hans Jonas's account of a 'nonreductive physicalist and hence emergent status for organismic life' (2016: 37).

[164] Ansell Pearson and Protevi appear to conflate reductive physicalism (roughly, the view that putatively non-physical entities or properties are *identical to* physical entities or properties) with eliminativism (the view that *there are no* putatively non-physical entities or properties) when describing the 'eliminative posture' of the former and the subsequent 'dispensability of the notion of vital, social, or mental properties' (2016: 34).

into an ontological and a methodological sort. Physicalism is a metaphysical thesis that privileges the subject matter of physics, thereby casting doubt on the ontological seriousness of all other entities. But, Ladyman and Ross observe: 'There is a tension between the goal of providing a naturalist defence of physicalism, and that of making physicalism an ontological thesis but not an epistemological one' (*ETMG*: 40). Assuming physicalism is not just some view about the blind, speculative harmony of one's metaphysical commitments with those of the sciences, it must be *motivated* by science in some important respect. Such motivation must take the form of *evidence*, Ladyman and Ross argue, 'and such evidence will consist in a catalogue of explanatory—that is, epistemological—successes' (*ETMG*: 40). And yet, such evidence cannot imply physicalism because all kinds of sciences other than physics enjoy such success. Thus:

> a responsible naturalist who defers to science as it stands in matters of belief formation will find herself ontologically committed to all sorts of entities and properties that aren't straightforwardly physical, in the sense of being studied as such by physicists. (*ETMG*: 40)

As with the causal closure thesis examined above, Ladyman and Ross argue that physicalism is motivated largely by our neo-scholastic worldview. Again, we model the world in terms of individuals interacting with one another in various causal and compositional ways. We observe the relations between sand and sandcastles, bricks and walls, people and communities, foodstuff and sandwiches, and are led to suppose—with the help of a domesticated image of classical physics—that the world consists of sub-microscopic entities that occupy some ontologically foundational or fundamental

position, either within a cascading series of asymmetrical determining relations between parts and wholes, or within a hierarchy of 'levels', often associated with the divisions between scientific disciplines—the physical, the biological, and the neurological, to borrow Ansell Pearson and Protevi's own examples (2016: 34). It is this supposition that leads physicalists to conclude that the metaphysical commitments of the special sciences, or those entities that are not themselves the subatomic building blocks of physics, are either not real or otherwise 'inherit [their] ontological seriousness from their relationship to physics' (*ETMG*: 298). In other words:

> commitment to a world of levels strictly composed out of deep-down little things has played an essential role in leading neo-scholastic metaphysicians to cast doubt on the ontological seriousness of all the special sciences. This is very far-reaching anti-naturalism. (*ETMG*: 193)

As the just-cited passage suggests, Ladyman and Ross sometimes appear to conflate what Hüttemann and Papineau argue are two distinct variants of the physicalist view—referred to as 'part-whole' and 'levels' physicalism respectively (2005). Nonetheless, Ladyman and Ross do observe Hüttemann and Papineau's claim that the two can and should be treated independently, and thus provide distinct arguments against each formulation.

Against 'part-whole' physicalism—or the view that all macrophysical entities 'are asymmetrically determined by their microscopic physical parts and the microscopic physical laws that apply to those parts' (Hüttemann and Papineau 2005: 34)—they simply cite Hüttemann and Papineau's argument to the effect that there is nothing in such composition relations that implies an *asymmetrical*—rather than, say,

a *reciprocal*—determination relation between parts and wholes (*ETMG*: 41; see Hüttemann and Papineau 2005: 36–37). Where the mass of some macrophysical system, to borrow Papineau and Hüttemann's example, is equal to the total mass of the microphysical subsystems that comprise it, this equivalence relation in and of itself does *not* privilege those subsystems or suggest that they asymmetrically determine the mass of the whole. Partial information regarding the relevant masses, for instance, is sufficient to determine the mass of the rest—whether that be the total mass of the system, or that of a particular subsystem. 'The […] relation of parts and wholes thus seems to imply no asymmetric determination of the macromass, but simply a mutual dependence of parts and wholes' (Hüttemann and Papineau 2005: 36–37).[165]

Against 'levels' physicalism, Ladyman and Ross deny the requisite 'fundamental framework within which to describe the levels against which everything else exists' (*ETMG*: 179). That is to say, the idea that the world is organized into levels presupposes some absolute metric against which such levels can be measured or understood. But there is no scientific evidence to suppose that any such metric exists, and indeed much to suggest that *no* such metric exists. One obvious candidate for such a metric, for example, is size: the 'lowest' or fundamental level consisting of subatomic particles, the 'higher' levels consisting of increasingly complex entities—from atoms, molecules and single-celled organisms to larger animals, tectonic plates and galaxies. And yet, as we have already seen, and as Ladyman and Ross point out once more, physicists 'regard the structure of space and the metric used to measure length as themselves emergent structures' (*ETMG*: 179). Size therefore fails to qualify as an

[165] Incidentally, Ladyman and Ross also argue that composition in science 'is usually a dynamic and complex feature that is much more interesting than its metaphysical counterpart' (*ETMG*: 21), and DeLanda makes a similar point on behalf of Deleuze's philosophy of difference. And *both* Ladyman and Ross and DeLanda cite philosopher of chemistry Jaap van Brakel's work (see van Brakel 2000; cited in DeLanda and Harman 2017: 63–64; and see van Brakel 1986; cited in *ETMG*: 21, n.26).

appropriate comparative scale for measuring putative levels against one another. More to the point, the very fact that metrics such as space and time appear to be emergent phenomena in the first place implies what Ladyman and Ross refer to as the 'scale relativity of ontology', which they describe as the hypothesis that 'claims about what (really, mind-independently) exists should be relativized to (real, mind-independent) scales at which nature is measurable' (*ETMG*: 200).[166] That is to say, and despite what the homely metaphor of levels suggests, the world does *not* exhibit the same basic character at each and every scale of measurement. As Ladyman writes in a later essay: 'The microworld is not just a smaller version of the macroworld in the sense that the laws of nature seem to care about length scales, energy scale, and velocity' (2017: 158). Just as we cannot focus visually on objects that are close at hand and far afield *at the same time*, then, Ladyman and Ross argue that neither can we hold the respective ontologies of, say, quantum mechanics and microbiology in one and the same 'conceptual horizon', so to speak.[167] If we are indeed to be properly naturalistic, on Ladyman and Ross's view, then we must accept that our metaphysical commitments will change depending upon the scales at which we measure the world. For example:

> at the quantum scale there are no cats; at scales appropriate for astrophysics there are no mountains; and there are no cross-elasticities of demand in a two-person economy. (*ETMG*: 199)

[166] Incidentally, DeLanda also advocates the scale relativity of ontology: 'The world may be mind-independent but it is not *scale-independent*' (DeLanda and Harman 2017: 22).
[167] Note that such relativity does not express a fact *about us*. Just as it is a fact *about light* that (ordinary) lenses cannot hold objects close at hand and far away in focus simultaneously, so too is it a fact *about the world* that not all of its features exist in all contexts.

As with the epistemic success argument above, then, the sciences recommend an egalitarian attitude toward their metaphysical commitments. If such commitments cannot be set 'side by side', so to speak, along some universal scale denoting ontological priority, then we ought to take each and every one of them equally seriously. 'Good generalizations at any scale deserve the same scientific respect' (*ETMG*: 51). And, as Ladyman himself later makes clear: 'The ontological commitments of the special sciences should be taken as metaphysically on a par with those of physics' (2017: 152). These arguments apply just as much to emergentism as they do to physicalism, on Ladyman and Ross's account, as the former 'warrants its name because it holds that "higher" levels of organization "emerge" indeterminably out of "lower" level ones' (*ETMG*: 56).

Ultimately, then, neither Patton nor Ansell Pearson and Protevi provide an adequate conception of ontological naturalism. Where Patton betrays his neo-scholasticism by making causation fundamental, Ansell Pearson and Protevi do the same by appealing to an image of the world as either mereologically composed of parts and wholes or otherwise organized into levels between which supervenience or reduction relations may or may not obtain. And, as we will now see, similar arguments can be levelled against their respective account of *methodological* naturalism.

5.1.3 Methodological Naturalism

Patton and Ansell Pearson and Protevi hold similar accounts of methodological naturalism. The latter, for instance, distinguish three versions of the view. 'Weak' methodological naturalism 'asserts a *compatibility* between the goals and methods of philosophy and natural science, so that they can and should inform each other, even

though philosophy maintains its specificity and independence from science' (Ansell Pearson and Protevi 2016: 34; my emphasis). 'Strong' methodological naturalism, on the other hand, 'asserts a *continuity* between philosophy and natural science, so that philosophy has no real independence', whereas 'superstrong' methodological naturalism is just 'scientism', according to which 'only natural science produces meaningful statements, credence-worthy beliefs, and so on' (2016: 34; my emphasis). And similarly, Patton distinguishes between weaker and stronger versions, according to which 'natural science is a privileged if not the only form of knowledge and that, to the extent that philosophy aims to produce knowledge, it is continuous with science' (2016: 351).

Now, perhaps the most obvious feature of both accounts is that they restrict all forms of methodological naturalism to *natural* science. Note, however, that by describing naturalism in this way both Patton and Ansell Pearson and Protevi exhibit the same physicalist tendencies criticized above (or they are arbitrarily selective in their choice of *which* scientific disciplines warrant philosophical attention). To recapitulate: both the scale relativity of ontology and the epistemic success argument suggest that we adopt an egalitarian attitude toward the sciences and their metaphysical commitments. Thus, the methodological naturalist (of any strength) ought to defer just as much to economics, behavioural psychology and linguistics as they do to physics, chemistry and biology.

Already, then, both Patton and Ansell Pearson and Protevi's accounts of methodological naturalism appear to be just as enmeshed in neo-scholasticism as their accounts of ontological naturalism. That being said, the question of *which* sciences are subject to the methodological naturalist's deferential attitude is perhaps not quite as pertinent as the question of that deferential attitude itself—that is, its scope and limits.

What is at stake in the question of methodological naturalism is, for Ansell Pearson and Protevi, the 'specificity and independence' of philosophical inquiry. The weakest version preserves this independence, whereas the strongest version eliminates the need for philosophical inquiry altogether. The same concern is evident in Patton, who distinguishes weaker and stronger versions of methodological naturalism according to the extent to which they allow for 'distinct philosophical knowledge and ways of knowing' (2016: 351). The ambiguities surrounding precisely what one means by 'specificity', 'independence' and 'distinctness' here notwithstanding, we have scientifically informed reasons for rejecting the idea that commitment to methodological naturalism can be graded in this way. That is to say, both 'weak' and 'superstrong' or 'scientistic' methodological naturalism prove to be *non*-naturalistic upon closer examination.

Let us remind ourselves, for instance, that we are concerned with the relationship between science and philosophy *qua metaphysics*. Presumably, then, we ought to acknowledge a *continuity* between philosophy and science in so far as *both* aim to describe what the world is really like—albeit to differing degrees of generality. Wanting to secure the autonomy of metaphysical inquiry, the weak methodological naturalist might insist that only metaphysics produces knowledge of the world as it is in itself while the sciences provide beliefs about the world only in accordance with some preestablished conceptual framework that is itself misrepresentative of what the world is *really* like. Such a claim, however, faces the challenge of well-known 'no miracles' style arguments in favour of scientific realism. That is to say, and as we have already seen **(1.1)**, the unparalleled empirical and predictive success of the sciences can only be explained by the fact that they *do* in fact track what the world is really like—

even if only to some degree of approximation. To deny that science yields genuine metaphysical insight, then, is to render the success of science a mystery.

As for 'superstrong' methodological naturalism, consider Ladyman and Ross's own view as counterexample. Though they do not embrace the terminology, they identify themselves as 'radical methodological naturalists' (*ETMG*: 27). They even openly confess that their admiration of science extends 'to the point of frank scientism' (*ETMG*: 61). And yet, they assign to philosophy or metaphysics *its own* distinctive task—namely, that of providing a general ontological framework for scientific theories and hypotheses. We consider this task in greater detail in the next section. For now, the point to recognize is that Ansell Pearson and Protevi's suggestion that 'superstrong' or 'scientistic' methodological naturalism eliminates the need for metaphysical inquiry altogether is itself based on metaphysical assumptions that are in fact non-naturalistic. For to suggest that metaphysics is made redundant in this way, one must claim *either* that all science reduces to physics and that physics exhaustively describes the world *or* that the world is fundamentally disunified and there can be no account of the world that generalizes beyond each specific science's own domain of description. The former position is just a form of physicalism and can be rejected for reasons detailed above. The latter position, though famously held by philosophers of science such as Cartwright (1999) and Dupré (1993), is equally non-naturalistic according to Ladyman and Ross—as indeed we saw in a previous chapter **(2.1)**. To recapitulate: rather than implying disunity, the sciences do in fact trend towards increasingly unified explanations of phenomena. Though once considered independent, for example, electricity and magnetism are now explained by a single theory. And, to borrow an example from Friedman, the kinetic theory of gases provides a unificatory explanation for the Boyle-Charles law, Graham's law, and the specific-heat capacities of particular gases (1974:

14–15). Moreover, recall Ladyman and Ross's claim that 'a stranded hypothesis represents a mystery' for the scientist, and thus 'calls out for scientific work aimed at eliminating it' (*ETMG*: 27). That is to say, integrability is a significant source of justification for scientific theories, suggesting that they provide good explanations, and so lack of such integrability is usually cause for suspicion.

That both the history and practice of scientific inquiry exhibit this unificatory tendency, together with their extraordinary successes, suggests that the world *is* in fact unified and is thus amenable to some maximally general description. Thus, and 'partly because important efficiency considerations recommend disciplinary specialization', metaphysics inherits the task of articulating such a description—or it becomes 'the enterprise of critically elucidating consilience networks across the sciences' (*ETMG*: 28).

In summary, to suggest that metaphysics and science are entirely independent enterprises runs the risk of making the success of science a miracle, and even self-professed and radically 'scientistic' philosophers such as Ladyman and Ross refuse to accept the notion that *only* science (natural or otherwise) 'produces meaningful statements, credence-worthy beliefs, and so on' (Ansell Pearson and Protevi 2016: 34). Contrary to both Patton and Ansell Pearson and Protevi's claims, then, there appears to be no (properly naturalistic) version of methodological naturalism according to which metaphysics is *not* continuous with the sciences in the relevant sense and does *not* have some important contribution to make. Though, as we have seen, even then the 'strong' version of methodological naturalism (in Ansell Pearson and Protevi's terms), which itself endorses the continuity of metaphysics and the sciences, needs to be modified to reflect the latter's more egalitarian commitments.

5.1.4 Going Forward

I hope to have shown that these more prominent attempts to make sense of Deleuze's naturalist status within the literature fail, and that they do so because, in their efforts to establish some kind of standard for *what naturalism is*, they fail to reflect the commitments of the sciences and otherwise suffer from lack of engagement with contemporary philosophy of science. To recapitulate: Patton's account of ontological naturalism fails because he draws on causal closure accounts; Ansell Pearson and Protevi's account fails because they appeal to neo-scholastic wisdom regarding different forms of physicalism; and both their accounts of methodological naturalism fail because they still adopt this neo-scholastic physicalist framework, they fail to appreciate that the success of the sciences implies that they yield some metaphysical insight, and they fail to appreciate that the sciences imply some maximally general and unificatory description of the world. Similarly, Patton mistakenly attributes to some of Deleuze's concepts a 'spooky' status when in fact they represent a form of immanent objective modality that is perfectly compatible with a commitment to naturalism.

The question thus arises as to how those interested in the role of science and mathematics in Deleuze's philosophical writings ought to proceed. And part of the project of this thesis is to answer this question. Until it can be shown that Deleuze does in fact attribute to the world some metaphysical feature that is *not* recognized by the sciences (as, for example, Patton attempts to do with his claims regarding 'spookiness'), then it seems as though his thought can be considered to be naturalistic in the ontological sense. The *real* question, it would seem, is whether Deleuze is naturalistic in the methodological sense—that is, whether Deleuze's many references to the sciences and mathematics play some evidentiary or explanatory role in the articulation

of his metaphysics of difference. I return, and attempt to explore an answer, to this question in a following section **(5.3)**.

5.2 Naturalism and the Primacy of Physics

Having extended Ladyman and Ross's critique of neo-scholasticism in the analytic tradition to those who attempt to make sense of Deleuze's naturalist status, I now want to subject Ladyman and Ross's own positive account of naturalism to greater scrutiny. In particular, I want to ask whether their principle of naturalistic closure is best articulated alongside their primacy of physics constraint, or whether such a constraint ought best to be abandoned. I will present various challenges to the primacy of physics constraint and provide an alternative conception of naturalistic metaphysics.

5.2.1 Why the Primacy of Physics?

Let us briefly revisit the so-called Primacy of Physics Constraint and acknowledge its motivations. As we have already seen **(2.1)**, Ladyman and Ross maintain that naturalistic metaphysics proper is the enterprise of 'critically elucidating consilience networks across the sciences' (*ETMG*: 28), or of articulating a unificatory ontological framework that makes sense of multiple scientific hypotheses, where at least one such hypothesis must always come from fundamental physics. This latter clause of their Principle of Naturalistic Closure is then further clarified and justified by the Primacy of Physics Constraint, which states:

> Special science hypotheses that conflict with fundamental physics, or such consensus as there is in fundamental physics, should be rejected for that reason alone. Fundamental physical hypotheses are not symmetrically hostage to the conclusions of the special sciences. (*ETMG*: 44)

Again, and as acknowledged in a previous chapter **(2.1)**, Ladyman and Ross justify this claim by appealing to the history and practice of science. On their view, a Primacy of Physics Constraint does indeed appear to have emerged as a 'methodological rule' (*ETMG*: 38) or 'regulative principle' (*ETMG*: 44) in the construction of scientific theories, and such a principle appears to be justified by the history of science—numerous physical explanations of physical phenomena having been incredibly successful, no non-physical explanations of putatively non-physical phenomena having been successful, and various physical explanations of those same phenomena having been successful in their place. Thus, the Primacy of Physics Constraint 'is a regulative principle in current science, and it should be respected by naturalistic metaphysicians' (*ETMG*: 44)—and this because naturalistic metaphysics should seek to emulate scientific practice where possible.

5.2.2 What Work is the Primacy of Physics Constraint Doing?

The emulation of scientific practice is the only motivation explicitly stated by Ladyman and Ross for incorporating a primacy of physics constraint into their principle of naturalistic closure. That said, we can easily extrapolate and articulate the work done by such a constraint in metaphysical theory construction.

In the first instance, the primacy of physics constraint serves to filter out any potential inclusion of non-naturalistic, scientific-appearing hypotheses within metaphysical deliberation—as in the above case of a vital force theory, for instance. A vital force theory supposes that living systems can be described and explained in terms of a putative (non-physical) vital force alone. It thus conflicts with the relevant physics once physical explanations are offered for the same phenomena and must, therefore, and as we have just seen, 'be rejected for that reason alone' (*ETMG*: 44).[168] The primacy of physics constraint, in other words, ensures that only bona fide science makes it onto the metaphysician's conceptual workbench.

In the second instance, the constraint serves to prevent the extension of neo-scholastic notions into our most general metaphysical description of the world. Plenty of bona fide special scientific hypotheses deal with objects, for instance; just as plenty (or perhaps all) such hypotheses adopt a spatiotemporal framework. As we have already seen, however, fundamental physics eliminates (or promises to eliminate in the case of spacetime) each of these notions from its conceptual and descriptive machinery. Though a naturalistic metaphysics must indeed accommodate such bona fide special scientific hypotheses into its unificatory enterprise, then, it must also exclude such objectival and spatiotemporal content from its ultimate description of what the world is really like and instead provide a way of rearticulating these special scientific hypotheses in its own, more general, metaphysical terms (as Ladyman and Ross do with their talk of real patterns).

[168] Ladyman and Ross admit that 'mechanists' (classical or Newtonian mechanics being the reigning physical theory of the time) 'were initially unable to explain' those phenomena purportedly explained by vital or equivalent forces (*ETMG*: 42). It seems, then, for a limited time at least, that such forces did *not* violate the primacy of physics constraint and thus *did* qualify as bona fide science (even if they were ultimately disproven).

Any putatively metaphysical hypothesis that fails to take some part of fundamental physics into consideration therefore risks allowing into our most general description of the world some piece of descriptive or conceptual machinery that is *not* represented in physics and therefore ought *not* to feature in that description. For this reason, Ladyman and Ross claim that

> a [metaphysical] hypothesis that unified specific hypotheses from sciences other than fundamental physics, but unified them with no specific hypotheses from fundamental physics, would not be a metaphysical hypothesis. It would instead be a hypothesis of a special science of wider scope than those it partially unified. (*ETMG*: 37)

Note here, then, that the primacy of physics constraint is especially important for Ladyman and Ross as, on their view, it is 'contemporary physics [that] motivates a metaphysics of *ontic structural realism*' (*ETMG*: 44). Without the primacy of physics constraint, in other words, they lose any warrant for their structuralist metaphysics.

5.2.2 Against the Primacy of Physics Constraint

I now provide a few arguments, in order of what I consider to be increasing strength, for why one might want to relinquish their commitment to the primacy of physics constraint.

i. A concern about generality.

We saw (though did not elaborate) in a previous chapter that Ladyman and Ross index their account of naturalistic metaphysics to scientific hypotheses that are *contemporary* to that metaphysics **(2.1)**. That is, any metaphysical claim advanced at time *t* should seek to unify scientific hypotheses, where '"scientific hypothesis" is understood as an [*sic*] hypothesis that is taken seriously by institutionally bona fide science at *t*' (*ETMG*: 38). This qualification nicely allows Ladyman and Ross to claim *both* that we ought to accept their metaphysics *and* that we ought to expect it to prove false at some future time. As they put it: 'we expect that our particular positive account of the nature of the world will be deemed mainly or perhaps even entirely incorrect by future philosophers who will know future science' (*ETMG*: vii). This qualification also allows for the study of a history of metaphysical accounts—going back through Descartes, Spinoza and Leibniz, all the way to Lucretius and the pre-Socratics—that may or may not legitimately count as naturalistic according to Ladyman and Ross.

But, and as we have just seen, by endorsing the primacy of physics Ladyman and Ross also index their account of naturalistic metaphysics to the actual history of science. Thus, metaphysics for them is no longer the best and most general description of what the world is really like at time *t*, given the science at time *t*. Rather, it is the best and most general description of what the world is really like at time *t*, given the science at time *t*, and given the particular history of science leading up to time *t*. In light of such further indexing, one might object that here Ladyman and Ross fail to do justice to the *degree of generality* at which metaphysics aims—affording, as it does, our *most general* description of what the world is really like, or constituting, as Moore puts it, 'the *most general* attempt to make sense of things' (2012: 1; my emphasis). Surely metaphysics ought not to depend on the contingencies of the history of science and instead provide

our most general description of the world *regardless of how that history may or may not have turned out*.

One possible line of response here would be to insist that there is no real contingency. Our metaphysical description of the world is not subject to change depending on the history of science because either that history *could not* turn out any other way, or the metaphysics would remain the same regardless of how this history turned out.[169] Note, however, that this particular line of approach is not available to Ladyman and Ross, as adopting it would mean violating their commitment to naturalism. They cannot make claims that are not themselves warranted by the sciences, and no science affords us knowledge of such alternate histories.

Thus, Ladyman and Ross appear to be committed to biting this particular bullet. It is just a demand of naturalistic metaphysics that it reflects the historical and institutional norms of science, and so their metaphysical description of the world, given the further indexing just specified, *does* in fact attain the highest degree of generality available to a sufficiently naturalistic metaphysics (which is the only form of legitimate metaphysics on their view). This specified indexing, in other words, just *is* the relationship that must obtain between a properly naturalistic metaphysics and the sciences:

> we see no direct objection to indexing the naturalistic constraints on metaphysical hypotheses to historically adjustable norms. After all, the point of such a constraint is to require metaphysicians to be motivated by what the scientific communities with which they are contemporary find significant; we

[169] Ladyman and Ross do claim the primacy of physics to be 'contingent', and so the first option described here is not available to them (*ETMG*: 251).

should not demand that metaphysicians be more prescient than the scientists of their times. (*ETMG*: 34–35)

The very suggestion that metaphysics might grasp at a degree of generality beyond that specified above, then, is itself non-naturalistic on Ladyman and Ross's account. Still, those with grander metaphysical sensibilities might yet baulk at this requirement.

ii. Ontological parity.

Another, and perhaps the most obvious, complaint that one might level against the primacy of physics constraint is that it appears to be in tension with ontic structural realism itself. 'The tentative metaphysical hypothesis of this book', Ladyman and Ross write, 'is that there is no fundamental level' (*ETMG*: 178). And, in the place of fundamentality and the attendant notion that the world is organized according to some kind of asymmetrical hierarchy of ontological priority, they insist upon the ontological parity of everything that is. Everything that is real is so *equally*. Recall their claim that: 'Prices, neurons, peptides, gold, and Napoleon are all real patterns, existing in the same unqualified sense as quarks, bosons, and the weak force' (*ETMG*: 300). And yet, Ladyman and Ross are 'committed to a generic *asymmetry*' in the form of their primacy of physics constraint: 'special sciences do not relate to physics the way that it relates to them' (*ETMG*: 39). Their metametaphysical account of what counts as naturalistic metaphysics therefore seems to sit uneasily with that metaphysics itself—the latter describing a world of ontological parity or equivalence; the former according to (fundamental) physics a special status among the sciences. This is especially concerning, given their claim, much earlier in their book, that 'naturalistic

metametaphysics […] should be based on naturalistic metaphysics, which should in turn be based on science' (*ETMG*: 6).[170]

Ladyman and Ross *are* aware of this concern, which can also be expressed by the fact that they reject any strong notion of ontological fundamentality while also endorsing a distinction between special science and 'fundamental' physics: 'Our distinction must obviously avoid identifying the "fundamental" with the study of "ultimate building blocks" out of which everything else is composed' (*ETMG*: 238). In other words, while they deny that the *subject matter* of fundamental physics enjoys any special *ontological* status or priority, they do confer '*epistemic* priority' upon said physics (*ETMG*: 37)—that is, in the form of the primacy of physics constraint.

To see how they make sense of this (merely) epistemic distinction, consider the distinction they draw between the kinds of real patterns dealt with by special science and fundamental physics respectively. As we have already seen, Ladyman and Ross claim that the putative objects of the special sciences are actually 'real patterns' **(2.2)**. They also acknowledge, however, that because of our limited vantage point as observers, we can never have complete knowledge of any real pattern: 'No observer ever has access to the complete extent of a real pattern' (*ETMG*: 241). Thus, and to borrow their own example, we can never possess *complete* knowledge of the real pattern 'Napolean', for instance, because, though he in principle enjoyed a definite number of hairs on his head at different times, numbers that were in principle accessible during these times, such numbers are now forever lost to us:

[170] Curiously, and despite the order of explanation implied by this passage, Ladyman and Ross *first* articulate their metametaphysics (based on consideration of the sciences) and *then* articulate the metaphysics that issues from it. At no point does their naturalistic metaphysics—that is, their ontic structural realism—itself inform the naturalistic metametaphysics set out and established in the very first chapter of their book.

> All sorts of inferences about the state of Napoleon's hair […] could be made from the inaccessible information if we had it, so there are aspects of the real pattern that is Napoleon—projectible, non-compressible regularities—we are missing and can't get. Such is the fate of observers. (*ETMG*: 241)

Despite this incomplete knowledge, however, historians obviously *are* capable of tracking the pattern 'Napoleon' with great reliability. And this because, as Ladyman and Ross explain, they have in fact fastened onto an appropriate proxy for this complete pattern—namely, 'Napoleon' as object (or person) possessing whatever properties that we (or historians) *do* in fact know he possessed. In so far as we 'represent' the complete real pattern to ourselves by means of this proxy, Ladyman and Ross label this proxy-pattern a 'representational' real pattern—otherwise described as 'second-order' with respect to the pattern it represents. And, accordingly, they describe those real patterns that are not themselves representational or second-order upon some other pattern 'extra-representational' (*ETMG*: 243). Whereas the special sciences deal exclusively with representational real patterns, then, 'fundamental physics directly studies extra-representational real patterns' (*ETMG*: 298).

Now, Ladyman and Ross take pains to emphasize that this is *not* an *ontological* distinction: '"Being second-order" is not a property of a real pattern that makes it "less real"' (*ETMG*: 243). Representational real patterns, in other words, are no less real than extra-representational ones. Indeed, the 'complete' Napolean pattern referred to above is just as much an example of an *extra*-representational real pattern as an electron, and so, for Ladyman and Ross, there *are* in fact all manner of extra-representational patterns at which the sciences, both special and fundamental, aim; it is merely the case that fundamental physics, owing to the character of its methods and subject matter, is able

to access its target extra-representational real patterns without relying upon additional representational tools.[171]

But none of this explains the epistemic priority accorded to fundamental physics. There must be *something* that distinguishes the representational real patterns studied by special science—and, presumably, the extra-representational patterns such representational real patterns represent—from those extra-representational real patterns studied by fundamental physics *such that* the relevant asymmetry between fundamental physics and special science arises. And it is *here* that Ladyman and Ross introduce what does in fact appear to be an *ontological* distinction—one that violates their already-noted claims to parity. That is, they introduce what they call 'universal real patterns' (see *ETMG*: 250–51), the term 'universal' expressing the fact that measurements taken *anywhere* at *any time*—that is, *universally*—carry information about such patterns:

> there are some real patterns about which measurements taken *anywhere in spacetime at any scale of measurement* carry information […]. Fundamental physics is that part of institutional science responsible for trying to discover maximally redundant real patterns. (*ETMG*: 251)

It is *this* universality or 'maximal redundancy' that, on Ladyman and Ross's account, *explains* the apparent epistemic priority enjoyed by fundamental physics:

> The hypothesis that there is a true fundamental physics explains our observation of the PPC [primacy of physics constraint]: every measurement of some real

[171] Note that Ladyman and Ross can make this claim because, in essence, they offer a functional definition of fundamental physics. Fundamental physics, for them, just *is* 'that part of physics about which measurements taken anywhere in the universe carry information' (*ETMG*: 55).

> pattern on a scale of resolution appropriate to a special science that studies real patterns of that type must be consistent with fundamental physics. (*ETMG*: 252)

And this is *because* fundamental, or 'universal' extra-representational, real patterns are those about which any measurement whatsoever carries information. The difference between those real patterns studied by special science and those studied by fundamental physics, then, simply cannot be merely epistemic or pragmatic or part of some purely methodological conceit. That is to say, once we turn to describe *that in virtue of which* the relevant asymmetry arises, then the distinction becomes ontological. And it is by drawing such an ontological distinction in order to uphold this supposedly merely epistemological asymmetry that they undermine their repeated claims that the special sciences, and their ontological commitments, count as 'full, first-class, citizens' (*ETMG*: 300) in the ontology of science.

iii. Emulating the modalized nature of scientific theories.

Another argument revisits the idea that the history of science could have gone otherwise and points out the tension between having one's metametaphysics emulate *one* aspect of scientific theory construction and having it emulate another, arguably more important, aspect.

Recall the fact that scientific theories themselves describe not just *actual* states of affairs but provide descriptions of what *would* have happened had things gone otherwise. To repeat a passage cited earlier from Ladyman:

> Scientists never bother to formulate theories that only refer to what actually happens in the world; instead theories are always modalized in the sense that they allow for a variety of different initial conditions or background assumptions rather than just the actual ones, and so describe counterfactual states of affairs. (2000: 852)

Just as a scientific theory allows for counterfactual knowledge of different evolutions of the systems they describe, then, why not suppose that metaphysics ought to do precisely the same with respect to *its* subject matter—namely, the unified network of consilience relationships that obtains between scientific theories and hypotheses?

Ladyman and Ross admit that the primacy of physics constraint, though 'historically supported', is nonetheless 'contingent' (*ETMG*: 251). It seems reasonable to suppose, then, that different evolutions of the history of science might have occurred—one possible evolution, for example, being that in which *biology* is the most advanced science, with physics and chemistry still mired in talk of a luminiferous aether and processes of dephlogistication. To accommodate the possibility of such circumstances, and indeed to better emulate the modalized nature of scientific theories, it seems as though our metametaphysical account of what counts as naturalistic metaphysics should relinquish the primacy of physics constraint.

This conclusion seems especially apt given the importance placed upon a commitment to objective modality by Ladyman (2000, 2004) and Ladyman and Ross (*ETMG*). As we saw in an earlier chapter **(1.3)**, their ontic structural realism can be described as a 'modal structural empiricism' (*ETMG*: 99) in so far as its ultimate claim is that 'science describes the objective modal structure of the world' (*ETMG*: 130)—and that such structure *is all there is*. Their commitment to a form of objective modality

is what separates their position from constructive empiricism, and it is what makes their structuralism a form of realism. Their commitment to objective modal structure is therefore so essential to their understanding of the sciences and the metaphysics they entail that it strikes one as odd, and perhaps even borderline inconsistent, to forgo this commitment in their metametaphysics in favour of their primacy of physics constraint.

iv. 'Maximally conciliatory' as the new standard.

I now propose that the primacy of physics constraint be abandoned in favour of the weaker and more neutral requirement that metaphysics aim at a 'maximally conciliatory' account of the relationships between scientific theories and hypotheses. In essence, then, I am simply endorsing the principle of naturalistic closure, *minus* Ladyman and Ross's qualification that at least one of those scientific hypotheses under consideration always come from 'fundamental' physics. I will show that the concern with maximal conciliatoriness still issues in a metaphysics of ontic structural realism, still does the relevant work that the primacy of physics constraint is supposed to do, and does this all while avoiding each of the challenges (*i*–*iii*) just mentioned.

Consider, for instance, the tasks accomplished by the primacy of physics constraint above: namely, ensuring that only bona fide science makes it onto the metaphysician's conceptual workbench, as well as filtering out any vestiges of neo-scholasticism from said science. In our above case of a vital force (or equivalent) theory, for example, Ladyman and Ross claim the problem to be that such a theory conflicts with the physics. I argue, however, that here 'consistency with the physics' is a proxy for 'maximally conciliatory'. That is to say, the problem is *not* that our vital force theory (or equivalent) conflicts with the physics; the problem is that such a theory represents

a ‘stranded hypothesis’ that cannot be reconciled with our already interconnected body of scientific belief—of which our physics just so happens to be a part, given the actual (though contingent) history of science. Had this history developed another way, with biologists studying neurons and cells but with physicists still talking about the aether and phlogiston, then the *physics* would be the object of scrutiny—talk of phlogiston, for instance, conflicting with our more conciliatory biological talk of respiration and other processes involving oxygen.

With respect to the task of filtering any neo-scholastic temptations from bona fide science, the process and outcome remain unchanged. A maximally conciliatory metaphysics will include consideration of the relevant and appropriate physics—though just because such a metaphysics aims at *maximal* conciliation; *not* because it affords physics some special priority. Accordingly, the lessons learnt in our first chapter concerning identity and individuality (or the lack thereof) in quantum mechanics **(1.4)** will still be recognized and a structuralist metaphysics will still prove to be the best and most appropriately naturalistic description of what the world is really like.

Regarding those challenges posed above (*i*–*iii*), our revised metametaphysics based on the standard of maximal conciliatoriness appears either to satisfy or avoid. It appeases, for instance, those who might insist that metaphysics operate at a higher degree of generality than that allowed by Ladyman and Ross (*i*). And this because it better reflects the modalized nature of scientific theories, accommodating different possible evolutions of the history of science (*iii*). It also avoids attributing to any features of the world some special ontological status because, though it is certainly compatible with the observation of a primacy-of-physics norm in recent and contemporary theory construction in the sciences, it is not committed to *explaining* the primacy of physics as such. Rather, such a norm can be explained entirely in terms of

conciliatoriness (or lack thereof), where such an explanation would serve just as well given some other evolution of the respective developments of each of the sciences. A reorientation of naturalistic metametaphysics back towards maximal conciliatoriness alone, then, does greater justice to the ontological parity or egalitarianism endorsed by Ladyman and Ross.

5.3 Deleuze's Naturalism

Let us take stock. So far we have identified various failed attempts by commentators to determine Deleuze's naturalist status **(5.1)**. These attempts fail, we observed, because they employ inadequate, neo-scholastic, accounts of the sciences—and otherwise fail to engage sufficiently with contemporary philosophy of science. In other words, they involve accounts of naturalism that are themselves non-naturalistic and thus fail to act as appropriate standards for determining Deleuze's naturalist status. We then turned to Ladyman and Ross's own positive account of naturalistic metaphysics **(5.2)**. Here I highlighted some problems with the 'primacy of physics' component of their account and suggested that it might best be abandoned. In doing so, we arrived at a revised positive account of naturalistic metaphysics—namely, that such metaphysics consists in attempting to develop a maximally conciliatory ontological framework for scientific theories and hypotheses.

I now want to show how Deleuze's philosophy of difference represents an example of this revised, alternative conception of naturalistic metaphysics. As already mentioned **(5.0)**, I do this as follows. First, I show how the question of Deleuze's naturalistic status manifests itself in his own writings. Here I introduce what May describes as Deleuze's 'two levels' of engagement with the sciences (2005). I then

examine attempts by May (2005) and Mader (2017) to resolve this question in favour of their non-naturalistic interpretations of Deleuze before then critiquing their accounts in light of the neglected distinction, drawn by Deleuze and Guattari in *A Thousand Plateaus*, between 'major' and 'minor' science. Drawing on this distinction, I suggest that Deleuze can be regarded as naturalistic in our new sense.

5.3.1 The Question of Naturalism in Deleuze's Writings

We are now in a position to pick up on a thread introduced in an earlier chapter concerning the role of the sciences in Deleuze's philosophical writings **(3.3)**. There we observed Deleuze's famous statement of interest in 'the metaphysics science needs', but we also observed a hitherto unrecognized *underdetermination* present in this statement. Deleuze, it would seem, can be interpreted here as science-critical or *non*-naturalistic in the style of Bergson. That is, we can read him as assigning to metaphysics the task of correcting the putatively *misrepresentative* scientific view of what the world is really like. We can also, however, interpret him as seemingly naturalistic. That is, as *deriving* his metaphysics *from* the sciences. Here I want to show that this underdetermination maps neatly onto the 'two levels' of Deleuze's engagement with the sciences helpfully identified by May (2005).[172]

The first so-called level is Deleuze and Guattari's more sustained discussion of science and its relation to philosophy in *What is Philosophy?*. And it is this level in which we find putative textual evidence for Deleuze's Bergsonian or seemingly non-naturalistic attitude to the sciences.

[172] Note that May does not cite the 'metaphysics science needs' claim, nor does he (or anyone else) recognize the sense in which it underdetermines Deleuze's view.

Recall that, for Bergson, the ultimate nature of the world is best characterized as 'duration', which is his way of describing the continuously flowing or fleeting quality of time and motion. He elaborates: 'This reality is mobility. There do not exist *things* made, but only things in the making, not *states* that remain fixed, but only states in process of change' (2007: 203). Much of Bergson's philosophical position, then, is cashed out using the descriptive machinery of mobility and immobility or speed and slowness. As we have just seen, duration is described as a 'continuity of flow' (2007: 175) or as 'pure mobility' (2007: 177). Science, on the other hand, is for Bergson a 'slowing down' (2007: 196); it 'congeals' this continuous flow by means of 'fixed, distinct and immobile concepts' (2007: 209). Crucially, for Bergson, mobility cannot be reconstructed out of immobility, and so the immobile concepts of science are incapable of delivering properly metaphysical knowledge:

> *fixed concepts can be extracted by our thought from the mobile reality; but there is no means whatever of reconstituting with the fixity of concepts the mobility of the real*. (2007: 204)

What is Philosophy? inherits both this conceptual framework and its descriptive machinery. For example, philosophy on Deleuze and Guattari's account trades in 'concepts', which they define as '*the inseparability of a finite number of heterogeneous components traversed by a point of absolute survey at infinite speed*' (*WP*: 21). Obviously, this definition is somewhat opaque. But reading it in light of the conceptual framework set up by Bergson renders it much easier to decode. When they define concepts as 'traversing' 'heterogeneous components' 'at infinite speed', then, Deleuze and Guattari are simply expressing the claim that philosophy is capable of grasping and

reflecting the fundamentally mobile, relational, or differential character of the world. Philosophy, through concepts, is able to think the 'pure and simple *variations*' (*WP*: 20) of the world and is thus perfectly capable of delivering metaphysical knowledge.

Science, on the other hand, deals with 'functions', which are described (in much the same way as Bergson's own description of the sciences) as a 'fantastic *slowing down*' (*WP*: 118). Whereas philosophy manages to preserve and convey the fundamentally heterogenous quality of the world, science establishes regions of stability in order to isolate and chart specific relations between fixed points. As May observes, science 'fixes the relationships among its variables rather than giving play to differen*t*iated variations' (2005: 252). In the combined language of *What is Philosophy?* and *Difference and Repetition*, science 'relinquishes the infinite, infinite speed, in order to gain *a reference able to actualize the virtual*', while philosophy seeks to think the virtual by '*giving the virtual a consistency specific to it*' (*WP*: 118).

By associating philosophy with the continuous variation of the virtual, and science with the fixity or stability of the actual, then, Deleuze and Guattari follow Bergson in treating the two as largely independent enterprises. Hence May's claim that: 'Philosophy is a project distinct from science' (2005: 254). According to the account presented in *What is Philosophy?*, the project of metaphysics or ontology can only be done by philosophy, whose task it is to ground and explain the metaphysically misrepresentative claims of science.

So much for the first, Bergsonian or non-naturalistic level identified by May. The *second* level he identifies consists in those references to various bits of science and mathematics that are scattered throughout earlier works—most notably in *Difference and Repetition*, *Anti-Oedipus*, and in the third chapter of *A Thousand Plateaus*.

We saw examples of this level of engagement in action in the previous chapter—specifically, in Deleuze's treatments of the concept of intensity **(4.1)** and the calculus **(4.2)**. Recall, for instance, his appeals to gradient-based embryological theories from the early-to-mid twentieth century. There we witnessed Deleuze's interest in the kinematics of an egg, driven by temperature differentials or differences in chemical concentration—driven, in other words, by *intensive* difference. Such intensive differences, on Deleuze's view, condition or generate extensively determined individuals, be these the specific organs or other viscera within an animal's body, or the three-dimensional structure of the animal body itself. As Deleuze and Guattari write in *A Thousand Plateaus*, their interest is in

> the […] egg before the extension of the organism and the organization of the organs, before the formation of the strata; as the intense egg defined by axes and vectors, gradients and thresholds, by dynamic tendencies involving energy transformation and kinematic movements involving group displacement, by migrations: all independent of *accessory forms* because the organs appear and function here only as pure intensities.[173] (*ATP*: 153)

As we remarked at the time, Deleuze appears to be deriving *from* such theories a global ontology of intensive difference. 'The entire world is an egg', after all (*DR*: 216). Moreover, May himself points out that Deleuze appears to iterate this extrapolatory procedure within other scientific domains, including (but by no means limited to) Jacques Monod's analysis of allosteric enzymes (*AO*: 288–89, 328; May 2005: 245–

[173] Deleuze and Guattari cite Dalcq here (see *ATP*: 153, n.7).

46), Darwin's theory of evolution, and geology more broadly (*ATP*: 39–74; May 2005: 249–51).

With respect to geology, for example, Deleuze derives the same picture; this time from claims about intensive flows of magma or sediment that, by means of differences in temperature and pressure respectively, stratify and striate themselves into solid, extensive formations:

> the Earth […] is permeated by unformed, unstable matters, by flows in all directions, by free intensities or nomadic singularities, by mad or transitory particles. […] there simultaneously occurs upon the earth a very important, inevitable phenomenon that is beneficial in many respects and unfortunate in many others: stratification. Strata are Layers, Belts. They consist of giving form to matters, of imprisoning intensities or locking singularities into systems of resonance and redundancy… (*ATP*: 40)

And of course, as previously witnessed, and as observed by May (2005: 247), Deleuze strikes upon particular interpretations of the differential or infinitesimal calculus—according to which differential relations enjoy priority over primitive functions—in order to develop a kind of logic or language through which to express and represent his fundamentally differential ontology, with its talk of gradients and singularities and continuous variation. As May remarks: Deleuze 'sees in the differential an entire ontology of difference that can actualize itself into various functions and, consequently, specific curvilinear patterns' (2005: 247).

These extrapolations of a difference-based ontology from various scientific fields suggest that Deleuze is in fact doing naturalistic metaphysics of the kind

described at the end of our previous section. That is, metaphysics as articulating a conciliatory ontology across various scientific domains. The question therefore becomes, then: how are we to reconcile these two levels of engagement—the Bergsonian or non-naturalistic level found in *What is Philosophy?*, on the one hand, and those naturalistic engagements found throughout earlier works, on the other?

5.3.2 Reconciling the Two Levels

The basic strategy adopted by May is essentially to re-interpret one of these levels as a qualified version of the other, which he does by insisting that *What is Philosophy?* (the 'first' level of engagement with the sciences) is Deleuze's ultimate account of science and that his other seemingly deferential appeals (the 'second' level) are in fact appropriations or 'reworkings' of the science for distinctively philosophical ends:[174]

> In the second level of engagement, Deleuze is not referring to science *as science*; he is not offering us a view of science that either conforms to or confirms his own philosophical project. He is, instead, appropriating and often reworking scientific themes for his own philosophical purposes. (May 2005: 239)

Though May does not adopt this terminology, we can therefore regard him as claiming that Deleuze's apparent naturalism is just that—merely *apparent*. What is *actually* going on within this second level, then, is some kind of pedagogical manoeuvre, one

[174] Patton (2016: 350) and Mader (2017) adopt a similar approach. Both take *What is Philosophy?* as the final word on Deleuze's account of science, with Mader remarking explicitly that 'Deleuze does not enjoin science to adopt the project of ontology that is philosophy's pursuit' (2017: 275).

that appropriates the science in order to give some sense of what an ontology of difference looks like. As May puts it, this time employing the idiom of 'speed' and 'slowness' from Bergson and *What is Philosophy?*:

> …the incorporation of science into Deleuze's work is an attempt to "speed up" scientific viewpoints by offering them an ontological perspective that draws them "out of themselves" and brings them into contact with pure difference, difference in itself. (2005: 254)

But what precisely does May mean by this peculiar locution: the 'speeding-up' of scientific viewpoints? Note that such 'speeding-up' cannot simply be a process of *illustrating* or *exemplifying* a philosophy of difference. May is explicit on this point, emphasizing (again with *What is Philosophy?* in mind) that '[scientific] functions work in too different a realm from [philosophical] concepts to stand as examples of them' (2005: 254). So what *exactly* is going on, on May's account?

Given his claims about the 'reworking' of science (2005: 239), or about the drawing of scientific viewpoints 'out of themselves' (2005: 254), we might expect such accelerative appropriations to involve a degree of distortion, manipulation, or misrepresentation of whatever scientific theory is being referenced. Deleuze's depictions of scientific theories, however, tend to be extremely faithful—or, at the very least, he exhibits a great deal of concern about the accuracy of such depictions.

Recall his engagement with embryology. Or, rather, consider the relevant source material. Deleuze claims that embryologists, such as Charles Manning Child and Albert Dalcq, claim intensive gradients to underlie and determine the development of animal organisms. And indeed Child *does* claim that

> a definite relation exists in each individual between the direction of the gradient in any axis and the physiological and structural order which arises along that axis. (1915: 87)

Similarly, Dalcq also claims that 'the development of a part or of a system automatically results from the primary gradient and field, or their immediate derivatives' (1938: 101). Rather than betraying any kind of exegetical violence or interpretative licence, then, Deleuze's engagements with embryology appear to demonstrate a high degree of accuracy or faithfulness.

That said, perhaps the most apparent examples of Deleuze's concern with the fidelity of his representations of scientific theories can be found in his engagements with mathematics—and especially those found in the seminars he taught at the Université de Paris VIII–Vincennes à St. Denis. As we saw in the previous chapter **(4.2)**, for instance, Deleuze's reading of the calculus is not so much a 'rereading' (as Evens would have it (2000: 111)), nor does he merely 'suppose' or stipulate (as May has it (2005: 247)) a reversal of our ordinary, classroom interpretation of the relation between differential and primitive function. Rather, he endorses the fundamentality or priority of the differential relation based on a close and *literal* reading of one of Leibniz's original essays, as well as on other mathematical sources that advocate such an approach—including Weierstrass and Robinson.

Another such example of Deleuze's concern with the fidelity of his representation of mathematics can be found in his seminar discussions of singular or critical points. Again, he engages in a close reading of Poincaré's essays on the qualitative approach to differential equations (Deleuze 29 Apr 1980; Poincaré 1881,

1882). And indeed, in later seminars on the same topic, he even goes so far as to invite a mathematics professor (referred to in the transcripts simply as 'Marek') to these discussions in order to supervise his presentation of the material.[175] 'This is very important', Deleuze explains, 'because here I am dealing with things not so good from a mathematical point of view, but he's [Marek is] there to correct me' (6 Jan 1987). Deleuze repeatedly verifies his comprehension with Marek ('it's nearly my turn to ask you certain things' (6 Jan 1987) and 'That's it, right?' (27 Jan 1987) being typical examples of such interactions), and he even solicits a brief lecture from him on the topic of singularity, which then serves as a basis for discussion for the rest of the course.[176]

Deleuze *clearly* cares about the accuracy of his references to the sciences and mathematics. In the face of such concerted efforts to authenticate his engagements with the sciences, then, the claim that Deleuze regards such engagements as purposeful misrepresentations becomes increasingly difficult to defend. Consequently, we once again find ourselves confronted with the question of what precisely is meant by the 'speeding-up' of science on May's view.

Given his specific characterization of Deleuze's engagements with biology as 'going beyond the biological to the ontological' (2005: 245), as well as his broader claims about Deleuze lending the science 'an ontological perspective' (2005: 254), or having 'ranged over biology, microbiology, mathematics, and chemistry' in order to arrive at 'a single ontological picture' (2005: 249), we might suggest that something like 'abstraction' better describes what May has in mind. But this is just naturalistic metaphysics! That is to say, such an understanding of what is meant by the 'speeding-

[175] For Stivale's note on Marek's identity, see (27 Jan 1987, n.8). Note also that the philosopher of science (and chemist by training) Isabelle Stengers also frequented and participated in Deleuze's seminars.
[176] For Marek's presentation, see Deleuze (27 Jan 1987); for the solicitation itself, see: 'if I may dare, but you tell me sincerely if this bothers you or not, if you return another time, then I would obviously desire an intervention by you' (6 Jan 1987).

up' of science aligns perfectly with the conception of naturalism borrowed and modified from Ladyman and Ross above. Deleuze, it would seem, is simply extracting the salient features of scientific theories in order to articulate a broader reconciliatory and scientifically informed ontology.

Here May has one final argumentative refuge from which to deny Deleuze's naturalism. 'Science cannot provide evidence for philosophy', he writes, 'since philosophy is not a matter of truth; it does not seek evidence' (2005: 254). Here he is alluding to *What is Philosophy?*, in which Deleuze and Guattari famously claim that

> Philosophy does not consist in knowing and is not inspired by truth. Rather, it is categories like Interesting, Remarkable, or Important that determine success or failure. (*WP*: 82; cited in May 2005: 251)

On the face of it, such a claim poses a significant problem for any naturalistic interpretation of Deleuze. After all, if philosophy has no regard for the truth (and therefore evidence), how can metaphysics be scientifically informed in the way the naturalist requires? The advocate for Deleuze's naturalism can respond in the following ways.

First of all, we need not read 'is not inspired by truth' as implying 'has no regard for truth'. After all, it would seem that at least some amount of factual information is required in order to distinguish the interesting, remarkable, or important from the dull, quotidian, or insignificant. As May himself admits: 'Believing one can walk through walls does not generally result in anything interesting' (2005: 256, n.53).[177] Similarly,

[177] May, then, *does* acknowledge this objection, emphasizing that 'Deleuze does not reject truth, but rather says that truth is not the primary object of philosophy' (2005: 251). That being said, no such qualification accompanies his later claim that 'philosophy is not a matter of truth' (2005: 254).

one must possess plenty of uninteresting information about the behaviour of water at various temperatures in order to strike upon the remarkable events that occur at zero and one-hundred degrees Celsius. That philosophy is not 'inspired' by truth, or that truth is not the principal aim of philosophical inquiry, then, in no way entails that truth and evidence are not necessary prerequisites for the pursuit of whatever its principal aim might be (in this case, the interesting, remarkable, and important).

Second, and much more significantly, consider what is meant by the 'Interesting, Remarkable, or Important' on Deleuze and Guattari's account. What they have in mind is *singularity*. That is to say, they are interested in precisely the same kind of singular points or events studied by singularity theory and other disciplines concerned with dynamic systems. As Deleuze and Guattari write earlier on in *What is Philosophy?*, 'the question of philosophy is the singular point' (*WP*: 11). As we have already acknowledged, such points represent critical thresholds, or moments at which the behaviour of some physical system either changes abruptly or reaches some equilibrium state. Boiling, melting, or freezing points are examples of such thresholds, as are peaks, troughs, and other changes in direction, as well as the starting, stopping, or the settling into regular patterns of motion—all of which can be identified by the maxima, minima, nodes, saddles, focuses, and centres classified by Poincaré in his aforementioned essays, as well as various other special configurations in the geometrical representation of dynamic systems (such as so-called 'strange' attractors).

Deleuze and Guattari, then, make no philosophical appeal to the 'Interesting, Remarkable, or Important' that is not already prefigured by, or indeed derived from, mathematics and science. So, rather than giving us reason to deny the claim that Deleuze is naturalistic, May's reference to the passage above actually testifies to this very interpretation. It would therefore appear that May's attempts to incorporate this

second level of engagement into some broader non-naturalist account of the role of science in Deleuze's thought can at each step be reversed into further testimonies for Deleuze's naturalism.

Unfortunately, then, we once again find ourselves faced with the problem of how to reconcile this second level of engagement with the first, or of how to break the aforementioned underdetermination of Deleuze's attitude towards science. Fortunately, however, Deleuze and Guattari distinguish between two different senses of 'science' in the 'Treatise on Nomadology' chapter from *A Thousand Plateaus*—a chapter that May and many others neglect to mention.[178] And, we will see in the next subsection, this distinction maps perfectly onto the distinction between science and philosophy in *What is Philosophy?*, thereby allowing for a naturalistic interpretation of Deleuze's thought.

First, though, I want to acknowledge another attempt to reconcile these two levels—and here I pick up on a thread from an earlier chapter **(4.1)**. Though Mader (2017) does not write in terms of May's 'levels', nor does she address these problems in (our) terms of Deleuze's naturalist status, she does appear to operate within this same broad dialectical space. That is, she recognizes 'intensity' to be a key concept in Deleuze's metaphysics of difference, and she recognizes that many examples of intensive phenomena (including those mentioned by Deleuze) are scientific in nature, and yet she warns against our interpreting Deleuze as somehow deriving his ontology of intensive difference from scientific treatments of intensity. 'Deleuze does not in fact lift a conception of intensity from the physical sciences to embed it as the fundamental term in his differential ontology' (2017: 259). Drawing primarily—just like May (2005) and Patton (2016)—on *What is Philosophy?*, Mader argues that 'Deleuze does *not*

[178] The 'major'/'minor' science distinction is mentioned by neither May (2005) nor Ansell Pearson and Protevi (2016) nor Patton (2016) nor Mader (2017).

endorse scientific accounts of intensive phenomena as philosophically adequate' (2017: 275; my emphasis) and thus that, in our terms, Deleuze does *not* naturalistically adopt a scientific notion of intensity for his metaphysics but instead adopts an entirely *different* notion of intensive difference. Her article, then, is dedicated to arguing for a *difference in kind* between Deleuze's *philosophical* notion of intensity and those *scientific* examples to which he refers repeatedly throughout his works.

Mader does this by insisting that, whereas Deleuze's philosophical concept of intensity (as with Aristotle's proto-concept of intensity or alteration mentioned in the previous chapter) is purely qualitative, the scientific notion of intensity is always understood extensively or in quantitative terms. She writes that:

> Deleuze holds that science identifies intensities in the natural world (pressures, temperatures, altitudes), but does not have a theory of intensity that does not ultimately reduce intensity to extensive terms. (2017: 262–63)

And that:

> It is specifically the quantification of intensities, their quantified expression, […] that separates Deleuze's ontological account of the nature and roles of intensity from strictly scientific conceptions and uses of the concept. (2017: 260)

In order to provide an account of the scientific 'quantification' of intensity, Mader unpacks Deleuze and Guattari's references to Russell's account of how intensities (or,

in Russell's terminology, 'distances') are conceptualized in quantitative or extensive terms.[179]

Now, these references take place in the context of Deleuze and Guattari's drawing a distinction between different kinds of multiplicities: one 'metric' and 'striated'; the other 'non-metric' or 'smooth' (*ATP*: 483). As with Deleuze's use of 'singularity' in the previous chapter **(4.2)**, however, note that Deleuze and Guattari employ rather idiosyncratic—and indeed quite messy or haphazard—uses of these terms. Given how they and their commentators discuss the relevant ideas, it seems as though the crucial mathematical qualities that they are *actually* tracking are 'intrinsic' and 'extrinsic' properties—where the latter denotes properties or features that depend upon some higher-dimensional embedding space, and the former does not. Fortunately, however, Deleuze and Guattari's flexible use of terminology here cuts both ways, and they can be reinterpreted as simply meaning either 'intrinsic' or 'extrinsic' whenever they use the words 'smooth' or 'non-metric' and 'striated' and 'metric' respectively. I *do* retain *their* terminology when citing them, though, because I am articulating an exegetical argument against Mader, one that depends on the language Deleuze and Guattari actually use. We can, however, acknowledge that they are flexible enough in their usages, often using terms that may, strictly speaking, have different referents in mathematics, but nonetheless all gesture towards the same basic idea in their ontology.

Referring to their 'smooth' kind of space, Deleuze and Guattari write: 'It is an intensive rather than extensive space, one of distances, not of measures and properties' (*ATP*: 479). And it is with this allusion to 'distances' and their lack of measurability that, to return to Mader, Deleuze and Guattari invoke the work of Russell. For there is

[179] For Deleuze and Guattari's references to Russell (or at least those recognized and taken up by Mader), see *ATP*: 483.

a sense in which smooth or intensive spaces can be *made* measurable, or in which they 'allow themselves to be striated and measured', though 'only by indirect means, which they always resist' (*ATP*: 483). It is this notion of 'distance', which Russell opposes to 'magnitude', and this procedure of making-measurable that Mader elaborates upon in her account of the difference between properly philosophical and merely scientific conceptions of intensity.

As Mader observes: 'In *The Principles of Mathematics*, Russell proposes a conception of distance according to which distance may be a quantity or magnitude, but it need not be one' (2017: 263); 'a distance need not be a quantity or a magnitude; although it is usually taken to be such' (Russell 2010: 255). Such non-quantitative, non-magnitudinous distances can be understood, according to Mader, as

> relations that apply to certain kinds of series, including a series such as colours arranged in terms of 'immediate resemblance' of shade, or a time-series about which one can say that it includes more and less recent events… (2017: 264)

In other words, we can think of this kind of distance as expressing *how much* change occurs within an intensive difference or Aristotelian alteration—though, again, *not* in quantitative terms. Such distances, then, express the *difference* between terms of a so-called 'series'—whether that be between this or that shade of blue, this or that moment in time, this or that temperature, or this or that degree of speed. Distances of this kind 'are indivisible', writes Russell, 'no distance is really a sum of other distances' (2010: 181), here prefiguring Deleuze and Guattari on intensive difference or 'distance': 'An intensity […] is not composed of addable and displaceable magnitudes: a temperature

is not the sum of two smaller temperatures, a speed is not the sum of two smaller speeds' (*ATP*: 483).

And yet, as already anticipated, such distances *are* susceptible to measurement of a sort on Russell's view: 'numerical measurement' is possible, though 'must be in part conventional', he remarks (2010: 181). This convention, Mader observes, involves the assigning of numbers, or what Meinong (who influenced Russell) refers to as 'surrogate measures' (Mader 2017: 266), to such distances. As Russell puts it:

> The convention is this. Let it be agreed that, when the distances a_0a_1, a_1a_2 . . . $a_{n-1}a_n$ are all equal and in the same sense, then a_0a_n is said to be n times each of the distances a_0a_1, etc., i.e. is to be measured by a number n times as great. (2010: 180–81)

In essence, then (and in a perhaps simpler idiom):

> Numbers are […] assigned by this method to the members of the class between which the distances hold; these numbers have, in addition to the arbitrary factor, an arbitrary additive constant… (2010: 181)

This convention, in other words, is akin to the 'latitude'—observed in the previous chapter **(4.1)**—ascribed to intensive changes or alterations by Aristotle's medieval commentators, according to which purely qualitative changes or alterations can be treated as changes in numerical degree—or as 'increase' or 'decrease' in Aristotle's terminology.

Mader, then, claims that, on Deleuze's account, *this* is what is going on when the sciences deal with intensive phenomena:

> Deleuze's position is that science—or what he means by 'science'—operates, to use Russell's terms, with the 'conventional' type of numerical measurement of supposedly intensive realities that have actually been *converted* into extensive quantities. (2017: 265)

Thus, the scientific notion of intensity is a quantified, striated, or a 'made-measurable' version of intensity that does not reflect the purely qualitative form of intensity that plays such a vital role in Deleuze's ontology. He cannot, therefore, be considered naturalistic on Mader's account.

In what follows, we will see how Deleuze and Guattari describe this same 'striating' or 'making-measurable' procedure as taking place between science in their 'major' and 'minor' sense. That is to say, we shall see that Deleuze and Guattari associate their 'minor' conception of science with those 'smooth' and intensive spaces or multiplicities just mentioned, and that they describe a process through which a 'minor' scientific worldview is appropriated and translated into a 'major' scientific worldview by means of this same technique of quantification, 'striation', or overlaying of a homogenous measurement space. I will argue, then, and *contra* Mader, that Deleuze and Guattari do in fact endorse a ('minor') conception of science that deals with the same form of intensity described by Deleuze's metaphysics of difference and is subject to the same forces of quantification by an alternative and misguided (for Deleuze) conception of science.

5.3.3 Deleuze's 'Minor' Naturalism

So what is this distinction between 'major' (or 'Royal' or 'State') and 'minor' (or 'nomadic' or 'ambulatory') science, on Deleuze and Guattari's account? And how does it relate to Deleuze's two levels of engagement with the sciences identified by May? Well, the 'major' science of *A Thousand Plateaus* appears to enjoy the same basic character as what is called 'science' in *What is Philosophy?*, whereas 'minor' science shares the same basic character as 'philosophy' in *What is Philosophy?*.[180] Just as scientific 'functions' are concerned with stability and identity, or with 'constants or limits' (*WP*: 205), for example, so too is 'major' science concerned with 'extracting constants' (*ATP*: 369). And, just as philosophical 'concepts' describe fundamental difference, or 'pure and simple *variations*' (*WP*: 20), so too does 'minor' science deal with 'continuous variation' (*ATP*: 363, 365), or with that 'objective zone of fluctuation that is coextensive with reality itself' (*ATP*: 373). Similarly, and as Patton observes, nomad science enjoys 'a defining relationship to smooth space' (2018: 211), whereas major or Royal science is associated with striated space. As Deleuze and Guattari write, the difference between minor and major science respectively

> is the difference between a *smooth* (vectorial, projective, or topological) space and a *striated* (metric) space: in the first case "space is occupied without being counted", and in the second case "space is counted in order to be occupied". (*ATP*: 361–62)

[180] This particular claim is not a revelation. Bonta and Protevi, for instance, follow DeLanda (2013: 219) in observing that 'nomad or minor science […] is not the Royal or major science that makes up the entirety of what *DG* [Deleuze and Guattari] call "science" in *WP* [*What is Philosophy?*]' (2004: 28). Neither DeLanda nor Bonta and Protevi, however, explicitly thematize the question of naturalism in the way I do here.

Now, there is a temptation to read Deleuze and Guattari, as Pickering does, as proposing a distinction between 'two *kinds* of science' (Pickering 2010: 155). This, however, is not the case. Indeed, they claim explicitly several times that what concerns them is the 'treatment of science' (*ATP*: 361), 'different modes of formalization' (*ATP*: 362), or the difference between one 'conception of science' (*ATP*: 362, 368) and another. That is:

> What we have […] are two formally different conceptions of science, and, ontologically, a single field of interaction in which royal science continually appropriates the contents of vague or nomad science while nomad science continually cuts the contents of royal science loose. (*ATP*: 367)

We will return to the process or interaction in which 'royal science continually appropriates the contents of […] nomad science' shortly. For now, let us recognize that Deleuze and Guattari are interested here in the *representation* of scientific theories—to borrow some language from the philosophy of science in the analytic tradition. That is, they are interested in different ways in which any and all of the sciences can be represented, and in how these different modes of representation portray the ontological commitments of the sciences differently.

The 'major' approach is described as 'theorematic' (*ATP*: 362) and as 'axiomatic' (*ATP*: 373). This approach is therefore akin to the 'syntactic' approach to theories in analytic philosophy of science, according to which theories are understood as collections of sentences, whose relations to one another are understood by means of 'first-order quantificational logic' (*ETMG*: 128). Deleuze and Guattari also describe the

major approach as 'inseparable from a "hylomorphic" model implying both a form that organizes matter and a matter prepared for the form' (*ATP*: 369), meaning that it treats or portrays the world as though it were composed of some inert content, matter or substance upon which forms and order are imposed by unchanging and external or transcendent laws. Appealing to this notion of 'law', Deleuze and Guattari refer to the 'legalist model employed by royal science':

> The search for laws consists in extracting constants, even if those constants are only relations between variables […]. An invariable form for variables, a variable matter of the invariant: such is the foundation of the hylomorphic schema. (*ATP*: 369)

The 'minor' approach, on the other hand, is described as 'problematic' instead of 'axiomatic' (*ATP*: 362), as couched in terms of 'a qualitative calculus' (*ATP*: 364) or 'differential equations irreducible to the algebraic form' (*ATP*: 369), and as adopting a 'hydraulic model' (*ATP*: 361). By 'hydraulic model', Deleuze and Guattari mean to invoke fluid dynamics or the study of the different forms of behaviour that emerge when fluids flow at different speeds—as, for example, with air around the wings of an aircraft or liquids in a Taylor-Couette apparatus.[181] As DeLanda writes:

> while major science prefers uniform or laminar flows, minor science is fascinated by the spirals and vortices that form when [fluids] cross intensive thresholds, giving rise to convection and turbulence. (2016: 96)

[181] Taylor-Couette experiments involve observing the behaviour of fluid contained in between two rotating cylinders. At increasing speeds, different patterns of flow emerge: from laminar to convective to turbulent (broadly speaking). For more on this experiment, see DeLanda (2016: 118) and Stewart (1989: 175–78).

The point here is that minor science, as opposed to hylomorphic major science, portrays *not* a world of inert matter ready to receive some externally imposed form, but an *animate* and *self-organizing* world that generates *its own* forms and regularities by means of its interactions with itself, or by means of its own dynamics. As Smith elaborates:

> In problematics, a figure is defined dynamically by its capacity to be affected—that is, by the ideal accidents and events that can befall the figure (sectioning, cutting, projecting, folding, bending, stretching, reflecting, rotating, and so on). (2006: 149)

Or, in Deleuze and Guattari's own words: 'figures are considered only from the viewpoint of the *affections* that befall them' (*ATP*: 362), or 'one engages in a continuous variation of variables' (*ATP*: 372), experimenting with and perturbating dynamic systems, populating phase portraits and vector fields, in order to discover how they behave and, importantly, those thresholds or singular points at which such behaviours alter in significant ways. '*There are itinerant, ambulant sciences that consist in following a flow in a vectorial field across which singularities are scattered*' (*ATP*: 372).

One example of the kind of experimentation Deleuze and Guattari have in mind is group theoretical. In group theory (in the context of geometry, at least) we subject some figure to various transformations—rotations, for instance. Those transformations under which a figure is left invariant (such as when a square is rotated by 90, 180, 270, or 360 degrees) are identified as significant or singular moments, 'events', and are taken

to represent or encode important information concerning the *basic character* of a square. Thus, minor science

> involves all kinds of deformations, transmutations, passages to the limit, operations in which each figure designates an "event" much more than an essence; the square no longer exists independently of a quadrature, the cube of a cubature, the straight line of a rectification. (*ATP*: 362)

Let us return now to that procedure through which 'royal science continually appropriates the contents of […] nomad science'. We have already seen how minor science approximates the enterprise of philosophical ontology as described in *What is Philosophy?* and elsewhere in *A Thousand Plateaus*. That is, the description of a form of fundamental intensive difference or continuous variation, populated by modally informed singular points or events, modelled in terms of so-called 'smooth' spaces. And we can now also appreciate how the appropriation of the minor scientific viewpoint by the major scientific approach reflects the quantifying, 'making-measurable' procedure enacted upon genuine intensity by the sciences on Mader's view. Deleuze and Guattari, for instance, describe a process through which

> ambulant procedures and processes are necessarily tied to a striated space—always formalized by royal science—which deprives them of their model, submits them to its own model […]. […] a fundamental operation by which one repeatedly overlays upon each point of smooth space a tangent Euclidean space endowed with a sufficient number of dimensions, by which one reintroduces

> parallelism between two vectors, treating multiplicity as though it were immersed in this homogenous and striated space… (*ATP*: 372–73)

Such 'overlaying' of 'a tangent Euclidean', that is, metric and measurable, space is precisely the same kind of procedure described by Mader (drawing on Russell) above and thus further speaks to how, *contra* Mader, *minor* science approximates the project of philosophy on Deleuze and Guattari's view.

The principal claim that I want to draw from such conclusions is that *this* neglected distinction between major and minor science, and *not* the account presented in *What is Philosophy?*, provides the key for understanding the relationship between the two levels of scientific engagement identified by May. For the key is that these two apparently contradictory levels—the non-naturalistic or Bergsonian level of *What is Philosophy?* on the one hand, and the naturalistic level of Deleuze's sporadic references on the other—do *not* in fact need to be reconciled at all. Deleuze *does* adopt a Bergsonian or non-naturalistic attitude to the sciences as described in *What is Philosophy?* because that text presents the 'major' approach to scientific theories, which itself describes what is, for Deleuze, a faulty metaphysics—one that involves transcendent laws, a hylomorphic conception of matter, and that treats first-order logic as the most suitable language for describing the world. Similarly, Deleuze *does* adopt a naturalistic attitude to the sciences more generally, because he himself approaches them in a 'minor' way—that is, a way that conveys the fundamentally differential, relational, or continuously varying nature of the world, that recognizes the immanent objective modality encoded within those singularities they describe, and which endorses

mathematics—and specifically, the calculus—as the most appropriate descriptive machinery for metaphysics.[182]

[182] Again, an interesting point of comparison here, upon which I do not have space to elaborate, would be Wallace (2021).

Concluding remarks

My principal aim in this thesis has been to initiate a line of inquiry into Deleuze's philosophy of difference, ontic structural realism, and indeed the philosophy of science more broadly. I argued that employing ontic structural realism as a foil helps to cast some exegetical light onto Deleuze's philosophical position. And indeed, I argued that the core of Deleuze's position can be understood as the attempt to articulate an immanent and primitive form of objective modality—in a similar vein, that is, to the ontic structural realist. I also claimed that Deleuze's transcendental empiricism can be understood by means of a mathematically informed Deleuzean analogue to the structuralist Poincaré Manoeuvre. I hope to have provided a corrective to recent attempts to understand the role of the sciences in Deleuze's philosophical writings that nonetheless fail to engage sufficiently with contemporary philosophy of science—and indeed fail to take all the relevant parts of Deleuze's philosophy into consideration. And I hope also to have expressed an interesting puzzle for Ladyman and Ross's version of ontic structural realism.

Some potential future lines of research include the following. We observed that Deleuze and Guattari's distinction between 'major' and 'minor' science is a distinction between 'different modes of formalization' (*ATP*: 362)—or, rather, between different approaches to the *representation* of scientific theories. Now, we observed at the start of this thesis that Dewar (2022) has recently speculated as to whether Deleuze provides the conceptual resources for a *category-theoretical* approach to scientific theories. I suggest a simpler initial question. We remarked that certain aspects of 'major' science—its axiomatic nature, for instance—resemble the syntactic approach to

scientific theories. So the question arises: *is* major science the syntactic approach,[183] and if so, or regardless, is *minor* science a version of the semantic approach, or does it represent some (category-theoretical, if you like) alternative? Investigating these questions, in light of Deleuze's casting most of his philosophical project in *mathematical* terms, alongside Wallace's recent 'math-first' approach also seems to be worthwhile.

Deleuze understands his project as a form of transcendental empiricism. It is therefore worth noting that some philosophers of science have attempted to formulate weaker, more contingent versions 'transcendental' inquiry that reflect the basic structure of abductive reasoning or inferences to the best explanation.[184] The question thus arises as to whether *Deleuze's* notion of the transcendental is comparable, and thus whether Deleuze's philosophy can be understood as working through abductive reasoning. Also, and as remarked in a previous chapter, French's appeal to the Cassirerian claim 'Take the "conditions of accessibility" to be "conditions of the objects of experience"' (*SotW*: 59) opens up an interesting line of inquiry regarding whether Deleuze's notion of the transcendental or of immanence compares. 'Immanence' for Deleuze seems to be both an epistemological or critical notion (owing to his indebtedness to Hume and Kant) *and* a metaphysical or ontological notion (owing to his radicalization of Hume and Kant), and so he appears to be embodying what French sees as 'the not unreasonable view that we should strive to bring our metaphysics in line with our epistemology, as far as we can' (*SotW*: 60, n.16).

Finally, and most speculatively, I want to say something about the breadth of Deleuze's philosophical writings and about the fact that he is a systematic thinker.

[183] Smith (2006) comes close to pursuing this question.
[184] See Chang (2008) and Lyre (2009).

Obviously, in this respect he differs from many philosophers of science. Recall, after all, that Deleuze wrote books (all part of his differential philosophical system) about cinema, Francis Bacon, and Proust. If Ladyman and Ross admonish Cartwright being influenced by the work of Gerald Manley Hopkins, then one can only wonder how they would react to Deleuze (*ETMG*: 6). And yet, Murphy remarks that

> In recent years, we have seen edited collections dedicated to exploring issues that connect art and science and often make references to the role of fiction and imagination in thought experiments, models, and metaphors in science… (Murphy 2022: 2)

Aesthetic considerations and experience therefore do appear be part of our thinking about the sciences. It is not unreasonable to suppose, then, that Deleuze might have something to offer in this arena—not least because his philosophical system is, as we have seen throughout the course of this thesis, already enmeshed within a (minor) scientific and mathematical conceptual framework.

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