Substantial Priority
An Essay in Fundamental Mereology

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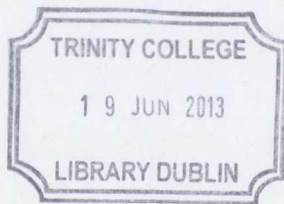
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I, Ross Inman, hereby certify that this thesis has not been submitted as an exercise for a degree at this or any other university and is entirely the product of my own writing and research. I hereby agree that the library may lend or copy the thesis upon request.

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To Suzanne,
my love,
whose "beauty awakens the soul to act."
— Dante Alighieri

Acknowledgements

Abstract

Philosophical inquiry concerning the relationship between wholes and their parts (mereology) has occupied center stage in some of the most fruitful periods in the Western philosophical tradition. With the recent resurgence of interest in metaphysical grounding and priority, the question of fundamental mereology—whether wholes or their proper parts are metaphysically fundamental—has taken on renewed life in contemporary metaphysics. In this essay I explicate and defend a fundamental mereology with a rich historical precedent in the Aristotelian and scholastic tradition with a grounding-based conception of the structure of composite substances at its core, what I call 'substantial priority.'

According to substantial priority, at least some ordinary composite objects are metaphysically fundamental in that they not only fail to depend for their nature on any distinct entity, they also place grounding or dependence constraints on the natures of their proper parts. I offer both empirical and philosophical considerations against the view that the parts of every composite object are metaphysically prior, in particular the view that ascribes ontological pride of place to the smallest microphysical parts of composite objects (priority microphysicalism) which currently dominates contemporary thinking about material objects in metaphysics, philosophy of science, and the philosophy of mind. I present insights from quantum mechanics, chemistry, and systems biology that threaten the tenability of priority microphysicalism and, in addition, count in favor of a view of the structure of material objects along the lines of substantial priority.

I then attempt to show that substantial priority is well-motivated in virtue of its offering a unified solution to a host of metaphysical conundrums involving material objects. In particular, it offers a unified and novel solution to the puzzle of Tibbles the Cat, The Problem of Material Constitution, The Problem of the Many, The Vagueness Argument, and Causal Overdetermination. In so far as the view is both scientifically serious and philosophically fruitful, it deserves a place at the table as a viable yet under appreciated position in the metaphysics of material objects. I conclude the essay by interacting with several objections to substantial priority, most notably the charge that it is empirically inadequate in its inability to capture the causal structure and activity of the parts of complex substances. Here I aim to justify the view before the tribunal of empirical adequacy. I offer the proponent of substantial priority five distinct ways to reconstruct the appearances as to how the parts of composite substances appear to be fundamental or ontologically prior in virtue of their playing a non-redundant causal role in our best empirical theories.

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Introduction

There is very little consensus in contemporary analytic metaphysics. There are, on the one hand, those who ardently defend a reductive account of modality arguing that modality is not a fundamental feature of the world. On the other hand, there are those who gladly embrace primitive modal structure, arguing that the world is replete with irreducible ways the world could have been. Both sides are unwavering in their commitment to their respective views. As anyone generally familiar with the landscape of contemporary metaphysics knows, this very same situation can be multiplied to a host of issues: Is causation singular? What sort of modal import, if any, do the laws of nature exhibit? Are there restrictions on composition? Do concrete particulars persist by means of enduring, perduring, or exduring? We have even seen in recent years metaphysicians turning their gaze on their very own discipline (not without an unfriendly nudge from those outside the guild), the result being what has been recently labeled 'metametaphysics' or 'metaontology.'

Be that as it may, amidst the widespread disagreement in contemporary metaphysics there has emerged roughly two very general schools of thought, two fundamental postures or stances we might say, in approaching metaphysical reflection on the nature of properties, modality, laws of nature, time, causation, persistence, and mereology (to name a few).[1] While the origins of these two metaphysical postures can be traced back to our ancient philosophical predecessors, their influence on analytic metaphysics in the second half of the twentieth century hardly needs emphasizing.

The first general metaphysical posture, what I will refer to as "neo-Aristotelianism," takes its cue from Aristotle and his medieval interpreters.[2] For the neo-Aristotelian, the denizens of spacetime are metaphysically ordered by means of their fundamental ontological and natural kinds as expressed by their existence, identity, and persistence conditions. Some of these spacetime occupants are elite, ontologically fundamental, or basic in that their natures are such that they fail to depend on any distinct entity for their existence and identity. The category of substance as a basic particular lies at the heart of a neo-Aristotelian ontology. Particular non-transferable properties, we are told,

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[1] Here I emphasize the word 'general' as there are a wide variety of views that fall under both orientations in contemporary metaphysics.

[2] See the recent volumes by Tahko (2012) and Novák et al. (2012) for a sampling.

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are ontologically dependent on their substantial bearers. Causation, it is argued, is best understood in light of the manifestation of the powers and liabilities of substantial particulars. Modal truths, according to some in this camp, are plausibly grounded in the powers and dispositions (and the relations between them) of substances.[3] Laws of nature, argue some, derive from or supervene on the dispositional essences of the natural properties of substances.[4] A neo-Aristotelian metaphysic, then, is shot-through with necessary connections, particularly those necessary connections that stem from the natures of fundamental substances. In short, for the neo-Aristotelian, the causal motor and cement of the universe studied and systematized by the natural sciences ultimately derives from propertied particulars that are metaphysically fundamental, that is, Aristotelian substances.

The second general metaphysical posture, what has gone under the label of "neo-Humeanism," has as its patron saint the Scottish Enlightenment philosopher David Hume. The widespread appeal and influence of neo-Humeanism in contemporary analytic metaphysics, however, is the product of the work of the late David Lewis. Perhaps the central tenet of neo-Humeanism is the doctrine of *Independence*, the thesis that there are no necessary connections between distinct existences. According to Independence, the instantiation of a property at some point in spacetime cannot entail anything about any distinct point in spacetime. Accompanying Independence is the thesis of *Humean Supervenience*: the thesis that the world is an arrangement of instantaneous, point-sized instantiations of perfectly natural properties, a "vast mosaic of local matters of particular fact, just one little thing and then another... And that is all."[5] By Lewis' lights, the only relations that obtain between the occupants of spacetime are temporal or spatial relations, nothing more. While not all adherents to a neo-Humean metaphysic follow Lewis on this score, the fact remains that the neo-Humean task is to account for the apparent causal, modal, and nomic riches of the actual world in terms of the spatiotemporal distribution of these point-sized qualities and the fundamental relations between them. On this view, the identity and qualitative nature of ordinary material objects composed of these point-sized masses such as trees, people, and poodles—*what* they are and *how* they are—are entirely dependent on the point-sized distribution of local matters of fact.

Yet an adherence to Independence makes this task a difficult one in so far as the distribution of qualities and the relations between them does not, by itself, entail anything about what *does* happen, what *would* happen, or what *must* happen at any distinct place in the arrangement. Be that as it may, Neo-Humeans have all but shied away from such a daunting task. It is precisely because the distribution of qualities in our world is construed along the lines of Independence that the neo-Humean looks beyond it for the

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[3] Jacobs (2010).
[4] Bird (2007).
[5] Lewis (1986b: ix).

needed resources to ground such facts about the world.

Properties, by the neo-Humean's lights, are intrinsically impotent in that they in no way entail or necessitate a particular outcome in the world. As such, in order to account for facts about ways the world could have been, i.e. modal facts, the neo-Humean must look beyond the rather dim resources of the actual world. The neo-Humean solution here is to increase the number of Humean mosaics that resemble the actual world so that there are enough of them to account for the plenitude of possibilities, that is, all of the ways things could have been. Possible worlds, at least for Lewis, are simply alternative concrete Humean mosaics and are just as real as the actual mosaic we find ourselves in. Thus to affirm that there could have been a talking donkey is to say that there exists a concrete (albeit isolated) spatiotemporal world that contains a talking donkey as a part (although even non-Lewisian varieties of neo-Humeanism 'outsource' the truthmakers for modal claims as well, albeit to abstracta considered as either maximally consistent states of affairs or propositions); facts about what is necessary and possible, then, are best construed in terms of existential quantification over possible worlds.

With this machinery in hand, the neo-Humean is able to ground ways the actual world *would* have been if certain circumstances had obtained, i.e. counterfactuals, in terms of ways things go in distinct possible worlds. A counterfactual conditional $A\square \rightarrow C$ is true, for instance, just in case in the possible worlds most similar to the actual world where A is true, C is true as well. Causation, likewise, is analyzed in terms of counterfactual dependence: event b causes event b just in case a and b both occur and are distinct and were a not to occur, b would not have occurred. Finally, the laws of nature, as opposed to mere accidental regularities in nature, are those regularities that are theorems of an ideally simple and explanatorily strong description of the world. Employing only the resources of actual and possible local matters of fact devoid of intrinsic modal content, the neo-Humean offers a competing fundamental ontology of properties, modality, mereology, causation, and laws than that of the neo-Aristotelian.

Neo-Aristotelianism is on the rise in contemporary analytic metaphysics. But while those in the neo-Aristotelian camp have been diligent as of late in offering in-depth treatments of laws, causation, and modality in terms of irreducibly powerful properties, there has been, by comparison, very little work devoted to considering what a neo-Aristotelian mereology might look like.[6] The exception of Fine (1994c; 1999; 2010), Koslicki (2007; 2008), and Lowe (1998) withstanding, such a gap in the neo-Aristotelian camp is peculiar indeed given the pride of place Aristotle and the medievals gave to the category of substance over property in fundamental ontology.

A central aim of this essay is to help narrow this gap in the neo-Aristotelian literature. The current metaphysical climate, I believe, is ripe for reexamining a classical concep-

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[6]For a sampling of this work see Bird (2007), Mumford and Anjum (2011), and Jacobs (2010), respectively.

tion of substance. There are two contemporary factors that contribute to the timeliness of such a project. First, analytic metaphysics has seen a resurgence of interest in the notion of metaphysical grounding or priority in the very recent past. While the notion of metaphysical dependence or priority has been with the Western philosophical tradition from its inception, an increasing number of philosophers are beginning to appreciate the enduring value of this piece of metaphysical machinery.[7]

Second, arguably one of the primary sub-areas of analytic metaphysics responsible for its triumphal return in the second half of the twentieth century has been the area of mereological metaphysics. Though its contemporary roots originate with the work of the Polish logician Stanislaw Leśniewski, particularly his 1916 *Foundations of a General Theory of Manifolds* published in Polish, it wasn't until the arrival of Henry S. Leonard's and Nelson Goodman's *The Calculus of Individuals* in English in 1940 that formal mereology began to be a topic of interest in its own right in contemporary anglophone philosophy. With the 1987 publication of Peter Simon's *Parts: a Study in Ontology* serving as the bridge linking issues in contemporary analytic metaphysics with formal mereology as well as the subsequent arrival of Peter van Inwagen's *Material Beings* in 1990, the sub-discipline of mereological metaphysics was underway. Today, it is difficult to think of any area of analytic metaphysics that remains untouched by the reach of mereology.

The study of parts and wholes (mereology) and the notion of metaphysical grounding naturally gives rise to the question of the grounding relations that obtain between a whole and its parts, what I call *fundamental mereology*. Fundamental mereology has a rich and exciting historical pedigree spanning the work of Plato, Aristotle, Plotinus, Boethius, Abelard, Aquinas, Scotus, Spinoza, Leibniz, Husserl, Bradley (to name a few), and continues to provide the underlying framework for many of the debates at the heart of contemporary metaphysics, philosophy of science, and the philosophy of mind.

The question of fundamental mereology—whether wholes or their parts are metaphysically fundamental—harbors a host of assumptions in fundamental ontology that need to be examined in their own right. For one, fundamental mereology presupposes a relation of metaphysical grounding or priority that is not reducible to any distinct form of grounding of the logical, mathematical, conceptual, or epistemic variety. The first chapter of the essay is devoted to developing and defending my preferred fundamental ontology—serious essentialism—which holds that the fundamental joints in reality are constituted by primitive natures which serve as the truthmakers for facts about necessity and possibility, i.e. modal truths. The deepest story we can tell about the causal behavior and the relations that obtain between the denizens of spacetime, on my view, is to be explained in terms of the natures or essences of fundamental substances.

In chapter 2 I examine the existence and structural features of metaphysical grounding

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[7]I take the publication of the outstanding collection of essays edited by Correia and Schieder (2012) as evidence of this resurgence.

relations and attempt to motivate a view with historical roots in medieval Aristotelianism which takes grounding relations to obtain in virtue of the natures of things. I argue that such a conception of grounding is best suited to undergird the idea that grounding is often thought to track relations of ontological priority and posteriority.

I then turn in chapter 3 to unpacking the question of fundamental mereology in light of the recent work by Jonathan Schaffer. I explicate Schaffer's proposed constraints and options in fundamental mereology and argue for an alternative classification of views—what I call *part-priority* and *whole-priority*—that does not run the risk of excluding ordinary composite objects such as tigers, trees, and people from being ontologically prior to their proper parts. I then begin to lay the foundations for the fundamental mereology that I defend in the sequel—substantial priority—which employs the classical Aristotelian insight that substantial wholes are metaphysically basic in the sense that they are not only ontologically prior to their proper parts but also serve to ground the existence and identity of each of their proper parts.

The primary aim of chapter 4 is to call into question the tenability of the predominant fundamental mereology at play in the contemporary literature, part-priority, in its most popular guise, priority microphysicalism. After considering several lines of evidence in favor of part-priority and priority microphysicalism, I offer two general arguments against these views. The first—*the argument from the possibility of gunk*—targets part-priority in particular and trades on both the metaphysical possibility of gunky worlds, worlds devoid of mereological simples, and the thesis that every (non-empty) grounding domain includes, of necessity, at least one basic entity. The second argument—*the argument from mereological emergence*—sets its sights on both part-priority and priority microphysicalism and argues that a whole's failing to supervene on its proper parts (and their basic arrangements) entails its failure to be grounded in its proper parts. I offer examples from quantum mechanics, chemistry, and systems biology which suggest a failure of whole-part supervenience for at least some mereological wholes. While part-priority may provide the correct grounding description for certain kinds of composite objects, it is ill-suited to account for certain instances of mereological structure in the natural sciences.

I then turn in chapter 5 to motivating substantial priority by showing that the view lends a unified solution to a host of conundrums in contemporary metaphysics such as Tib and Tibbles, Goliath and Lumpl, The Problem of the Many, The Argument from Vagueness, and Causal Overdetermination. All this while preserving important common-sense intuitions about the existence of ordinary composite substances, many of which play an integral role in our best empirical theories. I conclude this chapter by offering a few brief remarks as to why I think substantial priority is a more stable and well-motivated fundamental mereology than priority monism.

Any respectable view concerning the nature and structure of material objects must

carry its weight in light of impending objections, and substantial priority is no exception. In the final chapter I take up what I consider to be the most formidable objections to substantial priority, ranging from its empirical inadequacy and inability to capture what we know about the structure and causal activity of material objects and their parts from scientific inquiry, the metaphysical possibility of worlds with endless upward mereological complexity (mereological junk), to its conflicting with Moorean facts about wholes and their parts, and its alleged incompatibility with spacetime substantivalism. While substantial priority is certainly not without its own counterintuitive commitments, I argue that the view is worth taking seriously once again and deserves a place at the table as a viable yet under appreciated metaphysic of material objects.

Chapter 1

Serious Essentialism

"Anyway, what's wrong with sounding medieval? If the medievals recognised objective joints in the world–as I take it they did, realists and nominalists alike–more power to them. But I don't supposed that inegalitarianism of classifications is an especially medieval notion–rather, egalitarianism is a peculiarity of our own century." —David Lewis, "Putnam's Paradox"

1.1 Essentialism: On Getting Serious

It is now more commonplace than ever to find philosophers defending the view that reality is constituted by objective *de re* modal structure. In our present philosophical context, 'essentialism' is widely understood to be the view that (minimally) objects have some of their properties essentially or necessarily as opposed to accidentally. Mackie (2006: 1), for instance, remarks that by essentialism about individuals she means "the view that individual things have essential properties, where an essential property of an object is a property that the object could not have existed without." For those who have embraced the reinstatement of *de re* necessity after its long demise at the hands of Quine and his positivistic forerunners, such formulations are a welcome sign indeed.

There has, however, been a relatively recent surge of suspicion regarding whether such a thin modal conception of essence is suited to capture many of our thick essentialist intuitions about reality. Here I join the chorus of those who espouse what has been called 'genuine,' 'serious,' or 'real' essentialism, a modal ontology with a non-modal conception of essence at its core.[1] I take it for granted that reality does in fact exhibit modal structure of the metaphysical variety (I thereby leave the topic of modal conventionalism and deflationism to others), the joints of which are carved out by the natures of things as specified by their respective ontological category and natural kind (if they are empirically specifiable).

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[1]For some representatives of this line of thinking see Fine (1994a), Klima (2002), Lowe (2008b), Molnar (2003: 37-39), Oderberg (2007), and Ross (1989).

Broadly, my aim in this chapter is twofold. In the first section I set out to argue, following closely the work of Fine (1994a), Gorman (2005), Oderberg (2007), Lowe (2008b) that a modal gloss on essence is ill-suited to capture what we take ourselves to be after in countenancing objective *de re* modal structure in the world, namely, the fundamental nature or identity of things. As useful as possible worlds are as a formal device for facilitating modal inferences etc., they do little by way of elucidating the fundamental natures of things and the grounds of metaphysical necessity and possibility, or so I claim.

In the place of a modal account of essence, I develop in the second section a neo-Aristotelian alternative in terms of a robust notion of real definition, one that has been hinted at in the literature but has, with a few notable exceptions, yet to be significantly explored from the standpoint of contemporary metaphysics.[2] My own proposed neo-Aristotleian essentialism differs from Fine's in many respects, primarily with respect to its retention of the categorial and natural kind ontology in which the notion of real definition was first introduced.

1.1.1 Modal Essentialism

In its current guise, the predominant essentialist paradigm can be divided into two primary theses regarding the notion of essence, whose conjunction I will refer to as *modal essentialism*. Taking the operator '$\Box$' to stand for metaphysical necessity, we have the following tenets of modal essentialism:[3]

(ME) MODAL ESSENTIALISM

1. x is essentially $\Phi \equiv \Box(Ex \to \Phi x)$

2. x's essence or nature is identical to the collection of those properties that satisfy the description Φ.

ME1 and ME2 are standard fare for many contemporary metaphysicians who are congenial to essentialism in the metaphysics of modality.[4] ME1 captures the above notion

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[2]Oderberg (2007) is a notable exception here, although his gloss on serious essentialism is explicated using more traditional terminology such as 'act,' 'potency,' 'prime matter,' etc. While I am in substantial agreement, as we will see, with much of what Oderberg has to say (mirroring the wider Aristotelian tradition), one of my primary aims in this essay in general (and this chapter in particular) is to develop a neo-Aristotelian substance ontology in light of recent developments in analytic metaphysics. I have a deep concern that the abiding virtues of such an ontology will be lost to contemporary analytic metaphysicians if it is not explicated in terms of categories and concepts that are similar to those that are already operative in the literature.

[3]Where 'E' serves as the existence predicate such that $Ex =_{df} (\exists y) x = y$.

[4]Along with Plantinga (1974: 70) and Mackie (2006: 1) cited above, the representatives are numerous: Yablo (1987: 297), the essence of a thing is "an assortment of properties in virtue of which it is the entity in question." Chisholm (1989: 43), "the essence of a thing was said to be a property that is essential to the thing and necessarily repugnant to everything else;" Kaplan (1978: 100), "I prefer to think of an essence in this way (as a transworld heir line) rather than in the more familiar way (as a collection of properties)...." Lewis (1968: 120), "the whole of its essence is the intersection of its essential attributes."

that x's essential properties are those that it modally requires for its existence. ME2, on the other hand, expresses the thesis that the essence of x *just is* the sum or collection of properties that x modally requires for its existence, i.e. its essential properties.

The precise details as to how the modal essentialist fills out ME1 and ME2 will hinge on their wider views regarding the ontological status of possible worlds as well as the relations that obtain between the inhabitants of those worlds. On Lewis' modal concretism, for example, ME1 and ME2 are characterized in terms of world-bound individuals and their properties together with the counterpart relation that obtains between them.[5] For Lewis, an object's essential properties–those that it modally requires in order for it to exist–are those properties had by both the individual and all of its respective counterparts. In his (1979: 120) own words, "An attribute that something shares with all of its counterparts is an essential attribute of that thing, part of its essence." As for ME2, Lewis is clear that "the whole of its essence is the intersection of its essential attributes." The intersection of the object and its counterparts, i.e. what the object and its counterparts have in common, suffices to capture the essence of an object.

Contrast this construal of ME1 and ME2 with Plantinga's abstractionist gloss on possible worlds together with a commitment to transworld identity. Plantinga understands ME1 and ME2 in terms of individuals and those privileged properties that exist in every world in which the individual exists. For Socrates to be essentially human, for instance, just is for Socrates to exemplify the property of humanity in every possible world in which he exists (ME1); for Plantinga (1974:72), "an essence of Socrates is a property that he has essentially" (ME2).

1.1.2   Modal Essentialism and the Asymmetry of Essentiality

I want to take issue with both ME1 and ME2 of modal essentialism. With the publication of his 1994 paper "Essence and Modality," Kit Fine has led the contemporary charge against a modal analysis of essence. Since Fine's groundbreaking work in this area, there has been a surge of interest in neo-Aristotelian minded philosophers in highlighting the shortcomings of assimilating essence to modality as well as exploring alternative grounds for modal truths that are within the confines of the actual world.

Interestingly enough, the various critiques of modal essentialism offered by Fine and company have focused almost exclusively on ME1 of modal essentialism at the expense of ME2.[6] My aim is to show why *both* tenets of modal essentialism miss their mark in capturing a fine-grained notion of essence. This project is not a new one. The idea that natures or essences were the ground of modal truths and irreducible to properties was vigorously defended by many of the medieval scholastics.[7]

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[5] I borrow the labels 'concretism' and 'abstractionism' from van Inwagen (1986).
[6] Although Oderberg (2007, 2011) is a notable exception here as we will see.
[7] This is nicely captured in Des Chene (2006).

At its core, serious essentialism consists of both a positive and a negative project in the metaphysics of modality. Here I want to narrow in on the negative undercurrent of this particular strand of thinking against modal essentialism, and then turn to the positive project, viz. the development of a more fine-grained notion of essence, in the following section.

To begin, let us turn to ME1. ME1 states that x is essentially Φ if and only if it is necessarily the case that if x exists then it is Φ. First, note the force of the biconditional driving ME1: modal requirement for existence is both necessary *and* sufficient to capture a thing's essence. For an object to have a property essentially *just is* what it modally requires for its existence. Herein lies the first challenge put forward by Fine. While modal requirement for existence may be necessary for a thing's essence, it is certainly not sufficient. Objects that have properties essentially have them necessarily (i.e. it is no surprise that the fundamental identity of a thing tracks that thing in every world in which it exists), Fine argues that the converse of this is subject to several counterexamples which thereby render ME1 false.[8]

The first counterexample involves Socrates (s) and his singleton {s}, the set whose sole member is Socrates. It is plausible, according to standard modal set theory, that necessarily, if Socrates exists then he is a member of his singleton set (where, again, 'E' denotes the existence predicate):

(a) $\Box(Es \rightarrow s \in \{s\})$

This is precisely because {s} exists if and only if Socrates exists, that is, Socrates necessitates the existence of his singleton. Now, according to our first tenet of modal essentialism, ME1, (a) is equivalent to the following thesis, where the sentential operator with the subscript '$\Box_x$' is to be read as 'it is part of the essence of x' or 'x is essentially such that:'

(b) $\Box_s(s \in \{s\})$

(b) states that it is part of the essence of Socrates that he be a member of his singleton. But here, as Fine aptly points out, it is implausible to suggest that it is part of the essence or identity of Socrates that he be related to his singleton, or any set-theoretic entity for that matter, in this way. Surely Socrates could retain his essence without there being *any* sets whatsoever. More generally, the problem is that there does not seem to be an essential connection between set-theoretic entities and the nature or essence of persons. As Fine (1994a) puts it, "There is nothing in the nature of a person, if I may put it this way, which demands that he belongs to this or that set or which demands, given that the person exists, that there even be any sets."

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[8]Fine has several counterexamples to the sufficiency of ME1, although I mention what I take to be the most persuasive here.

To state this a bit more precisely, there is a *modal symmetry* between Socrates belonging to his singleton and his singleton having Socrates as a member. It is necessary that whenever both Socrates and his singleton exist they stand in such relations to one another. However, there appears to be an *essential asymmetry* between Socrates and his singleton, that is, in terms of their respective essence or identity. While the identity of Socrates' singleton–its being *what* it is–involves reference to Socrates, this is not the case regarding Socrates and his being a member of his singleton. The crux of the objection here is that, intuitively, ME1–modal requirement for existence–seems to misconstrue the essence of Socrates by including features that fail to delimit what he is fundamentally.

A second counterexample offered by serious essentialists relies on the notion of Socrates and his *life*.[9] Suppose we assume transworld identity as well as the plausible assumption that it is necessarily the case that in every world in which Socrates exists there exists a temporally extended event that is his life, S_L. Now consider all the worlds in which Socrates exists, $w_a \ldots w_n$, along with his respective lives in those worlds, $S_{La} \ldots S_{Ln}$. On one standard construal of the modal features of events, the existence and identity of $S_{La} \ldots S_{Ln}$ depends on the existence and identity of Socrates in $w_a \ldots w_n$. From this it follows that if it is one and the same Socrates that exists in $w_a \ldots w_n$ via transworld *identity*, then it is one and the same life that exists in those worlds as well. While $S_{La} \ldots S_{Ln}$ may differ from one another in a qualitative sense, they are numerically one and the same life, the life of Socrates. If so, then we have another case of *modal symmetry* between Socrates and his life. In every world in which Socrates exists, his life exists (and vice versa). However, like the case of Socrates and his singleton, there is a crucial *essential asymmetry* between Socrates and his life in that while $S_{La} \ldots S_{Ln}$ depend for their existence and identity on Socrates, the converse does not seem to be the case. As a result, ME1 does not have the resources to account for the essential asymmetry between Socrates and his life.

Lastly, for those who are less inclined toward sets and abstract objects in general, Fine provides a similar counterexample as the first to the sufficiency of ME1 without such machinery. He asks the reader to consider two seemingly unrelated objects, Socrates (s) and the Eiffel Tower (T). Now, from it necessarily being the case that if Socrates exists then he is numerically distinct from the Eiffel Tower,

(c) $\Box(Es \rightarrow s \neq T)$

together with ME1, we get the following result:

(d) $\Box_s(s \neq T)$

Since ME1 of modal essentialist construes the having of an essential property as being *equivalent* to modal requirement for existence, it follows that it belongs to the essence of

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[9]This is adapted from Correia (2008) who attributes the discussion of Socrates and his life to Lowe (1998: 143).

Socrates that he be numerically distinct from the Eiffel Tower. As before, Fine (1994: 5) argues, plausibly, that there is nothing in Socrates' nature or essence which relates him in any such way to the Eiffel Tower.

Here the modal essentialist might retort that the above counterexamples, far from undermining the reduction of essence to modal requirement for existence, demonstrates that a further condition must apply to the properties that are said to constitute Socrates' essence. More specifically, one might rejoin that the properties that constitute Socrates' essence must be *relevant* to Socrates in some sense or other. And, in the case of the above properties *being a member of {Socrates}* and *being numerically distinct from the Eiffel Tower*, such properties fail to exhibit the proper relevance to Socrates and thereby fail to qualify as parts of his essence.

However, this added condition of relevance to ME1 in order to account for the essential asymmetry that obtains between Socrates and his singleton faces a problem. As Fine points out, it is very difficult to account for such asymmetry in terms of the concept of relevance that does not already make reference to the essence of Socrates in some sense or other. For one, this line of thinking seems to be saying that the reason why it is not part of Socrates' essence that he be a member of his singleton is because the property *being a member of {Socrates}* does not exhibit the proper relevance to *what* Socrates is fundamentally, that is, his nature or essence. But again, the essence of Socrates appears to factor into the very notion of relevance used to adjudicate between those properties that are essentially connected to Socrates and those that are not. Consequently, such a notion of relevance cannot be used to ground the essential asymmetry between Socrates and his singleton.[10]

Consider one way of tightening up the relevant sorts of properties or features appealed to in ME1 that make up a Socrates' essence. Not just *any* properties that Socrates modally requires for his existence are privileged enough to be included in his essence. Della Roca (1996) has argued that Fine's counterexamples to modal essentialism rely heavily on what he calls 'trivially necessary properties,' properties that we can define as follows:

> A property P is a *trivially necessary property* of object x iff x necessarily has P and either (i) all objects necessarily have P or (ii) P is a logical consequence of some property G that all objects necessarily have.

Examples of trivially necessary properties that meet condition (i) would be *being a man if a bachelor, being self-identical, being either round or not round,* or *being temporally*

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[10] Arguably, this very same worry applies to restricting all the essence-constituting properties of Socrates to those that are *intrinsic* to Socrates in every world in which he exists. In so far as intrinsically per se is cashed-out in terms of qualitative duplication as per Lewis (1986: 61) or independence of accompaniment (1999f), then the reason why b in world w^* is not a duplicate of a in world w is that b fails to have properties that are, intuitively, definitive of a. In short: the notion of an exact duplicate of a presupposes a grasp of what it is to be a thing of kind a and hence what features hold fixed of a's throughout worlds.

extended or not being temporally extended. Such properties are necessarily exemplified by not only x but by every existing object whatsoever, i.e. they are universally necessary. Trivially necessary properties meeting condition (ii), on the other hand, are those that can be logically derived from a universal trivially necessary property. The (impure) property *being identical to x*, for instance, can be derived from x's exemplifying the property *being self-identical*, itself a trivially necessary property shared by every entity.

We can now contrast trivially necessary with non-trivially necessary properties and maintain that the essential properties of a thing are those non-trivially necessary properties that it modally requires for its existence. With this distinction in hand, the modal essentialist can go on to modify ME1 in the following manner (where 'F' denotes the class of trivially necessary properties):

ME1*: x is essentially $\Phi \equiv \Box(Ex \rightarrow \Phi x) \wedge \neg(\Phi \in F)$

ME1*, however, turns out to be the medicine that kills the patient in the end. Where ME1 was rendered inadequate precisely in virtue of ascribing properties to Socrates' essence that were wholly irrelevant to his identity, ME1* completely eliminates Socrates' essence altogether in that it implies that *all* necessary properties are trivially necessary properties.

To see this, suppose that Socrates is necessarily human, i.e. *being human* is a necessary property of Socrates. If *being human* is a necessary property of Socrates, it follows that every object (including Socrates) has the trivially necessary property *being Socrates and being human or not being Socrates*. From the supposition that Socrates is self-identical, it follows that *being Socrates and being human* is a trivially necessary property of Socrates. This, together with the application of the rule of simplification, it follows logically that *being human* is a trivially necessary property of Socrates. Since, by ME1*, no trivially necessary property can enter into the essence of a thing, it follows, implausibly, that *being human* is not an essential property of Socrates. In so far as this line of thinking can be generalized to any necessary property of a thing, ME1* threatens to dissolve the notion of essence entirely. As a result, ME1* is in no better position (it is, in fact, in a worse position) to explicate the notion of essence.[11]

Consequently, modal essentialism does not appear to have the resources to account for the essential asymmetry between Socrates and the various entities in the above counterexamples. The framework of possible worlds lacks the wherewithal to deliver what we intuitively take ourselves to grasp (however incipient or nascent this grasp may be) regarding the fundamental identities of things. In fact, ME1 appears to get the order of

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[11]Also, note that appealing to the notion of trivially necessary properties in order to blunt the force of Fine's counterexamples may not carry over to our second counterexample of the essential asymmetry between Socrates and his life. Whether Socrates' life is construed as an event or a temporally extended trope of some sort, at the very least, it seems that Socrates' life is a non-trivially necessary feature of Socrates as it is more closely tied to *what* he is (a spatiotemporal concrete particular) than the properties *being distinct from the Eiffel Tower* or *being a member of {Socrates}*.

explanation backwards: it is precisely *because* of Socrates' essence–*what* he is–that he is essentially distinct from the Eiffel Tower in every possible world in which he exists, if there be possible worlds at all. Contrary to what many take to be the pride of contemporary essentialism, essence is unable to be reduced to modal requirement for existence in so far as the latter is inadequate to capture the fine-grained structure of essence.

1.2   Serious Essentialism

For many contemporary essentialists, modalism is so ingrained in the current mindset that it is hard to imagine what an alternative essentialist framework might look like. I presume that part of this preference for modal essentialism stems from the fact that it provides a rather metaphysically thin account of essence that is rather conducive to an overall austere ontology. While possible worlds have played an important and indispensable role in the unfolding of our conception of things essential and accidental, I want to join the chorus of philosophers who recommend that we take a page from Aristotle and the medieval scholastics in understanding necessity and possibility in terms of the notion of essence and not vice versa.[12]

In this section I develop an alternative essentialist framework, what has generally come to be called 'serious' or 'real essentialism.'[13] We must acknowledge at the outset, however, that the label 'serious essentialism' has a broad semantic range that is capable of encompassing a wide variety of views in the metaphysics of modality. As I understand it here, the minimal unifying feature of serious essentialism in modal metaphysics is the conviction that essence is irreducible to modality.[14] I put my particular version of serious essentialism, which falls much more in line with the Aristotelian and medieval Aristotelian tradition, forward as being one particular variant of serious essentialism in the literature.

Towards this aim, I begin by examining the positive undercurrent of Fine's work in modality that has led to the reinstatement of Aristotelian essentialism in contemporary metaphysics. I then turn to an explication of essence in terms of real definition. While I wholeheartedly agree with Fine in the rejection of modal essentialism in favor of taking a more robust approach to the notion of essence in terms of real definition, I part company with Fine and other prominent serious essentialists in making a clean break with modal essentialism entirely.

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[12]For historical background see Knuuttila (2011).

[13]See note 1 for proponents of this line of thinking. The view has also been defended recently under the guise of 'hardcore actualism' in Contessa (2010) and 'the new actualism' in Vetter (2011). There are a wide variety of views that currently fall under the banner of 'serious essentialism.' For a nice survey of these views see Vetter (2011).

[14]Here there may be variation in specificity concerning whether the truthmakers for modal facts are (i) the essences of powerful, dispositional properties or (ii) the essences of entities in general, not merely properties per se.

1.2.1 Essence and Real Definition

We saw earlier that Fine's negative project was directed at undermining the sufficiency of modal requirement for existence in capturing the essence or identity of Socrates. Fine concludes from his negative project that:

> [T]he contemporary assimilation of essence to modality is fundamentally mis-
> guided and that, as a consequence, the corresponding conception of meta-
> physics should be given up... the notion of essence which is of central impor-
> tance to the metaphysics of identity is not to be understood in modal terms
> or even to be regarded as extensionally equivalent to a modal notion. (Fine
> 1994a: 3)

Thus, *any* modal account of essence that appeals to the prior concepts of necessity and possibility will fail to capture the requisite distinctions regarding the nature and identity of Socrates. We can, then, think of Fine's positive contribution to the reinstatement of an Aristotelian variety of essentialism as including (i) the explication of essence in terms of real definition and (ii) an account of the structure of essence in what he calls the 'constitutive' and the 'consequential' essence.

Let us begin with the first tenet of Fine's positive project that has helped reinstate serious essentialism in the metaphysics of modality. Fine suggests that instead of analyzing essence in terms of metaphysical necessity—what an object requires of necessity in order for it to exist—he maintains that the source of metaphysical necessity lies in the nature or identity of things. On Fine's view, truths of necessity and possibility are made true by truths of essence, and not vice versa.[15]

As a result, modal truths are not explanatory basic truths of reality, not explanatory 'bedrock' so to speak. Rather, "Necessity has its source in those objects which are the subject of the underlying essentialist claim ... We should view metaphysical necessity as a special case of essence..." (1994a: 9). Fine contends that various kinds of entities such as concepts (both *logical*, i.e. the concept of disjunction, and *non-logical*, i.e. the concept of bachelorhood), and individual objects give rise to their own domain of necessary truths that are true in virtue of the essence or nature of the entities in question. For a proposition to be metaphysically necessary, then, is for it to be true in virtue of the essence or nature of *all* objects whatsoever. Likewise, for a proposition to be logically and conceptually necessary is for it to be true in virtue of the essence of all logical concepts and true in virtue of the essence of all concepts, respectively. In general, it is because of what individual objects and concepts are that the relevant modal facts are true of them, and not vice

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[15]I should note that Fine (2002) does not say this is the case for all kinds of necessity. Rather, he excludes facts about natural and normative modality as further kinds of modality that are made true by facts about essence. Here I restrict my discussion to metaphysical modality.

versa. Contrary to modal essentialism (ME1), then, modal truths are true in virtue of the natures or essences of entities.

But how exactly are we to understand the notion of essence at work in the above account? We have seen that modal essentialism's inability to capture the structure of essence has led us to a more fine-grained notion of essence, one that does not include necessary features of Socrates that are seemingly unrelated to *what* he is in the most fundamental sense. What's more, the priority of essence over necessity requires that our requisite notion of essence needs to be unpacked in distinctively non-modal terms.

With Fine and other serious essentialists, I suggest that we return, once again, to the traditional Aristotelian and scholastic conception of *real definition* to elucidate a more fine-grained, non-modal account of essence.[16] Fine (1994a: 3) states,

> [T]he traditional assimilation of essence to definition is better suited to the task of explaining what essence is. It may not provide us with an analysis of the concept, but it does provide us with a good model of how the concept works. Thus my overall position is the reverse of the usual one. It sees real definition rather than de re modality as central to our understanding of the concept. (Fine 1994a: 3).

We do not, however, *analyze* essence in terms of real definition. Rather, the notion of essence itself ought to be taken as primitive and unanalyzable. Along these lines Fine (1995: 53) states, "Indeed, I doubt whether there exists any explanation of the notion in fundamentally different terms." This does not, however, consign us to silence when it comes to filling out what a non-modal conception of essence might look like.

In general, to define x is to set forth x's "limits in such a way that one can distinguish it from all other things of a different kind."[17] A definition can be said to include both a *definiendum*, that which is defined, and a *definiens*, that which does the defining. Following philosophical tradition, Fine contends that definitions *per se* can be either *nominal* (i.e. linguistic) or *objectual* (i.e. pertaining to a thing, *res*). A *nominal definition* has as its definiendum a *word*, where the definiens takes the form of a sentence or collection of sentences. By providing a nominal definition of a word, *exculpate* for instance as "to show or declare that someone is not guilty of wrongdoing," one is setting certain limits or boundaries on a linguistic item that distinguishes that item from other items in the language to which it belongs.

A *real definition*, on the other hand, has as its definiendum an object or entity, where the definiens takes the form of a proposition or collection of propositions that is true in virtue of the identity of the object being defined. Consequently, when we define some

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[16]Other contemporary philosophers who are sympathetic to the idea of real definition (though some more so than others) are Ellis (2001), Johnston (2006), Lowe (unpublished ms), Molnar (2003: 38), Oderberg (2011), and Ross (1989).

[17]Oderberg (2007: 19).

actual or possible entity we thereby specify its essence, that is, the very identity of that thing or what its identity *would* be if it existed.

For the most part, in what follows I will restrict my attention to the real definitions of substantial particulars that occupy a region of spacetime. Regarding the essence of a substantial particular x in general, it is important that we distinguish between the *specifying essence* and the *specified essence* of x, that is, between the real definition–the proposition stating x's fundamental identity–and what is being defined by the real definition–the individual substance itself, x.[18] This distinction is meant to track the idea that the locution 'the essence of x' can refer to either x's real definition (specifying essence) or x considered as a particular of a certain kind (specified essence).

More specifically, a real definition of a substance is a proposition or collection of propositions which signifies its fundamental nature, that is, what is directly *definitive* of the substance as determined by its fundamental natural kind.[19] Moreover, by x's 'identity' here I do not mean the relation of self-identity $(x = x)$ which every thing bears to itself trivially. Rather, I have in mind what Bishop Butler (1914: 23) meant by the notion: "[E]verything is what it is, and not another thing." For every occupant of spacetime to have an identity or essence in this sense is simply the affirmation that spatiotemporal reality is not an amorphous lump; that various regions are occupied by *identifiable* and *definable* physical structures or 'software' as the late James F. Ross aptly put it.[20]

The objects of substantial real definitions are particular kinds of substances.[21] Another way of stating this would be to say that individual substances are themselves the truthmakers for substantial real definitions. When speaking of the identity of a particular substance, I use synonymously the locutions 'the nature of x,' 'the essence of x,' and 'the kind to which x belongs.' Thus, one could, on my view, substitute 'individual substantial nature' for 'particular kind of individual substance' without loss of meaning or content. Contrary to some serious essentialists, an individual substance occupying a region of spacetime does not, strictly speaking, *have* a specified essence or nature in the same way it has a spatial location or a certain mass at a time; rather, it simply *is* a substance of a particular kind.[22] In the same way, the specified essence or nature of a substance ought not be thought of as a constituent or proper part to which the substance is related, whether such a relation be construed in mereological or non-mereological terms.

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[18]As noted in Pasnau (2011: 557-564), this distinction is a longstanding one in the history of essentialism, particularly in the work of the scholastics, see especially Suarez (2000).

[19]For Aristotle's explication of real definition as "a phrase signifying a thing's essence" see *Topics* I.5 101b38, VII.5 154a31 in Aristotle (1984a).

[20]See Ross (2008).

[21]See Loux (2006: 111-112), "Aristotelians will deny that the kind is a part or constituent or an object, something that enters into the composition of that object. It is, they will claim, *what* the object is" and Toner (2010: 4), "The idea is that substances are instances of substance kinds, not that they *have* them."

[22]This, of course, is one particular interpretation of Aristotle's view as stated in *Meta.* Z.6.

Thus, my own neo-Aristotelian ontology is in agreement with Lowe (2011) in claiming that x's essence ought to be construed as either no entity at all in addition to x or as being identical to x.[23] Where Lowe opts for the first route and refuses to reify essences in any sense, I take the second and claim that the specified nature or essence of x is identical to an individual member of a kind.[24] Thus, the real definition (specifying essence) of gold is <a metal whose atomic constituents have atomic number 79>, which encodes *being a metal* and *having atomic number 79*. The specified nature of gold, on the other hand, is simply the particular instances of the various portions of gold we find in the natural world.

At the heart of the notion of real definition and serious essentialism in particular is the thesis that reality exhibits objective *ontological* and *naturally specifiable joints*. By 'objective' here I mean that the truthmakers for our classificatory judgments about the kinds of entities that exist are mind-independent. Nature's joints are 'specifiable' in the sense that we commonly take our classificatory judgments about the different kinds of things that are said to occupy the various regions of spacetime to be justified to some degree or other (such justification is, of course, defeasible). For my purposes in this essay, I will assume without further argument that reality is in fact structured in this way, although I will have a bit more to say on this score below.[25]

Real definitions, then, aim to track these joints by answering the question *what is it to be a thing of a particular category or kind*.[26] We must not, however, presume that such a question has a *single* uniform answer in so far as every living being, for instance, falls under many distinct kinds thereby generating multiple answers to the question *what is it to be a thing of a particular kind, K*. For this reason, the serious essentialist has traditionally claimed that kinds, both categorial and natural, form a nested hierarchy with the more general being included in or implied by the more specific in the hierarchy. According to the serious essentialist, real definitions aim to capture the *fundamental* or lowest-level category or kind to which a thing belongs.[27]

Take an individual tiger by way of example. For the serious essentialist, the real definition of a tiger (whatever it may in fact be) will seek to explicate *what it is to be a tiger*, which will involve, at the very least, empirical inquiry into those distinguishing features, powers, and capacities that set tigers apart from every other living organism (category) as well as every other kind of carnivorous animal (natural kind). Thus, the real defini-

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[23]The primary reason being the threat of an infinite regress of essences (essences having essences ad infinitum) as noted by Aristotle in *Meta.* VII.17.

[24]See Oderberg (2007) for a different perspective on the relationship between a substance and its essence.

[25]I am of the opinion that these ontological commitments in particular provide a robust foundation for much of the machinery underlying the natural sciences such as inductive inferences, laws of nature, causal powers, and causal explanation. For a full-scale defense of these commitments I point the reader to Harré and Madden (1975), Bird (2007), Ellis (2001), and Lowe (1998; 2006).

[26]I ignore here the topic of individual essence, which would seek to answer the question: *what it is to be the particular individual of a category or kind*.

[27]The notion of natural kinds forming a nested hierarchy is stated nicely by Hacker (2011: 30-31).

tion of a tiger will involve reference to *both* its fundamental ontological category as well as the fundamental natural kind to which it belongs. A tiger's fundamental ontological category, for instance, is that of *living organism*.[28] It is in virtue of being a certain *kind* of object–a substance–that tigers are capable of persisting through the replacement of their constituting matter (contra mere portions of stuff or aggregates for instance). I take it *that* substances are capable of persisting in such a manner is known a priori by philosophical reflection on the concept of a substance.[29] More specifically, it is because a tiger is a certain *kind* of substance—a living organism to be exact—that it is capable of self-initiating and self-directing action as well as undergoing metabolic growth (contra non-living substances). Consequently, any entity that lacked the above features could not be a tiger in so far as such powers are inseparably tied to *what it is to be a tiger*.

As a tiger is a certain *kind* of living organism, reference to its fundamental ontological category only partly constitutes its identity; it hardly needs stating that the real definition of a tiger involves more than an appeal to the category *living organism*. Here we must appeal not only to categorial structure but to the lowest *natural kind* that is definitive of individual tigers. A tiger is a certain kind of *animal*: a *vertebrate*, *mammal*, and *carnivore*. The real definition (whatever it may be in point of fact) of a tiger will denote the fundamental kind of thing a tigers is, which will inevitably point (to be elucidated below) to those features and dispositions that distinguish tigers from other members of the genus *Panthera*. The point here is that a serious essentialist metaphysic is committed to the thesis that the real definition for *any* empirically specifiable entity will involve *both* categorial as well as natural kind classification. As a result, our knowledge of the real definitions of substances will inevitably involve integrating a robust engagement with the natural sciences with a well-developed categorial ontology.

1.2.1.1 Biological Essentialism and Evolutionary Biology

At this point it is important that I address the empirical worry that distinctively biological kinds (such as *Panthera Tigris*) are incompatible with contemporary evolutionary biology. It hardly needs emphasizing that there there is a strong anti-essentialism consensus in contemporary philosophy of biology (Okasha 2002: 198). This is not to deny, however, that there are ardent defenders of biological essentialism in the literature.[30]

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[28] It is what Lowe (ms-b) calls its 'fundamental general essence.'

[29] The perdurantist and endurantist will, of course, disagree on *how* substances persist through time, but not on strictly empirical grounds. My point is simply this: *that* substances exhibit diachronic persistence is not amendable to empirical discovery. What I do think is amendable to empirical inquiry are the various mechanisms operative within individual substances of various kinds that allow them to persist as such.

[30] I should note that the label 'biological essentialism' has a broad semantic range in that it can accommodate different views as to the ontological status of biological species or kinds (whether homeostatic property clusters, irreducible kinds, etc.). For some advocates of biological essentialism broadly construed, see Devitt (2008), Griffiths (1997), (1999), Boyd (1999), Wilson (1999), Okasha (2002), LaPorte (2004), Walsh (2006), and Dumsday (2012).

What grounds this anti-essentialist consensus? One alleged source of contention orig-inally championed by Mayr (1959) and Hull (1965) is that the existence of biological kinds or species is thought to be directly at odds with the variability or non-fixity of species over time; if species or higher taxa come into and go out of existence, and essen-tialist biological kinds are "fixed, unchangeable 'ideas' underlying the observed variabil-ity, with the *eidos* (idea) being the only thing that is fixed and real" and "[t]he essence or definition of a class (type) is completely constant; it is the same today as it was on the day of the Creation," then species cannot be essentialist kinds.

The charge carries little force against the serious essentialist metaphysic I am propos-ing. For one, the denial of the thesis that current species have evolved from ancestral ones and that species are therefore constant or 'fixed' through time is no part of serious es-sentialism. Being Aristotelian in spirit, serious essentialism is wholeheartedly consistent with various kinds of biological organisms giving rise to new kinds of biological organ-isms through reproductive mutation and natural selection over time. Reptiles (*Reptilia*), for instance, are commonly thought to be responsible (whether directly or through some further intermediaries) for the appearance of mammals (*Mammalia*) on the evolutionary scene some two hundred million years ago; biological organisms whose real definition included the kind *Reptilia* brought about, through reproductive mutation, biological or-ganisms whose real definition included the kind *Mammalia*. There is nothing in this account of the origin of biological diversity that conflicts with contemporary evolution-ary biology. In fact, the bankruptcy of this first objection to serious essentialism is readily acknowledged by even those who are set against essentialism in biology such as Sober (1993: 146-147):

> Transmutation of the elements is possible; an atom smasher can transform
> (samples of) lead into (samples of) gold. However, this does not undermine
> the idea that the chemical elements have immutable essences. Likewise, the
> fact that a population belonging to one species can give rise to a population
> belonging to another does not refute essentialism about species. Essential-
> ists regard species as perennial categories that individual organisms occupy;
> evolution just means that an ancestor and its descendants sometimes fall into
> different categories.[31]

The charge of the invariability and fixity of species put forward by Mayr and Hull appears to be aimed more at a Platonic variant of essentialism than the one on offer here.

A second worry underlying the anti-essentialist consensus in the philosophy of biology is that biological natures play no explanatory role in explaining genetic variation within

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[31]Okasha (2002) (citing Sober 1993) underscores this point in terms of chemical kinds as follows: "[t]he fact that oxygen can be transmutated into nitrogen is not usually taken to undermine essentialism about chemical kinds, so the fact that species are mutable should not count against essentialism about biological species either."

populations; 'population thinking' has supplanted individual organisms (and hence biological natures) in accounting for biological diversity.[32] Here we have real instead of apparent conflict between serious essentialism and evolutionary theory. If evolutionary theory is inherently characterized by population thinking, and population thinking discards with reference to individual biological natures and their powerful capacities, then evolutionary theory has no need for biological natures.

But what exactly are the grounds for thinking that individual biological natures are irrelevant to population thinking? What is the argument here? Let's take Sober (1980: 370) as a representative of this line of thinking:

> Darwin..... focused on the population as the unit of organization. The population is an entity, subject to its own forces, and obeying its own laws. The details concerning the individuals who are parts of this whole are pretty much irrelevant. Describing a single individual is as theoretically peripheral to a populationist as describing the motion of a single molecule is to the kinetic theory of gases. In this important sense, population thinking involves *ignoring individuals*...([1980], p. 370, emphasis in original).

We might make the preliminary point that some feature Ψ being irrelevant for some theoretical purpose does not, in and of itself, count as evidence against the existence of Ψ. To take Sober's preferred analogy, the irrelevance of the motion of a single molecule to the kinetic theory of gases in no way confers positive reason to think the single molecule lacks motion altogether. In the same way, even if we were to grant that individual biological natures and their adaptive capacities are entirely irrelevant to population thinking, it simply does not follow that *there are no biological natures*.

More importantly, however, is that it is misconceived to hold that biological natures are entirely irrelevant and thus 'theoretically peripheral' to populationist thinking in evolutionary theory. For one, even if we grant the objector the contentious view that populations are not groups of biological organisms but mere assemblages of Mendelian genes or traits, the point remains that "genes—or traits—don't occur as disembodied members of populations; they occur as constituents of organisms" and that "the very definition of what (if anything) a gene is depends on the properties of the cell in which the DNA is embedded."[33] If what it is to be a thing of the kind *gene* is functionally defined in terms of the individual organism of which it is a part such that "the fate of a gene or trait is tied to the fate of the organism it is in," and populations are assemblages of genes then, contra Sober, population thinking *cannot* ignore reference to individual organisms on pains of omitting salient facts about the behavior and context-sensitivity of genes. As Walsh aptly points out, the rates of variation with respect to gene frequency

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[32]The objection is pressed most forcefully by Mayr (1959) and (1963) as well as Sober (1980).
[33]Walsh (2006: 435) and Fox Keller (2010: 22), respectively.

in a given population (i.e. gene fitnesses) are realized by the differential survival and reproduction of organisms in which gene (trait) tokens occur. Consequently, individual organisms (and ipso facto biological natures) are indispensable to population thinking. Oderberg (2007: 208) makes essentially the same point, albeit in terms of our *knowledge* of population behavior, as follows:

> Knowledge of whether a population has evolved requires knowledge of whether adaptive traits have arisen within individual organisms. For evolution to occur, harmful mutations must be sufficiently rare or ineffectual within individuals, and fitness must be fairly constant across genetically similar individuals. Population thinking is simply not possible without individualistic thinking.

We cannot, then, follow Sober's advice and 'ignore individuals' in accounting for facts concerning the origination of adaptive traits in populations in so far as such facts involve ineliminable reference to the context-sensitivity of such traits and thus the organisms in which they are embedded.

Yet another potential source of conflict between serious essentialism and evolutionary biology stems from 'species pluralism,' which trades on there being a multiplicity of species concepts (biological, ecological, phenetic, cladistic, etc.) at play in biological taxonomy, each with their own distinctive criterion of species membership (interbreeding, ecological niche, genetic similarity, genealogy and common descent, respectively). Species pluralism, more specifically, is the view that there is no single privileged species concept, all such taxonomies are equally plausible and defensible. Some even go on to make the stronger claim that species pluralism renders the species concept in biology theoretically empty.[34] In so far as essentialism regarding biological kinds endorses a single criterion of species-membership, it is in direct opposition to species pluralism.

Species pluralism is by no means mandated by current evolutionary taxonomy and is far from consensus among philosophers of biology; defenders of species monism are by no means a minority.[35] Of course we need not deny that there are a multiplicity of species concepts currently at play in biological practice.[36] But as species monists have pointed out, this in no way supports the positive thesis that there *is* no single privileged or fundamental species concept among the many (the cladistic species concept, where genealogy and common descent are determinative factors in species membership, would be the clear frontrunner here).

A fourth worry here would be that on serious essentialism an organism's biological kind is at least partly *intrinsic* to that organism.[37] The intrinsicality of biological kinds is

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[34] In particular, see Marc Erefsheski (1992). For a reply to Erefsheski see Brigandt (2002).

[35] For an insightful overview of the concept of biological species at play in the literature see Ereshefsky (2010a).

[36] Ereshefsky (1998) maintains that there are around two-dozen species concepts, with at least seven of these being well-accepted by most pluralists.

[37] As the topic of this section is biological natures, I assume here that such natures must be at least partly

in direct conflict with *cladism*, the predominant version of species monism in the literature.[38] According to a cladistic species concept, biological species are purely *historical* in that they are constituted by evolutionary lineage on the phylogenetic tree; conspecificity is determined solely by occupying a common segment (clade) in the branching line of evolutionary descent (common ancestry) bounded by speciation and extinction events. Cladism, according to Okasha (2002: 200), suggests that we "identify species in terms of evolutionary history...[with] particular chunks of the genealogical nexus...Species come into existence when an existing lineage splits into two...and go extinct when the lineage divides, or when all members of the species die." Since biological species are purely relational on this view and have nothing to do with an intrinsic nature or essence, serious essentialism is false.

While cladism rightly emphasizes the importance of ancestral lineage for taxonomic practices, it falls prey to some notable objections, only one of which I am able to rehearse here.[39] Even if we were to grant that it is necessary for conspecificity that organisms belong to the same ancestral lineage and be bound by the same speciation and extinction events, it is certainly not sufficient; *what* biological organisms are cannot be fully captured by *where* they came from.

Take the event of an existing lineage l splitting into two lineages l_1 and l_2, where the splitting constitutes a genuine speciation event, e_1, such that l splits into two distinct lineages l_1 and l_2 with distinct species as members. Hence, e_1 gives rise to distinct branching lineages at one and the same time. Further, suppose that some time after the occurrence of e_1, the members of l_1 and l_2 simultaneously cease to exist as a result of a single extinction event, e_2 (due a meteorite perhaps). In this case, we have two distinct ancestral lineages l_1 and l_2 that share the very same ancestral lineage and are bounded by the very same speciation and extinction events e_1 and e_2. But on cladism it is difficult to see what *constitutes* the distinctness of l_1 and l_2 other than the fact that they are the products of a genuine speciation event e_1. This suggests that species-membership is something more than merely occupying the same clade on the phylogenetic tree and being bound by the same speciation and extinction events as the original notion of speciation at work in e_1 (i.e. the one that gives rise to two distinct species) involves factors that are *independent* of such considerations. In sum: cladism *cannot* be the final story regarding

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constituted by intrinsic features of the organism. Whether such natures are fully intrinsic is a question we need not take a stand on here; I remain neutral as to the possibility of biological natures being partly intrinsic and partly extrinsic or relational. Note that not all natures *per se* need be understood as such, there is room to countenance purely relational essences (say objects whose nature is constituted entirely by its standing in certain relations to human intentions).

[38] Although cladism is not the only species concept that renders biological species non-intrinsic or relational. Though I will not rehearse them here, I think there are arguments which show that biological species must consist, at least in part, of intrinsic features of a biological organism. The view that species cannot be *purely* relational is called 'Intrinsic Biological Essentialism' and is defended by Devitt (2008) and Dumsday (2012).

[39] Here I am indebted to Oderberg (2007).

species-membership in so far as it assumes a non-cladistic notion of speciation.[40]

Along similar lines, Okasha (2002), echoing Laporte (1997) has argued that biological essentialism is empirically untenable in so far as every species concept on offer in the literature entails the denial of the essentialist thesis that an organism's species is essential to it (by which he means that it could not have existed without it).[41] Whether we adopt an interbreeding, ecological, or phylogenetic account of species, it is possible that the organism in question could have belonged to a different species than the one to which it in fact belongs.

Okasha asks us to consider a single large population (p) from which a small splinter group becomes physically isolated (s). Suppose that over time s adapts to new environmental conditions and, as a result, diverges from p such that interbreeding between the two populations breaks down. According to the interbreeding species concept, the members of p and the members of s would thereby constitute two distinct species, call them s_1 and s_2 respectively. But, Okasha argues, since it is both possible that s remain within p and s might not have become reproductively isolated from p, it follows that any organism in s might not have belonged to s_2 but, rather, may have belonged to s_1 (the argument is then generalized to ecological and phylogenetic species concepts as well). As a result, an organism's biological species is not essential to it and hence biological essentialism is false.

The argument trades on a *de re/de dicto* modal ambiguity. Okasha (following Laporte) reasons as follows:

(E1) It is possible that s remain within p.

(E2) If it is possible that s remain within p, then it is possible that the members of s_2 belong to s_1.

Therefore:

(E3) It is possible that the members of s_2 belong to s_1.

Which Okasha takes to undermine the truth of biological essentialism such that:

(E4) The members of s_2 are not essentially members of s_2.

As it stands, E4 is a *de re* claim predicating s_2 to a particular class of biological organisms, which is the precise nub of the essentialist notion of species-membership. E3, however, is

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[40]This worry is acknowledged by proponents of cladism such as Okasha (2002: 201): "Indeed, a phylogenetic concept will have to rely on a concept of one of the other types to yield an account of speciation events, i.e., of one lineage splitting into two." Note also that this objection broadly mirrors Gibbard's (1975) response to the perdurantist solution to the problem of material constitution. Since Goliath and Lumpl have the very same spatiotemporal boundaries and thus the very same temporal parts as one another, the perdurantist is unable to ground the non-identity of Goliath and Lumpl in their having distinct temporal parts.

[41]See Laporte (1997).

a *de dicto* claim stating that the proposition <the members of s_2 belong to s_1> is possible. It is a claim, we might add, that the essentialist need in no way be threatened by; the proposition <the members of s_2 belong to s_1> is certainly not necessarily true in so far as the branching of s and p at a point in time is entirely *contingent*, it need not have happened.

Hence in order for E4 to follow from E3, Okasha needs the following *de re* reading of E3 in order to preserve the argument:

(E3*) The members of s_2 could have belonged to s_1.

But considered as a *de re* claim regarding species-membership, no essentialist worth their salt would grant the truth of E3* precisely because it *entails* the denial of biological essentialism. As a result, in collapsing the de re/de dicto distinction, the argument assumes the falsity of essentialism and thus fails to offer non-question begging grounds against the notion that organisms have their species essentially.

Lastly, it is often charged that biological essentialism is incompatible with the vagueness of biological species, that there are no sharp boundaries between species and thus no privileged way of demarcating kinds of biological organisms. Ereshefsky (1992: 188-189) states this worry nicely:

> The boundaries of species are vague in the same sense that the boundaries between rich and poor, bald and not bald, are vague. There is no precise number of dollars that marks the boundary between rich and poor. Similarly, there is no genetic or phenotypic trait that marks the boundary from one species to the next. Therefore no trait is essential for membership within a species.

Another common, albeit distinct, way of stating the objection from vagueness in the biological domain would be that since species arise by means of a gradual evolutionary process (speciation in particular) that is sorites-susceptible, and essentialism requires precise and non-arbitrary boundaries between biological kinds, essentialism is biologically untenable. This line is advanced by Griffiths (2002: 77) when he claims that essentialism "is precisely the 'typological' perspective on species that Darwin had to displace in order to establish the gradual transformation of one species into another."

Let's begin with the above quote from Ereshefsky. For one, his analogy between the vagueness of biological species and the vagueness concerning the amount of money that makes the difference between rich and poor is a bad one. Monetary units are intention-dependent objects, objects that could not exist in the absence of agents with beliefs, desires, and intentions. As such, the existence and identity conditions of monetary units are constituted by the intentions of rational agents. In this way, they are paradigmatically *non-natural*. The same applies to the predicates that such objects satisfy ('is rich' and 'is

poor'). Biological kinds or species, by contrast, are commonly thought to be highly natural in that if they exist at all their identity conditions are objective and intention-independent; natural kinds of entities, particularly kinds of biological organisms, carve objective joints in the world. To insist, then, that the two cases are *one and the same* is to tacitly assume a view of biological species that calls their naturalness or objectivity into question.

Second, it is a live question, debated by friend and foe of biological essentialism alike, as to whether the view actually *is* incompatible with there being cases of metaphysically indeterminate species-membership (for my purposes here I will use 'vague' and 'indeterminate' interchangeably).[42] Sober (1993), no friend of biological esssentialism, argues that "essentialism is a doctrine that is compatible with certain sorts of vagueness" and goes on to clarify as follows:

> The essentialist holds that the essence of gold is its atomic number. Essentialism would not be thrown into doubt if there were stages in the process of transmuting lead into gold in which it is indeterminate whether the sample undergoing the process belongs to one element or to the other. I suspect that no scientific concept is absolutely precise; that is, for every concept, a situation can be described in which the concept's application is indeterminate. Essentialism can tolerate imprecisions of this sort.

The point can be easily generalized to encompass biological as well as chemical kinds. In like manner, Devitt (2008), a defender of biological essentialism, maintains that "[e]ssentialism does *not* require sharp boundaries between species" and argues that:

> On the Essentialist picture, the evolution of S2 from S1 will involve a gradual process of moving from organisms that determinately have S1 to organisms that determinately have S2 via a whole lot of organisms that do not determinately have either. There is no fact of the matter about where precisely the line should be drawn between what constitutes S1 and what constitutes S2, hence no fact of the matter about where precisely to draw the line between being a member of S1 and being a member of S2. Essences are a bit indeterminate.

As far as I can tell, such remarks by Sober and Devitt are intended to show that they are of the opinion that there is no direct path from indeterminate biological kinds to the falsity of biological essentialism.

By my lights, however, countenancing indeterminate species amounts to the claim that there are biological organisms such that, *by their very nature*, are incapable of being classified as belonging to one species rather than another. If it were metaphysically

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[42]See Sober (1993) and Devitt (2008: 373), the latter being a defender of what he calls 'intrinsic biological essentialism'.

indeterminate as to whether an organism belonged to a particular species then the organism would be *no kind of biological organism in particular*. But is it not the case that for a biological organism to belong to a species *just is* for it to be a *particular* kind of biological organism? I am inclined to think that the above remarks from Ereshefsky are correct in that to admit metaphysically vague biological species is to call into question the very notion of a biological kind in the first place; if the organism has no biological nature in particular, it has no biological nature *tout court*. To say that there is no fact of the matter as to whether some biological organism is a member of S1 or a member of S2 (as per Devitt) would be to say that there is no fact of the matter as to whether the organism "is what it is, and not another thing," which is to deny that it has a nature at all.[43]

But here we come to the crux of the matter. Ereshefsky claims that biological species are vague *in precisely the same sense as* the boundaries between the rich and the poor, the bald and the non-bald. But as anyone familiar with the literature on vagueness knows, the question as to the *kind* of vagueness operative in these sorites-series is a live metaphysical debate. The nub of the debate centers on whether the sorts of vagueness we are confronted with are a result of (i) the way the world is independently of how we know or represent it (metaphysical), (ii) semantic indecision (supervaluationism), or (iii) gaps in our knowledge (epistemicism), or a combination of each depending on the case at hand. Since serious essentialism, including its application to the biological domain, is at its core a metaphysically heavyweight thesis about the natural joints in the world apart from how we know or represent them, its tenability is called into question here only if the vagueness we find in biological classification is *metaphysical*, whether in the biological domain there are genuine cases of metaphysically indeterminate species-membership.

Given that a full-scale treatment of the particular advantages and drawbacks of the various theories of vagueness is beyond the scope of this chapter, suffice it to say that the weight one ascribes to the above objection to biological essentialism from vagueness hinges on the tenability of vagueness that is neither the product of semantic indecision nor gaps in our knowledge of the world. At the very least, I am inclined to think that the biologist doesn't get to say, *qua* biologist, that the indeterminacy we all must learn to live with in biological classification is distinctively *metaphysical* in nature. The indeterminacy operative in biological classification is entirely consistent with it being the result of our cognitive inability to determine the particular species of an individual organism. The defender of serious essentialism that eschews metaphysical indeterminacy in general could argue that the gradual evolution of species S2 from S1 consists in the fact that some organisms determinately have S1 and some determinately have S2, via organisms such that our best taxonomic knowledge is incapable of determining whether the organisms are best categorized as belonging to S1 or S2 or neither. As we will see below, our inabil-

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[43]The point is made by Oderberg (2007: 227).

ity to state the complete real definition of a biological substance in no way casts doubt on the fact that reality exhibits objective biological joints.[44]

Even more, however, Walsh (2006) has argued that not only are biological kinds or natures compatible with evolutionary biology they also serve to explain certain adaptive features of organisms that are integral to the evolutionary process itself. Walsh argues that in order for adaptive evolution to obtain in the first place, biological organisms must exhibit a high degree of *stability* in having the "capacity to develop and maintain a well-functioning individual that is typical of its kind, despite the enormous complexity of its development and the vagaries of its environment and genome" (436). Such stability is attained through the organism's power for phenotypic plasticity. According to Walsh, phenotypic plasticity "consists in an organism's finely tuned capacity to develop and maintain a viable, stable homeostatic end state that is typical for organisms of its kind by the implementation of compensatory changes to its behavior, structure, and physiology" (441). It is the very same power for phenotypic plasticity that, according to Walsh, undergirds the *mutability* of biological organisms—their ability to give rise to adaptive novelties. He points to the fact that mutations in regulatory gene networks will often lead to the production of novel adaptive features such that "the malleability and versatility of gene networks and their ability to 'find new solutions' when constituents are changed, help to account for the properties of robustness, buffering and emergence."[45]

One notable example of an organism's phenotypic plasticity giving rise to novel adaptive traits is the eyeless *Drosophila* (banana fly).[46] The gene for eye production in *Drosophila* (ironically called *Eyeless*) can be mutated such that eye production in *Drosophila* can be blocked, thereby giving rise to tribes of banana flies that lack the gene for eye production. It was shown that after a few generations of breeding *Drosophila* that lacked the gene for eye production, there appeared *Drosophila* with eyes in spite of the fact that they still lacked the gene for eye production. In virtue of their phenotypic plasticity, *Drosophila* are able to give rise to adaptive novelties in order to maintain a viable and stable end state, in this case a viable state involving a need for visual sensations. Walsh concludes, "The picture that emerges from recent developmental biology is that the stability and the mutability of organisms that are pre-requisites for adaptive evolution are consequences

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[44]Oderberg (2007: 230-234), following Thomason (1969: 98) offers a rough sketch of one particular method—*the method of partition*—for handling epistemically vague cases of biological classification. The method of partition states, very simply, that *when in doubt, divide*. When the biologist is unable to classify a particular organism o as belonging to species S_1 or S_2, "he should simply classify it as belonging to a new species S_n and only reclassify it as belonging to an already-recognized species if further inquiry makes postulation of the new species unnecessary" (230). Thomason is worth quoting in full: "It sometimes happens that things are discovered which can lay claim to membership in sorts supposed to be disjoint: for instance, microbes which appear to be both animal and vegetable. I would prefer to regard such anomalous cases as not falling under the original scheme–e.g., a *neither* animal nor vegetable–thus preserving the principle [of disjointness]."

[45]Greenspan (2002: 385).

[46]Here I am indebted to Mumford and Anjum (2011).

of the distinctive capacities of organisms, particularly as they are manifested in their development." Far from posing a threat to evolutionary biology, biological kinds or natures serve to ground various powers and capacities that are central to adaptive evolution in the first place.

Returning to our original line of discussion, it is important to note that real definitions may exhibit a certain degree of accuracy and completeness. The fact that some real definitions are more accurate and complete than others in no way casts doubt on their ability to track reality's joints in general. To illustrate this, consider the following proposed real definitions:

A. A circle is the locus of a point moving continuously in a plane at a fixed distance from a given point.[47]

B. Sand is a naturally occurring granular material composed of finely divided rock and mineral particles.[48]

Compare A and B above. In contrast to A, which seems to be an accurate and complete real definition of a circle, B is not a *complete* real definition of sand in so far as it is not fine grained enough to distinguish it from other forms of granular material composed of finely divided rock and mineral particles such as silt and gravel (which would involve further specification of the required particle diameter range).

The view that essence is captured by real definition has a long and impressive historical pedigree. Arguably, the concept of real definition first appears in Plato's representation of Socrates' search for the nature of piety (*Euthyphro*), temperance (*Charmides*), justice (*Republic* I), courage (*Laches*), virtue (*Meno*), and beauty (*Hippias Major*). As Morrison (2006) notes, "In fact our concept 'essence' goes back historically to Socrates' quest for definitions: 'the essence of F' is whatever is given by a correct answer to the Socratic question, 'What is F?'" Aristotle (*Meta.* 1031a12), as is well known, himself upholds the connection between essence and real definition by saying, "clearly, then, definition is the formula of the essence."[49]

What's more, Aquinas relied heavily on the relationship between essence and real definition in his ontology. In addition to making the essentialist point that to "be circumscribed by essential limits belongs to all creatures" (*ST* 1.50.2), he holds that "it is clear that the essence of a thing is what its definition signifies" and "that by which a real thing is constituted in its proper genus or species is what is signified by the definition expressing what the real thing is, philosophers sometimes use the word 'quiddity' for

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[47]See Lowe (unpublished ms-a).

[48]See Oderberg (2011: 87).

[49]Morrison (2006: 110) goes on to state: "Socrates steers the conversation by searching for a 'definition.' Socrates asks his conversation partner to give a definition, to 'say what courage is' or 'what justice is.' What Socrates wants is not (what we would call) a dictionary definition, telling how the word is typically used, but (what philosophers have come to call) a 'real definition,' an account displaying the essential nature of, for example, courage or justice.

the word 'essence'."[50] For Aquinas, a real definition of an object signifies those funda-
mental characteristics that are *constitutive* of that object, i.e. that serve to mark out its
metaphysical limits or boundaries in the form of a lowest (*infima*) species and specific
difference (which thereby constitutes the definiendum).

Furthermore, real definition has been utilized in the work of Spinoza and Leibniz.
Spinoza, in his *On the Improvement of the Understanding*, states "A definition, if it is to
be called perfect, must explain the inmost essence of a thing."[51] Leibniz made an explicit
distinction between nominal and real definitions, primarily in his critique of Hobbes'
attempt to collapse all definition to the nominal variety. For Leibniz, a real definition of
an entity is that "through which the possibility of a thing is ascertained."[52]

1.2.2 The Structure of Essence

We have seen several reasons for thinking that ME1 falls short in capturing the fine-
grained structure of essence. At this point, I want to turn to the oft neglected second
tenet of modal essentialism explicated above, ME2.

Recall that ME2 states that the essence of an entity, x, is the sum or collection of its
essential properties, viz. those that it modally requires for its existence. On ME2, while
x's essence or identity is delimited to some extent to the sum of those properties that
satisfy the description Φ and none other, it consists of nothing more than an *unstructured*
list or conjunction of properties. Let us further divide ME2 into the following two claims:

ME2$_a$: Essences are *unstructured* sums or collections of entities.

ME2$_b$: Essences are sums or collections of *properties*.

One often finds both tenets of ME2 as part and parcel of the modal essentialist package
concerning the nature and structure of essence.[53] In this section I attempt to motivate a
clean break from modal essentialism in arguing against ME2 in its entirety. While Fine
is correct to challenge the current orthodoxy of ME2$_a$, he nonetheless retains much of
the spirit of modal essentialism in his affirmation of ME2$_b$.

Regarding ME2$_a$, we have seen that the modal essentialist construes an entity's essence
as the sum or collection of its necessary properties (recall the formulation above in §2.1).
To state an entity's essence E then is akin to listing the various members of a set or
the parts of an arbitrary mereological sum. Suppose we take an entities' essence to be
construed along the lines of a set, E, whose individual members p and q are necessary
properties. It is well known from set-theory that the structure or order of the individual
members p and q of E is irrelevant to the identity of the set of which they are members,

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[50]See his *Being and Essence*, 1 in Bobik (1988).
[51]Spinoza (1955: 35).
[52]Leibniz (1969: 293).
[53]See note 4 for references.

$\{p, q\}$. Where E = $\{p, q\}$, the task for the modal essentialist is to solve for p and q. This is precisely what we see in Plantinga (1974) with his search for the individual essence of Socrates, i.e. those properties that are unique to Socrates and Socrates alone such as *Socrateity* (the property of being identical to Socrates) along with all of Socrates' world-indexed properties (such as *being the husband of Xanthippe in the actual world*). On this view, the necessary properties of *being human*, *being identical to Socrates*, and the world-indexed property *being-married-to-Xanthippe-in-alpha* are all metaphysically on par with one another in partially stating the individual essence of Socrates.[54]

In opposition to the widespread modalist trend in treating essences as akin to un-structured set-theoretic entities, serious essentialists argue that that which is expressed by a thing's real definition is no mere list of necessary features.[55] That is, not all nec-essary features of a thing are created equal (as we have seen in our counterexamples to ME1 above). Serious essentialism, both historically and in its current guise, holds that a thing's necessary features are *structured* or ordered in such a way that not all of them are equally *definitive* of that thing in the most fundamental sense and thereby enter into its real definition.

On the serious essentialist view that I will develop below, the sum total of a thing's necessary features (what the modal essentialist would refer to as its essence)–those that it possesses in every possible world in which it exists–is more accurately described as being roughly akin to an ordered n-tuple such as N = $\langle f_1 \dots f_n \rangle$. Unlike sets, the structure of $f_1 \dots f_n$ of the ordered n-tuple is vital to the identity of that ordered n-tuple. Understood along the lines of an ordered n-tuple, the necessary features of a thing stand in certain pri-ority (whether logical or explanatory) relations to one another, where the precise nature of priority here varies among serious essentialists.

Fine's own way of capturing the ordered structure of a thing's necessary features is to distinguish between an object's *constitutive* and *consequential* essence, a distinction he claims (roughly) mirrors the Aristotelian distinction between essence and propria (more on this distinction below). The basic idea here is that not all necessary properties are metaphysically on par with one another in that some carve their bearers at the joints more than others.

On Fine's view, a property F is part of the *constitutive essence* of an object x if F is not had in virtue of being a consequence of some more basic necessary property of x. Correlatively, something G is part of the *consequential essence* of x if G is not part of the constitutive essence of x. The idea of consequence employed by Fine here is one of *logical consequence*: where "the property Q is a (logical) consequence of the properties $P_1, P_2, \dots$, or that they (logically) imply Q, if it is a logical truth, for any object, that

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[54]Plantinga (1974: 72).

[55]As we will see in the sequel, I use 'features' here in a very loose sense to include predicables that enter into the real definition of a substance and those that, albeit necessary, do not.

it has the property Q whenever it has the properties $P_1, P_2, \ldots$."[56] Here the properties belonging to the constitutive and the consequential essence are subsets of the total set of the necessary properties of an object.

According to Fine (1995: 57), "the constitutive essence is directly definitive of the object, but the consequential essence is only definitive through its connection with other properties." To illustrate, Fine asks us to consider, once again, the example of Socrates. The constitutive essence of Socrates will include (at the very least) his *being a man*, that is, *being a man* is said to signify (at least in part) what he is in the most fundamental sense and thereby factor into the real definition of Socrates. Contrast this with the disjunctive property *being a man or a mountain* which is said to belong to the consequential essence of Socrates in virtue of being a logical consequence (via the rule of addition) of Socrates' *being a man*.[57] But intuitively, *being a man* and *being a man or a mountain* do not carve Socrates' essence in precisely the same manner; the former seems to be more fundamental to Socrates' identity than the latter. Consequently, contra ME2a, there is a hierarchical ordering between Socrates' necessary properties, those belonging to the constitutive essence being more closely 'tied' to Socrates than those of the consequential essence. For this reason, the real definition of Socrates represents those properties of Socrates that belong solely to his constitutive essence.

The fundamental distinction between that which is directly definitive of a thing and that which is a consequence or follows from the former is one that I wholeheartedly accept. In fact, to some degree, I am in agreement with Fine's characterization of the constitutive essence as consisting of the explanatorily basic necessary features of an entity. However, one need not follow Fine in employing the machinery of logical consequence to explicate the notion that a thing's necessary features are hierarchically ordered with respect to one another.

For one, it appears that Fine's appropriation of logical consequence runs the risk of excluding features of a thing that are, plausibly, said to follow from or are closely tied to its essence proper.[58] For instance, it seems to follow from the essence of a triangle that it has three sides. Yet the proposition that triangles have three sides is not *logically* entailed by the proposition that triangles have three angles. A less abstract example is offered by Gorman (2005: 282):

> An atom's being prone to bond can legitimately be called a 'consequence' of its having such a number of protons—its having such a number of protons is

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[56]Kit Fine (1995: 56).

[57]Fine (1994b: 276) also gives the example of Socrates' singleton, where the property of *containing Socrates as a member* would be part of its constitutive essence and the property of containing some member or other being part of its consequential essence.

[58]A second reason might be that the use of logical consequence to explicate the structure of a thing's necessary features appears rather unstable in so far as it is questionable whether *being a man or a mountain* characterizes anything at all, let alone Socrates' consequential essence.

why it is prone to bond. But note that it is not a logical truth that an atom with such a number of protons is an atom that is prone to bond. Its proneness to bond follows from, is a consequence of, its having such a number of protons, but not in Fine's sense.

I will have much more to say below about my own understanding of the ordering that obtains between a thing's necessary features. The question as to what is directly definitive of an entity brings us our second tenet of ME2, ME2$_b$, the claim that essences are sums or collections of properties.

Before I turn to explicating my own alternative understanding of the ordering relationship between a thing's necessary features, we must first note that while Fine is adamant in his rejection of ME2$_a$, he is unequivocal in his endorsement of ME2$_b$, the view that the sum total of a thing's essence consists of properties *per se*. Fine is not alone among those who take real definition seriously in taking natures to be identical to a sum of properties.[59] Elsewhere, Fine reiterates his adherence to ME2$_b$ by saying "We have supposed that each object has a unique essence or definition, where this is something that may be identified either with the class of properties that it essentially has or with the class of propositions that are true in virtue of what it is."[60] For Fine, the real definition encodes a determinate range of properties that are constitutive of that thing, nothing more. In this way, a thing doesn't have a nature or essence in virtue of being a particular kind of thing, but rather because it exemplifies a certain range of properties.[61]

While Fine is surely right to part company with ME2a and thereby emphasize the fact that an entity's necessary features are structured to a certain degree, I think it is a mistake to divorce the notion of real definition from an ontology of kinds and contend that a thing's essence consists of *properties* that stand in certain logical relations to one another (Fine 1995: 66). On this point, Fine's view retains much more of the spirit of modal essentialism as per ME2 than he might like to admit. While I have no qualm with Fine's identification of the real definition with a proposition or collection of propositions, I do, however, want to take issue with the claim that that which is expressed by the real definition (i.e. the specified essence) *just is* a group of properties, strictly speaking. In rejecting tenet ME1 *and* ME2, we thereby make a clean break from modal essentialism in its entirety.

It is well known that Aristotle and medieval Aristotelians were of the opinion that a thing's essence as expressed by its real definition is not only prior to the various modal truths it makes true but is also prior to its characterizing properties and thus (contra ME2b) cannot be identified with any of those properties.[62] Contrary to modal essential-

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[59]Cf. Molnar (2003: 38) and Johnston (2006).

[60]Fine (1995: 66).

[61]While the reducibility of kinds to bundles of properties has a direct influence on the reducibility of objects to bundles of properties (whether tropes or universals), I restrict my attention to the former.

[62]For primary sources regarding natures as being modal truth makers as well the ground of a thing's

ism and Fine's own serious essentialist metaphysic, I wholeheartedly accept this line of thinking.

But before I attempt to justify this line of thinking, we need to get clear on what exactly is being proposed. In order to make the distinction between essence and properties more perspicuous we need to distinguish between two sorts of *predicables*, those that are *constitutive* of a thing and those that *characterize* a thing.[63] Constitutive predicables are those that enter into the real definitions of entities in so far as they delimit *what* a thing is fundamentally instead of *how* it is characterized. It is constitutive predicables that, strictly speaking, express the essence of a thing.

Characterizing predicables, in contrast to their constitutive counterparts, characterize a particular and therefore carve out *how* that particular is modified, including its relevant causal powers and capacities. Our turn to a more fine grained notion of essence brings with it (following Aristotle and the scholastics) the distinction between two sorts of accidents that serve to characterize a particular, those that are *extraneous* and those that are *proper* to an object.[64] Extraneous accidents largely correspond to what we would in contemporary parlance call accidental (non-essential) properties, properties a particular could lose and thereby continue to exist as such. Proper accidents, on the other hand, are those properties of a thing that necessarily characterize each member of a particular kind but are not, strictly speaking, part of the essence of a thing; they are not directly definitive of the object. Thus, proper accidents (or *propria* as they are traditionally called) are necessary non-essential properties.

This distinction between necessary non-essential properties (*propria*) and that which constitutes the essence of a thing has been neglected due to the widespread influence of modal essentialism in contemporary metaphysics that construes all of a thing's necessary features to be equally constitutive of its fundamental identity, i.e. *what* that thing is. Modal essentialism, as we have seen, collapses the distinction between that which is necessary and that which is essential, thereby making propria—the category of a necessary non-essential property—a non-starter.

One particular reason for the widespread conflation of constitutive and characterizing predicables is due to the great deal of ambiguity when we make predications of

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properties and powers in the thought of Thomas Aquinas, see *ST* III, q. 13, a. 1c and *In Meta.* IX, left. 1, n. 1782. For secondary sources regarding late medieval scholastic thought on this matter see Pasnau (2011: ch. 24); Knuuttila (1993: ch. 3); and Des Chene (1996: 71).

[63]See Oderberg (2007: 160) who therein cites Lowe (2006) as an example of this distinction at work. Also, Heil (2003: 46) explicitly adopts the above distinction between characterizing and sortal predicates. My own view differs from Lowe's (and is more in line with Heil) in that what corresponds to his constitutive predicables are substantial kinds qua universals, mine being particular kinds of substances. Also, the distinction roughly tracks what Bird (unpublished) calls *kind* and *non-kind properties*, although (as we will see) he parts company in his denial of the irreducibility of kinds. He states, "Kind properties are properties that concern belonging to a kind, e.g. the property of being gold, or the property of being a horse, whereas non-kind properties are those that do not involve kind membership."

[64]While this distinction may seem out-dated to some, I think it can be given a plausible contemporary rendering in terms explanation and Lewisian naturalness (see below), or something similar enough.

the form 'x is F.' This ambiguity regarding different sorts of predicables in natural language was naturally transferred over into the canonization of first-order predicate logic as championed by Frege and Russell. As Lowe (2006) has pointed out, given the particular categorial ontology (one devoid of natural kinds of entities) of object and property in which modern first-order predicate logic was forged, it is no surprise that it is incapable of formally distinguishing between a proposition stating that a substance is a certain *kind* of thing and a proposition stating that a substance exemplifies a certain *property*. This is because on standard first-order predicate logic both statements are expressed as 'x is F,' or simply Fx.

Now, consider the case where x stands for some mammal, a polar bear for instance. While both are true predications of x, there is a grave ontological difference between saying 'x is white' and 'x is a mammal.' The former involves a characterizing predicable of x, namely *whiteness*, which is said to characterize or modify x in some particular manner. The latter, on the other hand, involves a constitutive predicable of x, namely *mammal*, which is said to be constitutive of x and thereby (partly) enters into the real definition of a polar bear in a way that the property *whiteness* does not. While *being a mammal* can be predicated of x and rightly included as part of its essence, it would be imprecise to say that *being a mammal* is a *property* of x. This is precisely because, intuitively, *being a mammal* is not a *way* x is characterized but, rather, part of *what* x is; it is, to use our preferred terminology, a constitutive and not a characterizing predicable of x.[65]

But what exactly are the truthmakers for predications involving constitutive and characterizing predicables? Here I need to say a bit more about the overall categorial ontology that I will work from in the course of the essay. In general, I endorse (but will not argue for) an ontology of particulars which consists of the two fundamental categories of *substance* and *property*.[66] The categories of *substance* and *property* are fundamental, I claim, in the sense that entities in a given world which fall into these two categories are (collectively) necessary and sufficient as truthmakers for all truths about that world. As was previously stated, I assume here that reality exhibits deep ontological and naturally specifiable joints. That is, there is an objective difference between an electron and an

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[65] One of the clearest historical statements of the distinction between properties per se and essence is in Aquinas (1949: a. 11): "A property is like a substantial predicate, inasmuch as it is caused by the essential principles of a species; and consequently a property is demonstrated as belonging to a subject through a definition that signifies the essence. But it is like an accidental predicate in this sense, that it is neither the essence of a thing, nor a part of the essence, but something outside the essence itself. Whereas it differs from an accidental predicate, because an accidental predicate is not caused by the essential principles of a species, but it accrues to an individual thing as a property accrues to a species, yet sometimes separably, and sometimes inseparably. So, then, the powers of the soul are intermediate between the essence of the soul and an accident, as natural or essential properties, that is, as properties that are a natural consequence of the essence of the soul."

[66] I emphasize *fundamental* here in so far as I take there to be other non-fundamental ontological categories.

aardvark as well as an objective similarity between two members of the *Felinae* family. I am inclined to think that such joints, however, need not be explained in terms of the sharing or non-sharing of numerically identical, multiply exemplifiable universals. Rather, the similarity and difference between the above entities obtain in virtue of their particular natures; the natures of particular substances 'carve out' the objective natural joints in the world which account for the natural differences and similarities between things. Substances, then, are *natural kinds of things* whose kind-resemblance is explained in terms of a primitive relation of conspecificity (as opposed to the sharing of a multiply located kind-universal). Tropes, in like manner, are non-transferable properties, both powerful and non-powerful, whose natural groupings are explained by their primitive resemblance to one another.[67]

I endorse a truthmaker theory of predication which claims that the truth of all true predications, or at least all true predications of the form 'x is F,' are to be explained in terms of truthmakers. I take the truthmakers for the above constitutive and characterizing predications of the form 'x is a mammal' and 'x is white' to correspond to the items that make up my two-category ontology, substances and tropes respectively.[68] Predications involving constitutive predicables such as 'polar bears are mammals,' i.e. essential predications, are made true by a certain kind of substance, a polar bear. On the other hand, predications involving characterizing predicables such as 'polar bears are white,' have as their truthmaker non-transferable tropes. If the characterizing predication involved a dispositional-attribution such as 'polar bears are disposed to have fur,' then its truthmaker would be a dispositional trope.

I take the distinction between constitutive and characterizing predicables to be a natural and intuitive one to make. Along these lines, Lowe (2006: 92) gives the example of a rose, "Being red is a way a flower may be, as is being tall or being delicate. But being a *rose* is not a way a flower may be: it is what certain flowers are, in the sense that they are particular instances of that kind of thing." Similarly, Ellis (2001: 92) hints at the distinction between constitutive and characterizing predicables in stating, "I say that an electron is an electron, not something that has the property of being an electron. In my view, there is no such property. There is no property of being a horse, either, and for the same sort of reason." Lastly, Heil (2003: 47) puts it succinctly as follows: "Thus, 'is a horse' is satisfied, not by properties possessed by particular objects, but by substances of particular *kinds*."[69] As a result, individual roses *are* flowers; individual electrons *are* fundamental particles. Statements involving constitutive predicables aim to limn the classificatory and natural joints in nature.

One could multiply examples here. On this line of thinking, *being a metal* is not,

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[67]For a view that I am sympathetic to on this score see Molnar (2003).

[68]Cf. Heil (2005).

[69]Emphasis in original.

strictly speaking, a property of gold (as being of such-and-such hue would be) but rather partly constitutive of the essence of gold. *Having chemical composition H_2O is not, strictly speaking, a property of water, but is nonetheless constitutive of it and thereby part of its essence.*[70]

1.2.2.1 Essence, Explanation, and Property-Clustering

We have seen, then, that the explanatory priority (and hence irreducibility) of constitutive predicables to characterizing predicables (ipso facto, between essence and properties) is natural and intuitive. But is there any substantive argument that can be given in favor of the irreducibility of essence and properties beyond mere intuition? While I do not think there are knock-down arguments to be had here, I do believe that there is at least one plausible reason that supports such a thesis. Consider the following line of reasoning: if a thing's essence or nature were analyzed in terms of a group or collection of properties as per Fine's serious essentialism and ME2b, then it raises the question of *why* such properties are uniformly co-instantiated in things of that kind.

That various kinds of substances exhibit a stable pattern of activity in virtue of their causal powers and qualities is a central datum of scientific explanation. As Cartwright (1992: 46) rightly points out, "Modern explanation similarly relies on natures... Modern science insists that we found explanation on experimentally identifiable and verifiable structures and qualities. But, I maintain, what we learn about these structures and qualities is what it is in their natures to do." A living organism exhibits a certain stable pattern of activity. At the very least, part of the characteristic pattern of activity of a living organism is the power to undergo metabolic growth and reproduction. For those who endorse ME2b (including Fine) and thus the reducibility of constitutive to characterizing predicables maintain that the nature of a living organism *just is* its having the above powers, nothing more (assuming that such powers alone are sufficient to constitute its essence); the explanatory relationship runs from property-possession to essence and not vice versa.

One rather prominent defender of this line of thinking is Armstrong (1978: 62):

> Suppose that a particular has all the properties which are required for something to be gold or an electron. Will it not be gold or be an electron? Why postulate some further universal which it must exemplify in order to be gold or an electron? (1978: 62)[71]

Armstrong's point is that when it comes to accounting for the fact that reality consists of various kinds of substances, only properties need apply. An electron's possessing a privileged collection of properties is sufficient to account for the classificatory difference

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[70]These examples are taken from Oderberg (2011).
[71]See also Armstrong (1997: 67).

between itself and a photon, for instance. The objection can be traced back to the seventeenth century to Robert Boyle's (1991: 40) attempt to eliminate scholastic substantial forms in favor of a cluster of accidents which serves to 'stamp' or 'essentially modify' a portion of matter and thereby distinguish it from other modified portions of matter.[72]

We have, however, already stated a general problem with collapsing essence to properties in this way. If the kinds to which substances belong are reducible to mere collections of powers and properties one may plausibly ask *why* the properties and powers in such a collection are systematically unified the way they are.[73] We can put this as a need to explain the following, where 'P$_1$...P$_n$' denotes a range of essential properties that constitute a property cluster 'C', and 'Cs' represents the particular instances of C:

> CLUSTER: the essential properties, P$_1$...P$_n$ of a cluster, C, are systematically co-instantiated in the Cs.

That is, in virtue of *what* do properties and powers systematically cluster to form an integral unity and not a mere accidental grouping of features? What, for instance, explains the uniform possession of the power to dissolve gold by particular bodies of aqua regia? Again, without appealing to the fact that its being malleable and having high lustre are explanatorily grounded in gold's being a particular kind of substance (which is partly constituted by its free electron structure), what undergirds the uniform possession of such properties by particular isotopes of gold?

Take two representative essential properties of an electron endorsed by the proponent of ME2b: *being a fundamental particle* (P1) and *having a unit negative charge* (P2). Of these two properties we might ask: why are P1 and P2 systematically co-instantiated in electrons as opposed to some other particle? The demand for an explanation here is all the more pressing given the fact that there are particles that instantiate P1 and not P2 (photons) and particles that instantiate P2 and not P1 (chloride ions). If the nature of an electron were constituted solely by a cluster of properties (characterizing predicables), then one is hard-pressed to provide a substantive explanation as to *why* an electron is constituted by its particular, stable cluster of properties as opposed to those that constitute a photon or a chloride ion.[74]

One rather obvious retort is that that CLUSTER is simply a brute fact, one that is in no way in need of an explanation. I mention this view only to set it aside in so far as

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[72]For more on Boyle's views regarding natural kinds (as well as the general early modern suspicion regarding our ability to identify the objective natural kind structure in the world) see Pasnau (2011) 633-655.

[73]This line of reasoning is advanced by Suarez (2000), sections 15.1.14 and 15.10.64 in particular: "The strongest arguments by which substantial form is proven rely on the fact that for the complete constitution of a natural being it is necessary that all the faculties and operations of the same being be rooted in one essential principle (15.10.64)." For contemporary advocates of this line see Des Chene (1996: 71-75), Lowe (2006: 135), Oderberg (2011), and Scaltsas (1994: 78-80) where Oderberg (2011) is by far the most comprehensive and is the line of reasoning that I mirror closely in what follows.

[74]This is from Oderberg (2011).

the predominant view in the literature assumes there to be an objective feature of reality that serves to explain CLUSTER.[75]

A much more promising view would be to offer a nomological explanation of CLUSTER, one that grounds an explanation of CLUSTER in the laws of nature.[76] This response can be generalized to all kinds of substances at various levels of reality (not just biological or chemical) and is capable of being subdivided according to (i) the modal or non-modal status of the laws which serve to explain CLUSTER and (ii) the relevant degree of modal strength ascribed to such laws.

One obvious candidate for an explanation of CLUSTER along these lines, one which seems to presuppose an intrinsically demodalized account of laws, is Richard Boyd's *homeostatic property cluster view*. For Boyd, natural kind joints *just are* sufficiently unified clusters of properties (phenotypic traits for biological kinds, which is his primary concern), where the unity of the relevant property set is explained by *homeostasis*.

Homeostasis between a range of properties (whether taken from physics, chemistry, or biology) occurs when a law-governed mechanism or group of mechanisms ensures that a cluster of properties hover within a confined (albeit indeterminate) range. That a certain structural chemical property such as *being composed of two parts hydrogen and one part oxygen* is uniformly accompanied by the further chemical properties *boils at 100 degrees celsius* and *freezes at zero degrees celsius*, is explained by the presence of a stable (law-governed) homeostatic causal mechanism operative at the chemical level.

Here I think the best route for this view is to appeal to the success of nomological explanations of property clustering in general in fundamental physics as support for their position. The phenomena of quark confinement within a hadron (the failure of free quarks), for instance, can be explained nomologically by an appeal to the color force field which is generated by the exchange of gluons between quarks. One could argue that the strong nuclear force serves as the mechanism that regulates homeostasis between the quarks within the hadron, thereby providing an explanation of the clustering of quarks in strict nomological terms.

While Boyd claims that the co-occurrence of properties is more than mere 'statistical artifact,' he is clear that the clustering that results from homeostasis is a *contingent* matter. While this fact alone does not commit Boyd to a regularity view of the laws of nature, it does imply that the (first-order) relation governing homeostasis cannot be too strong so as to *necessitate* the clustering of a particular group of properties. Whatever glue holds property clusters together, it cannot be too strong. On the demodalized conception of laws undergirding Boyd's view, the clustering of the properties P1 and P2 is merely contingent: no heavyweight metaphysical machinery need apply in order to explain their co-instantiation in an individual electron.

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[75] See Schaffer (2003).
[76] This general line is taken by Elder (2004: 26).

As some have pointed out, perhaps the most glaring shortcoming of a nomological explanation for CLUSTER in general is the prima facie absence of the purported laws that are claimed to do the explanatory work on this account.[77] Regarding P1 and P2, Oderberg (2011: 90-91) contends that there *is* no law relating *only* these properties (which would be required in order to explain why *those* properties are co-instantiated), thus the explanation of CLUSTER in terms of such a law is a non-starter. Further, to stipulate that P1 and P2 are, in fact, related *only in the electrons* (as opposed to photons) is to tacitly restate the explanandum. The very fact that needs explaining is why, apart from being explained in terms of being an irreducible *kind* of thing (i.e. an electron), a certain range of properties exhibit such uniformity *in electrons* (i.e. Ks). Consequently, to say that P1 and P2 cluster in electrons *because* there is an electron-specific law that relates P1 and P2 leaves something to be desired.

Second, to identify the kinds to which substances belong with clusters of properties and homeostatic mechanisms adds little explanatory value. When considering which homeostatic mechanisms govern the relevant property cluster C (as opposed to a distinct cluster), the cluster view responds by saying that it is those mechanisms that cause co-varying similarity between the relevant properties in C. However, Boyd (1999) is clear that the properties that constitute C vary over time. If so, we may rightly ask which of these varying properties are those that constitute C instead of a distinct cluster, C*? After all, not just *any* covarying properties are sufficient to constitute C. In order to specify which properties are those that belong to C and not C*, the cluster proponent must quantify over a particular range of properties at the exclusion of others. But which properties make it into the domain? Here it would appear that the only avenue the cluster proponent has in specifying which properties belong to C (and not C*) is to appeal to those that are unified by the homeostatic mechanisms that belong to C. But this leaves us with our original question: which homeostatic mechanisms belong to C? Without recourse to the notion of a substance being an irreducible kind of being distinct from its characterizing properties, the cluster view is left in an explanatory circle.[78]

Third, in so far as the above appropriation of Boyd's homeostatic view relies on an intrinsically demodalized theory of laws, it falls prey to the very same objections that plague a Humean view of laws in general. Here I will not rehearse these objections as they are well-known to anyone familiar with the literature. I will only register my view that laws as mere reports or, at best, systematizations of nature (as important as these may be) as per the regularity theory fails to capture the deep explanatory structure undergirding the natural sciences.[79] To explain CLUSTER in terms of the fact that P1

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[77]See Oderberg (2011); cf. Schaffer (2003b: 132-133).

[78]This line of reasoning is put forward in Ereshefsky (2010b).

[79]Which, as many argue, is one that facilitates inductive inferences (i.e. plays a predictive role) and has the ability to support counterfactual reasoning, which appears to be integral to our best explanatory practices. Note that this line of thinking applies equally to both Hume's own view as well as to that of

and P2 are regularly or contingently co-instantiated is to merely state what we intuitively are after in the first place: an explanation as to *why* P1 and P2 behave in precisely this manner.

Here, I believe Denkel's (1996) remarks are on point:

> [I]f [properties] could exist independently, why should they, in actuality, exist in compresences everywhere? If such a possibility were granted, the fact that the world is inhabited by objects rather than scatterings and conglomerates of properties would need quite a bit of explaining. (1996: 31-2)[80]

Denkel's explanatory demand can be unpacked as follows. Take two worlds W and W^* and suppose there is a one-one correspondence between W and W^* that preserves all natural properties and relations; they are intrinsic world-duplicates. As per a regularity view of laws, despite being intrinsic world-duplicates it is entirely possible for W and W^* to vary with respect to their laws and, ipso facto, to what property clusters obtain in each world. But suppose now that the laws governing W^* fail to generate any clusters whatsoever. Here I think Denkel's remarks hit their mark: if the laws in W are cluster-generating and those in W^* are not, what explanation can be given as to why the laws in W are cluster-generating in the first place? If there is no constraint governing the clustering of properties, why think they would exhibit such a tight-knit unity at all? The sheer fact that property clustering on this first nomological explanation of CLUSTER is *contingent* as such renders it ill-suited in the eyes of many to fulfill their explanatory role in the natural sciences.

On the view that I am advocating, Denkel's demand for an explanation of the cohesion of properties in the natural world is accounted for in the following manner: the reason *why* certain properties and powers exhibit widespread cohesion and stability rather than being mere scatterings and aggregates is that they collectively inhere in the same kinds of substances, which therein explains their being co-instantiated with one another (both in this world and across worlds as well, as we will see below).

But perhaps a nomological explanation of CLUSTER can be salvaged by an appeal to a stronger theory of laws that can bear the weight of what we take ourselves to be after in the scientific enterprise. Here, David Armstrong's (1983) conception of laws as nomic necessitation relations between universals comes to mind.[81] Interestingly enough, Armstrong himself admits the need for an explanation of CLUSTER, one that involves a principle of unity with modal import. Toward satisfying this aim, he employs his theory of laws involving what he calls "nomic connections" between the properties required for

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Lewis (1973: 72-77) in so far as both construe laws as mere regularities, i.e. devoid of intrinsic modal content.

[80]For a similar critique of an explanation of CLUSTER in such terms see Harré and Madden (1973: 214).

[81]The view, of course, is standardly attributed to Dreske (1977), Tooely (1977), and Armstrong (1983). Here I restrict my attention to Armstrong's explication.

the existence of some particular: "nomic connections between... [the] properties [of gold or of an electron] which bind the properties up into a unity."[82] Second-order nomic connections ground the *nomologically necessary* co-presence of first-order properties (e.g. it is because the universal *F-ness necessitates* the universal *G-ness* that they are co-present in certain particulars).

Here it is important to note that, for Armstrong, nomic necessitation is a metaphysically contingent relation; it is weaker than robust metaphysical necessity, but stronger than mere (first-order) regularity (but entails such regularity).[83] Thus, if something is negatively charged then it *must*, according to the laws of nature, repel another negatively charged entity. But the modal import explaining the co-presence of universals in certain particulars is explained entirely in terms of properties and the relation of nomic necessitation: irreducible kinds of substances are rendered superfluous on his view (cf. Armstrong 1978: 63).

But here we might ask how adverting to a second-order necessitation relation to account for the unity and co-presence of first-order properties is explanatorily superior to the view that this unifying role is realized by particular natures or essences instead? There is no clear gain in explanatory power in positing relations of nomic necessitation to an ontology of substantial natures.

More importantly, however, is the fact that by Armstrong's own lights, the relation of nomic necessitation is not sufficient to adequately explain CLUSTER. In addition to the relation of nomic necessitation, Armstrong introduces what he calls *the principle of particularization* to explain CLUSTER:

> Although Essentialist Realism has been rejected, it does seem that it has an element of truth... It is the truth that for each particular, there exists at least one monadic universal which makes that particular just one, and not more than one, instance of a certain sort. Such a universal will be a 'particularlizing' universal, making that particular *one* of a kind. Without such a universal, the particular is not restricted to certain definite bounds, it is not 'signed to a certain quantity,' we do not have a 'substance,' we do not have *a* particular. (Armstrong 1978: 62)

This passage is revealing in its admission of precisely what the serious essentialist claims is required to adequately explain CLUSTER: substantial kinds or natures are irreducibly unified. Interestingly enough, with one hand Armstrong attempts to eliminate kinds altogether in favor of properties and relations of nomic necessitation. On the other hand, however, he countenances (under the guise of a "particularizing universal") a sort of

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[82]Armstrong (1978: 62).
[83]Thus, Armstrong retains Lewis' doctrine of Independence (no necessary connections between distinct existences) but rejects his notion of Humean Supervenience (that everything supervenenes on the (first-order) mosaic of local property instances).

universal which plays one of the roles traditionally assigned to substantial kinds. Here Loux's maxim rings true (1974: 782): "Invariably, it turned out that they could reduce substance-concepts to the concepts of characteristics only if they illicitly smuggled in vestiges of the kind-concepts they were trying to eliminate." Armstrong grants that without a unifier to the properties of a particular, there is no sense to be given to the claim that the particular with those properties is a *single* entity.

The need to explain the integrity and causal uniformity of the properties of particulars is one that is rarely noted by those operating within a modal essentialist framework as per ME2. The kind to which a substance belongs is no mere bundle of properties. Otherwise, one would be hard pressed to offer a substantive explanation as to both the uniform presence of various powers and properties in member of those kinds as well as the *absence* of other distinct combinations of powers and properties.

What we find in the natural world, however, are kinds of substances that exhibit a range of causal dispositions that are, for the most part, stable in the various causal contexts in which such dispositions are manifest. The various kinds of substances, be it an electron, a carbon atom, or a mammal, are *singular* and *stable* units of causal activity. Electrons spin and respond in certain ways to electromagnetic fields *in virtue* of their stable causal powers and properties. Consequently, Armstrong's admission of a unifier of the powers and properties of particulars concedes the point to the serious essentialist: there is something in virtue of which properties are intrinsically unified.

But suppose we strengthen the nomological explanation of CLUSTER one last time so that the laws are not merely nomologically necessary (and contingent) as per Armstrong, but metaphysically necessary as per dispositional essentialism. In its most general form, dispositional essentialism is the view that properties have dispositional essences.[84] When applied to natural laws the view states that laws supervene on the dispositional essences of properties. From these two theses it follows that laws are metaphysically necessary: if the essence of a disposition remains constant in every possible world in which it exists, and laws supervene on property-essences, then laws are metaphysically necessary.

In the concluding sections of his excellent book on the metaphysics of science, Bird (2007: 208-11) sets out to explain CLUSTER in terms of a dispositional essentialist gloss on Boyd's homeostatic property cluster view. Where Boyd's own law-governed explication of homeostasis was intrinsically de-modalized, Bird has metaphysical modality in spades. Bird states:

> Thus it seems to me to be plausible that Boyd's homeostatic property cluster idea can be extended to all natural kinds. The laws will explain why there are certain clusters; they will also explain the natures of those clusters—the loose and vague clusters in biology, the partially precise clusters of chem-

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[84]For a contemporary defense of dispositional essentialism see Bird (2007) and Ellis (2001).

istry and the perfectly precise clusters of particle physics. Boyd introduces his idea in order to provide an alternative to the essentialist view of natural kinds. However, if I am right, the homeostatic property cluster approach can be expanded to include the essentialist view in respect of the kinds to which it applies. The laws of nature will explain why—*necessarily*—there are no members of chemical and microphysical kinds that lack certain properties, why of necessity certain properties cluster together in a partially or fully precise manner. (Bird 2007: 210-11)

Apart from its being susceptible to the very same objections we noted earlier to nomological explanations of CLUSTER in general as well as homeostatic clustering in particular, the deeper problem regarding Bird's proposal stems from his own admission that laws are epiphenomenal: it is dispositional properties that do all the work in explaining *why* laws obtain (47). The order of explanation runs from dispositional properties to laws, not the other way around. It is a law of nature that everything possessing property P, under certain circumstances or stimulus S, yields a particular manifestation M, precisely *because* it is part of the nature of P to be disposed to yield M in S.

One is hard pressed, then, to interpret Bird's statement above that "laws will explain why there are certain clusters; they will also explain the natures of those clusters." Here Bird's view seems to be committed to a rather arbitrary asymmetry regarding the explanatory relationship between properties and laws (former explain the latter) and clusters of properties and laws (latter explain the former). What explains this asymmetry? After all, on this view, it is plausible to assume that natural laws regarding property clustering (if there be such laws) are just a subset of natural laws per se. If dispositional properties are the explanatory grounds for the laws of nature per se, then why wouldn't dispositional properties or clusters thereof also be the explanatory grounds for laws explaining the co-instantiation of properties?

There must, then, be something about the individual properties *themselves* (and not the laws which govern the homeostatic mechanism as per Bird's appropriation of Boyd) that play a role in explaining CLUSTER.[85] Perhaps Bird thinks that an explanation of CLUSTER lies in the fact that it is part of the individual dispositional essence of both P1 and P2 that they be exclusively co-instantiated with one another. But this is clearly false. It cannot be part of the dispositional essence of *being a fundamental particle* that it be disposed to be co-instantiated solely with the dispositional essence of *having unit negative charge* for the simple reason that it also (in fact) clusters with the dispositional essence *having zero charge* in photons. Likewise, as we have seen, *having unit negative*

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[85] Bird could contend that by saying that the laws of nature are 'epiphenomenal' one means that laws are 'nothing over and above' the dispositional properties and their directed manifestations. Without a clear endorsement of the Eleatic principle of 'to be is to have causal power,' I take an 'epiphenomenal' entity to be one that *exists*, but that lacks causal efficacy.

charge clusters not only with *being a fundamental particle* in electrons but also (in fact) with *being a non-fundamental particle* in Chloride ions.[86]

Bird might be tempted to make the following revision: it is part of the individual dispositional essence of both P1 and P2 that they be co-instantiated *only in electrons*. But as was stated before, to claim that the explanation for why P1 and P2 cluster and covary is that it is part of their dispositional essence to be co-instantiated *only in the electrons* is to once again threaten to restate the explanandum and not to explain it.

Consequently, I submit that reference to nature's natural kind structure is ineliminable when it comes to offering an ultimate explanation for CLUSTER. The deep causal uniformity and stability of property groupings we see in nature is best anchored in their having a single explanatory ground, an irreducible natural kind of substance. Irreducible natural kind structure, as Ellis (2001: 285) points out, "guarantees that certain properties are uniquely clustered."

Note however that while law-governed homeostatic mechanisms may not be suited to provide the reductive basis for natural kind structure and therein an ultimate explanation for CLUSTER in terms of properties alone, this is not to say that such mechanisms are entirely irrelevant to property clustering in nature. It simply does not follow that if natural kinds do not reduce to law-governed homeostatic property clusters that law-governed homeostatic mechanisms are therefore superfluous in accounting for property clusters in the natural world. Even if we grant that there were such law-governed homeostatic mechanisms at work in the clustering of the properties that characterize electrons, it is plausible to think that the presence of these mechanisms in particular would be explained by the presence of a certain kind of entity, an electron.

As another example, take individual substances of the biological kind *Apodemus sylvaticus*, i.e. common wood mice. Along with other distinctive murine properties (such as having a unique molar pattern), individual wood mice will be, in virtue of being certain kinds of entities, disposed to exhibit a particular range of properties, e.g. a weight of 20g to 35g and a length of 7cm to 12cm.[87] We may well suppose that law-governed biological mechanisms are causally relevant in accounting for the stability and cohesion of the above properties exemplified by individual wood mice. But as was noted above, the presence of specific biological mechanisms that ensure the stability and cohesion between the properties belonging to wood mice is explained by the fact that such mechanisms govern instances of the kind *Apodemus sylvaticus*. It is in virtue of being of the kind *Apodemus sylvaticus* that a wood mouse exhibits a *particular* range of properties and dispositions rather than another, whose cohesion is governed by distinct law-governed homeostatic mechanisms operative at the biological level.

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[86] These examples are from Oderberg (2011: 91).
[87] See Bird (2012: 100).

1.2.2.2 The Naturalness of Essence

While we have grounds to resist identifying a substance's kind or essence with its characterizing properties, this is not to deny that there is an intimate relationship between the two. But how exactly are we to understand the connection between essence and properties or, to use our prescribed terminology, between constitutive and characterizing predicables? If we are to part company with Fine's explication of the structure of essence in terms of a logical ordering over properties per se, what are we to offer in its place?

In this section I want to attempt to unpack an alternative account of the ordering that obtains between those necessary predicables that enter into the real definition of a substance. Here I retain my focus on the ordering relationship between those necessary predicables that enter into the real definition of *substances* and those that characterize substances in virtue of being a member of a particular kind.[88]

As the primary actors on the world's stage, substances are dynamic and active. Passivism, the view held by many early modern philosophers that the occupants of spacetime are fundamentally inert and passive, is a world devoid of substances, by my lights.[89] Some of these powerful particulars undergo radio active decay, some spin, some dissolve in water, others engage in the philosophical enterprise, and others biological assimilation, all depending on the kind of substance in question.

Herein lies our first conception of the ordering between the necessary predicables that are directly definitive of the substance and those that characterize it. This ordering is summed up nicely in the medieval maxim *agere sequitur esse*, i.e. act follows being or *what* a thing is determines *how* it is.[90] A substance's being of a particular ontological category and natural kind determines not only its necessary causal powers and capacities, but also the full range of ways that it can be characterized or modified. For Aristotelians, an adequate explanation of CLUSTER resides in the fact that necessary properties and powers are determined or fixed by *what* that substance is fundamentally. Herein lies the first ordering relation I want to draw our attention to between a substance's necessary predicables–those that it has in every world in which it exists.

A bit more carefully, let us refer to the range of causal activity a substance is disposed toward in every world in which it exists as its *causal profile*.[91] Driving the medieval maxim *agere sequitur esse* is the idea that the nature of a substance necessitates its specific

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[88]Hence when I use the word 'thing' I mean substance. I will have more to say on the nature of substances in chapter 3.

[89]See Ellis (2001).

[90]Who in turn followed Aristotle in *De Anima*, Book II, Ch. IV.

[91]Strictly speaking, the causal profile of a substance will include both passive causal powers or liabilities in addition to active causal powers. Moreover, if one takes there to be non-causal powers, then a causal profile stated as such would be a subset of a thing's power profile, where this is understood as the range of power a substance is capable of manifesting in virtue of its causal and non-causal power.

causal profile–*how* the substance qua member of the kind is disposed to behave. The medievals often referred to this ordering relationship between the nature of a substance and its causal profile (i.e. propria) by saying that the latter was 'caused by,'[92] 'added onto,'[93] 'follow from,'[94] 'conjoined to,'[95] 'rooted in,' [96] and 'connaturally and inseparably inhere,'[97] in a thing's essence. In addition, Locke, in summarizing the view of many of his scholastic predecessors, stated the view nicely when he said, "For, since the powers or qualities that are observable by us are not the real essence of that substance, but depend on it, and flow from it, any collection whatsoever of these qualities cannot be the real essence of that thing."[98]

More precisely, we can state this relationship between a substance of a particular kind and its respective causal profile as follows:

(KPC) *Kind-Power Connection*: for any kind of substance K, there is a causal profile P such that, necessarily, for any x, if x is a K then x has P.

Here we must tread carefully. KPC maintains that it is necessarily the case that a substance of kind K has a certain range of causal powers which dispose it toward a certain range of behaviors. Salt, on this view, is *disposed to dissolve in water* in every world in which it exists; there is a metaphysically necessary connection between the nature of salt and the causal power *being disposed to dissolve in water*.[99]

While the nature of a substance necessitates a particular range of dispositional properties as per KPC, it is important to note that it does not necessitate the *manifestation* of the various powers and liabilities that make up those profiles.[100] Substances of the kind *salt* do not necessitate the *manifestation* of the disposition to dissolve in water such that they are the truthmaker for the occurant predication "salt dissolves in water." As the manifestation of a causal power is susceptible to finks, mask, preventers, etc., the having of a power does not *necessitate* its manifestation, rather, it *disposes* the bearer of the power toward that manifestation.[101] While various kinds of substances do not necessitate the manifestation of their causal profiles, they nevertheless necessitate the having of the dispositional properties that make up such profiles; substances of that kind *must* have that causal profile in every world in which they exist.

[92] Aquinas, SCG 4.14.3508, see Aquinas (1975).
[93] Aquinas, SCG IV.14.12/3508, see Aquinas (1975).
[94] *ST* 1a.7.3c, see Aquinas (1947)
[95] Buridan, *In Phys.* II. 5, f. 33rb, as quoted in Pasnau (2011)
[96] Suarez, *Disp. Meta..* 15. 10.64, see Suarez (2000)
[97] *Disp. Meta..* 15.1.13, see Suarez (2000).
[98] Locke (1975): 2.31.13, p. 383.
[99] See Freddoso (1986) for a thorough treatment of this view.
[100] Here I assume that powers can exist in the absence of their manifestations. See Molnar (2006) for a defense of this claim.
[101] For more on the distinction between the sort of dispositionality operative in power-ascriptions see Anjum & Mumford (2011).

This view of the relationship between the natures of substances and their causal powers is not without its contemporary proponents. Regarding substances as objects of scientific inquiry, Harré (1970) maintains:

> Within this view one may see their behavior as flowing from their natures or constitutions as consequences of what they *are*. So they must behave in the specified way, or not be the things they are. And so necessarily while they are the things they are, they behave in those ways or have a tendency to behave in those ways or are disposed to behave in those ways...[B]eing of the right nature endows a thing or material with the power to manifest itself in certain ways or to behave in certain ways in the appropriate circumstances. (Harré 1970: 88)

Moreover, while Loux (1974: 782) holds fast to the irreducibility of kinds to characterizing properties, he nevertheless maintains the intimate relationship between the two predicables:

> To deny, however, that kinds can be eliminated in favor of characteristics is not to deny the important connection between being a member of a kind and exhibiting certain characteristics. That such a connection exists and that it is more than merely contingent are both claims no one can doubt. Their indubitability likely lies at the bottom of many attempts to reduce substance-kinds to characteristics. But while granting the relevant connection, one can deny that predicating a kind of an object is merely ascribing a set of characteristics to it. This is what I am denying; and denying it, I am arguing, is plausible. (Loux 1974: 782)

On this view, there are no substances of a particular kind that are not equipped with a specific causal profile in virtue of which they are capable of bringing about effects in the natural world. Consequently, a substance's possessing a particular causal profile is no mere contingent matter.

Understanding KPC goes a long way toward dissolving many of the objections originating in the early modern period surrounding the distinction between the nature of a substance and its characterizing properties. The main thrust of the objections come in two stages, beginning with a metaphysical charge of bare particularity given the distinction between the substance qua member of a kind and its characterizing properties, and proceeding to an epistemological worry about our knowledge of the natures of substances so considered.

If members of substantial kinds are distinct from their characterizing properties, then does this not construe the former as 'bare' substrata, mere featureless pincushions for

properties?[102] The objection of substances as bare substrata goes roughly as follows: (i) a particular kind of substance, say Tibbles the cat, is characterized by various properties (shape, size, color, etc.); (ii) On the Aristotelian view, Tibbles qua cat is numerically distinct from the characterizing properties which are said to inhere in it; (iii) therefore, Tibbles, strictly speaking, is entirely devoid of properties and is thus, implausibly, a bare substratum.

The epistemological worry is often thought to follow immediately from the metaphysical charge of bare particularity. The worry often takes the form of "I know not what" claims echoing the likes of Descartes' "this I know not what of mine" (referring to himself as a mental substance), Locke's characterization of substance as "I know not what," and Reid's (1994: i273) claim that "this obscure something, which is supposed to be the subject or substratum of those qualities." If substances are bare particulars, mere featureless pincushions for properties, then in what sense are they intelligible and capable of being known? In sum: the prospects of formulating real definitions of substances is far too dim given that particular kinds of substances are bare particulars, or something near enough.

As others have aptly pointed out, these charges simply misconstrue the Aristotelian gloss on the relationship between substantial kinds and properties.[103] For one, the above move from (ii) to (iii) is a non-sequitur. From the fact that substantial kinds of being are irreducible, and thus numerically distinct from their characterizing properties, it does not follow that such beings are therefore entirely devoid of properties altogether. Numerical distinctness does not, in itself, entail separability. Consider a trope and its bearer by way of analogy. Few trope-theorists would disagree that tropes are numerically distinct from their bearers. Nevertheless, the non-transferability of tropes, on standard accounts, is explained in terms of a trope's being grounded in and thus inseparable from its bearer. Hence, we have numerical distinctness without separability.

A similar relation obtains between a substance of a particular kind and its causal profile. As per KPC, in every possible world in which a substantial kind of being exists, it is characterized by its causal profile; there is no world in which a substance of a certain kind exists and lacks the causal dispositions that characterize things of that kind. On the trope-theoretic conception of properties I alluded to earlier, tropes are dependent on and thus non-transferable from their host substances. The substance itself is both the bearer of such dispositions as well as their explanatory base in every world in which it exists. No bare particulars or propertyless substrata need apply.[104] Rather, as we have seen, the substance's causal profile is *explained* by its substantial nature, *what* it is fundamentally.

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[102]In the twentieth century this objection traces back to Russell (1945: 211) and Mackie (1976: 77) and traces back even further to Descartes and Locke and Hobbes. For Locke in particular, compare Locke (1975: 295ff.) with 443ff. and 587ff.

[103]See Broackes (2006), Loux (2006: ch. 3), Oderberg (2007) and, to some extent, Heil (2012: 284-285).

[104]This point is made by Heil (2012: 284-285), Lowe (2006: 27-28) and Moreland (2001: 152).

This in no way, however, entails that substantial natures *just are* a particular range of dispositions. To think so would be to once again collapse the distinction between essence and necessity (that modal requirement for existence is necessary and sufficient to capture the notion of essence) and thereby revert to modal essentialism.

What, then, are we to make of the epistemological worry regarding our knowledge of substantial natures? While essences are explanatorily prior to properties in that they serve as their minimal explanatory base (as we will see below), few would deny that we generally come to know the natures of substances through coming to know how they behave, and therein their characterizing properties and causal powers. The primary means by which we attain knowledge of a thing's constitutive predicables is through its characterizing causal powers and capacities. This has been underscored nicely by Koons (2010: 286) when he says:

> We can come to know the natures of material things only because they fall into repeatable natural kinds, whose causal powers are delineated by the fundamental laws of nature... This *epistemic* priority of laws over intrinsic natures would hold true, even if, *metaphysically* speaking, it was the laws that supervened on the individual natures.

With Koons, the serious essentialist metaphysic that I am advocating is no *a priori* essentialism, at least when it comes to empirically specifiable entities.[105]

The irreducibility of natures to properties is in no way antithetical to coming to know the former on the basis of the latter. Again, this point is nicely underscored by Lowe (2009: 158):

> It is, of course, perfectly feasible to maintain this while acknowledging that investigation of a chemical specimen's empirically detectable properties *guides* us in classifying it as being an exemplar of this or that chemical kind and hence, say, as being a particular instance of the kind named 'gold'. (Lowe 2009: 158)

Causal powers and dispositions point to the nature of substances. More specifically, since causal dispositions, on my view, are non-transferable tropes that modify their bearers in a particular way, their existence and identity are grounded in their bearers. On this score, knowledge of a causal power and its manifestation constitutes, at the very least, partial knowledge of the substance.[106] My knowledge of the dispositional profile of a particular isotope of gold—its melting point, malleability, ductility, solubility in aqua regia, etc.—constitutes knowledge (albeit partial and defeasible) of its free electron structure,

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[105] One can, on my view, grasp the real definition of a circle a priori as the locus of a point moving continuously in a place at a fixed distance from a given point.

[106] For a novel account of knowledge of causal dispositions see Mumford & Anjum (2011).

which partly constitutes its nature. This was, in fact, Aquinas' view regarding our knowledge of fundamental substantial natures: "If anybody advances a definition that does not lead him to the properties of a thing, his definition is fanciful, off the subject, merely a debating point" and "the species of a thing is gathered from its proper operation; for the operation manifests the power, which reveals the essence."[107] We must admit, however, that such knowledge is not exhaustive, nor is it indefeasible.

Not only do the natures of substances necessitate their distinctive causal profiles as per KPC, there is also a rich *explanatory structure* that obtains between the two sub-classes of necessary predicables.[108] How, then, might we go about making this explanatory structure more precise? Must the serious essentialist rest content with what Armstrong (1997: 66) has called 'mere vague gesture' in distinguishing between that which is constitutive of the identity of a substance and that which characterizes it? I think not. Recall that I briefly stated above that the serious essentialist gloss on the totality of a thing's necessary predicables (N)–those that it has in every world in which it exists–is more accurately described as being loosely akin to an ordered *n*-tuple such as $N = \langle f_1 \dots f_n \rangle$ such that the necessary predicables of a thing stand in certain priority relations to one another, where Fine construed such relations in terms of logical consequence.[109]

In the place of Fine's notion of logical consequence, I want to offer a second notion of ordering captured by the above scholastic locutions regarding the distinction between the two varieties of necessary predicables. On the view I am advocating here, there is a privileged subset of a substance's necessary predicables that are more *explanatorily basic* than others, where the notion of explanation here is to be given a distinctively *metaphysical* (versus epistemological, causal or conceptual) gloss.[110] Metaphysical explanations track real, objective relations between the occupants of spacetime.

To help unpack this second variety of structure that obtains between a substance's necessary predicables, I recommend something similar to Lewis' (1986: 59-61) notion of a naturalness ordering over properties, albeit one that is extended to *all* predicables and their ontological correlates, both constitutive and characterizing.[111] Further, let us suppose for our purposes here that all predicables–whether constitutive or characterizing—are natural or sparse in that they account for "objective sameness and difference,

[107]Aquinas (1999) I, left 1 and Aquinas (1975) II.94, respectively.

[108]For another account that ties explanatory structure to natures see Laporte (2004: 19). Laporte remarks, "In particular, I propose, a natural kind is a kind with explanatory value. A lot is explained by an object's being a polar bear. That is is a polar bear explains why it raises cubs as it does, or why it has extremely dense fur, or why it swims long distances through icy water in search of ice floes... The polar bear kind is a useful one for providing significant explanations. It is a natural kind."

[109]Note, however, that there need not be any *single* explanatorily basic feature that serves to explain all the others (as f_1 would suggest).

[110]See Kim (1988).

[111]See Taylor (1993: 81) for the extension of naturalness to both constitutive and characterizing predicables. Moreover, Lewis (1999b: 65) himself hints at extending naturalness to objects as well as properties.

joints in the world, discriminatory classifications not of our own making."[112]

As we have seen, one can predicate a multiplicity of things to a polar bear, gold, a flower, water, or an electron. While all natural predicables are responsible for the objective joints in nature, some carve much deeper than others. There is, in other words, an inegalitarianism with respect to natural predicables in that some of them are *more natural* than others in that that they are better suited to carve nature at its deepest explanatory joints.[113]

To help elucidate the relationship between that which constitutes the nature of a substance and its characterizing causal profile in terms of a naturalness ordering, let us represent the total set of the necessary (natural) predicables of a substance S as '$\Box P_S$' and begin by offering the following notion of *explanatory basicness*:

> *Explanatory Basicness*: for any two proper subsets b and c of $\Box P_S$, b is explanatorily basic for c iff the necessary predicables in b explain the necessary predicables in c, and not vice versa.

This rather straightforward notion of explanatory basicness is meant to highlight the *asymmetrical* explanatory ordering that governs the necessary predicables (or any features for that matter) of any particular substance.

For plants belonging to the botanical genus *geranium*, for instance, the necessary (characterizing) predicable *being disposed to develop a root system* serves to explain the further necessary (characterizing) predicable *being disposed to undergo seed dispersal*, not vice versa. The fact that geraniums are necessarily characterized by the disposition for seed dispersal is precisely *because* they have the prior necessary disposition to develop a root system. The power to develop a root system, then, is explanatorily prior to the power for seed dispersal and thus the former, we might say, is more explanatory basic for geraniums than the latter. Of course, the above ordering relation between these two causal powers represents only a small slice of the explanatory structure that obtains between the features that are predicated of a geranium.[114]

On the serious essentialist metaphysic I am developing here, there will be necessary predicables of a substance that are not only more basic than others in the order of explanation, but ones which fail to be explained in terms of any other necessary predicables of

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[112]Lewis (1999a: 67).

[113]Interestingly enough, there has been a good deal of empirical research from cognitive psychology offering prima facie support for the above essentialist explanatory framework. In her 2006 book *The Essential Child*, Susan Gelman records that the classificatory framework of young children exhibits similarities with the above view that I am proposing. The inductive reasoning of young children is often governed by category-based inferences which rely on the distinction between explanatory deep features of a thing (which belong to its nature) and those that are more superficial to the thing in question. See also Gelman (2004) and (2009) as well as Keil (1989) for empirical work in this area.

[114]See Gorman (2005: 282) and Koslicki (2012) for a similar approach to the structure of a thing's necessary features in terms of metaphysical explanation.

that substance.[115] That is, the hierarchy of explanatory ordering for the necessary predicables of a substance terminates, ultimately, in those that are *minimally explanatorily basic* for that substance.

With this concept in hand, we can define the notion of *minimal explanatory basicness* as follows:

> *Minimal Explanatory Basicness*: a proper subset a of $\Box P_S$ is minimally explanatorily basic for $\Box P_S$ iff (i) a is explanatorily basic for every predicable not in a and (ii) there is no proper subset of a, a^*, such that a^* is explanatorily basic for $\Box P_S$.

A naturalness ranking over necessary predicables for a particular substance, then, generates a hierarchy of necessary predicables which are ordered by means of their explanatory basicness. The hierarchy of necessary predicables for a substance will ultimately terminate in a minimal explanatory base, a base which is not explained in terms of any other set of predicables for S and which serves to explain every other set of predicables for that substance.

On the naturalness conception of structure I am unpacking here, we can identify those necessary predicables that occupy the minimal explanatory base for that substance with its *perfectly natural predicables*:

> *Perfectly Natural Predicable*: F is a perfectly natural predicable of $\Box P_S$ iff F is minimally explanatorily basic for $\Box P_S$.

On my view, the constitutive predicables—those that enter into the real definition of a substance—are perfectly natural in so far as they, more than any other predicables, carve the deepest explanatory joints (and thus are directly definitive of S) in serving as the minimal explanatory ground as to *why* S exhibits the particular causal profile it, in fact, does. On this score, Harré and Madden (1975: 101-102) highlight the minimal explanatory role of constitutive predicables as follows: "Capacities, just as much as powers, what particulars or substances are liable to undergo as well as what they are able to do, are *explained* by reference to what the thing is in itself."[116]

A particular isotope of gold's being disposed toward *malleability* and *exhibiting a high lustre* as part of its causal profile is explained partly in terms of the nature of gold, in this case its particular electron configuration (having a free electron structure). The nature and structure of gold, as it were, 'carves out' and unifies a particular range of properties and powers that necessarily accompany substances of that kind. While gold is characterized by its being disposed toward *malleability* and *having high lustre* in every possible world in which it exists, the latter are not *perfectly* natural predicables of gold and therefore fail to enter into its real definition.

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[115]This is, I think, stated nicely in Aquinas (1949), a. 11. See note 65.
[116]Emphasis mine.

Again, the nature of Ethanol as consisting of a hydroxyl group—a group consisting of an oxygen atom connected by a covalent bond to a hydrogen atom—is what explains its being disposed to *being miscible in water*. Similarly, it is in virtue of the nature of a diamond as having a particular crystalline structure that it has the power to exhibit such a high hardness index on the Mohs scale. Ethanol's consisting of a hydroxyl group and a diamond's having a particular crystalline structure are perfectly natural predicables of these substances.

Here we need to consider more closely what sense can be given to the idea that, as Lewis (1986a: 59-61) points out, naturalness admits of degrees. As we have seen above, one predicable can be more or less natural than another, with perfectly natural predicables serving as the root of the naturalness ranking for various predicables of substances. Here I suggest we unpack the notion of 'comparative' or 'relative' naturalness' in terms of explanatory 'distance' from the perfectly natural predicables.[117] That is, if x is *more natural* than y, then the explanatory chain linking x to the perfectly natural predicables of a substance will be 'shorter' than the explanatory chain linking y to those very same predicables.

We can understand the idea of *explanatory 'distance'* between necessary predicables in terms of an *immediate explanatory base* as follows:

> *Immediate Explanatory Base:* x is the immediate explanatory base for y iff (i) x is explanatory basic for y and (ii) there is no x^* such that x is explanatorily basic for x^* and x^* is explanatorily basic for y.

If predicable x is the immediate explanatorily base for predicable y, then there is no intermediary in the order of explanation linking y and x. For y to be related to x in such a way is an example of an explanatory chain that is maximally 'short.' If one were to incrementally add explanatory 'links' to the chain connecting y to x one would thereby increase the explanatory 'distance' between the two predicables.

On this understanding of comparative or relative naturalness, then, non-necessary characterizing predicables (i.e. extraneous accidents) are the least natural of the natural predicables of a substance. The necessary characterizing predicables, however, are more natural than the non-necessary characterizing predicables in that there are fewer explanatory links in the chain connecting them to the perfectly natural predicables (minimal explanatory base). Not all necessary characterizing predicables need have at least one perfectly natural predicable as part of their immediate explanatory base; only those that have the highest degree of naturalness short of being perfectly natural have this elite status. Consequently, each necessary characterizing predicable will be linked to the perfectly natural predicables either directly by means of having them as part of their immediate explanatory base or indirectly by means of an explanatory chain running through

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[117]See Lewis (1999b: 66) for more on the notion of relative or comparative naturalness.

the former.[118] Lastly, a substance's perfectly natural predicables, i.e. constitutive predicables, lay at the root of the explanatory ordering over its necessary predicables. The real definition of a particular substance, then, aims to capture its minimally explanatory basic features or those that are directly definitive of the substance in question which serve to explain all other necessary predicables.

Consider the following examples of comparative naturalness at work. In virtue of its having an asymmetrical (non-uniform) charge distribution (which in turn gives rise to dipole-dipole interactions), a hydrogen chloride molecule is disposed towards *being acidic* and *boiling at minus 85 degrees celsius*. Plausibly, the molecule's having non-uniform charge distribution (i.e. its having a high molecular polarity) is the immediate explanatory base for the above necessary characterizing predicables. Even more, however, is the fact that it is precisely because it is part of the essence of hydrogen chloride that it is a chemical *compound* consisting of at least two atomic parts that it is capable of exhibiting an *aysmmetrical* charge distribution. For hydrogen chloride, the constitutive predicable *chemical compound* is an immediate explanatory base for the predicable *being asymmetrically charged*.[119]

Again, a mammal's having a certain follicular skin structure is more natural than its having hair. In fact, it would appear that the latter has the former as its immediate explanatory base. As a result, in the case of mammals, the explanatory chain linking the dispositional property *being disposed to have hair* to the constitutive (perfectly natural) predicables for mammals is 'longer' than the chain linking the property *being disposed to have a follicular skin structure* to those very same predicables.[120]

Consequently, the above notion of a naturalness ordering over a thing's necessary predicables, together with the distinction between the nature of a substance and its characterizing properties, stand in direct contrast to both ME2a and ME2b of modal essentialism (see above). In contrast to Fine's account of the structure of a thing's necessary features in terms of logical consequence, my own conception of the structure that obtains between a thing's necessary predicables in terms of explanatory naturalness is much less

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[118]Thus, the traditional notions of 'propria' (necessary characterizing properties) and 'extraneous accidents' can be reformulated in terms of their respective degree of naturalness relative to a thing's nature. Since the former have as their immediate explanatory base the substantial nature, we might call them the 'highly natural properties' (for lack of a better word), the latter might be explicated as the 'lesser natural properties' in so far as they are non-necessary natural properties of a substance.

[119]This is not to say that only chemical compounds are characterized as such, just that there is an explanatory relationship between chemical compounds and the property *being asymmetrically charged*. Nor does this mean that *being a chemical compound* is the sole immediate explanatory base for such a property, only that it is, at the very least, one of the immediate explanatory bases for this property.

[120]This example is from Oderberg (2011: 103). Moreover, as Bird (1998: 73) notes, it is often the case that providing an the immediate explanatory base of a particular predicable of a substance will be relativized to the sort of characteristic behavior of the substance under consideration: "In explaining why benzyl alcohol reacts with phosphorus chloride to form benzyl chloride, we may point out that this is a reaction characteristic of alcohols, while if what needs an explanation is the same substance's volatility and odour, then reference to its being an aromatic compound (a benzene derivative) is called for."

restrictive and thus includes certain features of an entity that are closely tied to it, but do not logically follow from its essence (as was stated above regarding triangles and having three sides).

Let's take stock of the present chapter. I began by rehearsing several now familiar lines against the sufficiency of a modal-existential account of essence, as stated in ME1. I then set out to unpack my own particular variety of a serious essentialist ontology, which attempts to reduce modality to essence and gives pride of place to a more fine-grained notion of essence in terms of real definition. By way of interlude I argued, contra the current anti-essentialist consensus in the philosophy of biology, that far from excluding the notion of essence in the biological realm, evolutionary biology in fact presupposes natures in explaining certain adaptive features of organisms that are integral to the evolutionary process itself. I then set out to motivate a clean break from modal essentialism in rejecting ME2 and hence the view that essences are unstructured collections of properties. We examined one reason in particular to think that the notion of essence is irreducible to a set or collection of properties: in virtue of *what* do properties and powers systematically cluster to form an integral unity? I argued that a deep and informative explanation of CLUSTER, one that supports the explanatory and predictive aims of the sciences, is best afforded by an ontology of irreducible substantial natures. I then turned to explicate my own medieval Aristotelian inspired account of the two-fold structure that governs the necessary predicables of a substance, as stated in the KIND-POWER CONNECTION and in the notion of an explanatory ordering in terms of naturalness.

Chapter 2

Grounding and Essence

"This need we can call dependence, so that we can say that anything which is essentially posterior [in this way] depends necessarily upon what is prior but not vice versa, even should the posterior at times proceed from it necessarily."
— John Duns Scotus, *De Primo Principio* 1.8

2.1 Grounding: A First Approximation

We have seen above that serious essentialism, with its non-modal conception of essence as stated by real definition, is at the foundation of my neo-Aristotelian ontology. I now turn to another major pillar upon which I will rely in developing the notion of fundamental mereology in the sequel, the notion of metaphysical grounding.

The notion of one entity being metaphysically grounded in, dependent on, or posterior to another is commonplace in contemporary philosophy. Events are said to be grounded in their respective temporal and particular constituents, holes in their hosts, non-empty sets in their members, Aristotelian universals in their instances, regions of spacetime in the substantival manifold, and so on. As these putative cases of grounding involve one thing depending on another for its *existence*, they pick out what appear to be plausible candidates for a distinctively metaphysical priority-ordering (as opposed to an ordering that is conceptual or epistemic).[1]

As a first pass, we can do no better than to appeal to the idea of the existence of one entity requiring the existence of another:[2]

(RG) x is *rigidly existentially grounded* in $y = \Box(Ex \to Ey)$

That is: necessarily, x exists only if y exists. RG captures the insight that one thing may depend on another *specific* entity (y) for its existence: it is metaphysically impossible for x

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[1] I use 'grounding' and 'ontological priority' interchangeably throughout.

[2] As per chapter 1, here I use the sentential operator 'E' for the existence predicate and define it in terms of the existential quantifier: $Ex =_{def} (\exists y)(x = y)$

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to exist unless y—*that* very object—exists. In this way, the proponent of RG takes there to be relations of necessitation in the world such that the mere existence of x necessitates the existence of y. The mere existence of an event, say the presidential inauguration of Barack Obama, necessitates the existence of Barack Obama; it is impossible that the event exist unless Barack Obama exists. As I have already indicated, events, Aristotelian universals, and regions of spacetime on substantivalism, are all plausible candidates of entities that stand in RG to their grounds. In addition, many advocates of a trope ontology take the sort of grounding or dependence relation between a trope and its bearer to be an instance of RG. The existence of the redness of this particular apple is rigidly grounded in this very apple as it cannot exist unless its specific bearer exists. Many of those that are congenial to grounding take RG to minimally represent a distinctively *metaphysical* variety of grounding or dependence.

We may, however, distinguish RG from a more generic variety of grounding, which differs in claiming that while an entities' existence is grounded in an F, it need not be grounded in any particular F. More precisely:

(GG) x is *generically existentially grounded* in $Fy =_{def} \Box(Ex \to (\exists y)Fy)$

There are two ways in which GG is weaker than RG. First, GG is much more inclusive in scope than RG: x exist only if there is some F, it need not be any F in particular. GG captures the notion of one entity being grounded in an entity of a certain kind or type. One common example of GG would be an Aristotelian kind-universal's being grounded in at least one of its instances. For instance, the kind *electron* exists only if there exists at least one thing that falls under the kind *electron*. For those who favor kind-universals, if there were no such instance, then the kind *electron* would fail to exist.

A second sense in which GG is weaker than RG is that RG *entails* GG, *but not the converse*. If x is rigidly grounded in y, then it follows that x requires at least one F, in this case, y, in order to exist. In virtue of being rigidly grounded in y (where y is F), x cannot exist unless *something*, that very y, is F. That is, x could not exist and be grounded in another thing that is F (z for instance).

Following Lowe (forthcoming), let us say that if an entity is generically existentially grounded in something that is F (Fy) but fails to be rigidly existentially grounded in any F in particular, that entity is *accidentally existentially grounded* in Fy:

(AG) x is *accidentally existentially grounded* in $Fy =_{def}$ (i) $\Box(Ex \to (\exists y)Fy)$
but (ii) $\neg(\Box(Ex \to Ey))$

As examples of AG at work, Lowe cites the case of a bronze statue and the bronze particles from which it is actually composed; while the statue fails to be rigidly existentially grounded in any collection of particles in particular, it nonetheless requires some collection or other in order to exist; bronze statues cannot exist without being composed of some bronze particles or other.

As a piece of metaphysical machinery, the notion of grounding has an impressive historical pedigree. The list of those who have put the concept to use in one way or another is like a who's-who in the history of philosophy: Plato, Aristotle, Augustine, Aquinas, Scotus, Descartes, Spinoza, Leibniz, Brentano, and Husserl, to name a few. For many of these thinkers, the notion of grounding was used primarily to elucidate the idea of a fundamental or basic entity, a substance. Descartes (1988: v. 1, 210), for instance, famously defined a substance as "nothing other than a thing which exists in such a way as to depend on no other thing for its existence." In a similar fashion, Spinoza (1985) maintained: "By substance I understand what is in itself and is conceived through itself, i.e. that whose concept does not require the concept of another thing, from which it must be formed" (1Def 3).

More recently, however, there has been a resurgence of interest in the nature of grounding and its usefulness in elucidating many of the concepts at play in contemporary metaphysics. Talk of grounding and fundamentality has reared its head in discussions surrounding the proper aims of metaphysics (metaphysics being about explicating the fundamental structure of reality), metaphysical realism (whether all of reality is grounded in the mental), truth-making (truth being grounded in being), substance (entities whose existence and identity are fundamental or basic), universals (whether properties are fundamental or non-fundamental), philosophy of mind (whether the mind is grounded in and dependent on matter), and mathematical objects (whether numbers are fundamental or grounded in their positions in abstract mathematical structures).[3] Even more recently still, the literature surrounding the notion of grounding has taken on a life of its own in that more and more philosophers are beginning to once again take this time-tested piece of machinery seriously in its own right. My aim in this section is to develop a particular notion of grounding that is an extension of the above serious essentialist framework set out thus far.

2.1.1 Grounding Skepticism

I begin with a glance toward those who take the extension of the grounding relation as per RG and GG to be entirely empty, they are what we might call 'grounding skeptics.' While there are other species of grounding such as epistemological and conceptual grounding (and priority), we have no need for such an ontologically loaded relation as that of *metaphysical* grounding, so argues the grounding skeptic. Here the grounding skeptic argues that either the notion itself is unintelligible or that all putative cases of metaphysical priority are, in the end, cases of some other species of priority such as epistemological, conceptual, or counterfactual.

Both claims are advanced by Thomas Hofweber (2009), whom I will use as a rep-

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[3]Some of these examples are taken from Schaffer (2009: 363).

resentative of grounding skepticism henceforth. Hofweber is in one accord with other grounding skeptics in holding that the very notion of grounding is obscure and unintelligible. Much of Hofweber's suspicion appears to be motivated by the fact that the wide majority (as we will see) of grounding proponents take the notion to be unanalyzable and thus a radically *sui generis* kind of priority. Hofweber's bewilderment regarding a primitive, unanalyzable relation of metaphysical priority is clear enough from the following remarks: "And there are other senses of priority that should not be confused with metaphysical priority, whatever that might be" and "I have enough doubts about the glorious history of philosophy to not take Aristotle's word for 'priority' to be a clear enough notion on which metaphysics can be based."

Hofweber's second main contention with a distinctively metaphysical gloss on grounding is that those who rely on such a notion are guilty of a slight of hand; they present what appear to be intuitively compelling instances of some domain being prior to another and, from this, infer that such priority is distinctively metaphysical. The charge, in essence, is that the warrant for positing a primitive metaphysical notion of priority is carried over from that of more common, less contentious species of priority (such as logical, mathematical, and conceptual priority).

Hofweber takes aim at the alleged clear cases of metaphysical grounding offered by the likes of Fine (2001) and Schaffer (2009), arguing that such cases can be analyzed in terms of some other form of priority or grounding (whether conceptual, logical, or mathematical). He thereby offers an undercutting defeater for the warrant grounding proponents claim for positing a primitive relation of metaphysical priority. He remarks,

> In a sense, of course, priority is a clear notion. There are many things that are prior or more fundamental than other ones, but they are so in many senses of these words. What is disputed and controversial is whether there is a special metaphysical sense of priority of fundamentality. This I deny. (Hofweber (2009: 271))

As an example of the alleged metaphysical slight of hand, Hofweber cites Fine's (2001) example of a true disjunction and its true disjunct, the latter being metaphysically prior to the former. Far from being a clear instance of metaphysical grounding, argues Hofweber, such a case is an example of an asymmetrical logical relationship: the disjunction logically implies the disjunct. For Hofweber, no relation of metaphysical grounding need apply.

Similarly regarding the claim that prime numbers are prior to even numbers, the former being more basic than the latter. The notion of priority operative here is that of mathematical priority; "the prime numbers are mathematically special, not metaphysically. Judgments of fundamentality here should not be given a metaphysical or ontological reading" (271-272). Consequently, the fact that no clear cases of a primitive metaphysical variety of grounding have been offered by its foremost proponents, together

with the fact that such a primitive notion is shrouded in obscurity and unintelligibility, undercuts the warrant for thinking that such a relation has an extension in the first place.

Let us first consider the grounding skeptic's charge that grounding is unclear and unintelligible. Here it is difficult to locate the precise misgivings had by the grounding skeptic. Apart from a few offhand remarks regarding grounding being 'unclear' and 'dark,' Hofweber (and company) say surprisingly little as to the precise nature of their disdain for the notion.

The grounding skeptic's charge of unintelligibility, I submit, is greatly exaggerated. The skeptic shoulders an enormous burden of proof in denying, at the very least, a *prima facie* intelligibility of distinctively metaphysical grounding claims. For one, the grounding relation is irreflexive, asymmetric, and transitive (partial ordering) and is thus structurally *identical* in this sense with the formal ontological relations of causation and proper parthood, relations that are widely regarded as intelligible and often indispensable to fundamental ontology. Any charge of unintelligibility regarding the formal features of grounding would, by parity of reasoning, likewise apply to the relations of causation and proper parthood.

Furthermore, while many grounding proponents do in fact take the notion to be primitive and unanalyzable, this in no way lends support to the idea that grounding is unclear and unintelligible. This point is underscored by Rosen (2010: 113) in that such a maneuver "is obviously no reason for regarding the idiom as unclear or unintelligible. Many of our best words—the words we deem fully acceptable for rigorous exposition—do not admit of definition, the notion of metaphysical necessity being one pertinent example." Rosen's point I take it is thus: there is no intrinsic connection between a concept's being primitive and its being unintelligible. Again, the relations of parthood and causation (at least for causal primitivists) are apt examples of a concept's being intelligible yet unanalyzable.

What's more, I would contend that grounding is an intelligible metaphysical posit precisely because of the role that it plays in undergirding and elucidating many of the most central issues in philosophy. As Schaffer (2009: 362) has pointed out, some of the most time-honored philosophical questions in the history of philosophy—metaphysical realism versus idealism, realism about universals versus nominalism, and substantival versus relational theories of space—are primarily disputes not about what exists per se but about what is metaphysically prior or fundamental.

In addition, grounding presents itself as a remarkably useful piece of metaphysical machinery. It has been argued that an appeal to metaphysical grounding as a form of non-causal, non-conceptual dependence improves our understanding of truthmaking (Schaffer 2009; Lowe 2009b), physicalism (Schaffer 2009; Loewer 2001: 39), intrinsicality (Witmer et al. 2005), objective similarity (Sider 2012), perfectly natural properties (Schaffer 2004), the nature of non-causal explanation (Audi forthcoming; Kim 1994:67), trope inherence (Lowe 2006), and an overall 'realist' approach to metaphysics

(Fine 2001; Schaffer 2009). As a result, grounding can be seen to be a *unified* posit that undergirds a variety of concepts in metaphysics.

Consequently, the notion of grounding is as prima facie intelligible as any other familiar partial ordering concept, it is remarkably fruitful in shedding light on wider issues in metaphysics, and it seems to be integral to metaphysical reflection from time immemorial. Its credentials as a metaphysical concept are commendable by any reasonable standard (by what other merits are we to commend a piece of metaphysical machinery?).

What are we to make of the grounding skeptic's second contention–that grounding proponents are guilty of a sleight of hand? The force of this objection hinges on which representative cases of metaphysical grounding one considers. And for many grounding proponents, not all putative examples of metaphysical priority are created equal; some examples of the grounding relation at work are more naturally construed as being of the metaphysical variety than others.

Admittedly, Fine's example of a true disjunction and its true disjunct is not a compelling case of a distinctively metaphysical variety of grounding at work. However, as has already been noted, there are a host of cases that are, arguably, more perspicuous examples of grounding as per RG and GG. In addition to the examples mentioned above, consider the following representative samples from the metaphysics and philosophy of science literature that employ a distinctively *metaphysical* gloss on grounding:

1. SPACETIME SUBSTANTIVALISM, METRIC ESSENTIALISM & MODERATE STRUCTURAL REALISM:

    "In describing space as being, on this view, 'unitary' or 'singlular', I mean that it is conceived as a whole which as ontological priority over its parts. . . its parts cannot exist independently of space as a whole." (Lowe 2002: 271)

    "Assume that space itself is real, but it is not made up of its parts, nor yet analysable into parts with any kind of ontic independence. Perhaps, even, that spatial parts and their relations are, ontologically, supervenient on the structure of space. Space, not its parts, is the foundation of spatial relations." (Nerlich 2005:131)

    "[T]he Lorentz metric tensor field, or the orthonormal frame field, is interpreted as representing the space-time structure and as providing structural identity to space-time points, which therefore cannot exist independently of the whole structure." (Esfield and Lam (2008))

2. ONTIC STRUCTURAL REALISM (OSR)

    "OSR is the view that the world has an objective modal structure that is ontologically fundamental, in the sense of not supervening on the

intrinsic properties of a set of individuals." (Ladyman and Ross 2007: 130)

"I shall take it that a core feature of OSR is the claim that putative objects are dependent in some manner upon the relevant relations (and hence these putative objects can be reconceptualized as mere nodes in the relevant structure)." (French 2010: 104)

"On the broadest construal OSR is any form of structural realism based on an ontological or metaphysical thesis that inflates the ontological priority of structure and relations." (Ladyman 2009)

3. Boundaries and their Hosts

"The dependence of a boundary on its host is a case of genuine ontological dependence... It is not merely a case of conceptual or *de dicto* dependence, as when we say that there cannot exist a husband without a wife. Every husband, i.e., every man who is in fact married, could have been a bachelor (or so we may suppose). But the surface of a table can only exist as a *surface of* a table–perhaps only as a surface of *that* table." (Varzi and Casati 1999: 96)

We could, of course, supplement the above examples with the standard examples already mentioned such as the relationship between a trope and its bearer, an event and its particular constituents, a (non-empty) set and its members, and so on. I take the above examples from the philosophy of science and metaphysics as more plausible candidates than a true disjunction and its true disjunct as an example of a distinctive metaphysical variety of grounding or dependence. While the grounding skeptic may remain undeterred and press that even these cases are not instances of metaphysical grounding, it is difficult to see what grounds remain for their full-fledged skepticism regarding the grounding relation.

2.1.2   Grounding as Supervenience?

In addition to those that maintain that the grounding relation has no extension, there are those close cousins of grounding skeptics that suggest we employ supervenience as a proxy for grounding: *all grounding claims can be analyzed in terms of supervenience claims*. One particular example of using supervenience as a proxy for grounding is Lewis (1999a: 29): "A supervenience thesis is, in a broad sense, reductionist. But it is a stripped-down form of reductionism, unencumbered by dubious denials of existence, claims of ontological priority, or claims of translatability."

There are well known problems, however, with employing supervenience as a stand-in for grounding. Most fundamentally, there is a lack of isomorphism regarding the

formal properties of the two relations. Supervenience is reflexive, transitive, and non-asymmetric, where grounding is irreflexive, transitive, and asymmetric.

More importantly, as Kim has effectively pointed out, supervenience is mere modal correlation between multiple domains and thus is not a very 'deep' relation at all. By this Kim means that the relation of supervenience is unable to play the role that it is often thought to play in one's fundamental ontology, namely to account for the meta-physically fundamental joints of nature. Supervenience is "not a type of dependence relation–it is not a relation that can be placed alongside causal dependence, reductive de-pendence, mereological dependence, dependence grounded in definability or entailment, and the like" (14). So much so that Kim argues that views which employ the notion of supervenience toward this end must "look elsewhere for its metaphysical grounding; supervenience itself is not capable of supplying it" (14).

One way of fleshing out this particular shortcoming of supervenience is to show that two dissenting parties can endorse the very same supervenience claims regarding two domains and yet differ regarding facts about grounding structure. Consider the Humean and anti-Humean regarding modality as a case in point. The former claims that reality is fundamentally devoid of modal structure; the world is intrinsically de-modalized for the Humean. The latter, of course, denies this and posits primitive intrinsic modal structure in spades. Now, suppose we construe the debate between the Humean and anti-Humean regarding modality in terms of supervenience alone. For the Humean, all modal facts supervene on the spatio-temporal distribution of local property instances.

Note, however, that the anti-Humean need not deny this. There is nothing about an anti-Humean stance on modality that precludes it from endorsing the thesis that when-ever two worlds are alike in their spatio-temporal distribution of local property instances they must also agree in their modal aspects. The dispositionalist regarding modality, for example, may hold that local dispositional properties are what ground modal truths about the world. Thus, the Humean and the anti-Humean may well accept the very same supervenience claim and yet differ on crucial facts concerning fundamentality, namely, whether modality is a fundamental feature of the world. This shows that framing claims about grounding or fundamentality in terms of supervenience is simply not 'deep' enough to capture what is at the heart of the matter.

Not only is supervenience not an adequate stand-in for grounding, Kim (1993: 167) goes so far as to point out that the supervening of one domain on another might plau-sibly be explained by the one domain being grounded in the other. More straightfor-ward, modal correlation is explained by dependence ordering. While I strictly reject the prospect of analyzing grounding in terms of supervenience alone, will see below that there is an intimate relationship between the two concepts that will be relevant for my purposes in the sequel.

2.1.3 The Grounding-Reduction Link

This brings us to the question of whether the grounded *reduce* to their grounds. Current orthodoxy answers in the affirmative, thereby endorsing what Rosen (2010: 122) has called the *grounding-reduction link*.[4] Here, however, it is unclear what the notion of reduction amounts to in the context of grounding. It is commonplace to state the grounding-reduction link—the view that the grounded reduce to their grounds—as the thesis that the grounded are 'nothing over and above' or 'no addition to being' to the ground. Such terminology is appropriated from Armstrong (1997: 12) in his discussion of the relation of supervenience in particular:

> [W]hatever supervenes on, or as we can also say, is entailed or necessitated, in this way, is not something ontologically additional to the subvenient, or necessitating, entity or entities. What supervenes is no addition to being.

On the surface, an appropriation of the locutions 'no addition to being' and 'nothing over and above' in the context of grounding suggests the following interpretation of the grounding-reduction link: one particular domain x reduces to another y just in case x is *identical* to y, that 'x reduces to y' just in case $x = y$. On this interpretation, the grounded *do not exist in addition to the domain upon which they are grounded.*

But this seems to be a much stronger thesis than what many grounding proponents with reductionist tendencies are prepared to endorse. For one, while Schaffer (2009: 353; forthcoming MS) utilizes such terminology, he is clear that the most inclusive domain of existents will include that which is grounded, the grounds, and the grounding relations. This suggests a non-identity between the grounded and their grounds, otherwise the inclusion of both would be needlessly redundant in an exhaustive ontological assay. Even more, however, is the fact that such an interpretation of the grounding-reduction link can be shown to be strictly *incompatible* with the notion of grounding in so far as it construes the notion of reduction as symmetric (since identity is symmetric), while grounding (as we have seen) is thought to be asymmetric. Consequently, the identity reading of the grounding-reduction link is no friend of the defender of grounding.

An alternative notion of reduction at play in the work of some grounding adherents is that derivative or grounded entities are, again borrowing terminology from Armstrong (1997), an 'ontological free lunch.' On this understanding of reduction, that which is grounded exists *in precisely the same sense* as the grounds and constitutes a numerically distinct domain of existing entities. However, a grounded entity *reduces* to its ground and thus is a 'free lunch' in the sense that it does not incur any fundamentality commitments in addition to those required by its grounds. If one were to draw up an exhaustive inventory of the metaphysically basic or fundamental entities, any mention of the derivatives in

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[4]See Fine (forthcoming); Schaffer (2009); (forthcoming); Rosen (2010); and Bricker (2006)).

addition to these basics would be double talk as "[t]he derivative entities, in order to be an 'ontological free lunch' and count as no further addition, ought to be already latent within the substances."[5]

On this view, in listing the basics one thereby lists the derivatives in so far as an ontological commitment to the former automatically incurs a commitment to the latter. In fact, this view of grounding is what undergirds Schaffer's (2009) own 'permissivism' regarding the existence of derivative entities as well as his reformulation of Ockham's razor to fundamental entities in particular: one should not multiply basic or non-derivative entities without necessity. Schaffer, again, is unequivocal: "there is no problem with the multiplication of derivative entities—they are an 'ontological free lunch.'"

Here, however, a potential problem arises for this particular gloss on the grounding-reduction link in its use of the locution 'ontological free lunch.' Here we are asked to appropriate Armstrong's notion of an ontological free lunch, without any qualification, from the context of supervenience and apply it to the domain of grounding. In the passage cited above, however, Armstrong goes on to wed the phrases 'no addition to being' and 'nothing over and above' to that of 'ontological free lunch,' suggesting that both locutions pick out one and the same concept:

> One may call this view, that the supervenient is not something additional to what it supervenes upon, the doctrine of the ontological free lunch... You get the supervenient for free, *but you do not really get an extra entity*. (Armstrong 1997: 12-13)[6]

and

> The doctrine of the ontologically free lunch rids us of superfluous entities, because the supervenient is ontologically nothing more than its base. (Ibid.)

According to Armstrong, that which supervenes is an ontological free lunch *precisely because* it is "not really an extra entity;" an ontological free lunch reduces to—in the sense of being *identical* (or at least *partially* identical) with—its subvenient base. From the mutual supervenience of whole on part and part on whole, Armstrong (1997:12) concludes that "[t]his has the consequence that mereological wholes are *identical* with all their parts taken together. Symmetrical supervenience yields identity." It is precisely because that which supervenes makes no existential difference to its subvenient base that Armstrong opts for a permissive mereology (compare with Schaffer's permissive ontology of derivatives) and sees "no objection to recognizing the whole."[7] My point is to underscore the fact that an interpretation of the grounding-reduction link in terms

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[5]Schaffer (2009: 378).
[6]Emphasis mine.
[7]Armstrong (1997: 13).

of the notion of an ontological free lunch is misguided in so far as it carries with it a conception of reduction as identity (or partial identity) which, as we have seen above, is strictly incompatible with grounding per se.

The grounding theorist might retort that since grounding and supervenience are formally distinct relations (former being asymmetric and the latter symmetric), the use of the notion of an ontological free lunch in explicating the grounding-reduction link does not harbor the unacceptable consequence that the grounded are identical to their grounds. I grant this point. At the very least, then, there is an equivocation regarding the locution 'ontological free lunch' by those who use it to elucidate the grounding-reduction link.

For this reason, the proponent of the grounding-reduction link must either eschew unqualified talk of derivative entities as being an ontological free lunch (as this would collapse into the claim that the grounded are identical to or partially identical to the ground) or inherit the original meaning of the phrase as specified by its original context and thereby opt for a characterization of grounding in terms of supervenience.[8] As we have seen, the latter simply evacuates all substantive content from the notion of grounding, a price that is certainly too great just to retain such language in unpacking the grounding-reduction link.

On the other hand, to say that an affirmation of the grounding-reduction link amounts to nothing more than the claim that the grounded fail to incur any fundamentality commitments in addition to those required by their grounds seems, on first pass, rather uninformative. *Of course* positing the existence of non-fundamental entities fails to incur any additional fundamentality commitments, precisely *because* they are non-fundamental. We make little progress in understanding the grounding-reduction link when we say that an exhaustive inventory of the fundamentals need not make any mention of the non-fundamentals, precisely because the set of the latter in no way intersects the set of the former.

The question of whether to accept the grounding-reduction link, then, hinges on whether or not a substantive reading of the grounding-reduction link can be given. In particular, what is needed here is an understanding of the grounding-reduction link that remains faithful to the structural features of grounding that allows it to do the work it is intended to do, that serves to generate a strict partial ordering and thus a genuine ontological ordering in reality, and that is informative. In so far as I am yet to encounter a treatment of the grounding-reduction link that satisfies the above desiderata, my sympathies lie with a non-reductivist account of grounding and hence a straightforward denial

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[8] The same would apply to the use of the phrase 'ontologically innocent' by grounding theorists in explicating the relationship between grounding and reduction. This language finds its source in Lewis's (1991: 81) discussion of composition as identity (or something near enough): "Mereology is ontologically innocent...But given a prior commitment to cats, say, a commitment to cat-fusions is not a *further* commitment. The fusion is nothing over and above the cats that compose it. It just *is* them. They just *are* it."

of the grounding-reduction link.

2.1.4   The Structure of Grounding

There are, I think, adequate reasons to think that the extension of grounding is non-empty. Grounding is (and has been) a metaphysical posit worth making. What, then, of the grounding relation itself? While there is much to be said about the relation in general, I consider below only the aspects of the relation that are integral to my overall project in the sequel.

In the broadest terms, I take the domain of entities that can serve as the relata of the grounding relation to be maximally general. Grounding, like identity and proper parthood, is *topic neutral*: entities of *any* ontological category can flank the grounding sign. Thus:

> G1: *Topic Neutrality*: entities of any ontological category can serve as the relata of the grounding relation.

The tenability of G1 stems from the intuitiveness of the following diverse cases of grounding: the individual innings of a baseball game are grounded in the game, non-empty sets are grounded in their individual members, the redness of the apple is grounded in that very apple, holes in a piece of Swiss cheese are grounded in its particular host, the Aristotelian universal *horseness* is grounded in the existence of individual horses, and individual truths are grounded in their truthmakers. Thus events, sets, properties, holes, universals, and propositions are, on my view, all potential relata of grounding relations.

Given my adherence to the topic neutrality of grounding, I take the logical form of the relation as best expressed by a two-place predicate such that '$x \triangleright y$' stands for 'x is grounded in y:'

$$x \triangleright y = x \text{ is grounded in } y$$

This predicative rendering of grounding claims leaves open, rightly so in my opinion, the possibility that substances, properties, states of affairs, and so on may serve as the relata of the grounding relation (and not just facts as is common in the literature).

Stated simply, I take grounding to be a type of metaphysical ordering relation. That is, it is irreflexive, asymmetric, and transitive and thus generates a strict partial ordering over a domain of entities:

> G2. *Irreflexivity*: $\neg(x \triangleright x)$

> G3. *Asymmetry*: $(y \triangleright x) \to \neg(x \triangleright y)$[9]

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[9]Strictly speaking, RG and GG are *non-symmetric* in so far as they allow for mutual existential grounding. It is precisely because of this feature of RG and GG that these modal-existential grounding concepts are unable to support the intuitive insight that grounding is a *priority* relation as well as a variety of metaphysical explanation (explanation being asymmetric). More on this below.

G4. *Transitivity*: $(y \rhd x \wedge z \rhd y) \to (z \rhd x)$

It must be underscored that while axioms G2-G4 are held by a great many friends of grounding, they are not entirely uncontroversial in so far as there have been proposed counterexamples, particularly to G2 and G4. Though I freely admit that a full-scale account of grounding would need to interact with these alleged counterexamples to the irreflexivity and the transitivity of grounding, I take the liberty here in passing over debates concerning the precise structural features of grounding. As I do not claim to offer a full-scale account of grounding here, I will simply work with one common notion of grounding found in the contemporary literature.

Grounding can be *total* as well as *partial*. This is an important structural feature of grounding as there are many instances where the relation may be one-many such that a single entity may have a plurality of grounds. Particularly clear examples of an entity having a plurality of grounds are found in the case of a non-empty set being grounded in each of its individual members, a state of affairs being grounded in each of its non-mereological constituents, and certain kinds of mereological wholes being grounded in their proper parts.

A clear statement of this particular structural feature of grounding demands the use of plural variables. My aim, however, is not to offer anything by way of a well-worked out logic of plural terms. Such a task would be beyond both the scope of my competency as well as my particular aim in this section. Rather, it is to elucidate the notion of total and partial grounding as well as the general insight that a thing may be grounded in a single entity or a plurality of entities.

Let's begin with some notation. Let the variables x, y, z stand for singular variables and a, b, c for singular or plural variables. In this way, quantifying over a domain including a, b, c allows us to represent cases of either singular or plural grounding in a precise manner. In addition to the use of variables whose values include both single and multiple grounds, I rely on the primitive two-place predicate 'ϵ' of singular inclusion, where '$a\epsilon b$' stands for 'a is one of the b's.'[10] In employing the machinery of singular inclusion, my aim is to remain as neutral as possible regarding the degree to which the following grounding axioms rely on set-theoretic notions, particularly the relation of set-membership.

With our plural variables a, b, c in hand, together with the above notion of singular inclusion, we can begin to work our way toward defining the axioms of total and partial grounding. With 'E' as the existence predicate, we begin by defining 'Ea' in terms of at least one existing entity standing in the relation of singular inclusion to a:

$$Ea =_{def} (\exists b)(b\epsilon a)$$

For some a to exist is for there to be at least one thing that is one of the a's, where Ea is consistent with both b being the sole entity in a or b being one among many in a.

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[10]See Simons (1987: 21).

With this in mind, we can define total grounding as follows:

G5. *Total Grounding:* $x \rhd_t a =_{def} Ea \wedge (\forall z)(z \epsilon a \equiv x \rhd z)$

In words: x is totally grounded in a if and only if a exists and x is grounded in every entity that is one of the a's. For instance, the total grounds for the state of affairs *Socrates' being snubnosed* involves *both* Socrates, a particular, and *being snubnosed*, a universal.

For partial grounding, we begin with the notion of *containment*, where '$a \subset b$' is read as 'a is contained in b' and can be defined in terms of singular inclusion as follows:

Containment: $a \subset b =_{def} (\forall y)(y \epsilon a \rightarrow y \epsilon b)$

We can now define partial grounding in terms of total grounding and containment in the following manner:

G6. *Partial Grounding:* $x \rhd_p a =_{def} Ea \wedge (\exists b)(x \rhd_t b \wedge a \subset b)$

As per G6, $x \rhd_p y$ is entirely consistent with $x \rhd_p z$, where $y \neq z$. Note that in stating a thing's partial ground one need not appeal to a multiplicity of entities among a thing's total grounds. This is because a single entity may be partially grounded in another single entity (one-one partial grounding) or a plurality of entities (one-many partial grounding).

To illustrate this, take the set $\{a, b, c, d\}$ as an example of the various ways a single entity can exhibit both one-one and one-many partial grounding. Now, according to one standard description of sets, $\{a, b, c, d\}$ is totally grounded in a, b, c, and d, collectively. However, in so far as the set has b as a member, it is partially (one-one) grounded in b. However, $\{a, b, c, d\}$ is also partially (one-many) grounded in both c and d in so far as it includes both as a members. The point here is simply that there are many ways to be partially grounded.

In addition to being total or partial, I take grounding to be both an existence entailing relation:

G7. *Existence Entailing:* $\square(x \rhd y \rightarrow (Ex \wedge Ey))$[11]

and one that holds of necessity:

G8. *Necessity:* $(x \rhd y \rightarrow \square(Ex \rightarrow x \rhd y))$

G7 states that necessarily, if x is grounded in y then both x and y exist. Regarding G8, if x is grounded in y, then it is necessarily the case that if x exists, then it is grounded in y. G8 tracks the intuition that an entity's depending on another entity for its existence is a non-contingent feature of that entity.

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[11]I should point out that it follows from this that partial grounding is also existence entailing.

I am also inclined to endorse the well-foundedness of grounding in that *for any non-empty grounding domain D there must be at least one metaphysically basic entity in D*.[12] To unpack this idea, call a *minimal element e* of a non-empty grounding domain D one such that there is no y in D where $e \triangleright y$. The minimal elements for D are those that are ungrounded, i.e. basic. This need not imply that the minimal elements of a domain also serve as grounds themselves, just that they remain ungrounded. With this notion of a minimal element for a domain in hand, we can then state the well-foundedness of grounding as follows:

> G9: *Well-Foundedness*: for any non-empty grounding domain D there is, of necessity, at least one minimal element in D.[13]

The basic idea underlying G9 is that there must, of necessity, be at least one ungrounded entity in D. G9 is the metaphysical analogue of the axiom of foundation in set theory, that every non-empty set contains a (membership) minimal element. The denial of G9 amounts to the possibility that the exhaustive inventory of reality consists entirely of grounded entities: its just one grounded thing after another where a exists in virtue of b, b exists in virtue of c, and so on ad infinitum. On this view, there is no minimal grounding element and thus no metaphysically basic entity, i.e. there is no substantial being to use the traditional terminology. Here I reserve comment on G9 as I will discuss it in much more detail in so far as it will serve as a cornerstone to one of my arguments against the priority of parts over their wholes.

In my earlier treatment of the prospects of substituting supervenience for grounding, I mentioned that while the latter cannot be analyzed in terms of the former, there nonetheless exists an intimate relationship between the two concepts. Kim (1993: 148), after rightly distinguishing the covariation element of supervenience from the alleged dependence ordering it is claimed to secure, nevertheless argues, "But the two components are not entirely independent; for it seems that the following is true: for there to be property dependence there must be property covariation." While supervenience analyses of grounding fail, it is plausible to think that grounding entails supervenience.[14] Again, Kim (1993: 167) suggests, "It [supervenience] is not a 'deep' metaphysical relation; rather, it is a 'surface' relation that reports a pattern of property covariation, suggesting the presence of an interesting dependency relation that might explain it."

Consider the following case of grounding: a trope's being grounded in its bearer. Here the bearer of the trope, the particular, is the ground and the trope is what is

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[12]Where a grounding domain D is *non-empty* just in case there are at least two existing entities in D (as per G2 and G7) that stand in the grounding relation with respect to one another (remaining neutral as to which grounds which).

[13]There need not be a *single* minimal grounding element in D, however. Here I leave open the possibility of there being a multiplicity of minimal grounding elements in D.

[14]Cf. Kim (1993: 167).

grounded. It is plausible to assume that there can be no difference in the trope–that which is grounded–without there being a difference in the particular–that which does the grounding. In other words, there is no variation in that which is grounded without there being a variation in the ground. This is just to say that the trope's being grounded in its bearer entails that the trope supervenes on its bearer (but not the converse). Where 'S' denotes the relation of supervenience:

G10: *Supervenience Entailment*: $\Box(x \rhd y \to S(x,y))$.[15]

The core insight behind G10 is that there can be no difference in the grounded without a difference in the grounds. Here I want to underscore an important insight regarding G10 that will prove essential in my arguments against the ontological priority of parts over wholes in the sequel. Regarding the modal consequences of grounding, Schaffer (2009: 364) mentions in passing the prospects for using the failure of supervenience as an indication of the failure of grounding. As per G10, since it is necessarily the case that if x is grounded in y, then x supervenes on y, x's failure to supervene on y shows that x thereby fails to be grounded in y. Consequently, if the supervening entity fails to covary with its subvening base, this is reason enough to conclude that it thereby fails to be grounded in its base.

2.2 Essence and Grounding

Alongside the reductionist consensus in the literature one finds the strict adherence to what I will call 'primitivism' regarding grounding. Primitivism is the view that grounding is a primitive, unanalyzable concept: "one should not expect to find any concept deeper."[16] The likes of those grounding proponents who adopt primitivism are many.[17]

Despite its widespread endorsement, I think primitivism about grounding fails to shed light on the fact that grounding is a metaphysical ordering that yields relations of priority and posteriority. Though we are told that grounding is a ubiquitous structuring relation which serves to generate nature's metaphysical joints, we are left in the dark as to what it is about the relata of such relations that *explain* why they are grounded in such a way that one is *prior* to the other. For some grounding claim $a \rhd b$ the primitivist will admit that there is nothing about a or b *per se* that undergirds *why* a is grounded in, and hence ontologically posterior to b, and not vice versa. As a result, primitivism appears ill-equipped to provide substantive content to claims of *ontological priority and posteriority*, the very

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[15] Although G10 may be limited to objects and properties in so far as they are standardly taken to be the relata of the supervenience relation.

[16] Schaffer (2010b: 347).

[17] Correia (2005: 57), Rosen (2010), Schaffer (2009; 2010b), Witmer et al (2005), Sider (2012), and Kim (1993: 166).

claims that the notion of grounding was intended to elucidate. Here I think the grounding skeptic's charge of unintelligibility hits its mark precisely because primitivism is silent as to what it is that *makes* a ground prior to that which is grounded. Of course, every theory has its primitives. And while this is certainly no argument against primitivism (I do not think such an argument is available), I do think that those who opt for primitivism have prematurely halted their search for a deeper analysis of the grounding relation, one that elucidates claims of ontological priority.

But note that it is this very feature of grounding that renders our initial gloss in terms of RG and GG inadequate.[18] Arguably, neither RG nor GG are fine-grained enough to track many of the distinctively *asymmetric* dependence and priority relations at work in ontology. Recall that both RG and GG were analyzed purely in modal-existential terms: *x* is grounded in *y* if and only if necessarily, *x* exists only if *y* exists (where *y* was taken to be either a particular entity or a generic type of entity). For reasons that largely mirror those raised against modal essentialism in chapter 1 (§1.1-1.2), many have pointed out that an analysis of grounding in terms of modal requirement for existence is much too general to undergird claims to metaphysical priority and posteriority.

One rather prominent shortcoming of RG in this regard is that it comes out vacuous for necessarily existing entities. If there are necessarily existing entities such as numbers, propositions, or God, then according to RG *every* existing thing is grounded in and hence dependent on such entities. The reason being that it follows rather trivially that every existing entity modally necessitates the existence of any necessary being (since it is necessarily the case that in every world in which that thing exists is a world in which the necessary being exists).[19] But this seems to many to be wholly unintuitive, as Peter Simons (1987: 295) puts it, "Pythagoreanism aside, I am not ontologically dependent on the number 23." If every existing thing necessitates the existence of any necessary being (and is thereby grounded in and posterior to it), it follows that the book resting on my desk could not have existed without the proposition <aqua regia has the power to dissolve gold>. But surely books do not depend for their existence on propositions of *any* sort. As a close relative of the modal essentialist account of essence (see §1.1 of chapter 1), RG generates a grounding-ordering between entities that appear to be wholly unrelated. Irrespective of whether necessary beings such as God, numbers, and propositions exist, the point is that merely accepting some objects as existing in every possible world should not result in such an implausible characterization of the dependence ordering in the world.

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[18]I must underscore here that I limit my attention to those grounding relations that aim to capture *asymmetric* relations of dependence. While I am inclined to think there are a multiplicity of grounding relations differing in strength and scope, my aim here is to focus on those that track relations of ontological *priority* and *posteriority* in particular.

[19]As Correia (2005: 47) rightly points out, the source of the worry here is the validity of $\Box B \rightarrow \Box(A \rightarrow B)$.

The basic point above can be generalized to form a similar line of reasoning to what was advanced in our discussion of modal essentialism.[20] Though it is necessarily the case that Socrates necessitates the existence of his singleton (necessarily, if Socrates exists then his singleton exists), surely the existence of Socrates is not grounded in or posterior to his singleton such that he exists only if his singleton exists (Fine 1994b: 271). But this is precisely what RG demands concerning the relationship between Socrates and his singleton. As such, the very same the lines of reasoning put forward against modal essentialism are relevant in showing that an RG gloss on grounding is too indiscriminate to do the ontological work that many advocates of grounding demand of it.[21]

What is needed then is a more fine-grained conception of grounding that is capable of yielding relations of priority and posteriority. Our turn from modal essentialism to serious essentialism provides just the account we are looking for. Recall from the previous chapter that on serious essentialism, essence is irreducible to necessity (the denial of ME1) and is much more fine-grained than mere modal requirement for existence. In the place of an analysis of RG in terms of modal requirement for existence, then, I want to bring a serious essentialist conception of essence to bear on an analysis of grounding. Historically, my serious essentialist gloss on grounding exhibits a close affinity with Duns Scotus' notion of essential order. Along more contemporary lines, there is a close resemblance of my view with Lowe (2005b) and, to some extent, Fine (1994a) in analyzing grounding in terms of essence or identity.

I am of the opinion that that for one entity to be ontologically prior or posterior to another involves reference (at least partly) to *what* it is fundamentally. It is natural to think that tropes are grounded in (posterior to) their bearers precisely because they are the sorts of things that, by their very natures, modify particulars. To think of a trope existing in isolation from a bearer would be to fail to think of a trope, or so many claim. This is all the more plausible if one takes grounding to be an internal relation, that is, one which supervenes upon the existence and natures (or, more generally, upon the intrinsic properties) of its relata.

2.2.1 A Precursory Note: Scotus on Essential Order

My own serious essentialist construal of grounding has a rich historical precedent in the work of the medieval scholastics, with perhaps the most well-developed account having been advanced by Duns Scotus. Here I take a brief historical excursus into Scotus' notion of essential order in order to pave the way for my own view.

Scotus's most developed treatment of the notion of dependence is found in his *De*

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[20]General forms of this problem as applied to grounding or dependence can be found in Simons (1987: 295).

[21]This would also explain why Fine's (1994b) own critique of RG followed his (1994a) critique of modal essentialism.

Primo Principio. There, he elucidates the notion of posteriority and priority, labeling it 'essential order' and proceeds to explicate two distinct varieties of essential order: the order of eminence and the order of dependence.[22] The order of eminence pertains to the notion of perfection; x is eminently ordered with respect to y if x's perfection exceeds the perfection of y, and is thereby said to be prior to y in the order of eminence. The order of dependence, on the other hand, involves the notion of priority and posteriority with respect to the essence or nature of the two relata involved; "the dependent is said to be posterior whereas that on which it depends is prior."[23]

Here it is crucial to note that Scotus maintains that the relata of essential ordering relations are *essences*. Again, in the context of the hypostatic union of the two natures of Christ, Scotus explicitly endorses the notion that the relata of essential ordering relations are essences, "As for the case at hand, the personal or hypostatic entity has no essential priority in respect to creatures, for an essential order obtains per se only between essences (in contrast to hypostatic entities), since it is forms (i.e. essences) that are like numbers."[24] Elsewhere, Scotus understands the locution 'of the essence of x' as "that which is included per se in the quidditative concept of x and therefore, is posited in the essential notion of its quiddity, and not as something added."[25] In short, the order is one of essential dependence in so far as the priority or posteriority stems from the nature or essence of the entity in question.

Scotus further suggests that essential ordering relations imply a sort of existential dependence of the posterior on that which is prior, "the prior according to nature and essence can exist without the posterior but the reverse is not true."[26] He continues,

> And this I understand as follows. Even though the prior should produce the posterior necessarily and consequently could not exist without it, it would not be because the prior requires the posterior for its own existence, but it is rather the other way about. For even assuming that posterior did not exist, the existence of the prior would not entail a contradiction. But the converse is not true, for the posterior needs the prior. This need we can call dependence, so that we can say that anything which is essentially posterior [in this way] depends necessarily upon what is prior but not vice versa, even should the posterior at times proceed from it necessarily. (Ibid.)

In short: Scotus maintains that if x is essentially posterior to y, then x depends on y for its existence. He states that if x is essentially ordered to y, then x's existence 'needs' or 'requires' y's existence, i.e. it is impossible that x exist without y's existing.

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[22] Here I rely on the Scotus (1949) edition of *De Primo Principio* (DPP) in what follows, see 1.6 in particular.

[23] *DPP*, 1.8.

[24] *Quod.* 19, n. 19., see Scotus (1975).

[25] *Quest.* 7, q. 1, see Scotus (1997).

[26] *DPP*, 1.8.

Here it is vital to note that Scotus appears to distinguish between a posterior (grounded entity in our terminology) proceeding from that which is prior (ground) *necessarily* and a posterior proceeding from that which is prior *essentially*. More specifically, *just because something posterior could not fail to proceed from that which is prior, one cannot infer that the thing is therefore essentially posterior to it.* While something's being essentially prior entails its being necessarily prior, the converse does not hold for Scotus. In this sense, I take Scotus to be a proponent of something in the general vicinity of a more fine-grained, non-modal conception of grounding as defended by Fine (1994b) and Lowe (2005b).

While it is not clear as to which notion of existential dependence Scotus takes essential order to entail, (whether RG or GG as stated above), it is evident that he is of the opinion that if an entity is essentially ordered to another entity, then the former is existentially dependent on the latter *in some sense or other*. However, for illustrative purposes, I will formulate his notion of essential order in terms of the stronger variety of existential dependence, RG.

Scotus' notion of essential order, a non-modal conception of grounding in terms of essence, can be stated using our sentential operator '$\Box_x$' once again to stand for 'it is part of the essence of x:'

(EO): x is *essentially ordered* to $y =_{def} \Box_x(Ex \to Ey)$

EO is to be read as follows: x is essentially ordered to y if and only if it is part of the essence of x that it exists only if y exists. Michael Gorman (1993) has pointed out that Scotus endorses several structural principles regarding essential ordering relations, principles that correspond nicely to our formulation of grounding in terms of G2-G4 above. Taking 'O_e' to stand for the relation of essential order, Scotus maintains that essential ordering relations are governed by the following axioms:

Irreflexivity: "Nothing whatever is essentially ordered to itself:" $\neg(O_e(x, x))$[27]

Asymmetry: "In any essential order a circle is impossible:" $O_e(x, y) \to \neg(O_e(y, x))$[28]

Transitivity: "What is not subsequent to the prior is not subsequent to the posterior:" $(O_e(x, y) \land O_e(y, z)) \to (O_e(x, z))$[29]

Consequently, what emerges from our brief excursus into Scotus's conception of grounding is a distinctively metaphysical ordering relation whose relata are essences, that entails (but is not entailed by) existential dependence, and is governed by the axioms of irreflexivity, asymmetry, and transitivity.

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[27]*DPP.* 2.2.

[28]*DPP.* 2.4.

[29]*DPP.* 2.6.

2.2.2 Essential Grounding

The core feature of Scotus's notion of essential order that I want to appropriate in the rest of the essay is the idea that the nature or essence of an entity (or entities) may be grounded in the nature or essence of another distinct entity (or entities). Mark Johnston (2006: 676) captures the connection between essence and grounding nicely, "Associated with the ideas of real definition and essence is the idea of the ontological dependence of one item on another; where an item x is ontologically dependent on an item y just when y features at some point in the full account of the essence of x (the real definition of x), but not vice versa." In the same vein, Lowe (unpublished ms-b) comments, "[W]e need to appreciate that in very many cases a thing's essence involves *other things*, to which it stands in relations of *essential dependence*." Here our working examples of particular events, spatial boundaries, non-empty sets, tropes, and spacetime points in their relation to the entire manifold nicely illustrates the concept of one thing's essence or identity–*what it is fundamentally*–being grounded in a distinct entity.[30]

Here I recommend that we take a page from the Subtle Doctor in explicating the sort of grounding that tracks relations of metaphysical *priority* and *posteriority* in non-modal terms. Taking the notion of essence as primitive as per serious essentialism, we can state the essential counterpart to RG as follows:

(REG) x is *rigidly essentially grounded* in $y =_{def} \Box_x(Ex \rightarrow Ey)$

REG is read as "it is part of the essence of x that it exists only if y exists." We can then go on to define generic essential grounding in terms of essence as follows:

(GEG) x is *generically essentially grounded* in $Fy =_{def} \Box_x(Ex \rightarrow (\exists y)Fy)$

Where GEG states that it is part of the essence of x such that x exists only if some F exists. And lastly, we get the essential counterpart to accidental existential grounding as:

(AEG) x is *accidentally essentially grounded* in $Fy =_{def}$ (i) $\Box_x(Ex \rightarrow (\exists y)Fy)$ but (ii) $\neg(\Box_x(Ex \rightarrow Ey))$

It is crucial to note that REG, GEG, and AEG are more fine-grained than RG, GG, and AG, precisely because they entail (but are not entailed by) their respective modal counterparts; while every case of rigid essential grounding is a case of rigid existential grounding, the converse does not hold (likewise for generic and accidental grounding). More specifically, if Socrates' singleton is essentially such that it exist only if Socrates exists (REG), then it is necessary that if Socrates' singleton exists then Socrates exists

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[30]See also Molnar (2003: 29): "a ontologically depends on b iff it is impossible for a to exist without b existing, and the impossibility is due to the nature (essence) of a" and "'ontological dependence' is meant to pick out that relation whereby one thing , a, depends for its existence on another, b, specifically because of the nature of a, of what a is."

(RG). In general, since the real definition of a singleton involves reference to its sole member, the existence of the singleton both *essentially* and *existentially* necessitates the existence of its sole member.

As we previously noted in the case of AG, AEG states that an entity may be *generically* essentially grounded in some *F* or other without being *rigidly* essentially grounded in any *F* in particular (and, since REG entails RG, it follows that an entity can be accidentally essentially grounded in a class of entities without being rigidly existentially grounded in any particular members of that class). This particular notion is vital for what I will have to say in the sequel regarding the fact that complex substances are ontologically prior to their proper parts. Though it is part of the essence of living organisms qua *composite* objects that they exist only if some parts or other exist, this in no way entails that *what* they are fundamentally involves reference to their individual proper parts. As we will see, the fact that complex substances are rigidly essentially independent (failure of REG) of their proper parts does not entail that they are therefore essentially generically independent of proper parts *tout court* (failure of GEG).

The virtues of explicating the variety of grounding that elucidates metaphysical priority in non-modal terms are significant.[31] First, an essentialist gloss on grounding avoids the charge that grounding runs vacuous for necessary beings. As a result, while one was able to infer from the existence of a necessary being that therefore every existing thing is rigidly grounded in it as per RG, this does not hold for REG. That is, one cannot infer from the existence of a necessary being that therefore every existing thing is rigidly *essentially* grounded in it; the *nature* or *essence* of a boson, for instance, in no way depends on the existence of the number 23.

Likewise, in contrast to RG, that which is rigidly essentially grounded *essentially* necessitates the existence of its ground; the identity and nature of the grounded on REG is directly relevant to the existence of its grounds. Contrary to RG, from Socrates' rigidly necessitating the existence of his singleton it does not follow that he is rigidly *essentially* grounded in his singleton; the *essence* of Socrates does not depend on the existence of any set-theoretic entity. Similarly, from Socrates' rigidly necessitating the existence of his life one cannot infer that therefore Socrates is rigidly *essentially* grounded in a particular temporally extended event. In short: in so far as REG *entails* but is not entailed by RG, it rightly characterizes the order of grounding as facts about Socrates are, intuitively, more fundamental than facts about either his singleton or the temporally extended event that is his life.

Moreover, analyzing grounding in terms of essence helps shed light on the connec-

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[31]While I think RG, GG, and AG (existential grounding relations) are indeed part of the family of grounding relations, I take the relation of essential grounding to be uniquely suited to capture the notion of metaphysical *priority*. Consequently, I restrict my use of grounding concepts in what follows to the essential variety in so far as my aim is to explore the question of whether mereological wholes or their proper parts are metaphysically prior.

tion between grounding and ontological priority, a connection which many who espouse primitivism have failed to see the need to offer an explanation. The account tracks the notion that for one entity to be ontologically prior or posterior to another involves reference (at least partly) to *what* it is fundamentally. It is natural to think that tropes are grounded in (posterior to) their bearers precisely because they are the sorts of things that, by their very natures, modify particulars. To think of a trope existing in isolation from a bearer would be to fail to think of a trope, or so it seems.[32] The essentialist gloss on grounding has a 'priority-maker' for grounding claims such as $a \triangleright b$ ready at hand: b is ontologically prior to a in virtue of the fact that while it is part of the essence of a that b exist, it is not part of the essence of b that a exist. For instance, the essentialist can fill out the notion of an occupant of spacetime being ontologically prior to its spatial boundary in terms of the respective natures of each: occupants of spacetime, by nature, are such that their existence does not require any particular spatiotemporal boundary (it can certainly be bound by distinct boundaries throughout its spatiotemporal career); it is natural to think that it is part of the nature of a boundary, by contrast, that it exists only if the particular material occupant it bounds exists.

Here it is vital to underscore that the above distinction between a modal-existential and an essentialist gloss on grounding crucially hinges on the fact that essence does not reduce to modal requirement for existence. On modal essentialism, REG and GEG are *equivalent* to RG and GG in so far as a thing's essence *just is* what it modally requires for its existence. Every instance of $\Box_x(Ex \rightarrow \Phi x)$ is equivalent to an instance of $\Box(Ex \rightarrow \Phi x)$. The point is commonly overlooked: availing oneself of REG and GEG as distinct and more fine-grained grounding relations *presupposes* a serious essentialist metaphysic.

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[32]This is all the more plausible if one takes grounding to be an internal relation, that is, one which supervenes upon the existence and natures (or, more generally, upon the intrinsic properties) of its relata.

Chapter 3

Fundamental Mereology and the Primacy of Substance

"The most ancient opinions are often returned to as if new, and many delight in resurrecting them because—having been forgotten—they seem to say new and marvelous things. And so it is that the young listen to them with pleasure, because it is natural for what is new and marvelous to delight the senses."
—John Buridan, *In De an.* III.11

3.1   The Structure of the Mereological Hierarchy

Arguably the contemporary *locus classicus* of the idea that concrete material reality is compositionally ordered is Paul Oppenheim and Hilary Putnam's 1958 paper "Unity of Science as a Working Hypothesis." There, Oppenheim and Putnam put forward a reductive account of the hierarchy of levels where each of the following levels is said to correlate with the various branches of the natural sciences:

6. Social groups

5. (Multicellular) living things

4. Cells

3. Molecules

2. Atoms

1. Elementary particles

According to Oppenheim and Putnam, "any thing of any level except the lowest must possess a decomposition into things belonging to the next lower level" (1958: 9). It is claimed that those entities occupying $n+1$ or higher, being ultimately decomposable into n-level entities are said to be contained in level n and thereby micro-reducible to it. In

this sense, all entities are already 'contained' in or micro-reducible to entities occupying level-n, i.e. the level of physics.

Though the strong reductive letter of Oppenheim and Putnam's account of the hierarchy of levels has been largely abandoned (for reasons we will see in the course of this essay), many philosophers are apt to endorse something similar in spirit. Perhaps the clearest statement of the hierarchical ordering conception of the structure of (concrete) reality that permeates contemporary analytic philosophy is by Kim (1998: 15):[1]

> What has replaced the picture of a dichotomized world is the familiar multi-layered model that views the world as stratified into different "levels," "orders," or "tiers" organized in a hierarchical structure. The bottom level is usually thought to consist of elementary particles, or whatever our best physics is going to tell us are the basic bits of matter out of which all material things are composed. As we go up the ladder, we successively encounter atoms, molecules, cells larger living organisms, and so on. The ordering relation that generates the hierarchical structure is the mereological (part-whole) relation: entities belonging to a given level, except those at the very bottom, have an exhaustive decomposition, without remainder, into entities belonging to the lower levels. Entities at the bottom level have no physically significant parts. (Kim 1998: 15)

As will become evident shortly, though Kim's statement of the view favors an atomistic understanding of the levels conception of reality, it is nonetheless a widespread assumption among most contemporary analytic philosophers that reality is ordered by the part-whole relation such that mereologically complex wholes are *composed* of objects occupying a lower-order level, with such a succession potentially extending *ad infinitum*. This is, of course, silent as to the precise relationship (other than part-whole) that obtains between the various 'levels' or 'layers' of the mereological hierarchy.

There are two general considerations that are taken to motivate a layered model of reality, both involving the notion that reality exhibits various kinds of *structure*. First, reality exhibits *mereological (part-whole) structure*. Everyone, pace the mereological nihilist, takes the deck to be *composed* of the cards, the building to be *composed* of its materials, and a human being to be (partly) *composed* of various organs, organs being *composed* of cells, and so on. While this entire essay can be seen as an attempt to undermine mereological nihilism, here I assume that the nihilist is mistaken and that reality exhibits mereological structure. By my lights, if one were to point out the existence of a molecule and its atoms but failed to take note of the parthood relations that obtain between them, one would have missed a deep structural feature of reality.

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[1] I henceforth assume that while abstract objects (if there are any) can stand in mereological relations, the mereological hierarchy consists solely of *concrete* entities standing in part-whole relations.

We have also seen that that in addition to its having mereological joints, reality exhibits *metaphysical structure* in that some entities (objects, events, facts, etc.) are thought to be grounded in other kinds or classes of entities. From the preceding chapter we noted that while many use 'supervenience' and 'grounding' or 'dependence' interchangeably to describe a distinctively metaphysical variety of structure in the world, the latter cannot be reduced to the former. For a great many philosophers, metaphysical structure is ubiquitous, many instances of which were noted in our previous discussion.

3.1.1 Mereological Structure

With respect to the mereological structure we find in the world, many advocates of a layered conception of reality express the idea as follows, what we will simply call *hierarchy*:

> **Hierarchy:** The natural world is divided into a hierarchy of levels or layers generated by the part-whole relation.[2]

As stated, **Hierarchy** is a rather uncontroversial thesis concerning the *existence* of mereological ordering in the natural world and one that only the mereological nihilist is apt to deny: that various entities stand in a part-whole relation to one another thereby generating ascending levels of composition and descending levels of decomposition. Electrons are proper parts of atoms; space-time points are proper parts of regions; instantaneous temporal parts are proper parts of space-time worms, etc. As we have seen, **Hierarchy** *just is* the concession that reality exhibits mereological joints and thus is generally accepted by all save those with an appetite for the austere in mereology.

Perhaps the simplest (I risk it being too simplistic) way to represent **Hierarchy** is in the following manner:
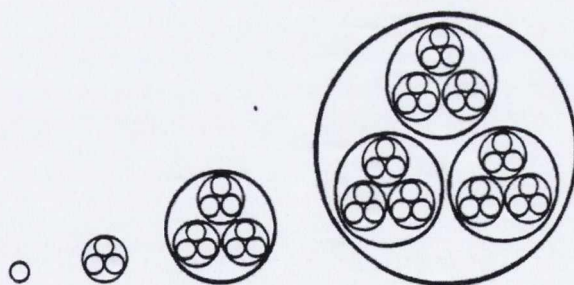
Figure 3.1: The Hierarchy of Composition

where lower-order entities (l) serve to compose higher-order mereologically complex entities ($l+1$, $l+2$, $l+3$). Roughly, we can understand the notion of a level or layer of

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[2]For a few proponents see Cameron (2008), Kim (1993, 1998), Markosian (2005), Oppenheim and Putnam (1958), Paseau (2010), Schaffer (2003).

the mereological hierarchy being 'higher' or 'lower' than another in terms of the various formal properties of the proper parthood relation that generate them. Regarding Figure 3.1 above, level $l+2$ is 'higher' than $l+1$ precisely because entities occupying $l+1$ (which are composed of entities occupying level l) enter into the asymmetrical relation of proper parthood with mereologically complex entities at $l+2$. Given the asymmetry of proper parthood, the same does not apply to the entities at $l+2$, i.e. entities occupying level $l+2$ are not proper parts of entities occupying $l+1$. If one were to admit the existence of the Universe as per classical extensional mereology, such a mereologically complex entity (the mereological fusion of all objects) would serve as the 'highest' level of the mereological hierarchy such that every thing is part of it and it is not a proper part of anything. From the assumption that the mereological hierarchy is governed by the partial ordering relation of proper parthood, we can say that for any level on the mereological hierarchy (where '$\succ$' stands for 'higher than'), the following holds:

Irreflexivity: $\neg(l \succ l)$

No level is higher than itself.

Transitivity: $((l + 2 \succ l + 1 \wedge l + 1 \succ l) \rightarrow l + 2 \succ l)$

If level x is higher than level y, and y is higher than z, then x is higher than z.

Asymmetricality: $((l + 2 \succ l + 1 \rightarrow \neg(l + 1 \succ l + 2))$

If level x is higher than level y, then it is not the case that level y is higher than level x.

One of the weaknesses of Figure 1, as we will see shortly, is that there is nothing about **Hierarchy** *in itself* that precludes such a hierarchy of levels to be infinite in descent. Nonetheless, I take it that many philosophers will find **Hierarchy** plausible given both the structure and discoveries of the sciences as well as the intuitive datum that reality exhibits mereological structure.[3]

3.1.2 Metaphysical Structure

We have already examined in the previous chapter the notion that reality admits of relations of metaphysical priority and posteriority, and hence plausible instances of structure that are distinctively metaphysical in kind. Here, however, we are concerned with whether the metaphysical structure that governs the natural world admits of a fundamental or basic level. One common way to capture this insight is the following:

Fundamentality: There is a fundamental or ground level of the mereological hierarchy.

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[3]See Markosian (2005) and Schaffer (2003: 498).

However, it is often the case that when **Fundamentality** is put forward in the context of the mereological hierarchy it is associated with our first tenet, the *mereological* structure of reality. The question as to whether there is a 'fundamental level of reality' is often associated with whether reality exhibits an ultimate mereological terminus. In this sense, **Fundamentality** conveys the idea that the hierarchy of composition 'bottoms out' in a level containing entities devoid of proper parts, i.e. mereological simples.[4] Mereological simples serve as the fundamental 'building blocks' from which all else is composed. Call this the 'compositional fundamentality' variant of **Fundamentality**:

> **Compositional Fundamentality:** the entities at the fundamental level are mereologically simple and are the 'building blocks' from which the rest of the mereological hierarchy is composed.

Much of the debate surrounding the levels conception of reality pertains to whether or not the world has a fundamental level in the sense of **Compositional Fundamentality**. For instance, Schaffer (2003) considers the question of whether or not there is a fundamental level to reality as being synonymous to the question of whether mereological atomism is true. Given that our best science gives no credence to the existence of material simples, claims Schaffer, we should reject the thesis that the mereological hierarchy 'bottoms out' in a level whose occupants lack proper parts. In the same vein, a **Compositional Fundamentality** interpretation of **Fundamentality** is advanced by Ladyman & Ross (2007: 53-57), where they conclude that **Hierarchy** is suspect precisely on the grounds that there is no adequate evidence in favor of mereological atomism.

However, many have rightly pointed out that there is nothing inherent in the layered conception of reality as stated in **Hierarchy** that requires the truth of atomism and thus need not be a core tenet of this general view regarding the compositional ordering of reality. As stated, **Hierarchy** is entirely consistent with what David Lewis (1986a) has famously labeled 'atomless gunk:' objects each of whose parts have proper parts. As Jaegwon Kim (1998: 123) notes, "The layered model as such of course does not need to posit a bottom level; it is consistent with an infinitely descending serious of levels." What's more, as Peter Simons has shown, classical extensional mereology is entirely consistent with the existence of gunk. As an example of a gunky mereology, Simons (1987: 41) points to "the regular open sets of a Euclidean space, the part-relation being set-inclusion confined to these sets."[5]

All this to say that **Hierarchy** is consistent with a wide range of mereologies in so far as it is neutral as to whether such a hierarchy is infinite in descent with respect to its part-whole ordering. To put this a bit more precisely, the claim is that **Hierarchy** is consistent with the following mereologies (where 'A' stands for atom, '≤' parthood, and

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[4]In particular, see Kim (1998), Oppenheim and Putnam (1958), and Schaffer (2003).

[5]See also Simons (2004: 373).

'<' proper parthood):

Atomic: $(\forall x)(\exists y)(Ay \wedge y \leq x))$

Gunky: $(\forall x)(\exists y)(y < x)$

Non-Atomic: $(\exists x)(Ax \wedge (\exists x)(\forall y)(y \leq x \rightarrow (\exists z)(z < y)))$

An *atomic* conception of the mereological hierarchy holds that every existent is either itself an atom (A) or is mereologically composed of atoms. A *gunky* interpretation of the hierarchy, on the other hand, states that every existent on the hierarchy is infinitely divisible into further proper parts. On this reading of the hierarchy, there simply is no mereologically fundamental level, understood as a level that 'bottoms out' in mereologically simple entities. Lastly, a *non-atomic* reading of the mereological hierarchy is such that some of the existents in the hierarchy are atomic and others are atomless. As a result, both the atomless and the non-atomic construals of the hierarchy are committed to the view that for some entities there is no mereologically fundamental level, it's 'turtles all the way down' as the saying goes. From this I conclude that the layered model of reality, as embodied in **Hierarchy**, is *neutral* concerning the existence of atomic simples and thus the truth of metaphysical atomism need not be built into the view from the start. Consequently, there is a minimal core to the notion that reality is hierarchically ordered by means of the part-whole relation (**Hierarchy**) which can be coupled with either an atomic, gunky, or non-atomic mereology.

Here I want to underscore a further variant on **Fundamentality** that aims to explicate the above idea that the hierarchy of composition exhibits a distinctively metaphysical variety of fundamentality. We begin with the claim, as underscored in the previous chapter, that the mereological hierarchy exhibits not only part-whole relations but essential grounding relations, relations of metaphysical priority and posteriority.[6] As applied to the compositional ordering of the natural world, the idea concerns how the parts, properties, and behaviors of objects at a given mereological level are metaphysically ordered with respect to those at a distinct mereological level. Concrete material reality exhibits not only mereological structure (as embodied in our minimal core of H and an atomic, atomless, or non-atomic mereology), but also *grounding structure* which generates relations of priority and posteriority.

And since it is natural indeed to suppose that grounding relations are well-founded as per G9 (see §2.1.4), admitting such relations raises the question of a metaphysically fundamental or minimal ontological base upon which they terminate. Here we must be

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[6]Consider Hütteman (2004: 10) on microphysicalism, "Microphysicalism provides a decisive interpretation of the multilayered conception of reality. The properties on the macro-level, i.e. the properties of biological and neurophysiological systems or systems with mental states, are completely determined by microphysical properties. The microphysical laws govern the macro-systems. The causal relations among the macro-systems turn out to derive from those on the micro-level. Microphysicalism thus provides on ontological interpretation of the hierarchical structure of the many layers of reality."

careful to distinguish between a *comparative* and an *absolute* notion of metaphysical fundamentality. The former states that one entity is *more fundamental than* or *metaphysically prior to* a distinct entity, and the latter maintains that one entity (or collection of entities) are fundamental or metaphysically prior *tout court*.[7] The general idea here is straightforward: something can be *comparatively* or *relatively* fundamental without itself being *absolutely* fundamental. For instance, the various members of the baseball team may be more fundamental and hence metaphysically prior to the events that constitute the innings of the game, without thereby being absolutely fundamental or metaphysically prior full stop.

Whether those who endorse **Hierarchy** are committed to the further thesis of **Compositional Fundamentality**, most are of the opinion that there is a *metaphysically* fundamental level to the mereological hierarchy that consists of entities taken to be metaphysically fundamental in the absolute sense, i.e. metaphysically ungrounded or basic.[8] Such entities are taken to be ontologically independent in the sense that they, at the very least, fail to be grounded in any distinct entity for their existence.[9] The metaphysically basic entities are commonly thought to be either (i) 'maximally real' or (ii) ontologically ungrounded and thus metaphysically prior to non-fundamental entities. We can state this particular variety of **Fundamentality** as follows:

> **Metaphysical Fundamentality:** the entities at the metaphysically fundamental level are ontologically basic or ultimate in the sense that they are either (i) 'more real' than non-fundamental entities or (ii) ungrounded and hence metaphysically prior to the domain of non-fundamental entities.

At this point, I wish to dismiss tenet (i) of **Metaphysical Fundamentality** at the outset. Several philosophers, mistakenly I believe, take it that if x is grounded in or dependent on y, then x is somehow 'more real' than y. For instance, Markosian (2005: 74) explicates what he calls 'ontological fundamentalism' as the thesis that "ours is fundamentally a world of mereological simples, which are in some sense more real than the entities that are composed of them." He goes on to state, "And there is a long tradition in philosophy that involves saying that whenever x depends for its existence on y, then y exists more fully, and is more real, than x."

The very same assumption is found in Murphy (2007: 23) when she states, "only the entities at the lowest level are really real; higher-level entities-molecules, cells, organisms-

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[7]In a sense, we might think of cases of absolute fundamentality as being cases of comparative fundamentality whose contrast class is the total class of existing entities.

[8]For a sampling of those that interpret a fundamental layer of reality in terms of ontological independence see Cameron (2008) and Paseau (2010).

[9]The particular kind of metaphysical ordering that is thought to govern the mereological hierarchy ranges from purely existential grounding to essential grounding. Most would, at the very least, agree that the ordering includes rigid existential grounding (see RG in chapter 2, section 1).

are only composites made of atoms. This is the assumption, mentioned above, that the atoms have ontological priority over the things they constitute." Note Murphy's assumption that for *x* to be ontologically prior *y just is* for *x* to be 'really real,' i.e. to enjoy a higher degree of existence or being than *y*. In fact, Murphy goes on to state that such a locution is a "non-sense phrase" and recommends that ontological priority be cashed out in terms of causal priority instead.

But I submit that the assumption of various degrees of existence is no part of the claim that one entity is grounded in—whether for its existence or its identity or both—another. An entity's being existentially grounded in another in no way entails that the former is somehow 'less real' than the latter. Rather, in claims of grounding, dependence, or priority, 'existence' is used univocally such that both relata of grounding relations exist *in precisely the same sense.*

With that clarification in mind it should be pointed out that in contrast to **Compositional Fundamentality**, many philosophers who endorse a hierarchical conception of reality are apt to consider **Metaphysical Fundamentality** as a core thesis of such a view, together with **Hierarchy** and the choice of an accompanying atomic, atomless, or non-atomic mereology. I say this precisely because a good many views in metaphysics and the philosophy of mind are explicated (though not always explicitly) in terms of the notion that a metaphysically elite class of entities 'fix' or 'determine' the properties and behaviors of other entities at a distinct mereological level, where the latter are thought to supervene or depend on the former. In this way, entities occupying the metaphysically fundamental level of the hierarchy of composition form the ultimate ontological base on which the hierarchy rests, everything else being grounded or ontologically dependent on such entities. An oft repeated slogan: fix the fundamentals, and you thereby fix everything else.

A few important things to note about **Metaphysical Fundamentality** and its relation to **Compositional Fundamentality**. First, while not all hierarchy theorists who endorse **Metaphysical Fundamentality** go on to endorse **Compositional Fundamentality**, the converse is almost always the case. That is, those who adopt **Compositional Fundamentality** take the mereologically fundamental entities to be metaphysically basic as well. For those who include simples in their ontology, it is often claimed that such entities are *ontologically prior to the wholes they compose* and that composite entities are built up out of these (absolutely) basic entities. Another way of stating this is that mereologically complex wholes are exhaustively decomposable into entities that are ontologically independent and thus capable of existing as such apart from those wholes. Second, **Metaphysical Fundamentality** is silent as to which ontological category the ontologically basic entities belong. As far as **Metaphysical Fundamentality** is concerned, the fundamental entities could be substances, events, properties, relations, structures, etc. Finally, **Metaphysical Fundamentality** is neutral as to the size of the fundamental units of being, that is,

whether such entities (or entity) are microscopic (as in particles, fields distributed across spacetime, etc.), macroscopic (ordinary material objects), or the entire cosmos.

3.2 Fundamental Mereology

An adherence to **Metaphysical Fundamentality**, conjoined with the thesis that reality exhibits mereological structure (**Hierarchy**), raises what Jonathan Schaffer (2010b) has called *the question of fundamental mereology*: what is the fundamental ontological ground of the mereological hierarchy. That is, the question of fundamental mereology inquires as to which objects are the basic units of being that serve as the absolute terminus of the grounding ordering of the mereological hierarchy. The question of fundamental mereology has an impressive historical pedigree and provides much of the underlying framework for many of the debates in contemporary metaphysics, philosophy of science, and the philosophy of mind.

3.2.1 Schaffer on Fundamental Mereology

While the concept of fundamental mereology is one with a long-standing historical precedent, the most extensive treatment of the idea in the recent literature is provided by Jonathan Schaffer, particularly as it pertains to his substantive (76 page) article titled "Monism: The Priority of the Whole." To help motivate the notion of metaphysical priority and posteriority as applied to wholes and their parts, Schaffer begins by asking the reader to consider the question as to which is prior: a circle or its pair of semicircles? He asks, "Are the semicircles dependent abstractions from their whole, or is the circle a derivative construction from its parts?" (31). Schaffer then asks the reader to consider the cosmos as a whole and whether or not it is prior to its parts or vice versa. It is this latter question that he takes to be at the heart of fundamental mereology.[10]

The project of fundamental mereology rests on several assumptions that need to be stated at the outset. First, as was argued for in the previous chapter, fundamental mereology proceeds on the assumption that there is a relation of metaphysical grounding or priority, that reality exhibits a distinctively metaphysical grounding structure ordered by relations of priority and posteriority. Second, fundamental mereology assumes that the items generated by part-whole relations are numerically distinct from the items from which they are generated; that is, *composition is not identity*.[11] By this I mean to reject

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[10]Kim (1993) hints at the intersection of mereological and metaphysical structure when he states: "One interesting application of the supervenience concept is mereological supervenience, the doctrine that the character of a whole is supervenient on the properties and relationships holding for its parts. This apparently calls for two distinct domains: one domain consisting of wholes and another consisting of their parts. It would be of interest to know how a dependency relation can be formulated across two domains."

[11]The contemporary locus classicus here in favor of a strong reading of composition as identity is Baxter (1988).

the thesis that the relation a whole bears to its parts *is one and the same as* (or even sufficiently similar to) the identity relation. Though controversial, I take this assumption to be well-warranted given the distinct modal and historical properties of wholes and their parts as well as the existence (and ipso facto possibility) of strongly emergent properties which I take to be incompatible with composition as identity.[12] According to fundamental mereology, then, there are no 'free ontological lunches' when it comes to composite objects; mereological wholes are not 'ontologically innocent' in that they are 'nothing over and above' their parts.

3.2.1.1 The Tiling Constraint

Schaffer begins his discussion of fundamental mereology by putting forward what he calls a 'tiling constraint' on possible answers to the question of fundamental mereology. He argues that the metaphysically basic entities (the entities that satisfy **Metaphysical Fundamentality**) ought to collectively cover the the cosmos without overlapping. For the basics, then, *there are no gaps and no overlaps*. To get clear on what constitutes the tiling constraint as well as the possible answers to the question of fundamental mereology, let us adopt the following notation:

$x < y = x$ is a proper part of y[13]

$x \triangleright y = x$ is grounded in y

u = the cosmos

B = basic (concrete) object

Schaffer opts for a traditional (albeit highly minimal as we will see below) conception of the basic concrete entities as *substances*, which he goes on to define in terms of existential independence as follows:[14]

$$Bx = \neg(\exists y)(x \triangleright y)$$

With the above notation and the working definition of a basic or substantial entity in hand, Schaffer goes on to explicate the following two tenets (where '$\sigma x : (\Phi x)$' denotes the sum of all entities that satisfy the description Φ) that jointly constitute the tiling constraint for the basics of one's fundamental mereology:

Covering: $\sigma x : (Bx) = u$

No Parthood: $(\forall x)(\forall y)((Bx \wedge By \wedge x \neq y) \rightarrow \neg(x < y))$[15]

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[12]For more on this line see McDaniel (2008).

[13]Unless otherwise noted, by 'part' henceforth I mean proper part in particular.

[14]Although we will see below that this notion of a basic or substance is inadequate.

[15]I should note that while I follow Schaffer's choice of terminology in the sequel, I think 'No Parthood' is a misnomer for the view expressed above and is better captured by the locution 'No Basic Parthood.'

Regarding **Covering**, Schaffer argues that the basic entities must be *complete* in that their collective duplication, together with the fundamental relations that obtain between them, suffices to duplicate the entire cosmos. The notion of completeness here is one such that a set of entities S at world w is complete for w if and only if S serves to characterize w, by providing a grounding base for w. **Covering**, then, requires the basics to serve as the exhaustive grounding base of w. That is, *all* non-basic entities must depend on or be grounded in the basics. It is important to note here that Schaffer's formation of **Covering** above *assumes* that there is a mereological sum that is identical to the cosmos, i.e. the maximal mereological fusion of classical mereology. While this assumption is harmless for our purposes at this stage in setting up the question of fundamental mereology, it is important to note that the core notion behind **Covering** can be formulated without this metaphysically loaded assumption.[16]

Covering is a mereological extension of Lewis' (1986a: 60) notion that the sparse or natural properties ought to "characterize things completely and without redundancy." Again, following Lewis (1986a: 59-63), we can take x and y to be duplicates just in case there is a one-one correspondence between their parts that preserves perfectly natural properties and relations. On this score, **Covering** is the thesis that there ought to be a one-one correspondence between the sum or fusion of the basic entities and the entire cosmos itself. If the sum of the basics ($\sigma x : (Bx)$) did not stand in a one-one correspondence to the entire cosmos (u) it would be incomplete in so far as there would be segments of reality that would remain unaccounted for in such an inventory.

As a constraint on possible answers to the question of fundamental mereology, **Covering** is meant to exclude entities whose duplication would leave out large portions of reality, such as if the sum of the basics was the total collection of books in all the libraries in the world. It also follows from **Covering** that if there is but a single basic entity that entity is the cosmos, as there is nothing else whose duplication could suffice to preserve the natural properties and relations of the totality of the natural world.

No Parthood, on the other hand, is the claim that basics fail to stand in part-whole relations to one another. This is not to say, however, that substances or basics need be mereologically simple and thus lacking proper parts *altogether*.[17] Rather, **No Parthood** is simply the claim that basics do not have other *basics* as proper parts (according to Schaffer, the cosmos is *not* mereologically simple in so far as it has non-basic proper

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Also, it is worth pointing out that Schaffer initially relies on a much stronger thesis he calls No OVER-LAP:$(\forall x)(\forall y)((Bx \land By \land x \neq y) \rightarrow \neg(\exists z)(z < x \land z < y))$, but later weakens this to **No Parthood** as explicated above.

[16]Example: one might simply say that while the basics *collectively* provide a grounding base for w, this does not entail that there is some *one* thing that is the sum of the basics which plays this role. One might say that it is the *plural duplication* of all of the basic entities (with their basic relations) that suffices to duplicate the entire cosmos.

[17]Thus, Morganti (2009: 276) misconstrues Schaffer's tiling constraint to include the following: "Schaffer's tiling constraint and the view that composition is not identity will not be questioned. First, it is very plausible that basic entities are simple, and so cannot overlap or share parts."

parts). Given **No Parthood** it follows that if there is more than one basic entity, then the cosmos is not a basic entity as the former would be independent parts of the cosmos, thereby rendering the cosmos as non-basic.

No Parthood will no doubt strike the reader as being an extremely strong claim regarding the relation between the mereological and the metaphysical ordering of reality. And strong it is! Nonetheless, as we will examine below, **No Parthood** is one of the most enduring pieces of mereological machinery concerning basic or substantial entities in the history of Western philosophy. What's more, it is a thesis that plays an absolutely central role in my overall neo-Aristotelian metaphysic of material objects. In light of the fact that I will examine **No Parthood** and Schaffer's arguments in favor of it in much greater detail below, I simply mention it here as a part of Schaffer's tiling constraint on fundamental mereology.

3.2.1.2 Monism and Pluralism

With the above tiling constraint in place, Schaffer proceeds to offer two exhaustive and mutually exclusive *general* answers to the question of fundamental mereology—*monism* and *pluralism*—each differentiated by the direction of grounding that obtains between the cosmos and its many proper parts:

> The monist holds that the whole is prior to its parts, and thus views the cosmos as fundamental, with metaphysical explanation dangling downward from the One. The pluralist holds that the parts are prior to their whole, and thus tends to consider particles fundamental, with metaphysical explanation snaking upward from the many. (Schaffer 2010b: 31-32)

According to Schaffer, the core intuition driving monism is the idea that *the whole is ontologically prior to its parts*. Schaffer's use of the definite article suggests that by 'whole' here he means the unique maximal mereological fusion, i.e. the cosmos. On this view, the cosmos serves as the metaphysical ground of the mereological hierarchy and thus grounds the existence and identity of its many proper parts. Given the tiling constraint, if the cosmos is the metaphysical ground of the hierarchy, then it is the *sole* basic entity on the hierarchy of composition since everything else at a lower level of decomposition would be a non-basic part of it.

The core intuition behind pluralism, on the other hand, is the thesis that *the parts are ontologically prior to the whole cosmos*. Hence, the many proper parts of the cosmos are metaphysically prior in the sense that the existence of the cosmos is grounded in them. Pluralism entails the denial of monism as, per the tiling constraint, the cosmos cannot be basic in so far as at least one of its parts is basic.

As is well known, Schaffer ingeniously defends (and is perhaps the only contemporary defender of) a monistic fundamental mereology that takes the cosmos to be the sole

metaphysically basic entity with its many parts (planets, humans, bicycles, etc.) being derivative on it. Schaffer argues against what he takes to be the main pluralistic rival to monism: an atomistic variant that takes the *minimal* parts of the cosmos (what he refers to as 'particles') as being (absolutely) basic or metaphysically ultimate. As a version of pluralism, *atomism* is the view that (i) there are at least two metaphysically basic entities, (ii) such entities are proper parts of the cosmos, and that (iii) these entities are the *ultimate* or *minimal* proper parts of the cosmos (subatomic particles, waves, fields, etc.). For the atomist, then, it is the minimal parts of the cosmos that are metaphysically basic and thus ontologically prior to both intermediate mereological wholes and the entire cosmos. Though at times Schaffer (see the above quote) appears to take pluralism to *just be* atomism, he is clear that the latter should not be built into the definition of the former given (as we will see) the availability of alternative versions of pluralism.

Given that the label 'pluralism' refers to a multiplicity of options in fundamental mereology and thus is not limited to an atomistic interpretation, Schaffer defines *monism* and *pluralism* in light of the tiling constraint as follows (as per chapter 2, '$\triangleright$' should be read as 'is grounded in'):

(M) **Monism:** $(\forall x)(x < u \rightarrow x \triangleright u)$

(P) **Pluralism:** $(\exists x)(x < u \wedge u \triangleright x)$[18]

What is crucial for my purpose here is Schaffer's classification of the live options in fundamental mereology (M and P)–including the two core intuitions driving monism and pluralism–primarily in terms of the cosmos as the maximal mereological individual. More on this later.

To help elucidate the various options in fundamental mereology, it will be helpful to examine Schaffer's own preferred method of utilizing the three-atom model of classical extensional mereology. Consider the following very general slice of the mereological structure of the world as captured by the three-atom model of classical extensional mereology:[19]

[18]Note that on Schaffer's view, even the universe's being *partially* grounded in one of its proper parts renders it non-basic.

[19]This figure is taken from Schaffer (2007a). Although we have already seen that the mereological hierarchy does not require the truth of atomism and is entirely consistent with either a gunky or a non-atomic mereology.

Figure 3.2: Three Atom Model
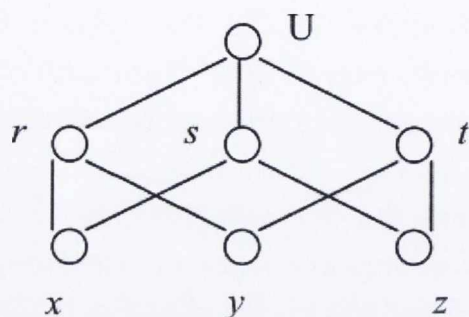
At the top of the mereological hierarchy is the Universe (U)—the unique mereological sum of everything (Schaffer's cosmos)—and our respective atoms occupying the lowest mereological level (x, y, z). Schaffer uses 'molecules' to denote the mereologically inter-mediate entitities (r, s, t) each of which are proper parts of U and have at least two atoms as proper parts.

Now, using the above three-atom model, Schaffer's more fine-grained classification of the options in fundamental mereology are as follows:

Monism: $x, y, z \triangleright r, s, t \triangleright U$[20]

Intermediate: $(x, y, z \triangleright r, s, t) \wedge (U \triangleright r, s, t)$[21]

Atomism: $U \triangleright r, s, t \triangleright x, y, z$

On monism, the grounding chain begins with the atoms, extends through the intermediates, and ultimately terminates in the Universe. The intermediate position states that all grounding chains terminate in the mereological intermediates, whether originating from the atoms or from the Universe. For the atomist, on the other hand, the grounding chain begins with the Universe, proceeds through the intermediates, and ultimately terminates in the atoms.

According to Schaffer's taxonomy, monism corresponds to the insight that wholes are ontologically prior to parts and intermediate and atomism correspond to the insight that parts are ontologically prior to wholes. While Schaffer is unequivocal that the most defensible of the three options are monism and atomism (for reasons that will become

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[20]Strictly speaking, Schaffer's view is called 'priority monism' but since I am considering options in fundamental mereology (where the notion of priority and posteriority are already being assumed), I use 'monism' for short.

[21]The addition of U to the formulation of **Intermediate** will obviously depend on whether one countenances the universe U of classical extensional mereology qua composite individual. For reservations, see Simons (2003: 249).

evident later on), he does not exclude intermediate as a potential option in fundamental mereology.

3.2.2 On the Wedding of Monism to Whole-Priority

There are, however, several unappealing aspects of Schaffer's classification of fundamental mereology. At times, Schaffer tends to unnecessarily wed the priority theses—i.e. wholes being prior to their proper parts and vice versa (call them 'whole-priority' and 'part-priority' respectively)—to monism and pluralism, respectively. While Schaffer's definitions of monism and pluralism above (M&P) are neutral as to whether they *exclusively* correspond to whole-priority and part-priority respectively, he often (as in the above quote) takes monism to be a *consequence* of a commitment to whole-priority *as a general thesis concerning the relationship between a whole per se and its parts*. In short: Schaffer gives the impression that the monist has exclusive rights to the core notion that wholes are ontologically prior to their parts.

To see this, it is important to underscore the fact that Schaffer often alternates between the following interpretations of whole-priority:

(WP$_a$) **Whole-Priority$_a$:** The whole is ontologically prior to its parts.

(WP$_b$) **Whole-Priority$_b$:** Wholes *per se* are ontologically prior to their parts.

Schaffer's use of WP$_a$ is often signified by the presence of the definite article, which as we have seen, he takes to refer to the Universe, the maximally unique sum of classical mereology. And, as our representative quote above makes clear, Schaffer understands monism as being *equivalent* to WP$_a$ so stated.[22]

However, Schaffer often speaks of whole-priority in a much more general way in terms of WP$_b$. For instance, Schaffer labels the intermediate position—in virtue of attributing ontological priority to intermediate wholes—as 'quasi-monistic'. Taking molecules as metaphysically basic intermediate wholes, Schaffer (2010b: 63-64) argues:

> Further, the use of basic molecules is already *quasi-monistic*. Given the tiling constraint (§1.3), no proper parts of any basic molecules can themselves be basic. Hence the use of basic molecules involves treating the whole as prior to its parts, with respect to the basic molecules and their derivative parts. So it is hard to see how the molecular pluralist could have any principled objection to monism. (2010b: 63-64)

This is a puzzling statement indeed. Surely Schaffer doesn't mean that the intermediate position is 'quasi-monistic' in the sense that it takes "the whole as prior to its parts"

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[22]He states, "Monism is equivalent to the thesis that every proper part of the cosmos depends on the cosmos."

(note the use of the definite article) to mean that the *cosmos* is prior to its parts; the view says no such thing! Rather, what he means here is that the intermediate position is 'quasi-monistic' in that it attributes ontological priority to the molecule *qua* intermediate whole. Here we have two different interpretations of whole-priority at play, one that is (i) equivalent to monism (WP_a) and one that (ii) refers to a much more inclusive mereological thesis such that wholes *per se* are ontologically prior to their proper parts (WP_b). The latter is more inclusive than the former in the sense that it is neutral as to *which* wholes are ontologically prior to their parts, whether the maximal whole (cosmos) or the intermediates (e.g. molecules).

Nonetheless, in labeling non-monistic views that adopt WP_b as being 'quasi-monistic' Schaffer often gives the impression that a commitment to WP_a in some sense or other is a consequence of a commitment to WP_b and that, in the end, a non-monistic variant of whole-priority is in danger of collapsing into monism.[23] Perhaps the clearest example of this is the following quote, where Schaffer again considers the intermediate position which takes intermediate wholes to be basic and thus ontologically prior to their parts (thereby adopting WP_b):

> Second, the priority pluralist might (on wanting to maintain basic entities in a gunky scenario, but not wanting to take the whole as basic) take some intermediate level of mereological structure to be basic. But this is hardly thematic for the pluralist, as now she would be treating these intermediate structures monistically, as prior to their parts. (Schaffer 2007b)

Where the intermediate position (which endorses WP_b but not WP_a) was previously described as 'quasi-monistic' in virtue of adopting WP_b, here we see that the prefix 'quasi' has been dropped to give us the much stronger claim that WP_b *just is* a monistic fundamental mereology. One is left with the impression that to take seriously the ontological priority of wholes per se over their parts is *equivalent* to adopting monism.

There are further traces of this wedding of monism with WP_b all throughout Schaffer's massive "Monism: Priority of the Whole." For one, Schaffer often uses the locution 'priority of whole to part,' which on the surface appears to denote the more general thesis of WP_b, to characterize what he takes to be the core notion of the monistic tradition.[24] But the use of such a phrase (given the absence of the definite article that serves to distinguish the two variants of whole-priority) tends to gloss over the aforementioned distinction between WP_a and WP_b and serves to reinforce the idea that monism has exclusive rights to WP_b or, at the very least, is the natural consequence of such a view.

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[23]Cameron (2010a) expresses something similar when he says, "A sum is ontologically dependent on its parts, if priority pluralism is true—and vice-versa if priority monism is true..." Here again we see the wedding of part-priority with pluralism and whole-priority with monism.

[24]Schaffer (2010b: 66).

We see the same thing in Schaffer's strong reliance on Aristotle's notion of a macro-physical living organism being an *organic unity*, a substantial whole that is ontologically prior to its parts. He states:

> [T]he notion of organic unity is a perfect fit for *Priority Monism*. Aristotle's view of the organism is that of a unified substantial whole, prior to its parts (like a syllable, not like a heap: §2.1). As such the claim that the whole possesses organic unity is just an expression of the priority thesis that the whole is prior to its parts (2010b: 68).

Here we see Schaffer appropriating a mereological insight from Aristotle's fundamental mereology which is perhaps *the* paradigmatic instance of a *non-monistic* variant of WP_b in virtue of countenancing intermediate substances in spades (which thereby *entails* the falsity of monism due to the tiling constraint). It is strange, then, that Schaffer remarks that the notion of organic unity—a piece of mereological machinery that has been traditionally reserved for intermediate substantial wholes—is a "perfect fit" for monism. The close association of monism and WP_b is evident in Schaffer's defining monism in terms of a notion that is constitutive of a non-monistic variant of WP_b.

But why think that WP_b is 'monistic' or even 'quasi-monistic' simply in virtue of appropriating the mereological insight that wholes *per se* are ontologically prior to their parts? As a general mereological thesis concerning the relationship between wholes and their parts, WP_b is entirely *neutral* as to *which* mereological wholes one ought to be ontologically committed.[25] How, then, does a fundamental mereology which appropriates such an insight come to be identified with a view that entails an ontological commitment to the cosmos? The fact that Schaffer says as much reveals that he takes the general mereological insight of the ontological priority of wholes *per se* over their parts (WP_b) to be wedded to a monistic fundamental mereology.

But the monist has no right to stake out WP_b as a piece of monistic metaphysics. In doing so, the monist fails to account for important logical space regarding the options in fundamental mereology. While Schaffer gives lip service to the intermediate view as a viable option in fundamental mereology at the outset, his tendency to wed WP_b to monism prohibits all non-monistic mereologies from appropriating the core insight underlying WP_b. This, however, precludes the intermediate position discussed above, one that appears to be a plausible candidate for the ground of the mereological hierarchy with just as much historical precedent as monism and atomism.[26]

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[25] I follow Koslicki (2008: 171), "Thus, mereology, on this conception, does not settle matters of ontological commitment; rather, it presupposes them to be resolved elsewhere within metaphysics or outside of philosophy altogether."

[26] Think here of the many adherents of the view throughout the span of the Aristotelian tradition in Western philosophy.

Schaffer's line of thinking appears to be as follows: the cosmos exists as a mereologically complex whole, and since wholes are ontologically prior to their parts (WP_b), it follows that the cosmos is ontologically prior to its parts (WP_a). If the above reasoning establishes that the cosmos is ontologically prior to its parts, then it follows—given **No Parthood**—that *no other whole is prior to its parts*. Herein lies Schaffer's close association of whole-priority with monism.

However, the separability of WP_b and WP_a is evident in that one could easily turn Schaffer's modus ponens into a modus tollens to arrive at the conclusion that the cosmos is *not* a whole while, at the same time, retaining the whole-priority thesis.[27] In other words, *monism could be false even if WP_b is true*. The driving premise here would be that the cosmos is not ontologically prior to its parts. And this precisely because many—myself included—are of the opinion that there are medium-sized material objects that are of the order of substance, i.e. metaphysically basic, such as you, me, living organisms, and lumps of bronze. If these entities are indeed substances and thus capable of existing in their own right, then it follows by **No Parthood** that the cosmos is *not* metaphysically fundamental in so far as some of its parts are not ontologically dependent on it.

To illustrate, take the example of a non-monistic endorsement of whole-priority in the recent work of Kit Fine (2010). Fine takes there to be what he calls 'generative operations'—operations the application of which are identity-explaining—that proceed from whole to part and not vice versa: "…[I]t seems to me that some basic generative operations are in fact *de*-compositional. Far from serving to account for the identity of the whole in terms of its parts, they serve to account for the parts in terms of the whole." Consequently, not all fundamental mereologies that are congenial to a whole-priority description of the mereological hierarchy fall under the label of monism or even 'quasi-monism.'

One reason that contributes to Schaffer's fusing WP_b to monism is that he begins with the cosmos as his point of reference in characterizing the options in fundamental mereology. According to Schaffer, the following options are exhaustive and exclusive: either the entire cosmos is metaphysically basic or its proper parts are (whether intermediate or minimal). We have seen that, for Schaffer, this is just *equivalent* to whether the one whole or its parts are ontologically prior.[28] But why take as the locus of one's classification the *maximal whole*–the cosmos–instead of the *many intermediate wholes* at a lower level of decomposition? Why privilege Spinoza over Aristotle here? If one takes as one's starting point the unique maximal whole of standard mereology, then *anything*

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[27]Here it is important to note that my concern here is not to argue that the cosmos is not a whole in its own right (and thereby undermine priority monism). Rather, it is strictly methodological in showing that Schaffer's chosen characterization of fundamental mereology is far from exhaustive.

[28]Schaffer (2010b: 42) states, "Monism is equivalent to the thesis that every proper part of the cosmos depends on the cosmos."

and *everything* at a lower level of decomposition will be a part of that whole. As a result, *any* fundamental mereology that takes there to be metaphysically basic entities at a lower level of decomposition than the cosmos will be misclassified as being committed to the ontological priority of parts over wholes.

Schaffer is not alone in his wedding of WP_b to monism which, as we have seen, tends to exclude medium-sized objects from being ontologically prior to their parts.[29] Louis deRosset (2010) has argued that a fundamental mereology (what he calls a "priority theory") is best captured by the conjunction of the following three theses:

> **Modesty:** the claims of common sense abetted by science about the existence and features of macroscopic concreta are roughly correct: there are tables, raindrops, tectonic plates, galaxies, etc.
>
> **Explanation:** the existence and features of the macroscopic concrete objects alleged by common sense abetted by science can be completely explained solely by reference to the existence and properties of other things.
>
> **Sparsity:** the ontological sparsity of the world is determined by the number and variety of fundamental entities and kinds.[30]

Modesty serves to distinguish fundamental merelogies from the likes of mereological nihilism (or eliminitivism) and existence monism in endorsing the reality of intermediary composite objects that make up the mereological hierarchy.[31] On the three-atom model in Figure 3.2, these are represented by the intermediates *r, s, t* in so far as they occupy a level of composition that is 'in between' the atoms and the Universe. Unlike the nihilist who endorses only the existence of mereological atoms *x, y, z* and the various arrangements thereof and the existence monist who takes the cosmos (U) to be the sole existing entity, fundamental mereologies include complex wholes in their most inclusive ontological assay of the world.

Second, **Explanation** states that while intermediate objects exist, they are derivative in the sense of being grounded entities, i.e. non-basic, and thus their existence and identity is grounded in the existence and identity of other entities. On our three-atom model above, this amounts to the exclusion of **Intermediate** such that the grounding chain ($\triangleright$) runs *through* intermediate wholes, terminating in entities that are either maximal (U) or minimal (x,y,z); which is just to say that there are no metaphysically basic intermediates, i.e. no intermediate substances. On this characterization, the only mereological whole that could be accurately described as basic and thus ontologically prior to its parts is the Universe (U). Herein lies the close association of whole-priority with monism.

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[29]Note that this is not to say that intermediates *alone* are metaphysically basic. In fact, the view that I will defend does not take intermediates as exclusively basic, but substances per se.

[30]deRosset (2010).

[31]Although some take mereological nihilism to be a variant, albeit a radical one, of Priority Microphysicalism (see Markosian 2005).

Finally, **Sparsity** ties in with **Explanation** in capturing the idea that fundamental mereology takes as ontologically primary the fundamental or basic entities on the mereological hierarchy.

With his inclusion of **Explanation** as being definitive of fundamental mereology, deRosset's characterization is even more restrictive than Schaffer's. Though Schaffer ultimately rejects the intermediate view as being an "objectionably arbitrary" fundamental mereology, he nonetheless is clear that the view is at least on the table as a viable option for the fundamental mereologist. By contrast, deRosset leaves no such room.

But this is much too quick as there is no principled reason to build **Explanation** and hence the rejection of the intermediate position into one's classification of fundamental mereology. Ross Cameron (2008: p. 6), no priority theorist in the sense explicated here, acknowledges as much when he states:

> These [what we are calling monism and atomism] are not the only options, of course. Perhaps ordinary medium-sized objects like persons, tables, houses, dogs, etc., are fundamental, and both their proper parts and their mereological sums ontologically depend on them. On this view, there is a fundamental level, and ontologically dependent entities are obtained both by composing and by decomposing. [32]

I take such remarks to show that there is no principled reason to exclude the mere possibility of endorsing a fundamental mereology that countenances intermediate basics. Given the logical space regarding options in fundamental mereology, we have reason enough to resist the claim that **Explanation** ought to be built into the very notion of fundamental mereology from the start.

There is one final reason for thinking that deRosset's inclusion of **Explanation** as a core tenet of fundamental mereology is mistaken. It is that the view that I will be defending in the course of this essay is a fundamental mereology that begins by rejecting the assumption that there must be a uniform answer to the question of whether the whole per se or its parts are ontologically prior. As we will see in more detail below, I am inclined to think that the order of grounding between a whole and its parts should be answered in light of the *category* of the mereologically complex object under consideration. The neo-Aristotelian fundamental mereology that I will be defending rests on an important categorial difference between the grounding structure that obtains among the proper parts of a substantial and non-substantial whole (aggregate). **Explanation**, I submit, has no place alongside **Modesty** and **Sparsity** as being a core feature of fundamental mereology.

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[32] Cameron (2008: 6).

3.3   Fundamental Mereology Reformulated

As will become evident in the course of this work, I am in substantial agreement with much of what Schaffer has to say about the overall constraints on fundamental mereology and thus much of what I will have to say in the sequel is an attempt to build on his arguments in favor of WP_b as a *general* thesis in fundamental mereology. For my purposes in this essay, I follow Schaffer in adopting the tiling constraint to govern the potential options in fundamental mereology.

I recognize the controversial nature of proceeding on such strong preliminary assumptions regarding the mereological ordering of fundamental substances. For some, **No Parthood** will seem excessively restrictive, even demonstrably false. My purpose for proceeding on the assumption that no basic has another basic as a proper part is threefold. First, **No Parthood** is a mereological constraint on the notion of a substance qua *metaphysically fundamental* entity that has a rich historical precedent, most notably in the work of Aristotle, Aquinas, and Leibniz. Of course, historical considerations are by no means an infallible guide to truth; rather, at the very least, such considerations suggest that **No Parthood** is not an unprecedented assumption when thinking about the intersection of grounding and mereology. Second, in so far as the question of fundamental mereology has recently been reinstated by Schaffer in terms that explicitly make use of the tiling constraint, I think it is wise and dialectically advantageous to defend my own position from within the very same parameters in which the debate is situated. Finally, I will argue in the sequel that a particular application of **No Parthood** to ordinary composite substances yields a unified solution to a host of conundrums that occupy center-stage in debates in material objects. Thus any theoretical advantages that accrue to the fundamental mereology on offer in this essay I take to be indirect support to the idea that **No Parthood** is a tenable constraint regarding the grounding structure of fundamental substances.

While Schaffer and I agree on the formal machinery that governs the mereological and metaphysical structure in reality, we part company concerning his denial of the claim that there are mereologically intermediate substantial wholes. Where Schaffer, with Spinoza and Hegel, posits a single substantial whole (the cosmos), I, with Aristotle and Aquinas, posit a multiplicity of intermediate substantial wholes (you and I being examples of such entities).[33] While I wholeheartedly agree with Schaffer that substances are ontologically basic and thus do not have other substances as proper parts, we disagree as to *which* entities belong in the extension of 'substance.' Part of my aim in what is to come is to show that there are both physical and philosophical considerations in favor of the view that at least *some* intermediate entities are ontologically prior to their parts and thus qualify as substantial wholes in their own right.

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[33]See also Schaffer (2009b).

Nonetheless, given the widespread tendency to exclusively wed whole-priority (WP_b) to monism (as per Schaffer and deRosset), it is necessary at this point to reorient the question in such a way that does not prematurely exclude my view from outset (while preserving much of the above structural framework of fundamental mereology as set forth by Schaffer). For the purposes of charting the options in fundamental mereology, then, it seems much more advantageous to take the locus of the debate to center around mereological wholes *per se* and proceed to ask whether wholes per se or their parts are ontologically prior. My alternative rendering below, I believe, allows for a more precise taxonomy of views in fundamental mereology.

3.3.1   The Direction of Mereological Grounding

In order to explicate the options in fundamental mereology so as to not preclude intermediate complex wholes from being ontologically prior to their parts, I propose the following alternative characterization of fundamental mereology in terms of what I will call 'the direction of mereological grounding' as applied to the hierarchy of composition:

> **(DG) Direction of Mereological Grounding:** are wholes *per se* ontologically prior to their parts or vice versa?

The question of the direction of mereological grounding seeks to get clear on whether a complex whole in general or its many parts are basic or fundamental, i.e. whether wholes *per se* rigidly essentially ground their parts or vice versa. Here we do not start with one *particular* whole, whether the cosmos or an intermediate, and formulate the possible views in fundamental mereology in relation to it.[34] Rather we are, at least at this stage, concerned primarily with how mereological and metaphysical structure intersect with one another in the most general terms—and thus not with how such structure comes together in any one whole in particular. As a result, situating the debate in terms of DG in contrast to the maximal mereological whole rightly classifies the intermediate position as being committed to a whole-priority description of fundamental mereology.

With DG in hand, consider a rather simple grounding chain consisting of four objects standing in the asymmetrical proper parthood relation: $o_1 \leq o_2 \leq o_3 \leq o_4$. For ease of illustration, suppose we adopt an atomistic reading of the hierarchy of composition and consider o_1 as lacking proper parts altogether. A DG characterization of fundamental mereology seeks to replace Schaffer's *monism* and *pluralism* with the following *general* descriptions of the order of dependence in the above chain.

According to a *part-priority* description of the representative slice of mereological structure in the world, the grounding chain begins with o_4 and terminates in o_1 such that

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[34]For instance, one could begin with the intermediates and claim that either the intermediates are basic or they are not, if so, then the cosmos and its minimal parts are not basic, etc.

o_4 is rigidly grounded in o_3, o_3 in o_2, and o_2 in o_1–where the latter serves as the (absolutely) fundamental entity in the grounding chain. On this construal, the complex whole o_4–whether it be the cosmos or an intermediate whole–is rigidly essentially grounded in its proper parts (o_1-o_3).[35] A part-priority fundamental mereology, as stated by Kim (1978: 154), holds that "[w]holes are completely *determined*, causally and *ontologically*, by their parts."[36]

Given the tiling constraint, composite objects on part-priority are derivative (non-basic) entities in so far as they are totally essentially grounded in each of their proper parts. If grounding is transitive (see G4 of chapter 2) then mereological wholes on this view will *ultimately* be grounded in either a fundamental base that is itself lacking in proper parts or, as per gunky worlds, will proceed infinitely and never reach 'ontological bedrock.'[37]

Alternatively, on a *whole-priority* description of the relevant portion of mereological structure, the grounding chain begins with o_1 and terminates in a basic composite object, o_4. Wholes *per se*, irrespective of their size or location on the hierarchy, would be ontologically prior to their proper parts and, given they are not further grounded in any higher-level composite object, would serve as the (absolutely) fundamental units of being upon which the mereological hierarchy terminates. Once more, given the tiling constraint, it follows that no proper part of a basic whole is itself metaphysically basic. Again, the *location* of o_4 on the hierarchy of composition–whether it be an intermediate or a maximal whole–is irrelevant for the purposes of classification at this point.

Here it is important to point out the implications of the tiling constraint concerning the grounding ordering over the composite objects that make up the mereological hierarchy, as well as the formal features of the parthood relation on both part-priority and whole-priority. On part-priority, for any composite object you choose on the hierarchy of composition, its (ultimate) essential ground will be its substantial parts which themselves lack proper parts or will proceed *ad infinitum* as per a gunky mereology.[38] Either way, part-priority has it that the (proper) parts of all composite objects are themselves metaphysically prior, which are capable of existing apart from the objects they serve to compose.

On this description, the mereological hierarchy consists of nested wholes each of which are composed of basic entities in their own right that are *separable* from the composite objects they compose. A bit more precisely (as per chapter 2, the sentential operator '$\square_x$' is to be read as 'it is part of the essence of x'):

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[35] Although o_2 and o_3 are complex objects as well and hence grounded in o_1.

[36] Emphasis in original.

[37] This feature of part-priority will, as we will see, serve to generate a disjunctive dilemma such that either the part-priority theorists rejects the well-foundedness of grounding (or supervenience) or the possibility of gunky worlds, neither of which seem plausible, therefore part-priority is suspect.

[38] As we will see, for gunky worlds it follows on part-priority that grounding is non-well-founded.

Separable Part: x is a *separable part* of $y =_{def} (x < y \land \neg\Box_x(Ex \to x < y))$

In words: a proper part is separable from its whole just in case it is not rigidly essentially grounded in the whole of which it is a proper part. In addition to the notion of a separable part, part-priority has it that parthood itself is understood as an *external* relation. By 'external relation' here I mean a relation R_e whose relata exist and are what they are, irrespective of whether or not R_e obtains. In other words, x's being a part of y is external in the sense that it is possible that x exist *as such* without being a part of y. More precisely:

(R_e) x is *externally related* to $y =_{def} R_exy \to \neg\Box_x(Ex \land Ey \to Rxy)$

On this score, proper parthood resembles the relation of set-membership in that just as the members of a set can enter into the set-membership relation and remain essentially unchanged, so too with separable parts standing in the parthood relation according to a part-priority description of the mereological hierarchy.

Corresponding to the above notion of a separable part, a whole-priority description of the mereological hierarchy is committed to the notion of an *inseparable part*, a part whose *existence* and *identity* is essentially grounded in whole of which it is a part:

Inseparable Part: x is a *inseparable part* of $y =_{def} (x < y \land \Box_x(Ex \to x < y))$

The distinction between a separable and an inseparable part is a far reaching one in the history of philosophy. Having first been introduced to the Western philosophical tradition by Plato, the notion was given its most explicit and detailed formulation by Edmund Husserl in part three of his *Logical Investigations*.[39] If wholes are ontologically prior to their parts such that they rigidly ground the existence and identity of their proper parts, it follows by the tiling constraint that no proper part of a whole is capable of existing independently of that very whole, i.e. they are inseparable from the wholes of which they are a part.

The parthood relation, on whole-priority, is *internal* as opposed to external as per part-priority. An internal relation, as I am using the term here, is one such that if x is internally related to y by the relation R_i then it is logically impossible for x to exist unless y exists and x is related to it by R_i.[40] Hence:

(R_i) x is *internally related* to $y =_{def} R_ixy \to \Box_x(Ex \land Ey \to Rxy)$

Parts that are R_i related to their wholes are rigidly essentially grounded in their wholes.

Having characterized the two general answers to DG as well as their respective commitments to the grounding constraints on the proper parts of composite objects (as well as on the relation of parthood itself), let us proceed to consider a few options in fundamental mereology that are individual variants of whole-priority and part-priority:

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[39] For Plato, see Harte (2002) where she refers to the inseparability feature what I am calling inseparable parts as their being 'structure-laden.'

[40] Johansson (1989: 113).

Priority Monism: the maximal mereological whole, the cosmos, is metaphysically basic and is ontologically prior to its proper parts.

Priority Macrophysicalism: intermediate macrophysical wholes are metaphysically basic and are ontologically prior to their proper parts.[41]

Priority Microphysicalism: the microphysical parts of composite wholes are metaphysically basic and are ontologically prior to their wholes.

The above formulation of fundamental mereology in terms of mereological wholes *per se* and their parts (DG), I believe, is best-suited to capture the full spectrum of fundamental mereologies as including priority macrophysicalism as a possible description of the ordering of the hierarchy. Unlike the taxonomy of Schaffer and deRosset, DG allows for a whole-priority fundamental mereology to be broad enough to include the view that intermediate objects, not just the entire cosmos per priority monism, can (if reason dictates) serve as the ultimate grounding base for the hierarchy of composition. In doing so, it rightly rejects the thesis that monism has exclusive rights to the insight of WP$_b$. The point deserves underscoring: *for the defender of ordinary composite substances, the disassociation of monism and WP$_b$ is absolutely vital if they do not want their view to be swept away with the widespread dismissal of priority monism as a fundamental mereology.*

To take stock, we have been concerned with shifting the locus of classification in fundamental mereology from the cosmos to mereological wholes *per se* in order to make room for the possibility of fundamental intermediate wholes (i.e. those wholes that occupy a lower level of decomposition than the cosmos but one that is higher than the atoms) that are ontologically prior to their proper parts. Toward this aim, we introduced the question of *the direction of mereological grounding* which thereby generated two general positions in fundamental mereology—*whole-priority* and *part-priority*—which were intended to supplant Schaffer's characterization of fundamental mereology in terms of *monism* and *pluralism*. We then considered the following species of these two general answers to the direction of grounding: **Priority Monism, Priority Macrophysicalism,** and **Priority Microphysicalism.**[42]

3.4 Fundamental Mereology as Substantial Priority

There are, however, several points of contention that I'd like to raise concerning the above three options in fundamental mereology as well as DG in general that will help us

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[41]I take it that **Priority Macrophysicalism** as stated is what most take to be the most plausible intermediate position in so far medium sized living organisms are substances, if any. Cf. Cameron (2008: p. 6).

[42]I take these to represent the most widely held fundamental mereologies in the Western tradition as well as the contemporary literature. I make no claim as to whether or not they exhaust the options.

hone in on the view that I intend to defend in the sequel. First, note that all three fundamental mereologies are individuated not merely by the direction of grounding from whole-to-part or from part-to-whole, but by the *level of the mereological hierarchy at which the fundamental entities reside*. What differentiates monism and priority macrophysicalism as species of whole-priority, for instance, is that the latter takes the basics to occupy the intermediate level of the hierarchy of composition, the former the maximal level. But this requires, rather implausibly in my opinion, that the ontologically fundamental entities must be *either* (exclusively) maximally large, medium sized, *or* maximally small. On the surface, this seems needlessly restrictive as nothing demands that we take the basic entities to exhibit such uniformity regarding their level of occupation on the mereological hierarchy. Unless we are given reason to think otherwise, we should allow for the possibility that the basic entities occupy a multiplicity of levels on the mereological hierarchy, as long as this remains consistent with the tiling constraint as per **No Parthood**.[43]

Second, and most importantly, while whole-priority and part-priority present themselves as being mutually exclusive grounding descriptions of mereological wholes—either wholes ground their proper parts or they are grounded in their proper parts—I do not take them to be as such. The widespread underlying assumption here is that there is only a single *kind* of mereological whole at play in the discussion as to whether wholes per se or their parts are basic. This assumption, I presume, is the result of the pervasive influence of classical extensional mereology as applied to ordinary objects and is ubiquitous in contemporary debates in material objects.

To illustrate the widespread view that there is but a single kind of mereological whole, consider van Inwagen's (1990) well known Special Composition Question. It is widely assumed that any plausible response to the question of when two or more entities compose a further entity demands a *single* uniform answer that holds for every composite object whatsoever. This assumption, I believe, drives much of the widespread suspicion towards a Series-style response to the question as being objectionably arbitrary and ontologically extravagent.[44] If we adopt the predominant view that there is only a single kind of mereological whole—mereological sums or fusions perhaps—then whole-priority and part-priority are indeed mutually exclusive; one and the same kind of whole cannot both ground and be grounded in its proper parts at the same time.

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[43] Of course, if the cosmos is basic, then nothing else is basic and, *ipso facto*, no basic occupies a level of decomposition lower than the cosmos. Thus, when I allow for the basics to occupy a multiplicity of mereological levels as consistent with **No Parthood**, my aim is to allow for some intermediate basic entity (a molecule, for example) that does not enter into the composition of a basic whole at a higher-level (whether or not there are such entities)

[44] Markosian (1998) states the Series response as follows: "For perhaps the truth of the matter is that there are different types of object in the world, and that for each such type, there is some unique relation such that whenever some xs of that type stand in that relation to one another, then there is an object composed of those xs."

However, if we follow Aristotle, Aquinas, Husserl as well as a handful of contemporary philosophers such as Kit Fine, Mark Johnston, Kathrin Koslicki, E.J. Lowe, J.P. Moreland, David Oderberg, Peter Simons and even Schaffer himself, and countenance distinct *kinds* of mereological wholes with differing existence and identity conditions, then it is entirely reasonable to maintain that some are governed by whole-priority and others by part-priority.[45]

As is well known, Aristotle and many of his Latin interpreters differentiated between composite objects *qua* substances and *qua* accidental unities (or what Aquinas refered to as *per se* and *per accidens* unities). For these thinkers, as we will see in more detail later, substances are ontologically prior to their parts in that they ground the identity and existence of their proper parts. Accidental unities, on the other hand, are non-substantial wholes which are grounded in their proper parts such that they derive their existence and essence from their decompositional structure.

Following this long-standing tradition in mereology, Schaffer himself distinguishes between 'integral wholes' or 'organic unities' and 'mere aggregates' precisely on the grounds that the former are governed by whole-priority and the latter by part-priority. He states,

> I think common sense distinguishes mere aggregates from integrated wholes: 'that which is compounded out of something so that the whole is one... not like a heap, but like a syllable ' (Aristotle 1984b, 1644). Common sense probably does endorse the priority of the parts in cases of mere aggregation, such as with the heap. Yet common sense probably endorses the priority of the whole in cases of integrated wholes, such as with the syllable. (Schaffer 2010b: 47)

In a similar vein, Kit Fine (1994c) adjudicates between two different kinds of mereological wholes, what he calls 'compounds' and 'aggregates,' on the basis of their differing existence conditions. Regarding compounds, Fine recommends "that we take the bold step of recognizing a new kind of whole" which, in contrast to aggregates, are ontologically prior to their parts in some sense or other (1994c: 139).

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[45] Consider the following representatives of this line of thinking: Lowe (2009: 94) states, "What I do think is that mereological sums and things like cats have different principles of composition, just as they have different criteria of identity, and that the principle of composition for mereological sums is simply that some things, the xs, have a mereological sum, y, just so long as the xs (all of them) exist. Hence, I maintain, if one or more of the xs ceases to exist, so does y. Things like cats have a much more complicated and interesting principle of composition." Further, Simons (1987: 324), "That the distinction between sums and non-sums–which we may call *complexes*–is an ontological one may be seen by comparing their existence conditions. For sums these are minimal: the sum exists just when all the constituent parts exist... By contrast, a complex constituted of the same parts as the sum only exists if a further constitutive condition is fulfilled." Lastly, Johnston (2006) states, "Each genuine kind of complex item will have associated with it a characteristic principle of unity; for arguably, it is sameness in principle of unity and kinds of parts than in turn qualifies the members of a given kind to be included in the complex whole that is the kind."

With the above distinction between different kinds of mereological wholes in hand we come to a fourth option in fundamental mereology that situates an answer to DG in terms of the *ontological category* of the mereological whole in question:

> **Substantial Priority:** substantial wholes are metaphysically basic and are ontologically prior to their proper parts.

Following Aristotle, the medieval scholastics, and a host of contemporary substance ontologists, substantial priority maintains that the elite status of being a basic or fundamental kind of entity on the hierarchy of composition is reserved for objects of the category of substance.[46] On this view the dependence relations that obtain between a whole and its proper parts are determined by *what* the object is in terms of its ontological category, whether a composite substance or a composite non-substance (e.g. an accidental unity or an aggregate), irrespective of the size or level at which the whole is located. DG asks "Are wholes *per se* ontologically prior to their parts or vice versa?" Substantial priority answers: "sometimes they are and sometimes they are not, it depends on the *category* of the merelogical whole under consideration."

But how exactly are we to understand the notion of substance at the heart of substantial priority? The question of the criteria for substantiality is well-traveled and I certainly don't intend to say anything new on the matter here. I do, however, want to underscore in particular the importance of unity considerations when it comes to delineating substantial versus non-substantial composite objects. Borrowing from Gorman (2006), Lowe (2010), and Toner (2010), I propose the following necessary conditions for the concept of a substance in terms of essential grounding and unity:

> **Substance:** x is a *substance* only if (a) there is no y such that (i) y is concrete, (ii) y is not identical with x, (iii) x is rigidly essentially grounded in y and (b) x is unified in the right kind of way.[47]

Clause (a) of **Substance** employs the notion of rigid essential grounding as explicated in chapter 2 in order to capture a vital aspect of the metaphysical fundamentality of substances; the real definitions of substances are not derived from the real definition of any distinct concrete entity. It is the fundamentality of substances per se (whether complex

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[46]Note that Schaffer could plausibly be interpreted here as a proponent of substantial priority. However, in so far as Schaffer makes the further claim that the cosmos is a substance, he goes beyond the scope of substantial priority and into priority monism. While **Priority Monism** entails **Substantial Priority**, the converse does not hold. My contention here is that the issue of *which* entities fall under substantial kinds–whether the cosmos, the intermediates, or their minimal parts–is orthogonal to whether substances *per se* are ontologically basic entities. Substantial priority is meant to capture this distinction.

[47]I assume here that substances are concrete in so far as I take them to be (at the very least) capable of persisting (although they need not in fact persist as with the possibility of substances that exist only for an instant and thus have zero temporal extant) and are the locus of fundamental causal powers. Both of these conditions, as I see it, exclude abstract objects from playing the role of substances, although I won't argue for this thesis here.

or simple) that is captured by Schaffer's notion of **Covering** as per the tiling constraint. As constituting reality's metaphysical foundation, substances are complete for a world w in that they collectively provide an essential grounding base for w; all non-substantial entities are grounded in the substances.[48] Substances, on this reading, are ontologically prior to non-substances precisely *because* they serve as their essential grounds and are themselves essentially ungrounded entities, i.e. their natures are fundamental or primary. In contrast to existential grounding, the asymmetry of essential grounding is aptly suited to capture the ontological *priority* of substances which has traditionally been at the heart of the notion of substance.

Clause (a) states that there is no distinct concrete entity in which a substance is rigidly essentially grounded. Note that this holds even for the theist who is committed to the existence of a God who conserves and sustains the existence of every distinct entity whatsoever (or perhaps every distinct concrete entity). This is precisely because of the fact that while every (concrete) entity that is not identical to God is *existentially* grounded in God's sustaining causal power, this does not imply that every entity is therefore *essentially* grounded in God's sustaining causal power. While substances may depend for their existence on the sustaining power of God, on this view, *what* they are fundamentally as expressed by their real definition need not make reference to the existence and sustaining power of God.[49] Moreover, it needs to be pointed out that clause (iii) in particular is entirely compatible with a substance being *accidentally existentially grounded* in an entity of a particular type. A plausible example of this would be that while a composite substance fails to depend for its existence and identity on any one of its individual proper parts, it does depend for its existence qua composite object on its being composed of *some parts or other*.

Note also that on the assumption that composition is not identity, (a) implies that a composite substance fails to be rigidly existentially as well as rigidly essentially grounded in its proper parts. Yet it is widespread among current substance ontologists to find a definition of substance as an ontologically fundamental or independent entity to include an exception clause for its being rigidly grounded in or dependent on its proper parts (if it has any). Fine (1995), for instance, notes "…a substance may be taken to be anything that does not depend upon anything else *or, at least, upon anything other than its parts.*"[50] In like manner, Simons (1998: 236) states that "The ontological primacy of substances arises chiefly from their independence, or ability to subsist alone… An object is independent in the corresponding sense when it depends on nothing apart from itself *and perhaps parts of itself*, giving a sense to the idea of something depending on nothing

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[48] The traditional statement of this is found in Aristotle's *Categories* 2b6-7 (See 1984: 5): "So if the primary substances did not exist it would be impossible for any of the other things to exist."

[49] As Gorman (2006: 7) points out, this was Aquinas' view regarding the dependence of creatures on God. See Aquinas *ST* 1, q.44, a.1, ad. 1.

[50] Emphasis mine.

'outside itself'."[51] Lastly, Gorman (2006) includes the following exception clause for proper parts in his definition of substance, where x is a substance such that there is no particular y such that "y is not one of x's proper parts and the identity of x depends on the identity of y."

But if complex substances are truly ontologically independent and hence complete in the sense that they collectively serve as the exhaustive grounding base for our world, then the inclusion of the above exception clauses for the proper parts of substances seems misplaced.[52] As Robb (2009) has aptly pointed out, "[i]f something exists because its parts do, then it's not basic, doesn't exist in its own right. This premise also seems to be self-evident." No object is identical with any of its (proper) parts, and so if an object exists because its parts do, it is parasitic on something else and therefore not a substance. On the assumption that mereological wholes (and *ipso facto* substantial wholes) are numerically distinct from their proper parts, I am inclined to think that any definition of the notion of substance in terms of ontological independence or metaphysical fundamentality ought to say that substances fail to be rigidly essentially grounded in any distinct entity *tout court*, including its proper parts.

This brings us to clause (b) of **Substance**. In contrast to the foregoing substance ontologists who presume that the fundamentality of substances is compatible with their being rigidly grounded—whether existentially or essentially—in their proper parts (if they exhibit mereological structure at all), Lowe (2012) maintains that composite substances are neither rigidly existentially nor rigidly essentially grounded as such. For Lowe, composite substances such as living organisms fail to rigidly depend for their existence and identity on *any* distinct thing, including their proper parts. While I am in wholehearted agreement with Lowe that the ontological basicness of substances is rightly captured by their failing to be essentially grounded (or what he calls "identity dependent") in *any* distinct thing whatsoever (including their proper parts), we differ as to whether the fundamentality of substances is exhausted by clause (a) of **Substance** above.

In contrast to Lowe, I am inclined to think that the fundamentality or ontological priority of substances extends not only to their being essentially ungrounded as in (a), but also to their exhibiting a high degree of unity as stated in (b) above. But how exactly we unpack the unity involved in (b) is a difficult matter that has been at the heart of the debate concerning the definition of substance throughout the history of philosophy. The view that I take to be at the heart of substantial priority and one that I will be defending in the course of this essay (by showing that such a conception of substantial unity is both scientifically serious and philosophically fruitful), which has a rich historical precedent and finds contemporary defenders in Moreland (2009), Schaffer (2010) and Toner (2010), is that a substance's being 'unified in the right kind of way' involves its

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[51]Emphasis mine.
[52]This is underscored by Toner (2010).

lacking *separable parts* (see above) and thus adhering to **No Parthood.**

We must proceed with caution at this point as the preceding claim is liable to misrepresentation. There are two distinct ways a composite object might lack separable parts: either by (i) lacking proper parts altogether or (ii) having only proper parts that are *inseparable* (see above). The unity clause as understood in terms of lacking separable parts is satisfied by both simple substances (if there are any) in so far as they conform to (i) as well as composite substances in so far as they adhere to (ii).

More specifically, on the view that I am recommending here, substances are not only the terminus of essential grounding relations, they also place certain grounding constraints on their proper parts (if they have any). The proposed unity that is said to characterize a substantial whole as per clause (b) is precisely one that stems from its serving as the essential ground for each of its proper parts. The proper parts of substances, to borrow an apt phrase from Harte (2002: 165), are 'structure-laden' in that "they get their identity only in the context of the structure of which they are part."[53] Pace Lowe, I am inclined to think that the fundamentality of substances suggests that they are not only *complete* but *minimally complete*, where a set S of entities at world w is minimally complete for w iff (i) S is complete for w, and (ii) no proper subset of S is complete for w. Substances—whether simple or complex—fail to have a proper sub-plurality that are themselves basic or fundamental. As a result, both clauses (a) and (b) of **Substance** aim to explicate the defining feature of a substance qua metaphysically fundamental or non-derivative entity.

The above conception of a composite substance as one that exhibits an essential grounding ordering over its proper parts (as per (b)) whereby the parts are 'structure-laden' gives us a way to account for the difference between substantial and non-substantial mereological wholes.[54] Let us distinguish between what I will henceforth call *grounding wholes* and *grounded wholes*, the former corresponding to substantial wholes and the latter to non-substantial wholes. Using 'O' to signify (actual) concrete objects, we can state this a bit more precisely a follows:

Grounding Whole: x is a *grounding whole* $=_{def}$

$$(\exists y)(Oy \wedge y < x \wedge (\forall z)(z < x \to \Box_z(z \rhd_t x)))$$

Grounded Whole: x is a *grounded whole* $=_{def}$

$$(\exists y)(Oy \wedge y < x \wedge (\exists z)(z < x \to \Box_x(x \rhd z)))^{55}$$

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[53]Interestingly enough, Harte (2002) attributes this grounding-based view of the structure of wholes to Plato.

[54]This, in fact, is the precise way that Aquinas (1947) distinguishes between substances and non-substances: "A substantial form perfects not only the whole, but each part. For since the whole is made up of its parts, a form of the whole that does not give existence to the individual parts of the body is a form that is a composition and ordering (the form of a house, for example), and such a form is accidental. The soul, on the other hand, is a substantial form, and so it must be the form and actuality not only of the whole, but of each part." (*ST*, 1a.76.8c)

[55]Where '$\rhd$' can denote either total or partial grounding depending on whether the grounding base for

In words: x is a *grounding whole* just in case there is at least one individual object that is a proper part of x, and every proper part of x is such that it is (totally) rigidly essentially grounded in x. On the other hand, x is a *grounded whole* if and only if there is at least one individual object that is a proper part of x, and there is at least one proper part of x such that x is rigidly essentially grounded in it.[56]

It should be emphasized that the grounding descriptions that govern grounding and grounded wholes apply to their *individual* proper parts, i.e. those parts that belong to the category of *object*, *thing*, or *individual* (I use these interchangeably in what follows). Here I help myself to the fundamental distinction between an entity that is structured in a particular manner—what I refer to as an 'individual' or 'object'—and that which is structured to make an individual or object—what I refer to as 'stuff.'[57] More specifically, by 'object' here I simply mean an entity that has both determinate identity conditions as well as determinate countability.[58] Regarding the former, it is part of the nature of entities belonging to the category *object* that if x and y are both objects, then there must be a fact of the matter as to whether $x=y$. As for the latter, the determinate countability of objects stems from their being intrinsically unified or structured—x's being determinately countable obtains in virtue of its being *one* thing, a unit of being. While all substances are objects in so far as they have determine identity conditions and they are intrinsically unified, not all objects are substances (grounded wholes being an example of a non-substantial object). When I henceforth speak of the proper parts of a composite object in the sequel I mean those proper parts that are individuals or objects in the sense specified above.

As a grounding whole, a composite substance not only fails to be essentially grounded in any distinct entity, it is also ontologically prior to its proper parts in so far as it essentially grounds each one of them. As such, grounding wholes are governed by Schaffer's **No Parthood** constraint on fundamental entities in that they lack substantial or basic proper parts. A grounding whole is unified to the highest degree in virtue of being composed of *grounded* parts only (i.e. inseparable), parts whose existence and identity are defined in terms of the particular whole of which they are a part.

Grounded wholes are non-substantial composite objects and thus exhibit a much weaker kind of unity in so far as they are composed of *separable parts*, i.e. fundamental entities that retain their existence and identity apart from objects they compose at any particular time. In reference to the part-priority fundamental mereology of many of the early modern philosophers (in the form of what he calls "the actual parts doc-

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x is one or many.

[56]While the grounding base for grounded wholes will more often than not be a multiplicity of items, this formulation allows for the possibility of a grounded whole being (totally) grounded in just a single proper part.

[57]The question as to whether fundamental ontology can be accounted for using a thing, stuff, or a mixed ontology of both things and stuff is a matter of considerable debate in the literature.

[58]See Lowe (1998) and (2006) in particular.

trine"), Holden (2004: 150) draws out the traditional difference between grounding and grounded wholes as follows:

> The actual parts doctrine states that the parts of bodies are each fully-fledged distinct entities. This implies that the whole gross extended body is a composite or compound entity: a structured aggregate of these pre-existing, independently existing parts. Since each actual part is a distinct entity, the whole must be conceptualized as a composite structure, a compound built up from ontologically prior concrete elements...A second important corollary is sometimes thought to follow from this first point. Since extended entities constructed from actual parts are aggregates, they fail to meet two traditional criteria for substancehood. First, as aggregates, their existence is a derivative one, depending on the ontologically prior existence of their parts...Second, as aggregates, bodies lack the unity typically required for substancehood. Thus those who follow through the actual parts view to this corollary will deny that material bodies are substances in full metaphysical rigor: at best they are collections of substances... in Leibniz's phrase "substantiata," "of-substances." (Holden 2004: 150)

Some will no doubt object that requiring substances to be unified in such a way as to be either mereologically simple or be composed of only inseparable parts as much too restrictive. What arguments might be proposed in favor of such a radical view? In the sequel I'll argue that the above notion of a substance as a fundamental entity lacking separable proper parts is both scientifically serious as well as philosophically fruitful in its ability to dissolve a host of puzzle in contemporary metaphysics. However, in addition to this line of thinking in the sequel, it might be helpful at this point to consider several historical and contemporary considerations in favor of substances as grounding wholes.

We can do no better than begin with Aristotle's own unity constraint on substantial wholes. As noted by Scaltsas (1994), one particular interpretation of Aristotle's account of the unified nature of composite substances is aptly described as 'substantial holism.' Scaltsas remarks,

> This is Aristotle's way of establishing that a substance is not a cluster of copresent (even interrelated) components, but a single, unified whole. The form unifies the components of a substance, not by relating them (which would leave their distinctness in tact), but by *reidentifying* them, that is, by making them identity-dependent on the whole. It is not *relation* that unites, but the *identity dependence* of the constituents on the whole, in accordance with the principle of form. (1994: 3)

Aristotle's substantial holism sheds light on his well-known 'homonymy principle:' that a severed hand and an eye that cannot see is a 'hand' and an 'eye' in name only. In his

own words, "For they [the parts of a whole] cannot even exist if severed from the whole; for it is not a finger in any and every state that is the finger of a living thing, but a dead finger is a finger only in name."[59] Aristotle's principle reason for endorsing this variety of substantial holism stems from his desire to safeguard the unity of fundamental wholes: a substance's having a *plurality* of substantial parts would undermine its being a *single* fundamental entity.

Many of Aristotle's medieval interpreters, most notably Thomas Aquinas, followed suit in thinking that a substance's being composed of a plurality of distinct substances would compromise the intrinsic (*per se*) unity of the substance. The rather lively scholastic debate concerning the unicity or plurality of substantial forms in a substance was one that dominated the medieval metaphysical landscape. Citing one common argument for the unicity of substantial form (what I am calling **No Parthood**), Duns Scotus remarks (without endorsing) that "[s]ubstance, understood as one of the [ten] most general categories, is an *ens per se*. No part of a substance is an *ens per se* when it is part of a substance, because then it would be a particular thing (*hoc aliquid*), and one substance would be a particular thing from many particular things, which does not seem true."[60]

Aquinas, following Aristotle, took considerations of unity to be at the heart of what it means for a substance to be fundamental (or "complete in its species" as he would put it). Generally, Aquinas considered composition as a type of unifying relation such that if the xs compose y then y is unified to a certain degree.[61] As a *single* composite object, a mereological whole can be either 'one thing' *simpliciter* (*per se*) or 'one thing' *secundum quid* (*per accidens*), that is, either an intrinsically or extrinsically unified particular. Along these lines, he states:

> One thing *simpliciter* is produced out of many actually existing things only if there is something uniting and in some way tying them to each other. In this way, then, if Socrates were an animal and were rational in virtue of different forms, then these two, in order to be united simpliciter, would need something to make them one. Therefore, since nothing is available to do this, the result will be that a human being is one thing only as an aggregate, like a heap, which is one thing *secundum quid* and many things *simpliciter*.[62]

Here Aquinas is of the opinion that since the intrinsic unity of a substance requires the existence of a unifying relation or relations, and since there is no such relation that grounds the fact that *animality* and *rationality* are substantial forms of a *single* substance as opposed to two numerically distinct substances that are related to each other, Socrates is therefore fundamentally a 'many' and a 'one' only in a secondary or derivative sense.

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[59] *Metaphysics* 1035b23-25, see his (1984b).
[60] *In Praed*. 15.1 as cited in Pasnau (2011: 607-608).
[61] See *ST* III, q. 90, a. 3, ad. 3 in particular.
[62] Aquinas (1984: 11c.)

But as Lowe (2012) has pointed out, the above Aristotelian line of reasoning in favor of **No Parthood** conflates the *composition* relation with the relation of *identity*.[63] He argues, rightly in my opinion, that the plurality at play in the case at hand is to be attributed not to Socrates but to his proper parts. Though the proper parts of Socrates are many, Socrates himself is a *single* unified whole. If Socrates were *identical* to his proper parts, then he would be a plurality in virtue of being identical to a plurality of proper parts. If composition is not identity, however, then a substances' being composed of a plurality of substantial proper parts does not compromise the oneness of the substance itself.

While I grant Lowe's point in general, I am inclined to think the above Aristotelian line can be salvaged. By my lights, Lowe fails to appreciate the fact that composition is a type of generative (or 'building') operation, which presumably explains why its application gives rise to a numerically distinct entity.[64] While composite objects are numerically distinct from their many proper parts, they do not merely *contain* such parts as a region of spacetime contains a material object, rather, it is natural to think that they are *constructed* or *generated* from their parts.

An entities' being the product of a generative operation in general is quite easy to see in the case of the construction of a set, where the set $\{x, y, z\}$ is the result of the application of the *set-builder* operation S on x, y, and z. Moreover, it is precisely *because* the objects from which $\{x, y, z\}$ is generated remain essentially *as such* after the application of S that we commonly take them to be ontologically prior to the set itself; the existence and identity of the construct are grounded in the existence and identity of the entities from which it is constructed. Similarly, consider the generation of a mereological sum or fusion as on classical mereology, where fusion F with x_1, x_2, x_3 as proper parts is the product of the application of the fusion operation O on x_1, x_2, x_3. As with sets, the objects over which O is applied remain *as such* after F is generated or constructed, which again plausibly explains *why* many are apt to think fusions are grounded in their parts, that the parts of fusions are ontologically prior even though the axioms of classical mereology *per se* are entirely non-modal.[65]

Take, then, a substantial whole S and the two proper parts a and b from which it is generated by means of applying the *substantial composition* operation C.[66] Quite

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[63] See also Harte (2002) for this same objection albeit applied to the general mereological insight among the ancients, what Harte calls 'the pluralizing parts principle,' that an object is just as many as its parts; objects are pluralized in virtue of their many parts.

[64] See Fine (2010: 582), Paul (2012a), as well as Bennett (2011).

[65] The assumption that fusions or mereological sums are grounded in their proper parts is widespread indeed, although there are some exceptions. For a more detailed discussion of the interplay between classical mereology and modality see Uzquiano (forthcoming).

[66] Here I presuppose for illustration that there are multiple composition operations each giving rise to distinct kinds of mereological wholes (although these operations need not be fundamental or basic). Or, at the very least, a distinction between the generative operations that govern substances and those that govern fusions or sums.

simply: S is the result of applying C to a and b. But here is where I think the Aristotelian intuition gets its traction: if substantial composition is generative in that it gives rise to a distinct entity S by means of C, and were a and b to remain essentially unaltered after the generation of S, it is difficult to see how S could fail to be *what* it is in virtue of a and b.[67] That is, it is natural indeed to think that if that from which a substance is generated (a and b) continues to exist *as such* as part of its compositional base (whether such parts are substantial or non-substantial), that the substance would thereby be *dependent* on these objects for its fundamental identity and hence fail to be a substance (via its failure to satisfy clause (a) of **Substance**). This, I submit, is *precisely* what underlies the widespread adherence to the view that parts are ontologically prior to their wholes (part-priority).

The Aristotelian intuition states that the substantial whole will remain essentially dependent on the objects from which it is generated (and hence ontologically posterior) unless such objects are essentially altered upon the generation of the substance. On the natural assumption that composition is a generative operation, the substance ontologist who is keen to retain the fundamentality or priority of substances is faced with the following dilemma regarding their mereological structure: either (i) substances are not genuinely fundamental entities in so far as they appear to be rigidly essentially grounded in some of the distinct objects from which they are generated or (ii) the objects from which a substantial whole is generated are essentially altered upon composition. As far as I can tell, Aquinas opts for the latter. In contemporary parlance, his view is that the ontological priority of substances demands not only their essential completeness but rather their minimal completeness in that they serve to essentially ground each of their proper parts. He states, "A substantial form perfects not only the whole, but each part. *For since the whole is made up of its parts*, a form of the whole that does not give existence to the individual parts of the body is a form that is a composition and ordering (the form of a house, for example), and such a form is accidental."[68]

In addition to the above considerations involving ontological priority and the generative nature of composition, John Heil (2012) has recently argued that substances fail to have other substances as proper parts (how I'm construing clause (b) of **Substance**) on the grounds that the primary role of substances qua property bearers requires it. Property-possession, for Heil, requires the right sort of metaphysical underpinning: bearers of properties must be *singular* units of being and thus sufficiently *unified*. Since objects that have substances as proper parts are, strictly speaking, pluralities or complexes of sub-

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[67]In Paul Humphrey's (1997) terminology, substantial composition is a type of 'fusion operation' such that the entities over which it operates "no longer have an independent existence within the fusion" and "have been 'used up' in forming the fused property instance" (where he takes property-instances in particular to be the entities governed by the fusional operation). Interestingly enough, Humphreys acknowledges the shortcoming of his chosen label for such an operation, "[s]ince this paper was first drafted in 1991 I have realized that the term 'fusion' has a standard use in the mereological literature that is almost opposite to its use here."

[68]ST 1.76.8c, emphasis mine.

stances that stand in relations to one another, they are unfit to bear properties according to Heil. With the tradition role of substances as being primary property bearers in hand, **No Parthood** follows quite naturally. Since Heil takes complex objects such as tables, turnips, and spires as being ultimately composed of substances (particles), such ordinary macrophysical objects are rendered non-substantial and thereby fail to be property bearers (they are, he claims, 'quasi-substances,' substances by courtesy, and their properties 'quasi-properties').

Turning now to Schaffer's own considerations for favoring **No Parthood**, he offers two primary reasons to endorse this traditional Aristotelian insight. The first states that the substances—as independent units of being—must be modally unconstrained in their relation to one another. To illustrate, consider two substances x and y, where x is a proper part of y and both of which are characterized by the intrinsic property F. For our purposes here, assume also that x is the only proper part of y that bears F. In virtue of x being a proper part of y, x and y share a common part, in this case x (where x is an improper part of itself and y has x as a proper part). Now suppose it to be the case that x undergoes intrinsic alteration and ceases to be F. It follows, in virtue of their overlap, that y would thereby cease to be F as well. More generally, x and y would be modally constrained such that "it is not possible to vary the intrinsic properties of the common part with respect to the one overlapping thing, without varying the intrinsic properties or composition of the other (Ibid.)." Consequently, in so far as substances would be modally constrained were they to exhibit mereological overlap, they cannot stand in part-whole relations to one another.

The second argument hinges on considerations in ontological economy: since one should not multiply substances beyond necessity, and that since substances which stand in part-whole relations are redundant, it follows that substances fail to stand in part-whole relations to one another. The first premise is uncontroversial in so far as most would grant the truth of its weaker cousin that one ought not multiply entities without necessity; its plausible that such a principle applies all the more to *fundamental* entities. The second premise—that basics related by means of part-whole relations are redundant—relies on the notion that the duplication of the whole entails the duplication of all of its proper parts and thus "adding the parts contributes nothing new to the characterization of reality already provided by the whole."[69] Schaffer gives the example of Socrates having the property of *being snub nosed* intrinsically. Any intrinsic duplicate of Socrates as a whole will (must) have a snub nose as a proper part. In the same manner, any intrinsic duplicate of a substantial whole will suffice to duplicate all of its proper parts and their intrinsic properties and relations. If the duplication of the whole automatically secures the existence and intrinsic properties of its proper parts, then to maintain that the proper parts of substances are substances in their own right would be to multiply

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[69]Schaffer (2010b: 41).

substances beyond necessity.

Whether or not the above arguments in favor of **No Parthood** are ultimately persuasive is not my immediate concern at this point (I myself am not in full agreement with all of them). While I take, with Schaffer, the truth of **No Parthood** to be a reasonable constraint that ought to guide the project of fundamental mereology, one of the primary aims of this essay is to defend a *particular* application of this enduring piece of philosophical wisdom.

To see this, note that substantial priority as stated is entirely compatible with priority monism *per se* in so far as it is neutral as to *which* composite objects are substances, whether the world consists of a multiplicity of substances or a just a single substance. Where then lies the distinction between substantial priority and priority monism? The important point here is that it is part and parcel of Schaffer's priority monism that (i) the cosmos in particular is a substance and (ii) that composite material objects are, strictly speaking, proper parts of the cosmos, from which he then proceeds to infer that the cosmos is the only substance as per the application of **No Parthood**.[70] Though it is true generally that substantial wholes are ontologically prior to their proper parts, the substantiality of the cosmos, together with the fact that sub-world objects are proper parts of the cosmos, renders all sub-world objects non-substantial.

In the same way that priority monism is defined in terms of the substantiality of the cosmos whose proper parts are composite objects, substantial priority, as I will use the term in this essay, is the view that at least *some* of the intermediate proper parts of the cosmos are substances in their own right, including many of the ordinary composite objects countenanced by common sense and appealed to in our best empirical theories of the world. I submit that priority monism and substantial priority are best viewed as distinct species of a whole-priority fundamental mereology, both of which situate the question of the fundamentality of mereological wholes to their ontological category (although Schaffer is not explicit in this regard).

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[70]Although Schaffer's explication of a substance is weaker than mine in that fundamental entities are merely *existentially* as opposed to essentially ungrounded entities.

Chapter 4

Against Part-Priority

"There seems to be nothing more evident than that all bodies must consist of parts, and that every part of a body is a body, and a distinct being, which may exist without the other parts...when [matter] is divided into parts, every part is a being or substance distinct from all the other parts, and was so even before the division." —Thomas Reid, *Essays on the Intellectual Powers of Man*, i. 323.

My aim in this chapter is to examine the predominant fundamental mereology on offer in the contemporary literature, part-priority, as expressed in its most popular guise, priority microphysicalism. I begin by unpacking a few of the core tenets of priority microphysicalism in particular and then consider some of the lines of reasoning that have been advanced in its favor. I then set my sights on part-priority in general arguing that it is ill-suited to account for the metaphysical possibility of gunky worlds, worlds devoid of mereological simples. I then turn to considerations regarding the failure of whole-part supervenience within the domain of physics, chemistry, and biology with respect to both microphysical and macrophysical wholes, thereby taking aim at both part-priority and priority microphysicalism.[1]

4.1 Priority Microphysicalism

Arguably, the predominant fundamental mereology at work in contemporary metaphysics is *Priority Microphysicalism*:

> **(PM) Priority Microphysicalism:** the microphysical parts of composite wholes are metaphysically basic and are ontologically prior to their wholes.[2]

[1]As we will see below, I do not take the falsity of part-priority *per se* to entail the falsity of priority microphysicalism; the latter could be true even if the former were false. Hence the need to offer independent arguments against priority microphysicalism in addition to those aimed at part-priority.

[2]I borrow the term 'Priority Microphysicalism' from deRosset (2010).

As an ontological interpretation of the mereological hierarchy, PM holds (broadly) that all macrophysical reality is metaphysically grounded in microphysics.[3] While there is an intimate relationship between part-priority and priority microphysicalism, the latter does not entail the former. As we will see shortly, priority microphysicalism need not be committed to part-priority as a *global* fundamental mereology. Before we turn to examine the merits of part-priority and priority microphysicalism in detail, we need to get clear on the latter as it permeates many of the contemporary debates in metaphysics, philosophy of science, and philosophy of mind.

While PM is often formulated as a *supervenience thesis*, it is often the case that it is intended to denote a much stronger thesis than is captured by the mere covariance between properties or classes thereof. It is often pronounced that supervening properties are 'determined' or 'fixed' by their subveneing base.[4] As Kim (1998: 11) rightly notes,

> [I]t is customary to associate supervenience with the idea of dependence or determination: if the mental supervenes on the physical, the mental is dependent on the physical, or the physical determines the mental, roughly in the sense that the mental nature of a thing is entirely fixed by its physical nature... In fact common expressions like 'supervenience base' and 'base property' all but explicitly suggest asymmetric dependence (1998:11).

According to PM, microphysical entities serve as the ultimate ontological base–the terminus of the grounding sequence–that grounds the mereological structure we see in reality.

One need not look far to note the prevalence of PM in contemporary philosophy. Horgan (1982: 29) puts it well when he states:

> Many contemporary philosophers believe there is something ontologically fundamental about physics, particularly microphysics. They believe that all the facts about our world are somehow fully determined by the microphysical facts concerning the subatomic 'building blocks' of the world. (Horgan 1982: 29)

In like manner, Ellis (2001: 64) remarks:

> The accepted paradigm of ontological dependence is to be found in the theory of micro-reduction. Methane molecules, for example, are said to depend ontologically on their constituent hydrogen and carbon atoms. They are said to be ontologically dependent because the methane molecules could not in fact exist if these atoms did not exist. Conversely, however, the atoms could exist, even though the molecules did not exist. (Ellis 2001: 64)

[3]For a recent defense of PM that is sensitive to the question of fundamental mereology, see Heil (2012).
[4]For a thorough treatment of supervenience as a stronger determination relation, see Heil (1998).

One often finds PM formulated in broad terms as the view that the properties, behaviors, laws, and/or facts about macro-entities are grounded in the properties, behaviors, laws, and/or facts of micro-entities. In addition to Horgan's above formulation of PM in terms of facts, Sider (2003: 2) defines PM in terms of properties (both monadic and polyadic) as "the attractive principle that the properties of wholes, in the actual world anyway, are determined by the properties of and relations between their atomic parts (where 'atom' means 'atom of physics', not 'partless simple')."

What's more, Hütteman and Papineau (2005: 2) include microphysical laws in their characterization of PM as the view that "macroscopic physical entities are asymmetrically determined by their microscopic physical parts and the microphysical laws that apply to those parts." After discussing the nature of mereological supervenience—that the properties of wholes are fixed by the properties of their parts—Kim (1998: 18) goes on to note the natural progression to PM, "A general claim of macro-micro supervenience then becomes the Democritean atomistic doctrine that the world is the way it is because the microworld is the way it is."

In what is perhaps the most exhaustive treatment of PM on offer, Hütteman (2004) considers three theses that he takes to be jointly constitutive of PM, all of which can be seen to encompass the many divergent explications of PM in the literature:

(MD) *Micro-Determination:* "The behavior or the properties of compound systems are determined by the behavior or the properties of their constituents and the relations among them but not vice versa." (2004: 7)

(MG) *Micro-Government:* "The laws of the micro-level govern the systems on the macro-levels." (2004: 7)

(MC) *Micro-Causation:* "All causation takes place in virtue of the causation on the level of the (ultimate parts)–or the micro-level. Macro-causation is entirely derivative and piggybacks on the causation of the micro-constituents." (2004: 7-8)

According to Hütteman (2004: 7), the core doctrine that binds the above three 'micro-theses' together is "the affirmation of an *ontological priority of the micro-level.*" In fact, he explicitly ties his three-fold formulation of PM to the question of what I am calling fundamental mereology: "The theses of micro-determination, micro-government and micro-causation concern the question of whether there is an ontological priority of the level the fundamental parts vis-à-vis the level of the compounds."[5] Hütteman is clear that PM "provides a decisive interpretation of the multilayered conception of reality," in particular, "an ontological interpretation of the hierarchical structure of the many layers of reality."[6]

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[5] See Hütteman (2004: 122).
[6] Ibid. 10.

In a similar fashion, Murphy (2007: 21-22) rightly notes that the ontological priority of the parts over the whole is the explanatory ground as to *why* the of above micro-theses obtain. Speaking of a view she calls 'atomistic reductionism,' Murphy states:

> Causation on this view is 'bottom-up'; that is, the parts of an entity are located one rung *downward* in the hierarchy of complexity, and it is the parts that determine the characteristics of the whole, not the other way around. So *ultimate* causal explanations are thought to be based on laws pertaining to the lowest levels of the hierarchy. The crucial *metaphysical* assumption embodied in this view is the ontological priority of the atoms over that which they compose. This is metaphysical atomism-reductionism (2007: 21).

Henceforth, I will follow Hütteman and Murphy in thinking that the core unifying feature of PM to be the metaphysical thesis of the *ontological* priority of the microphysical level of being, with the above micro-theses being consequences thereof.

Let us begin, then, by getting clear on the precise tenets of PM, beginning with the mereological structure of the basic entities that are said to occupy the smallest level of the hierarchy of composition. There are several options available to the advocate of PM as to which sorts of microphysical entities are taken to be fundamental. Let us consider just a few of what I take to be the most interesting variants of PM.

First, the advocate of PM may adopt an *atomistic* (i.e. mereologically simple) interpretation of the basic microphysical entities and thus take either simple subatomic particles (quarks, leptons, bosons, etc.) or spacetime points as metaphysically fundamental.[7] The idea here is that the ontologically fundamental base is populated by entities that are mereologically fundamental, i.e. lacking proper parts, which serve to exhaustively ground the existence, properties, and behaviors of macro-entities. A concise statement of a particle variant of PM is given by deRosset (2010: 4) from whom I borrow the label 'Priority Microphysicalism', though deRosset is clear that he in no way takes PM to entail such an interpretation:

> Priority Microphysicalism holds that the fundamental concrete individuals are very small. On this view, the existence and features of tables, raindrops, tectonic plates, and galaxies are ultimately explicable solely by reference to the existence and features of particles, including which particles are arranged table-wise, tectonic-plate-wise, etc. (deRosset 2010:4)

One might, on the other hand, reject the premise that microphysical being need be mereologically fundamental, thereby adopting an *atomless* interpretation of the ultimate

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[7]Another rather exotic option presents itself: extended simples. The advocate of PM may accept the mereological fundamentality of micro-entities while, at the same, time reject the thesis that such entities are point-sized, i.e. unextended. There are good physical considerations to go this route in so far as entities that occupy a point of space at any given time would exhibit an infinite energy-density. The defender of extended simples argues just this, see Simons (2004: 373).

ontological base of the hierarchy. After all, there is no scientific constraint on the content of our best physics being atomistic in this sense (cf. Schaffer 2003). A further option here is to maintain that microphysical being is ontologically basic in its serving as an *atomless* supervenience base for all of non-microphysical reality.[8] According to Schaffer (2003), an atomless supervenience base of this kind could take one of two forms. The supervenience base could either 'bottom out' in an *ultimate* ontological base (well-founded) or it might simply be a point in the mereology hierarchy below which there is an infinite descent of *symmetric* supervenience relations. On the latter, the infinite descent here would be, in Schaffer's terms, 'boring' in that microphysical wholes below such a threshold would supervene on their parts and vice versa.

The precise nature of the atomless supervenience base, which would serve to ground the existence of macro-phenomena, will, no doubt, be tied to considerations concerning the content of our best fundamental physics.[9] By way of example, one particular option (though not the only option of course) is to adopt a wave-theoretic view of the (well-founded) supervenience base that takes the mereological hierarchy to terminate in 'wavefunction-stuff' as per the Ghirardi-Rimini-Weber (GRW) theory of quantum mechanics. On this view, one could refer to various aspects of the universal wavefunction that enter into the dependence sequence that serves to ground the existence of some composite object at a some higher level in the hierarchy. To say that wavefunction-stuff qua supervenience base is metaphysically basic is to say, for example, that the existence of a particular chair is ultimately grounded in a 'chair-like' distribution of 'wavefunction stuff' or 'chair-like' behavior of the universal wavefunction in a certain locality (cf. Lewis 2006).[10]

In addition to the question of the specific mereological structure of the basic entities at the micro-level, PM comes in varying degrees of strength depending on the sort of relations that are said to hold between entities at the minimal grounding base. Perhaps the strongest form of PM in the literature is defended (however tentatively) by David Lewis and is known as *Humean Supervenience*: that all facts are metaphysically determined by the intrinsic properties of point-sized parts, together with the spatiotemporal relationships between these parts.[11] Lewis (1986b: ix) famously states this doctrine as

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[8]This option is noted by Schaffer (2003: 509-512).

[9]Again, the options here for an atomless supervenience are many. A few other suggestions would be where quantum theory is best construed as pertaining to various kinds of stuff (Lavine 1991) or perhaps even to quantized excitations of a field Redhead (1988) and Ginsberg (1984).

[10]This particular suggestion is taken from Tahko (unpublished ms).

[11]Here I restrict myself to Lewis' own preferred gloss on priority microphysicalism. There are, however, various non-Humean views that, with Lewis, locate the metaphysically basic entities at the microphysical level yet, contra Lewis, are much more liberal concerning the range of fundamental external relations that relate the occupants of the microphysical level. See Hawley (2001), Oppy (2000: 77), and Zimmerman (1997). On such views, the riches of the world (including facts about the laws of nature as well as the unity of perduring or exduring particulars) cannot be adequately accounted for along the austere lines of Humean Supervenience as stated by Lewis.

follows:

> ...all there is to the world is a vast mosaic of local matters of particular fact, just one little thing and then another...We have geometry: a system of external relations of spatiotemporal distances between points. Maybe points of space-time itself, maybe point-sized bits of matter or aether or fields, maybe both. And at those points we have local qualities: perfectly natural intrinsic properties which need nothing bigger than a point at which to be instantiated. For short: we have an arrangement of qualities. And that is all. There is no difference without difference in the arrangement of qualities. All else supervenes on that. (Lewis 1986b: ix)

The rigidity of Lewis' particular version of PM is evident in his insistence that spatiotempral relations are the *only* fundamental relations allowed to hold between the point-sized entities of the ultimate supervenience base.[12] Though Lewis is agnostic about the type of micro-entity taken as fundamental (particles, points, fields, etc.), the picture is a rather austere one indeed: a mosaic of microphysical point-parts related solely by spatiotemporal relations (for example, *being-one-meter-away-from*). The spatiotemporally related point-parts of the mosaic, together with the intrinsic qualities instantiated (locally) at such points, serves to constitute the Humean supervenience base upon which all else depends.

Lewis is clear in his characterization of the notion of supervenience as the denial of independent variation: if x supervenes on y, there can be no difference in x without a difference in y. He states,

> To say that so-and-so supervenes on such-and-such is to say that there can be no difference in respect of so-and-so without difference in respect of such-and-such. Beauty of statues supervenes on their shape, size and colour, for instance, if no two statues, in the same or different worlds, ever differ in beauty without also differing in shape or size or size or colour. (1999a: 29)

Elsewhere, Lewis (1986b: 15) is unequivocal regarding the modal import of the supervenience relation in saying "Supervenience means that there *could* be no difference of the one sort without difference of the other sort. Clearly, this 'could' indicates modality. Without the modality we have nothing of interest." On this score, it is *impossible* for a macrophysical whole to instantiate a supervenient property without first instantiating the corresponding subvenient property at the Humean base.

Though Lewis expresses some reserve about there being any privileged metaphysically deep notion of priority (Lewis 1999a: 29), the notion of supervenience operative

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[12]See Lewis (1999c: 226)

in HS is strikingly similar to the modal explication of grounding we examined in chapter 2: x is (rigidly) existentially grounded in y just in case necessarily, if x exists, then y exists ($\Box(Ex \rightarrow Ey)$). Not only is it impossible for a macrophysical whole to exhibit supervenient features without first instantiating the respective subvenient features, the latter are also *sufficient* for the instantiation of the former (which suggests that the latter metaphysically *fix* or *determine* the former).[13]

As an example of the relationship between macrophysical objects and their features (properties, behaviors) and the ultimate Humean supervenience base, Lewis offers the metaphor of a dot-matrix (1986a: 14) and a grid of pixels (1999b: 294). Lewis asks us to consider a grid of a million tiny pixels each of which are capable of instantiating some property or other (light/dark in his example). Together, the pixels form a picture which itself instantiates various global intrinsic properties such that there is "a supervenience of the large upon the small and many" (1999b: 294). While the picture exists, claims Lewis, it along with its global intrinsic features *reduces* to the particular arrangement of the individual pixels and their intrinsic properties. Such a reduction obtains precisely because "the picture supervenes on the pixels: there could be no difference in the picture and its properties without some difference in the arrangement of light and dark pixels... In such a case, say I, supervenience is reduction" (Ibid.). According to Humean Supervenience, the picture and its global properties are nothing 'over and above' the local intrinsic qualities of the individual pixels and their arrangements in that they "could go unmentioned in an inventory of what there is without thereby rendering that inventory incomplete."[14]

Now, on the surface, the claim that the picture is 'nothing over and above' the pixels and the arrangements thereof is puzzling in that it seems to suggest that the picture does not exist *in any sense*. The above statement that concluded the previous paragraph reinforces this reading; one can provide an exhaustive inventory of *existing* entities per se without mention of supervenient entities. On the other hand, Lewis is unequivocal when he states, "Yes, the picture really does exist. Yes, it really does have those gestalt properties" (Ibid.).

One particular suggestion here is that what Lewis is aiming for is the thesis that while supervenient entities exist, they do not carve nature at the joints in the sense of constituting the sparse structure of being.[15] For Lewis, sparse or natural properties, in

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[13]While the possession of the subvenient property is sufficient to determine the possession of the supervenient property, it does not follow that possession of the former *explains* the possession of the latter. As Kim (2000: 18) notes, "But supervenience or determination is one thing, explanation quite another. We may know that B determines A (or A supervenes on B) without having any idea why this is so—why A should arise from B, not C, or why A, rather than D, arises from B."

[14]Recall Armstrong (1997: 12): "[W]hatever supervenes or, as we can also say, is entailed or necessitated,...is not something ontologically additional to the subvenient, or necessitating, entity or entities. What supervenes is no addition to being."

[15]See Schaffer (2004). Also, Lewis explicitly states that there is a certain naturalness ranking for objects as well as properties: "Among all the countless things and classes that there are, most are miscellaneous, geryymandered, ill-demarcated. Only an elite minority are carved at the joints, so that their boundaries are

contrast to abundant properties, 'carve nature at the joints' in that they are responsible for grounding (i) qualitative similarities, (ii) causal powers, and (iii) the minimal ontological base for properties. Regarding the role of sparse properties as providing the minimal ontological base for the class of properties, Lewis (1986a: 60) elaborates as follows, "…there are only just enough of them to characterize things completely and without redundancy." This, together with Lewis' admission that an adequate account of reality ought to accommodate both the sparse *and* abundant properties or objects, leads one to think that it is the duplication of the subvening entities at the Humean base that suffices to provide a complete inventory of the sparse structure of being in particular (not the inventory of being *tout court*). While supervenient entities exist, they do not carve nature at its sparse joints.

Moreover, Lewis elsewhere offers a more precise characterization of the relationship between supervenience and reduction that further bolsters the above reading of the status of supervening entities:

> A supervenience thesis is, in a broad sense, reductionist. But it is a stripped-down form of reductionism, unencumbered by dubious denials of existence, claims of ontological priority, or claims of translatability. One might wish to say that in some sense the beauty of statues is nothing over and above the shape and size and colour that beholders appreciate, but without denying that there is such a thing as beauty, without claiming that beauty exists only in some less-than-fundamental way, and without undertaking to paraphrase ascriptions of beauty in terms of shape, etc. A supervenience thesis seems to capture what the cautious reductionist wishes to say. (1999b: 29)

Lewis is clear that the sort of supervenience he employs in Humean Supervenience does not deny the existence of supervening entities (i.e. beauty in the above example) and thus serves more as a 'cautious reductionism.'

The application of Lewis' particular brand of fundamental mereology to macrophysical objects and their microphysical constituents is straightforward. We have seen from Lewis' illustration of the grid of pixels that entities at the macrophysical level asymmetrically supervene on their microphysical point-sized constituents, with the former reducing to the latter in the sense of being no addition to the *fundamental* or *sparse* inventory of reality. While Lewis countenances macrophysical objects as being composed of point-sized parts occupying the Humean base, the existence and identity of these 'higher-level' wholes depend entirely on the distribution and arrangement of the point-parts of the mosaic.

established by objective sameness and difference in nature. Only these elite things and classes are eligible to serve as referents." (1999d: 65).

Consequently, it is a very small step indeed to the thesis that the composite objects that have point-sized objects as parts are not metaphysically basic, i.e. are not fundamental substances. This stems from Lewis' contention (as hinted at above) that in order to provide a complete or exhaustive inventory of reality one need only duplicate the metaphysically basic or fundamental entities. And, if one need not include that which supervenes on the Humean base in order to arrive at such an inventory, it follows that all ordinary composite objects (as well as everything that supervenes on the mosaic) are not metaphysically basic.

Given the widespread influence the above picture (as well as Lewis in general) has had on the present metaphysical landscape, the above consequence of Humean Supervenience (and PM in general) concerning ordinary macrophysical objects is no trivial matter. In fact, as we will see in more detail in the sequel, the primacy of the microphysical is a deeply entrenched background assumption in contemporary metaphysics.

4.2   Why Priority Microphysicalism?

But what exactly is the lure of ascribing ontological primacy to the (microphysical) parts of composite objects? Why endorse the particular fundamental mereology (or something similar) advocated by Lewis? Here I will briefly consider three lines in favor of part-priority and priority microphysicalism: (i) physicalism demands it, (ii) the success of micro-explanation in the natural sciences is evidence for priority microphysicalism, and (iii) common sense takes parts to be separable and therefore ontologically prior to wholes.

Let us begin with the contention that physicalism regarding the mental demands an unwavering commitment to the ontological priority of parts over their wholes, particularly those occupying the level of microphysics. Compare the following two claims that often accompany versions of physicalism:

(P) All facts are identical to, or at least metaphysically supervene on, physical facts.

(P*) All facts are identical to, or at least metaphysically supervene on, microphysical facts.

The question before us is whether P entails P* and, *ipso facto*, priority microphysicalism. Now, certainly some self-proclaimed physicalists affirm such an entailment. For instance, Pettit (1993: 220-1) remarks, "The fundamentalism that the physicalist defends gives total hegemony, as we might say, to the microphysical order: it introduces the dictatorship of the proletariat." Pettit builds P* into the doctrine of physicalism without reserve.

But our concern here is whether P *entails* P* *per se*, whether the card-carrying physicalist *must* endorse P* at pains of giving up the label of physicalism.[16] Here a great deal

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[16]While I take it as an open question whether P entails P*, it is obvious that the converse holds (P*

hinges on the precise meaning of 'physical' at work in P. If 'physical' facts are taken to denote facts corresponding to the domain of microphysics, then P trivially entails P*. But why understand 'physical' in this sense? It certainly looks as if P and P* are independent theses, one being a claim about how things go *within* the mereological ordering of the physical (i.e. non-mental) domain (P*) and the other about how the allegedly non-physical (mental) domain relates to the physical domain (P). P is a claim about the metaphysical primacy of certain *kinds* of facts (all facts supervene on facts whose contents are expressed by our best empirical theories), P* a claim about the metaphysical primacy of facts involving the smallest *parts* of the physical domain.

Consequently, P* is a substantive metaphysical claim regarding the intersection of mereological and grounding structure: the basic or ungrounded entities (along with the fundamental facts involving such entities) correspond exclusively to the lowest mereological level, the domain of microphysics. But physicalism *per se* need not take a stand on such a heavyweight metaphysical position regarding which level in the physical domain hosts the metaphysically basic entities. As Papineau (2008) points out, the physicalist is under no obligation *qua physicalist* to follow suite in thinking that a fact's being 'physical' is determined entirely by whether or not that fact is identical to or supervenes on a *microphysical* fact. As long as every putative non-physical entity is identical to or metaphysically supervenient on a physical entity or process, this is enough to secure a commitment to physicalism.[17]

An example may help clearly distinguish between P and P*. Consider sensorimotor theories of phenomenal consciousness which argue that qualitative conscious experiences consist of patterns of interaction involving the environment and the experiencing subject. On this view, qualia *just are* patterned ways organisms go about engaging in externally directed activities in relation to their environment, and thus can be given an exhaustive *physical* (i.e. non-mental) description in terms of the characteristic physical capacities of the organism in question. However, the range of capacities that enable the organism to engage in such activities—such as bodily movement, speech and rational thought perhaps—may very well be higher-level physical capacities which belong to the organism as a whole and thus fail to be instantiated by any of its microphysical parts (P*). Nonetheless, sensorimotor theories of consciousness may rightly be classified as providing a physicalist account of phenomenal consciousness in so far as they construe all facts (including facts concerning phenomenal consciousness) as being *identical* to non-mental facts.

Perhaps one might respond that considerations regarding the causal closure of the physical domain might help tip the scales in favor of the claim that P entails P*. Again, a

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entails P).

[17]Papineau actually argues for the stronger claim that the physicalist *ought not* follow suit precisely in virtue of the existence of higher-level physical properties that are not reducible to properties occupying the level of fundamental physics.

great deal hinges on the precise meaning of the slogan in question. If by the 'causal closure of the physical domain' one means that every physical event (which has a cause) has a sufficient microphysical cause then this clearly begs the question against any view that endorses P yet takes there to be higher-level (non-mental) properties and causal powers that are irreducible to fundamental physics such as non-reductive physicalism and emergentism.[18] The alleged conflict between the rejection of part-priority and priority microphysicalism and physicalism per se stems from conflating what goes on within a particular domain (the macrophysical supervening on the microphysical) with the relationship between that domain and other allegedly distinct domains (physical vs. mental). The rejection of P*, I submit, in no way threatens the truth of P. There is no incompatibility between the thesis that everything that exists is physical (insert your favorite account of *being physical* here, such as being spatiotemporally located) or, at the very least, supervenes on the physical with the claim that macrophysical wholes do not exhaustively depend on the properties and powers of their proper parts. By all appearances, the truth of physicalism seems entirely independent of the truth of microphysicalism.

Even more, Papineau (2008: 144-147) makes the more general point, which I take to be correct, that the question of physicalism per se (P) is entirely *neutral* with respect to the dependence ordering between empirically specifiable wholes and their proper parts. Even if wholes failed to exhaustively depend on their proper parts in virtue of instantiating ontologically emergent properties or dispositions, this would (by itself) in no way undermine the *physicality* of the wholes nor the physicality of their emergent properties and dispositions. While a commitment to P does indeed exclude the ontological emergence of irreducibly mental (i.e. non-physical) substances or properties, it does not exclude the emergence of substances or properties *per se*.

The second line in favor of part-priority and priority microphysicalism is from the empirical success of micro-explanations regarding the properties and causal activity of macrophysical wholes. This is stated nicely by Sider (2003: 140):

> Why accept supervenience on the small? Because of the unrivaled success of the physics of the small. Physics and related disciplines have been so successful at explaining macroscopic phenomena that it would take a very powerful argument indeed to undermine our faith in this principle.[19]

Sider's point seems to be that the sheer explanatory power of microphysics in explaining the properties and causal powers of macrophysical wholes provides evidence in favor of priority microphysicalism, at least in the absence of any overriding considerations to the

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[18]This is underscored nicely by Corry (2012).

[19]Note that Sider intends a much stronger thesis here than simply that the macroscopic covaries with the microscopic. Rather, he has in mind a determination thesis: the properties of macroscopic wholes are *determined* by properties and relations between their microphysical parts (140).

contrary. Note the generality of Sider's claim regarding successful microphysical explanations of macroscopic phenomena, that *all* macroscopic wholes and their accompanying phenomena appear to be explainable in terms of their microphysical constituents. Though I think this is far from obvious, let's grant Sider this sweeping claim and ask what follows from it.

What exactly warrants the general inference from the success of microphysical *explanation* to the stronger thesis of the *ontological priority* of the microphysical? What the defender of priority microphysicalism needs to support this maneuver is something along the lines of what Kim (1988) calls 'explanatory realism,' the view that explanations track objective relations that obtain in the world. But note that not just *any* relation will support the move from successful *explanation* to metaphysical *priority*. What the priority microphysicalist needs is a relation that is both (i) distinctively *metaphysical* (as opposed to causal, conceptual, or nomological, for instance) and (ii) *asymmetric*, in so far as ontological priority is an asymmetric relation (see §2.1.4.). But neither the *kind* nor the relevant *formal properties* of the underlying relation can be 'read off' of explanatory realism as applied to the microphysical and macrophysical domains. From the fact that *some* objective relation must obtain between the two domains in order to ground successful micro-explanations of macrophysical phenomena, it does not follow that it need be an asymmetrical metaphysical grounding relation.

More importantly, in order to secure the asymmetry needed to ground the inference from the success of micro-explanation to the thesis of micro-grounding, Sider needs not only the minimal claim regarding the *ubiquity* of microphysical explanation—there are microphysical laws in which the features and behavior of *all* macro-phenomena are in accord—but also the *supremacy* or *hegemony* of microphysical explanation—the distribution of microphysical laws and properties metaphysically suffices to explain the *total* behavior of a macro-system. But this is just to assume micro-determination (MD) above and hence priority microphysicalism. The distinction between the ubiquity of micro-physics and the hegemony of microphysics is underscored by Hoefer (2003: 1408) when he says: "A fundamentalist thinks that the phenomena studied in chemistry, biology, meteorology, etc., all are composed of the doings of atoms, molecules, photons, fields, and so on; and that these constituents are perfectly governed by the fundamental laws. But she need not believe *any* sort of thesis of the reducibility of biology, chemistry, or meteorology to physics!" While the ontological primacy of microphysical explanation entails the ubiquity of microphysical explanation, the converse does not hold; one may grant that the behavior of higher-level composite objects are *governed* by microphysical laws without endorsing the stronger thesis that such behavior is wholly *grounded* in or *determined* by such laws.

It seems, then, that there is no non-question begging way to secure the asymmetry required in order for successful micro-explanations to count as evidence in favor of pri-

ority microphysicalism. This is *not*, however, to say that priority microphysicalism is false; perhaps it turns out that some or even all composite objects are grounded in their microphysical constituents. Rather, it is to point out that the widespread success of microphysical explanation in the sciences fails to provide positive evidence for priority microphysicalism. Consequently, the defender of priority microphysicalism must turn to further arguments in support of their position.

Perhaps one such argument available to the defender of part-priority is that common sense dictates that parts are ontologically prior to their mereological wholes. It is a Moorean fact, it is argued, that at any given time a composite object is 'built up' out of *separable* proper parts that retain their identity when they compose the whole in question. The atoms in a molecule, for instance, are separable parts of the molecule and thus capable of existing *as such* without being a proper part of that very molecule. Here the analogy of a whole, like a building, as being constructed out of prior independent materials illustrates this insight well.

The intuition can also be stated diachronically as follows: it seems natural to think that one is capable of tracing out the compositional history of one and the same carbon atom throughout its spatiotemporal career, the atom being a proper part of a host of distinct composite objects at different times of its existence. We have, then, the following claim attributed to common sense regarding the relationship between wholes and their proper parts:

(PS) PART-SEPARABILITY: one and the same object, O, can exist both as a proper part of a composite object, O_1, at t as well as a proper part of a distinct composite object, O_2, at t_1.

But note that the force of the argument from common sense hinges not only on PS being a dictate of common sense but also the general methodological principle known as *particularism* or *Mooreanism* with respect to the domain of material objects and their proper parts ('mereological Mooreanism,' we might say). As a general guiding methodological principle, particularism is the position that our common sense judgments about cases in the target domain of philosophical inquiry (ethics, epistemic justification, composition, etc.) are largely correct (albeit defeasible) and carry epistemic weight such that when conflict arises between general principles and intuitive judgments, the latter are capable of serving as defeaters for the former.[20] Since PS is a deliverance of common sense in the domain of material objects, and such deliverances carry epistemic authority in the absence of overriding defeaters, we have reason to accept part-priority.

As I am strongly inclined to accept particularism with respect to the domain of material objects as well as in other domains of philosophical inquiry, the above argument

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[20]Where by 'common sense' I simply mean propositions that are believed pre-theoretically with respect to the domain in question.

from common sense in favor of part-priority carries a great deal of weight in my opinion. But those who eschew particularism in the domain of material objects (which is becoming an increasing lot as of late) will likely part company at the second step of the argument from common sense and reject the view that the deliverances of common sense regarding material objects and their parts constitute epistemic difference-makers.

Note, however, that the defender of substantial priority is well-positioned to embrace PS with respect to the proper parts of a limited subclass of composite objects, namely what I referred to in the previous chapter as grounded wholes. If so, then there is no straightforward path to part-priority as a *wholesale* fundamental mereology from PS as a dictate of common sense. Substantial priority is not only compatible with PS, it is build into the view from the very start in its drawing a distinction between different kinds of composite objects that are governed by different grounding descriptions.[21]

The proponent of the argument from common sense in favor of part-priority has an easy rejoinder. Simply replace PS with the following thesis:

(PS*) PART-SEPARABILITY*: one and the same object, O, can exist both as a proper part of a composite substance (grounding whole), O_1, at t as well as a proper part of a distinct composite substance, O_2, at t_1.

PS* amounts to the claim that one and the same proper part of a substance is capable of retaining its identity upon composing distinct substances at different times. Here the defender of part-priority can simply restate the argument from common sense in terms of PS*.

It is true that the defender of substantial priority cannot accept PS* in so far as the proper parts of substances (grounding wholes) are grounded entities and therefore *inseparable* parts of their substantial wholes. But here we come to what I take to be the crux of the matter regarding the argument from common sense. The argument gets its traction by assuming that both PS and PS* are, in fact, deliverances of common sense regarding the relationship between parts and their wholes. But why think this? Strictly speaking, PS and PS* are claims, warranted solely on the basis of common sense, involving whether or not an object is capable of retaining its *numerical identity* when it composes distinct objects at different times. Here I must confess that I have my doubts as to whether common sense alone is capable of tracking such fine-grained details regarding facts about persistence and numerical identity, at least enough to single-handedly support a full-blown metaphysical thesis such as part-priority.[22]

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[21]Note Schaffer (2010b: 47): "I think common sense distinguishes mere aggregates from integrated wholes... Common sense probably does endorse the priority of the parts in cases of mere aggregation, such as with the heap. Yet common sense probably endorses the priority of the whole in cases of integrated wholes, such as with the syllable."

[22]As was noted above, substantial priority endorses PS with respect to grounded wholes. But, and this is key, it does not do so *on the basis of* common sense alone as is argued here.

To maintain that PS and PS* are deliverances of common sense is to claim that pre-theoretical beliefs about the world's structure are discerning enough to adjudicate between cases of numerical and qualitative identity. But why think this? Why think that our stock of common sense beliefs include beliefs such as "the carbon atom that was once a proper part of a substance at t is *numerically identical* to the carbon atom that is no longer a proper part of that substance at t_1?" How, we might ask, can pre-theoretical reflection on the world's structure discriminate between the above belief and the following: "the carbon atom that was once a proper part of a substance at t is *qualitatively identical* to the carbon atom that is no longer a proper part of that substance at t_1?"

Frankly, I do not see how it could. For one, it seems that our folk beliefs about identity (both synchronic and diachronic) would be exactly the same whether or not the independent carbon atom at t_1 was numerically or qualitatively identical to the carbon atom at t. Whether two exactly resembling sticks of chalk resting on the blackboard—one on Monday the other on Friday—are numerically identical to one another is a question that cannot be decided on the grounds of common sense alone, or so it seems to me. While it is plausible to include in our stock of common sense beliefs those involving qualitative sameness or exact resemblance (the Monday-chalk and the Friday-chalk are *exactly* alike), I am inclined to think that common sense is simply too coarse-grained to adjudicate between such claims and those of numerical sameness (the Monday chalk is *one and the same* as the Friday chalk). At the very least, we need to be given a reason to think that common sense intuitions are fine-grained enough to track the difference between instances of numerical and qualitative identity. Without such a reason, considerations from common sense carry little force as a stand-alone argument in favor of a part-priority fundamental mereology.

4.3   The Argument from the Possibility of Gunk

Having explicated part-priority and priority microphysicalism as well as a sampling of considerations in favor of such views, let us turn now to examine the merits of each fundamental mereology. The first argument I want to offer against part-priority in particular stems from the metaphysical possibility of gunky worlds.[23] Gunky worlds are worlds devoid of mereological simples. For each mereologically complex whole in a gunky world there are infinitely many proper parts, each with infinitely many proper parts, and so on. The question before us here is whether or not such worlds are *metaphysically* possible (just 'possible' henceforth) given a part-priority fundamental mereology.

Let me attempt to motivate the prima facie tension between the possibility of gunky worlds and part-priority. First, as per part-priority, if every complex whole is a grounded

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[23]The argument is advanced by Schaffer (2010b) and hinted at in Cameron (2008).

whole, then each whole is grounded in its proper parts. In gunky worlds where part-priority holds, we have a grounding chain of infinite descent which tracks infinite mereological descent. If decomposition of proper parts continues ad infinitum in gunky worlds, and if wholes are grounded in their proper parts, then it follows that there are no metaphysically basic (ungrounded) entities in gunky worlds. But surely it is not possible for *every* existing entity to borrow its existence from another; there must be a metaphysical foundation from which the derivatives *ultimately* derive their existence. If not, it is difficult to see how anything exists in the first place. As a result, part-priority seems ill-equipped to handle the mere possibility of gunky worlds.

The *the argument from the possibility of gunk* against part-priority can be stated as a reductio as follows:

1. Necessarily, composite objects are rigidly grounded in their proper parts.[24] (assume part-priority for reductio)

2. Gunky worlds are possible.

3. If gunky worlds are possible, then it is possible that there are no basic entities in such worlds.

4. It is not possible that there are no basic entities in such worlds. (the necessity of well-foundedness of grounding).

5. Therefore, it is false that necessarily, composite objects are rigidly grounded in their proper parts.

The rationale for 1 stems from the necessity of grounding as per G8 (see §2.1.4.), that grounding is a non-contingent relation between that which is grounded and its grounds, in this case, a mereological whole and its proper parts.[25] More specifically, 1 is the application of the necessity of grounding to part-priority in that if mereological wholes are grounded in their proper parts in the actual world, then (by G8) it follows that in every world in which composite objects exist they are grounded as such.[26]

I take the key premises in the argument from the possibility of gunk to be 2 and 4. Let us begin with premise 2. The mere possibility of gunky worlds is a rather minimal claim, one that may not turn many heads in the ontology room. As many have pointed out, gunk meets several of our best criteria for possibility such as conceivability (or, minimally,

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[24]I grant that Lewis himself would be weary of this first premise in so far as he was inclined to endorse the contingency of Humean Supervenience. Even so, it is difficult to see what substantive *metaphysical* content is to be given to the claim that wholes are metaphysically determined by their parts without taking grounding to be a non-contingent affair as per G8.

[25]Recall that G8 states: $(x \rhd y \to \Box(Ex \to x \rhd y))$.

[26]Independent support for this insight here would be the non-contingency of composition conditions for objects. If one takes an composite object's composition conditions to be a part of the nature or the ontological category to which that object belongs (substance or aggregate, for instance), and in so far as the content of ontological categories remains fixed across possible worlds including such categories, then so will the composition conditions.

the lack of an inconceivability argument against it) and coherence.[27] What's more, in so far as the axioms of standard mereology reflect possible mereological structures, then the availability of gunky mereologies as noted in chapter 3 suggests the possibility of worlds with infinite mereological descent. Lastly, the actuality of gunk has, as Schaffer (2010b: 61) notes, been taken seriously as an empirical hypothesis.[28] Consequently, in the absence of considerations to the contrary, the mere possibility of gunk is a reasonable hypothesis.

There are, however, those that *have* offered considerations to the contrary, that is, considerations against the possibility of gunky worlds. While I take such a thesis to be plausible in its own right (albeit one that lacks any knock-down arguments in its favor), a defense of 2 will inevitably involve rebutting potential defeaters to the possibility of gunky worlds.

Most notably, Hudson (2001: 84-90) has advanced an argument against the possibility of gunk that turns on the fact that the most defensible answers to The Simple Question (i.e. what are the necessary and jointly sufficient conditions for an object to be a material simple?) entail the impossibility of gunk. The two accounts of material simplicity Hudson considers are (i) x is a material simple iff x is *point-sized* (Pointy View for short) and (ii) x is a material simple iff x occupies a *maximally continuous* region of space (MaxCon for short).[29] The general structure of Hudson's argument proceeds as follows: (i) either the Pointy View or MaxCon is true, (ii) if MaxCon is true then gunk is impossible, (iii) if the Pointy View is true then gunk is impossible, (iv) hence, gunk is impossible.

Let me begin by highlighting the fact that Hudson *assumes* the disjunction that either the Pointy View or MaxCon is the correct answer to The Simple Question. It is far from obvious, however, that these options have exclusive rights as the only defensible answers to The Simple Question. For one, McDaniel (2007a) highlights six different answers to The Simple Question, only two of which are the Pointy View and MaxCon (both of which he classifies as 'spatial accounts,' the others being 'fundamentality accounts' and 'indivisibility accounts'). McDaniel himself argues indirectly for a seventh view–what he calls *The Brutal View*–that there is no non-mereological criterion for being a material simple by showing that each of the other options face serious difficulties. Now, my aim here is not to delve into the various answers to the Simple Question and argue that one is more plausible than another. Rather, it is the more minimal claim that the above argument against the possibility of gunk will only carry weight with those who are already convinced of the superiority of the Pointy View and MaxCon as answers to The Simple Question. But this is no lightweight assumption given the presence of alternative, defen-

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[27]See Schaffer (2003) and McDaniel (2006) in particular.

[28]For example, see Dehmelt (1989), Georgi (1989: 456), Greene (1999: 141-42).

[29]Where a region of space is maximally continuous iff (i) it is filled with matter, (ii) it is a continuous region, and (iii) it is not a proper sub-region of some continuous matter-filled region.

sible answers as well as the presence of positive reasons to reject both the Pointy View and MaxCon.[30] Consequently, we have reason to be suspicious of the exclusivity of (i).

Moving on from (i), let us consider Hudson's reasons for thinking that the Pointy View entails the impossibility of gunk as per (iii).[31] Hudson argues that the following jointly entail the impossibility of gunk:

H1. The Doctrine of Arbitrary Undetached Parts (DAUP).

H2. Necessarily, no hunk of gunk exactly occupies a point-sized region of space.

H3. Necessarily, any hunk of gunk exactly occupies some region or other.

H4. Necessarily, any region has at least one point-sized subregion.

H5. Necessarily, any point-sized region is exactly occupiable.

Roughly, DAUP is the thesis that necessarily, for every material object o and its occupying region R, and for any occupiable sub-region of R, r^*, there is a material object o^* that occupies r^* and is a proper part of o. Premise H2, that (necessarily) no hunk of gunk exactly occupies a point-sized region, immediately follows from the Pointy View of material simples. While a hunk of gunk fails to exactly occupy a point-sized region of space, it nevertheless is highly plausible to think that it, being *material*, must occupy some region of space or other, hence H3. But for any region of space R you choose, there must be at least one point-sized subregion of R, r^*, such that r^* is exactly occupiable. From this, together with DAUP, it follows that there must be a material object that occupies r^*, which is to say that r^* must be occupied by a material simple. Hence, gunk is impossible on the Pointy View of simples.

The argument is subtle, yet powerful. I take the driving premise to be the truth of DAUP (H1) (although one might also take issue with H4 as well). What reasons does Hudson offer in favor of DAUP? The only factor cited by Hudson is that the defender of gunk ought to be inclined to accept H1 on the grounds that gunk is itself motivated by DAUP.[32] Whether or not gunk has been historically motivated by an appeal to DAUP

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[30] For instance, there may very well be empirical considerations that count against the Pointy View in that entities with zero-dimensional spatial extent would have infinite density, which thereby causes difficulties for the Dirac equation (the Schrödinger equation which takes special relativity into account and is needed to discuss the quantum mechanical states of heavy atoms and the fine structural features of atomic spectra generally). Both Simons (2004: 373) and Lowe (2006: 139) argue along these lines. In particular, Simons notes, "However, such point-particles are physically impossible because they would have to have infinite density, being a finite mass in zero volume. Leaving this minor embarrassment aside as a product of idealization may be acceptable for physicists, but a metaphysician has to take it literally and seriously. Therefore there can be no point-particles." For reference, see *The Oxford Dictionary of Physics*, 4th edition (Oxford: Oxford University Press, 2000), p. 141. In addition, McDaniel (2003) argues that both the Pointy View and MaxCon are incompatible with the metaphysical possibility of co-located material objects. For friends of constitutionalism, this is evidence enough against the Pointy View and MaxCon.

[31] Given that Hudson needs *both* (ii) and (iii) for the argument to go through, I take it that blocking one such entailment suffices to block the conclusion.

[32] See Hudson (2001: 89).

or something similar I do not know.[33] But whether or not gunky worlds are possible certainly *need* not rely on the tenability of DAUP. A world every object of which has proper parts, yet one where the proper parts of objects fail to be isomorphic with the mereological structure of their occupiable sub-regions is entirely conceivable.[34] Thus, there is no conceptual constraint on the proponent of gunk to side with DAUP in order to motivate the possibility of gunk. Apart from its motivating role, we are simply given no other reason as to why the proponent of the possibility of gunk ought to look favorably on DAUP.

We need not rehearse the standard arguments against DAUP here as they will be familiar enough to many.[35] I instead want to gesture toward an independent (though often neglected) reason to hedge one's confidence in DAUP: the possibility of extended simples.[36] Whether one endorses DAUP will, as is common in metaphysics, partly depend on one's wider sympathies regarding the conceivability and possibility of other metaphysical theses. The possibility of extended simples—spatiotemporally extended hunks of matter lacking proper parts—offers a counterexample to DAUP (a thesis that is necessarily true if true at all) in that *no* subregion of the hunk's occupying region hosts a material object that is a proper part of that hunk. For those who look favorably on the possibility (and actuality) of extended simples, the path from (a) necessarily, there is at least one exactly occupiable point-sized subregion (r^*) of the region (R) occupied by o (premise H4) to (b) necessarily, there is an object that occupies r^* and is a *proper part* of o, is suspect (o could exactly occupy an extended region of space without having proper parts that correspond to point-sized subregions within its boundaries). As a result, the truth of DAUP will need to be weighed by other considerations involving possible mereological structures, such as extended simples. But Hudson has offered no principled reason to prefer DAUP over the possibility of extended simples other than the fact that gunk would be unmotivated if DAUP were denied, a reason we have already shown to be without merit. In sum, at the very least, I take the possibility of gunk to be undefeated by Hudson's arguments above.

Let us proceed, then, to premise 4 of the argument from the possibility of gunk: that it is not possible that there are no basic entities in gunky worlds. The premise is simply a negative formulation of the well-foundedness of grounding discussed earlier under the label G9 (§2.1.4.). G9 claims that non-empty grounding domains devoid of at least one basic entity are metaphysically impossible (positively, for any non-empty grounding domain, it is necessary that at least one basic entity exists in that domain). Schaffer illustrates the insight behind the well-foundedness of grounding by appealing to the analogue of foundationalism with respect to epistemic justification. If one's noetic structure were devoid of justified *basic* beliefs (beliefs which do not derive their epistemic

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[33] For a nice historical treatment of gunk and indivisibility, see Zimmerman (1996).

[34] Or, at the very least, there is no reason to think that such a world is inconceivable.

[35] For a classic objection to DAUP, see van Inwagen (2001: 75-95).

[36] This is the route taken by McDaniel (2006) as well.

justification from other beliefs), then it is difficult to see how any *non-basic* beliefs would be epistemically justified. Alternatively, if there were no *non-inferentially* justified beliefs, then there would be no *inferentially* justified beliefs.

Many who feel the pull of G9 justify their acceptance of it on the basis of its naturalness or intuitiveness; G9 strikes them as a reasonable thesis that, in the absence of overriding considerations to the contrary, is more plausible than its denial.[37] Some proponents of G9 take its underlying motivation to be that if there were no lower-bound to the grounding domain of a world, then nothing would exist in that world. For instance, Leibniz, in his June 30, 1704 letter to de Volder, stated thus: "Where there is no reality that is not borrowed, there will never be any reality, since it must belong ultimately to some subject."[38] Interestingly enough, Leibniz's commitment to a part-priority fundamental mereology seems to have directly influenced his further claim that there *must* be mereological simples (and hence the impossibility of gunky worlds):

> *I believe that where there are only beings by aggregation, there will not even be real beings.* For every being by aggregation presupposes beings endowed with true unity, because it has its reality only from that of its components, so that it will have none at all if each being of which it is composed is again a being by aggregation; or else yet another foundation of its reality must be sought, which cannot ever be found in this way if one must always go on seeking.[39]

On this view, since composite objects exist and are grounded in their proper parts (part-priority), there *must* be a terminus to descending mereological structure (simples), or else there would be no composite objects.

Schaffer (2010b: 62) shares the Leibnizian intuition in that "endless dependence conflicts with the foundationalist requirement that there be basic objects (1.2). On this option nothing is basic at gunky worlds. There would be no ultimate ground. Being would be infinitely deferred, never achieved." Others simply report their inability to comprehend the denial of G9 (and hence 4). On this score, Lowe (1998: 158) candidly states "all real existence must be 'grounded' or 'well-founded'. Such an 'axiom of foundation' is quite probably beyond conclusive proof and yet I find the vertiginous implications of its denial barely comprehensible." While I myself take the intuition driving 4 (and G9) to be a strong one, I am aware that many will not share this opinion. I am also of the view that any argument in favor of 4 will, most likely, fail to carry the same intuitive force as the premise itself. Be that as it may, such a task is not entirely without merit as I think there are ways to gesture toward the well-foundedness of grounding as per G9.

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[37]See Fine (1991: 267).
[38]Quoted in Adams (1994: 335).
[39]Ibid., p. 336.

One may, following Cameron (2008), suggest that accepting G9 has a certain theoretical utility in that it offers a unified explanatory ground for the existence of each grounded entity in a domain. In a domain deprived of ungrounded entities, the existence of each grounded entity is explained in terms of a distinct (albeit immediate) ground or collection of grounds, which are themselves grounded entities. Accepting the well-foundedness of grounding (and hence 4), on the other hand, allows the ungrounded entity (or class of ungrounded entities) to serve as one and the same explanation for the existence of each grounded entity in that domain. This preserves the theoretical principle that it is better to have a single explanatory ground for each phenomena (the phenomena here is the existence of each individual grounded entity) than to have a distinct explanatory ground for each phenomena. Even more, however, positing at least one ungrounded entity in a grounding domain lends an explanation for not only the existence of each grounded entity in that domain, but also for the existence of grounded entities *per se* in that domain. It is one thing for there to be an explanation for the existence of each grounded entity in a domain, quite another for there to be an explanation for why the class of grounded entities exist in that domain *in the first place*. Accepting 4 affords both theoretical simplicity as well as explanatory power with respect to the existence of grounded entities.

Interestingly enough, Schaffer (2010: 62-65) has argued that the possibility of gunk poses a problem not only for what I am calling part-priority (which, for our purposes here, includes priority microphysicalism), but for *any* non-monistic fundamental mereology, including substantial priority. In Schaffer's terminology, any pluralistic fundamental mereology (i.e. one that posits basic sub-world entities) is incapable of accommodating the possibility of gunk without doing an injustice to our intuitions regarding the well-foundedness of grounding. I disagree. As I was at pains to show in chapter 3, the rejection of priority monism does not result in the acceptance of a part-priority fundamental mereology. Rather, it is entirely consistent to reject both priority monism and part-priority (as well as priority microphysicalism) and endorse the view that, at the very least, some of the metaphysically basic entities are mereologically intermediate.

But what exactly is the source of Schaffer's worry with positing at least *some* intermediate wholes as ontologically prior to their proper parts as a way of carving out a non-monistic joint on the mereological hierarchy to host the metaphysically basic entities (or, at the very least, *a* basic entity)? There are two sources of contention, I will treat each in turn. First, Schaffer claims that ascribing whole-priority to mereologically intermediate (i.e. non-monistic) wholes would be "objectionably arbitrary, especially in cases where there is no natural joint in the mereological structure" (63). The specific case that Schaffer thinks renders substantial priority as objectionably arbitrary are gunky worlds. At gunky worlds, Schaffer argues, there simply *is* no *privileged* level of decomposition for the metaphysically basic entities to occupy other than the maximal level, the cosmos. To illustrate this, he cites the example of a homogeniously pink sphere of gunk. In his own

words, "all the levels of mereological structure (save for the top) are intermediate, and all are homogeneously pink. No layer of decomposition seems privileged (2010:63)." By Schaffer's lights, then, since the cosmos is the only privileged mereological joint in gunky worlds to metaphysically ground the mereological hierarchy, only the monist can plausibly entertain the possibility of gunk.

It is difficult to determine the nub of Schaffer's concern here. My best estimate as to what Schaffer is driving for is that the *non*-arbitrary mereological joints in an *atomistic* world are obtained by reaching a unique upper bound via composition and a minima via decomposition. Since decomposition fails to generate atomic minima in gunky worlds, the only privileged joint in the hierarchy that remains is the maximal joint, the Universe. In gunky worlds, the intermediates are rendered arbitrary.

But why grant the key assumption that the *only* non-arbitrary mereological joints in an atomistic world are the atoms and the Universe? Here it seems that Schaffer takes the non-arbitrariness or naturalness of a mereological joint to be a function of its serving as the *terminus* of the mereological hierarchy as represented by the three-atom model. But this, of course, excludes the privileged status of the intermediates from the start. Surely this victory by exclusion is not what Schaffer has in mind. After all, there would *be* no *hierarchy* or compositional structure were it not for the intermediates. If, as I think is plausible, we take the three-atom model to represent, at the very least, bare metaphysical possibilities concerning mereological structure, then there is no reason the intermediates are any more arbitrary than the atoms and the Universe in so far as they have a formal analogue in the three-atom model. The claim that gunky worlds leave us with a *single* non-arbitrary mereological joint (the Universe) assumes from the outset that *there were only two to begin with*. But we have been given no principled reason for such an exclusion.

Perhaps Schaffer would reply here with his example of the homogeneously pink sphere of gunk, claiming that its uniformity at each intermediate level of composition renders no level (save the top) structurally privileged. The example seems 'cooked-up,' as they say, to suit Schaffer's point. The problem stems not from the sphere's status as an intermediate *per se*, but rather its being homogeneous at each level of mereological structure. But no defender of substantial priority would bet their lot on a homogeneously pink sphere of gunk being a basic intermediate and thus ontologically prior to its proper parts. Rather, the metaphysical fundamentality of certain (non-monistic) composite objects stems precisely from their exhibiting a radical structural *heterogeneity* with respect to properties and causal dispositions of their lower-level compositional base. The proponent of substantial priority will argue that such homogeneity is precisely what we are *not* given in the domain of physics, chemistry and biology.

But suppose we grant Schaffer the claim that there are only two non-arbitrary or privileged mereological joints represented in the three-atom model, the atoms and the

Universe. What follows from this? The deeper worry here concerns the underlying assumption that there is a *structural isomorphism* between the three-atom model of formal mereology and the *actual* mereological structure in the world as specified by ontology and the natural sciences.

This brings us to fundamental questions concerning the relationship between mereology, ontology, and natural science, a full treatment of which is beyond the scope of this discussion. I noted above my sympathies with the view that the three-atom model of classical mereology can be plausibly taken to represent *possible* mereological structures. Assuming the atoms and the Universe represent the only non-arbitrary instances of mereological structure, Schaffer's charge of the arbitrariness of privileged intermediate joints hinges on the assumption that since there is no privileged *formal* intermediate joint in the three-atom model (presumably because the privileged joints are those that serve as termini of the part-whole ordering), there is no privileged intermediate joint in the world. This is a substantive claim regarding the ontological import of formal mereology as well as the division of labor between the mereologist proper and the scientifically informed metaphysician. As I am of the general opinion that the prospects of reading substantive ontological theses off of our linguistic or formal theories is rather dim, I am a bit hesitant to allow formal mereology alone to settle matters of ontological commitment. The question as to which formal mereological joints represented by the three atom model are both actual and suited to host fundamental substances is, as I see it, a question best answered by scientifically informed metaphysics.[40]

Schaffer's second concern regarding intermediate basics hinges on the fact that the proponent of molecules (his example) which are ontologically prior to their proper parts, is already committed to a sort of *quasi-monism* and thus "will have no principled objection to monism." We have already made the general point in chapter 3 that the priority monist has no right to stake out the ontological priority of wholes over their parts as a piece of monistic metaphysics. The question of *which* mereological wholes exist is entirely independent of the the ontological priority of wholes over their parts as a general thesis of fundamental mereology.

But what of Schaffer's concern that if proponents of intermediate (molecular) basics attribute ontological priority to non-monistic wholes, that they will be left without a principled reason to reject priority monism? He goes on to cite the argument from commonsense (common sense dictates that parts are prior to their wholes) and the argument from heterogeneity (that wholes exhibit qualitative variegation) as examples of considerations that would likewise undermine substantial priority. I think the worry is

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[40]I am reminded here of Simons (2006: 612): "When it comes to the honest toil of investigating the principles governing what objects are parts of others, and what collections of objects compose others, it appears that most ontologists have been following the paradigm of abstract algebra when it would have been better to take a lead from sciences such as geology, botany, anatomy, physiology, engineering, which deal with the real."

misguided. For one, the objection conflates being subject to the same (or highly similar) objections to whole-priority in general raised by the part-priority theorist with not having a reason to reject priority monism in particular. These are quite different claims. As two individual species of a whole-priority fundamental mereology, priority monism and substantial priority share a common fate, they stand or fall together in that any considerations against the ontological priority of wholes over their parts *per se* count against both priority monism and substantial priority. But this in no way implies that someone who endorses the existence of intermediate (non-monistic) substances is thereby bereft of principled reasons that might count against the substantiality of the cosmos in particular.

There could be (and I think there are) principled reasons to *not* extend metaphysical fundamentality to the entire cosmos, thereby rendering it non-basic.[41] One quick reason being that, as Simons (1987: 15) notes, the Universe of classical mereology is only "slightly less controversial than the existence of arbitrary sums." Note that if the controversy surrounds the very *existence* of the maximal mereological whole, how much more so its *fundamentality*. Being only slightly less controversial to a view (the existence of arbitrary sums) that many metaphysicians take to be highly implausible is no count in a view's favor. One might argue either that "The universe is not an individual: monism is false. It is a multiplicity" or "[s]urely the fact itself shows the world to be an aggregate, like a herd or a machine."[42]

Consequently, we have little reason to follow Schaffer in thinking that priority monism is the only whole-priority fundamental mereology that can accommodate the possibility of gunk; substantial priority is equally equipped to provide privileged mereological joints to host fundamental substances (i.e. the terminus of grounding chains) in gunky worlds. Both agree, however, that part-priority is ill-equipped to handle the full range of possible mereological structures while, at the same time, preserving the well-foundedness of grounding.

4.4 The Failure of Whole-Part Supervenience

I turn now to a second variety of argument aimed at part-priority, particularly priority microphysicalism, the latter being the predominant fundamental mereology in the literature. The general type of argument I advance in what follows hinges on the idea that part-priority and priority microphysicalism rule out, a priori, the thesis that composite objects per se as well as macrophysical wholes (respectively) instantiate ontologically emergent properties, including perfectly natural properties. In this section I want to argue that the properties and behavior of at least some composite objects taken from total

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[41]Wholly apart from the independent considerations in favor of substantial priority that I will give in chapter 5, which (as per the tiling constraint), render the cosmos non-basic.

[42]See Simons (2003: 249) and Leibniz (1969: 537), respectively.

science are genuinely emergent in the sense that they fail to supervene on the properties and behavior of their proper parts and their basic arrangements. If so, then such wholes fail to be grounded in their proper parts and thereby serve to undermine both part-priority and priority microphyicalism.

4.4.1 Against Part-Priority

Recall from our previous discussion that a part-priority fundamental mereology is a *global* thesis regarding the intersection of mereological and grounding structure: *all* composite objects are grounded wholes that are composed of proper parts that are freely recombinable with one another, i.e. separable. On a well-founded part-priority mereology, some of the proper parts of complex wholes are basic or substantial in their own right, the existence and features of wholes being (ultimately) explained in terms of the existence and properties of these substantial proper parts. Part-priority, as stated by Kim (1978: 154), maintains that "[w]holes are completely *determined*, causally and *ontologically*, by their parts."[43]

With this in mind, consider the following argument against part-priority from the failure of whole-part supervenience, what I call *the argument from mereological emergence*:

1. If a mereological whole exhibits emergent properties, it fails to be rigidly essentially grounded in its proper parts.

2. Some mereological wholes exhibit emergent properties.

3. Therefore, some mereological wholes fail to be rigidly essentially grounded in their proper parts.

The argument from mereological emergence is aimed at undermining the *global* nature of part-priority: that *all* complex wholes are grounded wholes (see §3.4). While it is plausible that *some* intermediate wholes may be grounded as such (aggregates or artifacts), there are grounds for thinking that not *all* composite objects fit this grounding description.

Before I turn to the premises themselves let me say a bit about the notion of emergence at play in the argument. By 'emergence' here I have in mind *ontological emergence* (as opposed to epistemic or structural emergence), properties of systems or wholes that include causal dispositions not reducible to any of the intrinsic causal dispositions of the parts or to any of the fundamental relations between them. More precisely, we can say that for some property F and some complex whole x, F is an ontologically emergent

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[43]Kim tends to use the label 'mereological supervenience' for what I am calling priority microphysicalism. To me, this is rather imprecise in so far as 'mereological supervenience' is vague concerning whole-part and part-whole superveneince and the label is silent as to the level of reality that is taken to host the metaphysically basic entities (micro-level).

property of x iff (i) x instantiates F, (ii) F is a perfectly natural property, and (iii) x's instantiating F does not supervene on the intrinsic properties of, and spatiotemporal relations among, x's proper parts. As Silberstein and McGeever (1999: 182) point out, "[o]ntological emergence entails the failure of mereological supervenenience" and Schaffer (2009) "the intended notion of an emergent property is one for which mereological supervenience fails."

Elaborating on (ii) above I, like many, presuppose a naturalness ordering over properties, with the *perfectly natural properties* being those elite natural properties that (i) ground objective similarities between things and (ii) carve out the non-redundant causal powers in the world.[44] While natural properties per se carve out the distinctively causal structure of the world, some carve the causal structure of the world *more precisely* than others. For instance, the power to tell a lie is, arguably, redundant in that it can be explained or reduced in terms of the *more natural* (although not necessarily perfectly natural) properties involved: the power to take a doxastic attitude toward a proposition (i.e. form beliefs), the power to speak, the power to entertain false propositions and to intend to report them as true, etc. As such, the power to tell a lie is not a perfectly natural property in so far as it can be reduced to more basic causal powers.

With the notion of a perfectly natural property in hand, we can elucidate tenet (iii) above by following Lewis (1999a: 27) in taking two complex objects to be *duplicates* if and only if there is a one-one correspondence between their parts that preserves perfectly natural properties (and perfectly natural relations). In like manner, let us say the xs are *plural duplicates* of the ys if and only if the xs and the ys can be put in one-one correspondence that preserves perfectly natural properties and relations.

Recall that on a part-priority fundamental mereology "[w]holes are completely *determined*, causally and *ontologically*, by their parts."[45] The qualitative and causal profiles of mereological wholes, then, supervene entirely on the profiles of their proper parts, together with their fundamental arrangements. In other words, part-priority adheres to the following *plural duplication principle* for mereological wholes:

> (PDP) *Plural Duplication Principle*: For any xs, w, and z, if the xs compose w, then z is a duplicate of w if and only if there are some ys that are plural duplicates of the xs, and the ys compose z.[46]

As a thesis about composite objects, PDP claims that *duplicating the perfectly natural properties of the parts and their basic arrangements suffices to duplicate the perfectly natural properties (and relations) of the whole*. The argument from mereological emergence sets out to establish the falsity of PDP; there are perfectly natural properties of

[44] Consider Bird (2007: 13), "The fundamental natural properties are those with non-redundant causal powers."
[45] Kim (1978).
[46] McDaniel (2008:129).

composite objects that fail to supervene on the properties and powers of their proper parts, together with their basic arrangements. In the case of certain intermediate wholes, duplicating the parts and their basic arrangements does not preserve the properties and causal dispositions of the whole.

With the above groundwork in place, let us turn to the argument itself. At its core, premise 1 is warranted on the basis of the more general thesis concerning the nature of grounding expressed by G10, the thesis that grounding entails supervenience (see §2.1.4). As was noted previously, while much of the recent literature on grounding has been quick to acknowledge the failure of analyzing grounding in terms of supervenience, there is an equal consensus that the two concepts are indeed intimately related. In fact, Kim (1993: 148), after rightly distinguishing the covariation element of supervenience from the alleged dependence ordering it is claimed to secure, argues, "But the two components are not entirely independent; for it seems that the following is true: for there to be property dependence there must be property covariation." While supervenience does not entail grounding, it is plausible to think that the converse does in fact hold.[47] Again, Kim (1993: 167) suggests that supervenience, "is not a 'deep' metaphysical relation; rather, it is a 'surface' relation that reports a pattern of property covariation, suggesting the presence of an interesting dependency relation that might explain it."

Consider the following case of grounding: a event's being grounded in its constituents. Here the constituents of the event of the presidential inauguration of Barack Obama (which include, at the very least, Barack Obama and the time at which the inauguration took place) ground the existence of the event itself. The thesis on the table here is that there can be no difference in the event–that which is grounded–without a difference in the constituents–that which does the grounding. In other words, there can be no variation in that which is grounded without a variation in the ground. This is just to say that the event's being grounded in its constituents entails that the event supervenes on its constituents (but not the converse).

Given the modal consequences of grounding, the failure of grounding follows quite naturally from the failure of supervenience. If the supervening entity fails to covary with its subvening base, this is reason enough to conclude that it thereby fails to be rigidly grounded in its base.

4.4.1.1 Quantum Entanglement

When then of 2, the claim that some composite wholes instantiate emergent properties? Perhaps one of the most plausible instances of ontological emergence (and hence the failure of PDP) is *quantum entanglement*. One of the hallmarks of classical physics is the

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[47]Cf. Kim (1993: 167). Also, see Karakostas (2009: 6): "if the whole state of a compound system is completely determined by the separate states of its subsystems, then the whole state necessarily supervenes on the separate states."

separability of physical systems: that the state of a compound physical system S consisting of n point particles is determined by the local magnitudes of its constituent particles which occupy distinct spacetime points.[48] Thus, the pure (i.e. unmixed) state of a classical system at any given time consists entirely of the pure states of its subsystems. Facts about S involving classical physical quantities such as mass, momentum, or kinetic energy supervene on local facts regarding the corresponding quantities of their constituent subsystems. We can capture the separability of classical physical systems by the following principle:

> *Separability Principle*: The states of any spatiotemporally separated subsystems S_1, S_2, ..., S_n of a compound system S are individually well-defined and the states of the compound system are wholly and completely determined by them and their physical interactions including their spatiotemporal relations. (Karakostas 2007).[49]

Consequently, for any compound physical system in a classical universe, its constituent subsystems are separable, individual parts that exhaustively determine the states of the systems in which they are embedded.

As many have pointed out, quantum mechanical systems exhibit a behavior that is radically at odds with the above separability principle. To illustrate this, suppose we have two nonidentical particles, call them a and b, where a and b each occupy distinct regions of space and jointly compose a compound system S. The individual spin states of a and b are associated with a two-dimensional vector (Hilbert) space H_a and H_b (in the z-direction) as follows (where '$|\uparrow\rangle_n$' is to be read as "particle n is in spin-up state"):

H_a: $|z\uparrow\rangle_a |z\downarrow\rangle_a$

H_b: $|z\uparrow\rangle_b |z\downarrow\rangle_b$

We can represent the four-dimensional vector space for the entire system S, call it H_S, as the tensor product ($\otimes$) of H_a and H_b, where $H_S = H_a \otimes H_b$:

H_S:

   i. $|z\uparrow\rangle_a \otimes |z\downarrow\rangle_b$

  ii. $|z\downarrow\rangle_a \otimes |z\uparrow\rangle_b$

States i and ii of H_S represent a few of the possible vector states of the compound system S, composed of a and b. States i and ii are easily expressed as the tensor product of the

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[48] Here I restrict my focus to a particle-theoretic interpretation of classical mechanics. One could easily restate this in field-theoretic terms such that the values of fundamental parameters of a field are well defined at every point of the underlying manifold. See Karakostas (2009) for more along these lines.

[49] See also Howard (1989: 226).

pair of vectors as per H_a and H_b and hence are exhaustively explained in terms of the spin states of S's component parts.

In addition to i and ii, however, S includes further spin states that are no mere product of the spin states of its components. Perhaps the best example of such a state is the *singlet state*, a *superposition* of a pair of particles with anti-correlated spin states, in this case $|z \uparrow\rangle_a |z \downarrow\rangle_b$ and $|z \downarrow\rangle_a |z \uparrow\rangle_b$:

iii. $\frac{1}{\sqrt{2}} |z \uparrow\rangle_a |z \downarrow\rangle_b - \frac{1}{\sqrt{2}} |z \downarrow\rangle_a |z \uparrow\rangle_b$

As per Born's rule, for each individual particle in the singlet state, a and b, there is a 50% chance that a will be $|z \uparrow\rangle$ and b will be $|z \downarrow\rangle$ and a 50% chance that a will measure $|z \downarrow\rangle$ and b $|z \uparrow\rangle$.[50] Here, however, we must note that things are quite different with respect to the entire system of which both a and b are components. The total spin for systems in the singlet state is zero. It is a fact about S alone that each of its component particles are disposed to yield opposite results if both spins are measured in the same direction (z-direction). The spin probability distribution of the system—that there is a zero chance of *both* a and b being measured at $|z \uparrow\rangle$ (or $|z \downarrow\rangle$ alternatively)–is an *irreducible*, *holistic* feature of S that is not capable of being derived from the facts concerning the expectation values of the spin of the individual particles themselves. The singlet state of S is a pure (un-mixed) state that can be attributed to neither a nor b individually, it is a genuine addition to being, it is ontologically emergent.

Consequently, S is an *entangled quantum system* given that its total vector state fails to be the tensor product of the vector states of its sub-components a and b: $H_S \neq H_a \otimes H_b$.[51] While the proper parts of a non-entangled whole w may be plural duplicates of the proper parts of an entangled whole w^*, it is evident that w and w^* are not duplicates *per se*. This is precisely because there are perfectly natural properties instantiated by entangled wholes, such as *having spin state zero* in the case of a system composed of two spin-1/2 particles in the singlet state, that fail to be instantiated by non-entangled wholes. As a result, an exhaustive inventory of the world's perfectly natural properties

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[50] Born's rule (named after the physicist Max Born) is used to determine the expectation value for each spin configuration of a given system. Following Maudlin (1998), "Given the state S, one can calculate expectation values for all of the Hermitean operators in the spin space of each single particle. The calculation is quite simple: for any given direction, there is a 50 percent chance that the spin will be found up and a 50 percent chance that it will be found down."

[51] In addition to the singlet state as an example of an entangled system, Maudlin (2006: 483) notes that "the failure of the quantum state of the whole to supervene on the quantum states of the parts is most strikingly illustrated by the so-called m=0 Triplet state." He formulates the m=0 Triplet state in terms of x-directional spin as follows: $\frac{1}{\sqrt{2}} |x \uparrow\rangle_a |x \uparrow\rangle_b - \frac{1}{\sqrt{2}} |x \downarrow\rangle_a |x \downarrow\rangle_b$. He argues that the mixed state ascribed to each individual particle in the m=0 Triplet state is identical to the mixed state of each particle in the singlet state (50% chance to each outcome). The difference, argues Maudlin, between the singlet state and the m=0 Triplet state can only be captured by a "*global measurement* made on both particles, and not by any possible *local* measurement made on one particle" (483). Maudlin again concludes that "The quantum state of a whole therefore does not supervene on the states of its parts, exhibiting a form of holism" (Ibid.). In our terminology, the comparison of the singlet and the m=0 Triplet state reveals that the duplication of the parts does not suffice to duplicate the whole, PDP fails.

that omitted features of entangled quantum wholes would be radically incomplete. The *holism* at work in quantum entanglement is such that the total system has features or states (singlet) that are irreducible to the features or states of its component particles. As Karakostas (2009: 10) puts it, "the entangled state W represents global properties for the whole system S that are neither *dependent* upon nor *determined* by any properties of its parts." The holism of entangled quantum systems, then, suggests the failure of whole-part supervenience.

Reflecting on the implications of entanglement for mereology, Maudlin (1998: 55) concludes:

> The physical state of a complex whole cannot always be reduced to those of its parts, or to those of its parts together with their spatiotemporal relations, even when the parts inhabit distinct regions of space. Modern science, and modern physics in particular, can hardly be accused of holding reductionism as a central premise, given that the result of the most intensive scientific investigations in history is a theory that contains an ineliminable holism.

In addition, Heil (2012: 47) concurs:

> Suppose quantum systems, systems of 'entangled' particles, are genuinely 'holistic', suppose their characteristics really do outstrip characteristics of their ingredients... [t]he 'parts' of such systems would have the status of modes: the wholes of which they are parts would not depend on the parts, the parts would depend on the wholes.

In short: quantum entanglement undermines the separability principle of classical physics, together with the metaphysical thesis of PDP upon which it rests.

Here the proponent of part-priority might retort that entangled wholes can be accounted for without dispensing with PDP and hence the ontological priority of parts over their wholes. To preserve part-priority, one might introduce primitive (external) *entanglement* or *correlation relations* in addition to those spatiotemporal relations that obtain between the components of an entangled system. The vector state of the entire quantum whole, on this view, would be a *structural property*, one that is nothing more than the vector states of its sub-components *together with the spatiotemporal and fundamental entanglement relations that obtain between them*. Ontological emergence at the quantum level, on this view, would undermine part-priority only if it were shown that entangled systems failed to supervene on the intrinsic properties of their proper parts, together with any fundamental relations among such parts (not just spatiotemporal relations).[52] With fundamental entanglement relations in hand, no irreducible quantum

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[52]Note that in claiming that the entangled system as a whole supervenes on its component parts together with the fundamental, non-spatiotemporal entanglement relation requires a weaker version of Humean Supervenience.

states of the whole need apply.

I take this to be a compelling rejoinder on behalf of part-priority in response to the failure of PDP with respect to quantum wholes. There are, however, a few concerns with this line of reasoning. First, it threatens to misconstrue an otherwise straightforward and natural reading of the results of Bell's Theorem, most notably the fact that the entangled state is a *global property* and thus encoded in the entire entangled system. We need, then, plausible grounds for introducing sui generis entanglement relations between individual particles, ones that are independently motivated apart from a desire to safeguard PDP and thus a part-priority fundamental mereology.

Second, such a maneuver comes at a high price for those who prefer a Humean gloss on part-priority. Countenancing brute entanglement relations as part of the microphysical supervenience base is tantamount to the denial of Humean Supervenience as traditionally stated. A world that is replete with basic entanglement relations is one that flies directly in the face of the thesis that reality is made up of intrinsically unconnected, independently existing concrete particulars.

Moreover, as Schaffer (2010: 54) has pointed out, positing such relations involves a proliferation of basic entanglement relations. If entangled systems are explained *entirely* in terms of individual particles standing in brute entanglement relations to one another, then for every entangled system consisting of n, $n+1$, $n+2$, ... particles, there is a distinct entanglement relation that correlates the particles in that system ($R(n)$, $R(n+1)$, $R(n+2)$, ...). Entanglement relations that differ in the number of particles they serve to correlate will differ with respect to their arity, and hence be numerically distinct relations. This not only inflates one's fundamental ontology, it also harbors "a loss of empirically important unity" in that it undermines one's ability to ascribe the same (or exactly resembling) entangled spin state to entangled systems.[53] However, if one attributes the perfectly natural (monadic) entangled-state directly to the entangled whole as per holism, then no such problem arises in so far as one attributes the very same (or exactly resembling) monadic property to systems which differ with respect to the number of their components.

Lastly, McDaniel (2008: 132) argues that this move requires that a perfectly natural property (spin zero) necessarily covaries with a perfectly natural relation (entanglement relation). But this seems to deny what many take to be at the heart of the very concept of perfect naturalness: that perfectly natural properties and relations are modally free with respect to one another.[54]

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[53]Schaffer (2010: 54).

[54]More precisely, the free recombinability of perfectly natural properties can be stated as follows: If (i) x has F and y has G, (ii) x and y are contingently existing objects, and (iii) F and G are perfectly natural properties, then there is a possible world in which both x and y exist, but in which x has F and y does not have G. See McDaniel (2007b: 247).

4.4.2 Against Priority Microphysicalism

While quantum entanglement offers compelling grounds for the falsity of PDP per se, the resilient defender of a particular variant of part-priority has a response close at hand. As stated, the conclusion of the argument from mereological emergence above is entirely compatible with priority microphysicalism; even if PDP fails as a *global* thesis regarding the mereological ordering of the world, we need not rid PDP entirely in so far as we may put it to use in a more restricted capacity. Even if duplicating the parts and their basic arrangements does not suffice to duplicate *all* mereological wholes, this is plausibly true for all macrophysical or 'higher-level' wholes such as molecules and living organisms. In other words, the failure of whole-part supervenience obtains solely at the quantum level. Priority microphysicalism may be true even if part-priority as a global fundamental mereology is false.[55]

This rejoinder on behalf of the priority microphysicalist surfaces the following dilemma at this stage in the argument: either every macrophysical object is grounded in its microphysical parts or it is not. If every macrophysical object is grounded in its microphysical parts, then the failure of PDP is a pervasive feature of the world given the ubiquity of quantum entanglement. If, however, not every macrophysical object is grounded in its microphysical parts–i.e. if PDP fails for at least some macrophysical wholes—then priority microphysicalism is false.[56] Either way, PDP fails.

The above argument, however, can be easily adapted to cover priority microphysicalism as well.[57] If whole-part supervenience fails for some macrophysical wholes in virtue of their possessing emergent properties, this is evidence for the falsity of priority microphysicalism. We can then revise premise 2 above to the following:

> 2*. Some macrophysical wholes exhibit emergent properties.

The revised conclusion of *the argument from mereological emergence* being:

> 3*. Therefore, some macrophysical wholes fail to be rigidly essentially grounded in their proper parts.

As was noted in §1 of this chapter, one important tenet of priority microphysicalism is that the occupants of the microphysical level are the exclusive bearers of the perfectly natural properties. Recall that the defender of an atomistic gloss on priority microphysicalism–the view that the mereologically simple microphysical parts of wholes are basic and are ontologically prior to their wholes–is committed to the following thesis concerning the various levels from which the ontologically fundamental causal powers of the world are to be drawn:

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[55]See Melnyk (2003) for a proposal along these lines.

[56]See Silberstein and McGeever (1999: 200).

[57]All of the arguments against priority microphysicalism from here on out are likewise arguments against part-priority as well.

(MC) *Micro-Causation*: all macro-causation takes place in virtue of the causation on the level of the (ultimate parts) or the micro-level. Macro-causation is entirely derivative and piggybacks on the causation of the micro-constituents. (Hütteman 2004).[58]

On MC the facts concerning the *non-redundant* causal joints of reality are calibrated exclusively by (ideal) fundamental physics. Hence, all macro-causation, on this view, is redundant in that it can be exhaustively explained in terms of the causal powers of microphysical entities. While the causal powers of molecules and biological organisms may be *relatively* natural with respect to the perfectly natural properties instantiated at the level of fundamental physics, such properties need not be invoked in our inventory of scientifically *irreducible* facts about the world.[59]

4.4.2.1   Chemical Structure

But might the irreducible holism distinctive of entangled systems extend beyond the quantum realm to molecules and biological organisms? I take this to be a question best answered by a metaphysically informed examination of the status of reductionism in chemistry and biology. My own inclination is the same as Papineau's (2008: 146):

> Non-local entanglement is ubiquitous in the real world. I illustrated it above
> by considering a system of two separated electrons. But it will also be present
> in systems comprising basic physical persisting objects, like atoms and molecules.
> The joint state of the local components of such composite systems will char-
> acteristically contain information additional to that implied by the local prop-
> erties of the components...There are facts about persisting objects like atoms
> and molecules that transcend the intrinsic physical properties of their spatial
> parts plus the spatial and causal relations between them.

What Papineau is suggesting is that PDP may well be falsified not only by quantum wholes, but by atomic and molecular wholes as well; there are facts involving the instantiation of perfectly natural properties by composite objects that are not reducible to facts about the perfectly natural properties (and relations) of their proper parts.

Let us begin at the intersection of physics and chemistry: *quantum chemistry*. At the heart of quantum chemistry is the appropriation of quantum mechanics to explain chemical bonding and structure. Following Robin Hendry (2010; forthcoming), for any

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[58]For representatives of MC see Lewis (1999:66) and Sider (2008:4). Lewis remarks, "Indeed physics discovers which things and classes are the most elite of all; but others are elite also, though to a lesser degree. The less elite are so because they are connected to the most elite by chains of definability. Long chains, by the time we reach the moderately elite classes of cats and pencils and puddles; but the chains required to reach the utterly ineligible would be far longer still."

[59]Hawthorne (2006: viii) uses the apt term 'micro-naturalism' to capture what I am (following Hütteman) calling 'micro-causation.'

isolated atom or molecule, there is a resultant Hamiltonian, a quantum mechanical description of the energetic properties of the entire system. The resultant Hamiltonian for an atom or molecule is determined by enumerating the various nuclei and electrons in the system, together with their interacting forces, the most prominent determinant of molecular structure and bonding being the electrostatic (Coulomb) force between charged particles.

As Hendry points out, it is very often the case that molecular structure is *holistic* in that it fails to be adequately captured in terms of resultant (Coulombic) Hamiltonians alone.[60] In other words, the mere enumeration of electrons and nuclei together with electrostatic forces does not yield the distinctive properties and causal dispositions that characterize chemical structures. Hendry (2010: 186) notes:

> Molecular structures cannot be recovered from the Coulomb Schrödinger equations, but not because of any mathematical intractability. The problem is that they are not there to begin with. The Coulomb Schrödinger equations describe mere assemblages of electrons and nuclei rather than molecules, which are structured entities.

Commenting on the calculation of the total energy state of complex molecules (by solving the molecular wave function by means of the Born-Oppenheimer approximation), Robert Bishop (2005: 714) makes precisely the same point:

> The Born-Oppenheimer approach amounts to a *change in topology*–i.e., a change in the mathematical elements modeling physical phenomena–as well as a *change in ontology*, including fundamental physical elements absent in the quantum description; in the case of molecular chemistry, the new ontological elements are structures absent from quantum mechanics...Now the molecular structure challenge to reduction can be put very succinctly: Neither the topology nor the ontology appropriate to molecular structure can be derived from or found in quantum mechanics alone...Hence, an empirically and explanatorily important structure in molecular chemistry looks to be missing from quantum mechanics.[61]

The ontological underpinnings that account for the existence of holistic molecular structure (including novel powers and dispositions,), according to Hendry and Bishop, simply cannot be accounted for in terms of quantum states alone.

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[60]This is *not* to say that resultant Hamiltonians fail to accurately describe molecular structure in *any* sense.

[61]Interestingly enough, Bishop explicitly identifies what I am calling part-priority as the root of the reduction of chemical structure to quantum mechanics stating: "*mereological dependence*, where properties of wholes depend in some way on properties of their parts, looks to indicate that quantum physics supplies the 'parts' for the 'wholes'–molecules–of chemistry. In other words, quantum physics provides the base from which the properties of chemical molecules arise."

One particular example cited by Hendry of the holism exhibited by certain chemical structures is hydrogen chloride (HCl). As a complex polyatomic molecule, the resultant Coulomb Hamiltonian for HCl can be determined by (i) specifying the electrostatic force predicted by Coulomb's law (ii) enumerating the charges, masses, and values (etc.) for both chlorine (partial negative charge) and hydrogen (partial positive charge), (iii) listing the polar covalent bond that obtains between chlorine and hydrogen, which therein gives rise to a dipole moment, and finally (iv) using the results of steps (i)-(iii) to list the kinetic and potential energy operators and adding them.[62] The resultant Hamiltonian for HCl, on this method, gives rise to a charge distribution that is spherically *symmetrical*. But, as Hendry points out, the charge distribution for HCl cannot be spherically symmetrical in so far as its acidic behavior and distinctive boiling point obtain in virtue of its being an *asymmetrically* charged molecule. The chemical whole HCl, which includes its distinctive causal powers and capacities, cannot be reduced to the features and relations between its component atoms, it is ontologically emergent.

In the case of HCl qua molecular whole, duplicating the parts and their basic arrangements does not suffice to duplicate the whole in that HCl instantiates certain natural properties that fail to supervene on the natural properties of chlorine or hydrogen taken individually or as a pair. Hendry (2010: 187) draws the following conclusion,

> If molecules are ontologically reducible to their physical bases, then they ought to have no causal powers beyond those that are conferred by those physical bases...if the acidic behavior of the hydrogen chloride molecule is conferred by its asymmetry, and the asymmetry is not conferred by the molecule's physical basis according to physical laws, then surely there is a prima facie argument that ontological reduction fails.

Another example of ontological emergence in chemistry is sodium chloride (NaCl), or common table salt. Rothschild (2006: 153) unpacks this nicely:

> Sodium is a soft, bright, silvery metal. It can float on water and, when doing so, decomposes with the production of hydrogen and the formation of hydroxide. Sodium may ignite spontaneously on water, depending on the amount of oxide and metal exposed to the water. It normally does not ignite in air at temperatures below 115 degrees celcius.

On the other hand:

> Chlorine is a greenish-yellow gas that is a respiratory irritant. As little as 3.5 p.p.m. (parts per million) can be detected as an odour, and 1000 p.p.m. is likely to be fatal after a only few deep breaths. Chlorine is so toxic it was used in gas warfare in 1915.[63]

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[62]Hendry (2006: 182).
[63]Ibid.

Rothschild goes on to make the point that the compound NaCl has fundamentally different dispositions (such as *solubility in water*) that is possessed by neither of its parts in isolation; solubility is an ontologically emergent property of NaCl.

4.4.2.2   Biological Structure

Biological explanation is replete with talk of novelty, organization and structure. Consider the following passage from a standard biology textbook:

> Identifying biological organization at its many levels is fundamental to the study of life…With each step upward in the hierarchy of biological order, novel properties emerge that were not present at the simpler levels of organization…A molecule such as a protein has attributes not exhibited by any of its component atoms, and a cell is certainly much more than a bag of molecules. If the intricate organization of the human brain is disrupted by a head injury, that organ will cease to function properly, even though all its parts may still be present. And an organism is a living whole greater than the sum of its parts…[W]e cannot fully explain a higher level of order by breaking it down into parts. A dissected animal no longer functions; a cell reduced to its chemical ingredients is not longer a cell. Disrupting a living system interferes with the meaningful explanation of its processes.[64]

Following the lead of Laubichler and Wagner (2001), molecular biology centers on the investigation of the mechanisms that ground the fundamental processes of life, such as DNA replication, protein synthesis, regulation of gene expression, cross-membrane transport, metabolic pathways, and intracellular communication. By their lights, the developmental mechanisms that ground the above processes are features of *structured* cellular *wholes*. Explanations in developmental molecular biology are irreducibly *holistic* in that they make reference to either the cell qua biological whole or the dynamical properties of developing systems; an appeal to component molecular properties (and their interactions) to explain the mechanisms that guide the unfolding of cellular growth and spatial differentiation are incomplete. All of the above developmental mechanisms take place within, and are enabled and constrained by, cellular wholes themselves. Lenny Moss (2003:95) argues along similar lines that "*cellular context* as a whole is basic to the nature and continuity of living beings and is irreducible to any of its constituent parts." As a result, duplicating the molecular parts and their basic arrangements does not suffice to duplicate the cellular whole with its accompanying perfectly natural properties (developmental mechanisms). Consequently, PDP fails with respect to cellular wholes.

John Dupré (2010) cites the phenomena of protein folding as an example of the emergent causal dispositions of cells at work. One particularly thorny problem in de-

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[64]Campbell (1996: 2-4).

velopmental molecular biology is accounting for the "transition from an amino acid sequence to the baroquely complex structure that results as this sequence folds into a three-dimensional shape." Dupré notes that while the precise topology of the protein structure is essential to its proper functioning, such structure is "strongly undetermined by the chemical properties of the links between successive amino acids." What is required 'over and above' the chemical properties of the component sequence are further 'chaperone' proteins to help aid in correct unfolding. Dupré argues that it is the structural context of the cellular whole (in its supplying the requisite chaperone proteins) that causally disposes the parts of the genome to produce an appropriately folded protein. Hütteman and Love (2011: 540) concur in stating that "[s]cientists now recognize that the causal powers requisite for folding are not all contained within the parts of the linear polypeptide." Dupré himself concludes, "The cell, I think we must say, with all its intricate structure and diverse contents, is what causes these contents to behave in these life-sustaining ways."

All of the above examples from physics, chemistry, and systems biology suggest that PDP fails with respect to certain microphysical *and* macrophysical wholes, thereby calling into question both part-priority as well as priority microphysicalism.

4.4.3   Evidence of Grounding Wholes?

I want to conclude this chapter by exploring the prospects of moving from the failure of a part-priority grounding description for certain composite objects to the stronger thesis of there being plausible instances of whole-priority grounding structure in nature (and hence instances of grounding wholes).

There are two lines of support for the move from the failure of PDP for certain composite objects (and hence the failure of part-priority) to the thesis that such objects are ontologically prior to their proper parts and hence grounding wholes, i.e. wholes that are composed entirely of inseparable parts (see §3.1). First, many friends of a naturalness ordering over properties are of the opinion that the minimal ontological base for *properties* and the *bearers* of those properties march in step: the metaphysically fundamental entities (i.e. the substances) bear the elite natural properties. Lewis (1986: ix), for instance, maintains that the perfectly natural properties are instantiated exclusively by the members of the Humean mosaic upon which all else supervenes. Those who favor the ontological primacy of microphysics endorse what Hawthorne (2006: viii) has aptly labeled *micronaturalism*: that the bearers of the perfectly natural properties belong exclusively to the microphysical domain. Irrespective of whether one has a penchant for the ontological primacy of the microphysical, the point remains that it is natural to think that the bearers of the elite properties that carve the non-redundant causal structure of the world are themselves metaphysically elite. Heil (2012: 29) puts it nicely, "If

you are going to have emergent fundamental properties, you are going to need emergent fundamental substances as bearers of those properties."

The second and more important line of support for the above move stems from the fact that in cases of ontological emergence we have not only the *whole's* failure to supervene on its proper parts, but the causal dispositions as well as the very *identity* of the *parts* themselves appear to be inseparably tied to or constrained by their respective wholes.

4.4.3.1 Identity-Constraints in Quantum Entangled Wholes

Consider quantum entangled wholes once more. The spin states of the particles that now compose an entangled whole in the singlet state can no longer be defined apart from the whole of which they are a part. As parts of a genuinely non-separable system, neither particle instantiates a *pure* (unmixed) spin state, a state that can be individuated apart from the other particles in the entangled whole. The components of entangled systems, then, are 'structure-laden' in that the spin state of each individual particle can be specified only by reference to the entangled whole. Karakostas (2009:12, 17-18) summarizes this nicely:

> In considering any entangled compound system, the nature and properties of component parts may only be determined from their 'role' — the forming pattern of the inseparable web of relations — within the whole...In a truly non-separable physical system, as in an entangled quantum system, the part does acquire a different identification within the whole from what it does outside the whole, in its own 'isolated', separate state.

and,

> For the non-separable character of the behavior of an entangled quantum system precludes in a novel way the possibility of describing its component subsystems as well-defined individuals, each with its own pure state or pre-determined physical properties. Upon any case of quantum entanglement, it is not permissible to consider the parts of a quantum whole as self-autonomous, intrinsically defined individual entities. (Ibid., p. 14)

However one goes about justifying the inference from the *properties* and *powers* of the particles being grounded in their entangled wholes to the thesis that their *natures* are grounded as such, the fact remains that many philosophers interpret the holistic implications of quantum entangled wholes to suggest that such wholes fit the description of what we have been calling grounding wholes (§3.4).[65] Heil (2012: 47) is worth reiterating on this score:

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[65] One suggestion as to how to move from the properties and powers of the particles to their natures being grounded as such: endorse the view that the qualitative and dispositional profile of a particular is part of its nature or, at the very least, necessitated by it.

Suppose quantum systems, systems of 'entangled' particles, are genuinely 'holistic', suppose their characteristics really do outstrip characteristics of their ingredients... [t]he 'parts' of such systems would have the status of modes: the wholes of which they are parts would not depend on the parts, the parts would depend on the wholes. (Heil 2012: 47)

According to Heil, the grounding structure that obtains between an entangled whole and its proper parts is precisely that of whole-priority.[66] So much so that he emphasizes that fundamental particles "... are abstractions, the nature and identity of which is dependent on systems to which they belong" (Ibid., 48).

In a similar manner, Josh Parsons (unpublished) makes the explicit connection between the holism embodied in entanglement and fundamental mereology:

This proposal is really nothing more than the application of a fairly traditional metaphysical idea–the idea that the fundamental ontology of the world consists of substances–where that means things that exist independently of each other. The elements of a non-separable quantum system don't seem to exist independently. Therefore, they are not substances, and if you buy into an ontology of substances, then they are not part of the fundamental ontology of the world.

Moreover, cosmologist George Ellis (2001: 270) writes:

Most quantum states are entangled states. This means that instead of thinking of bottom-up action by invariant constituents, one must consider cooperative effects between the constituent components that *modify their very nature*... In principle the particles have *no separate existence*. It can be suggested that our worldview should take this seriously, if indeed we take quantum theory seriously.[67]

Lastly, Kronz and Tiehen (2002: 346) refer to entangled quantum wholes as exhibiting what they call 'dynamic emergence' which they characterize in the following manner:

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[66]I hesitate to follow Heil here in characterizing the parts of entangled wholes (particles) as *modes* precisely because I take there to be a distinction between the parthood relation and the characterization relation (although, to be fair, he does put the word 'part' in quotation marks). Heil's labeling the entangled particles as modes of the whole, in my opinion, trades on the inference that because the parts of entangled wholes stand in the very same relation to their ground as do modes and their bearers—viz. ontological dependence—that therefore the parts of such systems *just are* modes. But the fact that x and y both stand in R to their individual grounds does not entail that x and y belong to the same ontological category (so if R is the relation of ontological dependence, x could be a number standing in R to a structure as per mathematical structuralism, or y could be a set standing in R to its members collectively). In my opinion, the identification of dependent or grounded parts with modes stems from the overall neglect of the concept of an inseparable part in contemporary metaphysics.

[67]Emphasis mine.

Emergent wholes have contemporaneous parts, but these parts cannot be characterized independently from their respective wholes...it does not make sense to talk about reducing an emergent whole to its parts, since the parts are in some sense constructs of our characterization of the whole...Emergent wholes are produced by an essential ongoing interaction of its parts, and *when that interaction ensues the independent particles become dependent*. But, if some of those parts are identical particles, then *they cannot be identified with those that existed prior to the interaction*, as a result of Pauli's exclusion principle. That is to say, *the independent parts cease to exist and the dependent parts come into existence*.[68]

Not only does quantum entanglement provide a counterexample to PDP as we have seen, it also suggests a more radical dependence ordering between entangled wholes and their proper parts such that even the identity of the parts are constrained by the entangled whole.

4.4.3.2   Identity-Constraints in Chemical Wholes

Lest anyone think that the whole-priority grounding structure that is thought to characterize entangled wholes is a phenomena unique to the domain of quantum mechanics, consider the following charge by philosopher of chemistry Joseph Earley (2003: 89):

Most philosophers have yet to recognize that, when components enter into chemical combination, *those components do not, in general, maintain the same identity that they would have had absent that combination* ... Interactions of such insights with the philosophical study of wholes and parts (mereology) is in its initial stages. It would be useful to develop a mereology adequate to deal with chemical systems, in order to facilitate future progress in dealing with other and more complex problems.[69]

Earley appeals to the dissolving of sodium chloride (NaCl) in water to form a saline solution. When the saline solution is produced, Earley argues:

[B]oth the constituents of the salt and also the solvent water are significantly changed. Parts are modified by their composition into a whole. This situation is excluded, by definition, from standard mereology. Mereology needs to be extended, to apply to cases where the assumption that wholes do not influence parts is not applicable.

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[68]Emphasis mine.

[69]My emphasis. Also, "An adequate theory of wholes and parts (mereology) must take into account that when individuals enter combinations of interesting sorts they no longer are the very same individuals that existed prior to the composition. It appears that no such formal theory now *actually* exists."

Earley is no lone voice in the philosophy of chemistry regarding the identity constraints on the parts of chemical compounds. There has been recent efforts by the likes of Harré and Llored (2010, 2011) to develop a formal mereological framework that mirrors the real unity and structure that characterize chemical compounds. Harré and Llored (2011) point to one of the most influential theories of chemical bonding of the twentieth century—*molecular orbital approximation*—as an example of the need for an alternative mereological framework that takes seriously the integral unity of chemical wholes as suggested by Earley.[70]

Classical accounts of molecular bonding centered on a molecule being a collection of atoms, each sustained by their individual combining power. This understanding of the molecule eventually gave rise to the shared electron theory of chemical bonding in which the positively charged nuclei of the atoms attract the shared negatively charged electrons. According to molecular orbital theory as advanced by Robert Mulliken (1932, 1981), the bonding between the individual atoms is understood as a combination of their electronic wave functions (atomic orbitals). The total electronic wave function for the entire molecule (molecular orbital) is then calculated as the weighted sum of its constituent atomic orbitals. According to Mulliken, the electrons are 'delocalized' in the sense that they are not assigned to individual bonds between atoms, rather, they are treated in relation to the nuclei of the entire molecular whole itself.

Mulliken offered the example of the molecule helium hydride (HeH) where "the atom of helium He disappears during the synthesis of the molecule HeH" such that "even ion-cores lose their thing-like status."[71] For Mulliken, then, a molecule is a composite whole in which the atoms "lose their singularity."[72] Reflecting on the implications of molecular orbital theory for mereology, Harré and Llored (2011: 73) remark:

> Using the expression 'diatomic molecule' for such a thing as a molecule of HCl or H2 suggests that the mereological analysis of these complex entities should lead us to say that the parts of such molecules are hydrogen and chlorine *atoms*. However, Mulliken's solution to the problem of how atoms are bound into molecules involves electron orbits that are not centered on the nuclei of the constituent atoms. Instead the one-electron wave function approximation for an electron becomes molecule centered, the paired nuclei serving as the reference for the model interpretation of the new orbital as a linear function of the wave equations for each electron considered with respect to each of the

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[70]It is important to note that Harré and Llored (2011) explicitly make reference to Earley in that they see their project to be an extension of his. Their remarks echo Earley's: "And that is why again, the topological chemical quantum turn is of the utmost importance for philosophical enquiries such as this. That is why, too, philosophers need to go back to laboratories of research to grasp what scientists are really doing with their new models and apparatus." (2011: 75).

[71]Harré and Llored (2011: 70).

[72]Ibid.

apparently constituent nuclei. If the criterion of identity for an atom or the ionic residue of such an atom, is the composition of the electron shells then these criteria could not be satisfied by the components of a complex molecule. The relevant nuclei form a doublet which, speaking in the accent of Mulliken, are a unit without parts, using the molecular orbital theory of electrons as the criterion for an individual part. A molecule does not have atoms or ions or even the nuclei of ions as its parts.

Again, noting the implications for mereology:

> We could express this insight in a mereological principle: Constituent atoms of molecules are not parts of those molecules when we look at the total entity in the light of molecular orbitals. Unlike chair parts which preserve their material properties whether in the chair or on the bench. Nor are they parts in the sense that buckets of water are parts of the ocean...looked at from the point of view of their constituent parts they are potentialities, not the things that are thereby afforded. (74)

Consequently, it is not unreasonable to think that chemical combination is such that the elements that are combined are substantially altered such that "when individuals enter combinations of interesting sorts they no longer are the very same individuals that existed prior to the composition."[73] That is to say, chemical wholes are plausible candidates for the status of grounding wholes as per substantial priority.

4.4.3.3 Identity-Constraints in Biological Wholes

Turning again to the domain of biology, not only do certain biological organisms instantiate emergent properties, there is also good reason to think that they constrain the identity of their proper parts. In fact, Keller (2010: 22) cites "the dependence of the identity of parts, and the interactions among them, on higher-order effects" as one of the defining features of biological explanation. Citing the example of a cell and its constituent genome, Keller goes on to claim that the global properties of biological wholes can not only causally influence but also fix the very identity of the parts of such wholes: "the very definition of what (if anything) a gene is depends on the properties of the cell in which the DNA is embedded."[74]

The recent advent of systems biology illustrates a biological holism with respect to the proper parts of living organisms. Biological organisms are *autopoietic systems*: self-organizing and self-regulating systems which perform the necessary operations to maintain their own identity. According to Juarrero (2000: 31), autopoietic systems are 'dissi-

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[73]Earley (2005: 85).
[74]Cf. Dupré (2010: 41).

pative structures' that exhibit constraints on the dispositions and identity of their proper parts:

> By delimiting the parts' initial repertoire of behavior, the structured whole in which the elements are suddenly embedded also redefines them. They are now something they were not before, nodes in a network, components of a system. As such, they are unable to access states that might have been available to them as independent entities."

Some philosophers of biology explicitly endorse whole-priority with respect to living biological organisms. Again, Laubichler and Wagner (2000: 23) represent this view nicely:

> In many cases, and in particular in the most problematic ones, the theories we are concerned with refer to sub-organismal objects, such as genes, or cellular and organismal characters (traits). The relationship of these objects to the individual organism can be of one of two kinds: (i) the organism can be thought of as a composite entity 'made up' of its traits and characters, or (ii) the traits can be thought of as (conceptual) abstractions of the organism. These two scenarios differ as to which object–part or whole–is ontologically prior. In the first case the characters or parts are ontologically prior to the higher level object or the organism... In the second case the higher level unit is ontologically prior. In this instance the sub-organismal objects (characters) are defined as conceptual abstractions of a higher level integrated whole and thus ontologically secondary. Here we argue that most biological objects at the sub-organismal scale are of the second kind. *In other words, we assume the ontological primacy of organisms and derive the objects relevant to the theory, i. e. the biological characters, by means of a conceptual decomposition of the organism.*[75]

The notion that the identity of the parts of living organisms are constrained by the whole of which they are a part was also shared by Alfred North Whitehead in his *Science and the Modern World*:

> The concrete enduring entities are organisms, so that the plan of the *whole* influences the very characters of the various subordinate organisms which enter into the plan of the total organism and thus modify the plans of the successive subordinate organisms until the ultimate smallest organisms, such as electrons, are reached. *Thus an electron within a living body is different from an electron outside it, by reason of the plan of the body...and this plan includes the mental state.*[76]

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[75] Emphasis mine.
[76] Whitehead (1926: 98-99), emphasis mine.

The kind of structure that defines living organic wholes not only threatens to undermine PDP, but also provides plausible grounds for thinking that some wholes are ontologically prior to their proper parts and hence plausible instances of grounding wholes.

We have examined what is perhaps the predominant fundamental mereology on offer in the recent literature, part-priority, in its most prevalent form, priority microphysicalism. I argued that part-priority in particular is faced with the challenge of accounting for the metaphysical possibility of gunk as well as the fact that both part-priority and priority microphysicalism are ill-suited to account for instances of whole-part supervenience failure in the domain of quantum mechanics, chemistry, and systems biology.

Kim (1999: 28) has argued that a whole's exhibiting constraints and causal influence on its proper parts borders on the incoherent: "But how is it possible for the whole to causally affect its constituent parts on which its very existence and nature depend?" I think Kim is right on point in this regard. But far from substantiating the alleged incoherence of a whole exhibiting constraints and causal influence on its parts, the above insights, I think, serve to stand Kim's dictum on its head: it is precisely *because* some wholes exhibit such constraints that they thereby fail to be grounded in their proper parts. We also noted that the failure of a part-priority grounding description for certain wholes is suggestive of (but does not entail) a stronger dependence ordering between a whole and its parts, namely, one that conforms to the notion of a grounding whole as per substantial priority. I turn now to a more direct attempt to motivate my preferred fundamental mereology, substantial priority, by showing that if offers a unified solution to a host of conundrums in the metaphysics of material objects.

Chapter 5

In Defense of Substantial Priority

"[O]ur moderns do not give enough credit to Saint Thomas and to the other great men of his time and that there is much more solidity than one imagines in the opinions of the Scholastic philosophers and theologians, provided that they are used appropriately and in their proper place. I am even convinced that, if some exact and thoughtful mind took the trouble to clarify and summarize their thoughts after the manner of the analytic geometers, he would find there a great treasure of extremely important and wholly demonstrative truths." — Gottfried Wilhelm Leibniz, *Discourse on Metaphysics* 11.

5.1 A Unified Solution to Puzzles in Material Objects

Much of the metaphysics advanced by its contemporary practitioners proceeds by model-building.[1] Competing models aimed at capturing the general structural features of reality tend to be weighed according to their elegance, simplicity, and overall explanatory virtues. Consequently, a metaphysical model that aims to capture the composition and structure of material objects is often judged as a more plausible candidate than its rivals on the basis of offering the best overall fit with the agreed-upon data in need of explanation. Of course, the scope of the relevant data concerning material objects that cries out

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[1]See Paul (2012b). By employing the phrase 'model-building' I in no way intend to convey the idea that metaphysics is concerned solely with our description of reality (whether representational or linguistic) or the construction of elegant and coherent formal systems. Rather, to my mind, the metaphysicians task in constructing a 'metaphysical model' about some particular domain of reality (e.g. time, human persons, free will, modality, composition, etc.) involves developing a view of the world that is coherent, displays many of the theoretical virtues like simplicity, elegance, explanatory power, scope, etc., and is epistemically justified on the basis of both rational intuition and inference to the best explanation. By my lights, a model regarding the nature of modality, say, is commendable in so far as it captures what we take ourselves to know about the world, particularly regarding what *is* and what *could* have been (a model involving complete modal collapse would, on this score, be an inadequate model by my lights). Coherence and explanatory power, for instance, are not sufficient grounds on which to commend one model over another; models or theories about the nature of modality must track the world as we know it (cf. Chisholm (1976).

for explanation is a contentious matter in its own right, and one to which I will certainly have nothing original to contribute.

I take the data concerning the composition and structure of material objects in need of explanation to concern not only the content of our best *total science*, but also our reflective common-sense intuitions concerning the world in which we find ourselves. Intuitively, composite material objects exist, persist through time, undergo change without thereby ceasing to exist, do not occupy the same place at the same time, and so on. Unless we are given a good reason to think otherwise, these common-sense intuitions ought to guide and shape our thinking about the inhabitants of the world, including ourselves as the objects engaged in the task of tracking reality's joints. This is not, however, to say that such intuitions are indefeasible or somehow closed-off from rational evaluation, only that they place prima facie constraints on philosophical theorizing about the existence and structure of material objects. We might say that philosophical intuitions about such matters are good servants, but very poor masters indeed.

The burden of the present chapter is to put on display some of the virtues of substantial priority. The view, say I and others before me, is worthy of consideration in so far as it offers a unified solution to a host of conundrums in contemporary metaphysics.[2] Substantial priority is not only scientifically serious (see §4.4) but also preserves many of our cherished intuitions about the denizens of spacetime. By substantial priority offering a 'unified' solution to the puzzles below, I mean the very same metaphysical machinery afforded by substantial priority, in particular its construing substances along the lines of grounding wholes, underlies the denial of at least one premise in all of the conundrums to follow.

As those well-traveled in the literature in this area will acknowledge, *every* solution to the following puzzles must learn to live with some counterintuitive consequence or other. And I freely admit substantial priority is no exception on this score. I take it as a general methodological principle that we ought to favor a solution to the puzzles that has, on balance, the most important advantages and the least serious drawbacks. As what one perceives to be 'the most important advantages' will inevitably be person-relative to some extent, I leave it to the reader to decide for themselves the merits of substantial priority alongside the likes of mereological essentialism, constitutionalism, mereological nihilism, stage theory, and perdurantism. I offer the view here only as a viable contender to these alternative models at play in the literature on material objects.

To begin, I follow the consensus in taking the following to be common-sense intuitions about material objects that are worth preserving, unless the advantages that result from their denial prove remarkably fruitful:

Existence: There are composite objects.

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[2]Note especially the work of Brown (2005) and Toner (2007) in demonstrating the fecundity of an application of a classical conception of substance to contemporary metaphysics.

Survival: Composite objects survive the loss or replacement of some of their proper parts.

No Coincidence: Two composite objects cannot exist in the same place at the same time.

Change: Composite objects persist through time and change.

Identity: Necessarily, identity is a transitive relation.[3]

While I'm of the opinion that we ought to try to accommodate all of the above intuitions in our theorizing about material objects, I do think that some are more deeply entrenched than others. I understand **Identity**, for instance, to be more firmly established as a datum worth preserving than **No Coincidence**, even though I take the denial of the latter to only slightly less counterintuitive than the former. With the above common-sense intuitions in place, let's turn to the puzzles.

5.1.1 Tib and Tibbles

Tibbles the cat is a mereologically complex object. Of the many proper parts of Tibbles at t is her tail, call it 'Tail.' Now, take all of Tibbles minus Tail, call this 'Tib,' and suppose that Tibbles undergoes an unfortunate accident at t_1 whereby she loses her tail and thus ceases to have Tail as a part. At t_1, then, Tibbles is a tailless cat. With this much in hand, we can generate the following puzzle:

T1. **Existence:** Tibbles and Tib exist.

T2. **Proper Parthood:** Tib-at-$t \neq$ Tibbles-at-t

T3. **Change:** Tib-at-t = Tib-at-t_1

T4. **No Coincidence:** Tib-at-t_1 = Tibbles-at-t_1

T5. **Survival:** Tibbles-at-t_1 = Tibbles-at-t

As is familiar, the puzzle turns on the fact that T1 together with T3-T5 jointly entail the denial of T2 via the transitivity of identity (**Identity**). Premise T2, however, is true by Leibniz's Law in virtue of Tib and Tibbles having distinct properties (topological, historical, etc.). Something must give.

There are, of course, a host of solutions on offer to the above conundrum, each of which have rather counterintuitive consequences in denying one of the above well-entrenched intuitions. One of the most prominent solutions is to deny **No Coincidence** and argue that while Tib and Tibbles occupy one and the same region at t_1, they are numerically distinct, albeit spatiotemporally coincident material objects.[4] Another option

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[3]That is: $\Box((x = y \land y = z) \rightarrow x = z)$.

[4]See Baker (2007), Johnston (1992, 2006: §8), Lowe (1983), Wiggins (1968), for a few representatives of this line.

would be to deny **Identity** and relativize the identity relation to times, sortals, or possible worlds.[5] Yet another would be to reject **Survival** and argue that upon losing Tail, Tibbles thereby ceases to exist, and thus endorse mereological essentialism.[6] Perhaps, some have argued, upon the loss of Tail there is only a single object where we initially thought there were two, albeit one that now belongs to two distinct kinds at t_1. Since Tibbles' dominant kind (i.e. cat) is associated with Tibbles and not Tib, we ought to identify the surviving object with Tibbles and conclude that Tib has ceased to exist at t_1, thereby denying **Change**.[7] On the other hand, some have found solace in an ontology of temporal parts as a means to reject **No Coincidence**: while Tibbles and Tib are distinct four-dimensional spacetime worms with different temporal parts, they nevertheless are partially spatiotemporally coincident at t_1 in virtue of sharing a common temporal part.[8] Or, lastly, one might simply deny **Existence** for at least one of the composite objects upon which the paradox is predicated, whether Tibbles or Tib or both.[9]

Here substantial priority offers an alternative solution. Suppose that Tibbles, qua biological organism, is a substantial whole. As a substance qua grounding whole, Tibbles fails to have proper parts that are themselves substances (**No Parthood**). Again, this is precisely because the existence and identity of the proper parts of substances are inseparably grounded in their particular substantial wholes (see §3.4). As per T2, since Tib is a proper part of a substance (Tibbles) at t, it follows that Tib is not a substance at t. The paradox of Tibbles the Cat seems to get its bite by assuming that the proper parts of Tibbles are substantial or basic in precisely the same sense as Tibbles; that cats and their proper parts are of the same ontological category. From T4, together with the plausible assumption that one's status as a basic or non-basic entity is among its essential (i.e. non-contingent) features, we can infer the denial of T3 (**Change**). If Tib-at-t is non-basic, then it cannot be identical to Tib-at-t_1, a basic. As a result, substantial priority offers a principled (i.e. non-ad hoc) reason to reject **Change** as it applies to the proper parts of substantial wholes in general, in this case Tib in particular.

What's more, the above solution to the paradox of Tibbles the Cat avoids one notable objection to the standard rejection of **Change** as embodied in the aforementioned dominant kinds account of Burke (1994) and Rea (2000). For instance, Sider (2001: 163) contends that the "good old-fashioned implausibility" of a denial of **Change** in this context stems from the following: "We are asked to believe that an artist can destroy a lump of clay by shaping it into a statue, and that a torso can be destroyed by detaching something external to it!" Note the last comment in particular, the one about the torso (Tib) being *externally* related to Tail. If this was the correct description of the relation-

[5]See Myro (1997), Geach (1967), Gibbard (1975), respectively.
[6]See Chisholm (1976: ch. 3).
[7]See Burke (1994) and Rea (2000).
[8]See Sider (2001: ch. 5).
[9]On this line, see Cameron (2010b), Dorr (2005), and Hawthorne and Cortens (1995).

ship between the many proper parts of a living organism such that they were *separable* with respect to one another in addition to their composing whole (see §3.3.1), then it is difficult indeed to explain Tib's ceasing to exist upon the detachment of Tail.

But on substantial priority, such a grounding description is precisely what we do *not* have concerning the mereological structure of composite substances. As grounding wholes, composite substances are composed only of inseparable parts, each of which are totally grounded in one and the same substantial whole (see §3.4). The proper parts of grounding wholes, then, are *interdependent* in that their natures, both individually and collectively, are grounded in their common substantial whole. Hence, in rejecting T3 (and thereby **Change** with respect to Tib) substantial priority offers a grounding story as to *why* Tib thereby ceases to exist upon the loss of Tail: in so far as the removal of Tail identifies Tib at t_1 with Tibbles at t_1, a substance, Tib at t thereby ceases to exist *precisely because it is not possible for something that is essentially grounded (inseparable part) to be identical with something that is essentially ungrounded (substantial whole)*. Tail's detachment affords the relevant identity between Tib and Tibbles which thereby brings about Tib's demise.

5.1.2 Goliath and Lumpl

Let us move on to what is perhaps the most well-known puzzle in material objects, which turns on the relationship between a statue, 'Goliath,' and the lump of bronze from which it is made, 'Lumpl.' The problem was reintroduced onto the contemporary scene by Alan Gibbard (1975) and trades on the tension between several of our common sense intuitions above. The puzzle consists in the fact that the following plausible theses regarding Goliath and Lumpl are mutually inconsistent:

C1. **Existence:** Goliath and Lumpl exist.
C2. **No Coincidence:** If Goliath and Lumpl both exist, then Goliath = Lumpl.
C3. Goliath has different properties from Lumpl.
C4. If Goliath has different properties from Lumpl, then Goliath $\neq$ Lumpl.

The problem, of course, is that C1-C4 cannot all be true. Common sense commends the existence of statues and lumps of bronze, hence C1. What's more, C2 is plausible in so far as both Goliath and Lumpl would appear to occupy the very same spatiotemporal location and thus share all and only the same proper parts. But surely the following principle holds: for any occupied spatiotemporal region r, there is exactly one material object that occupies r. On the other hand, Goliath and Lumpl have very different modal properties, namely different persistence conditions. Lumpl is able to survive being melted by the artist, not so with Goliath. The melting of Goliath, it is argued, results in the complete destruction of Goliath. It follows, by Leibniz's Law, that Goliath is not identical to Lumpl (C4).

Of course, a straightforward denial of C1 dissolves the problem at hand: there simply *are* no statues and no lumps of bronze to generate the puzzle.[10] Hence, van Inwagen (1990: 111): "If there are no artifacts, then there are no philosophical problems about artifacts." Again, for many, a denial of **Existence** for such objects is a cure that kills the metaphysical patient.

We could, on the other hand, take the puzzle to warrant the acceptance of a four-dimensional ontology, whether of a perdurantist or stage-theoretic variety.[11] The most common four-dimensionalist solution to the puzzle of Goliath and Lumpl is *perdurantism*. For the perdurantist, material objects are temporally as well as spatially extended particulars. Just as you are located in space by having distinct parts at different regions, i.e. spatial parts, you are also located in time by having distinct parts at different times, i.e. temporal parts. On this view, your entire spatiotemporal career consists of the mereological fusion of all of your spatial and temporal parts throughout the duration of your existence. For any given subinterval of your spatiotemporal career, you exist at that subinterval by having a temporal part that exactly overlaps that sub-interval. You, however, are only *partially* located at that interval in virtue of one of your parts existing at that interval.

Perdurantism lends a rather straightforward solution to the puzzle at hand, namely a rejection of **No Coincidence** (C2). Goliath and Lumpl are numerically distinct material objects with distinct spatiotemporal careers, albeit ones that share one and the same temporal part during the period of coincidence.[12] The spatial overlap between Goliath and Lumpl is no more problematic than the momentary spatial overlap of two distinct roads, only part of each road is picked out during the time of overlap.

On *stage theory*, however, the spatiotemporal careers of ordinary material objects are instantaneous and thus maximally short-lived.[13] On this view, ordinary material objects such as persons, playing cards, and molecules *just are* instantaneous stages. The only entities that satisfy predicates such as 'is a book,' 'is a statue,' or 'is a human being' are instantaneous stages. If so, how then do we account for numerical sameness or identity across time on this view? Here the stage theorist takes a page from Lewis (1986: 9-10) in construing identity across time as being analogous to identity across possible worlds. Individuals, for Lewis, are world-bound, i.e. they exist in only one world. Analogously, individuals exist at only one instant for the stage theorist. An instantaneous stage at t_1

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[10]For representatives of this line of thinking see Heller (1990), van Inwagen (1990: 124-127), Hoffman and Rosenkrantz (1997), Merricks (2001), and Olsen (2007).

[11]I take perdurance (what I am referring to here as the temporal parts theorist) and stage theory below to be species of a four-dimensional ontology concerning the nature and persistence of material objects.

[12]As is well-known, the puzzle can be easily adapted to spell problems for the temporal parts theorist. Suppose Goliath and Lumpl both come into existence and cease to exist at the very same time such that they have one and the same spatiotemporal career (i.e. they exactly overlap with respect to their spatial and temporal parts). The temporal parts theorist is forced to identify Goliath and Lumpl.

[13]For representatives, see Hawley (2001) and Sider (2001).

'persists' not by existing at a later time t_4 but, rather, by a numerically distinct instantaneous stage at t_4 standing in the temporal counterpart relation to it.

Stage theory affords a distinct four-dimensional solution to the puzzle of Goliath and Lumpl, namely the denial of C4. On this view, Goliath is *identical* to Lumpl, there is only one instantaneous stage, call it S, that occupies the region in question. How can this be given the fact that Goliath and Lumpl have different properties (C3), for instance? Answer: one and the same stage can be considered under different temporal counterpart relations. For one, where t^* represents the future time at which S will be flattened, it is currently true that S will not exist at t^* in so far as it fails to stand in the *statue counterpart relation* to a subsequent instantaneous stage that exists at t^* and satisfies the predicate 'is a statue.' Likewise, it is currently true that S will exist at t^* in so far as it stands in the *lump of bronze counterpart relation* to a subsequent instantaneous stage that exists at t^* and satisfies the predicate 'is a lump of bronze.' Considered under the *statue counterpart relation*, S will not survive flattening at t^* by the indecisive artist; under the *lump of bronze counterpart relation*, however, S will survive such flattening. Consequently, the stage theorist pins the differences in temporal properties between Goliath and Lumpl on differences in the temporal counterpart relations S bears to numerically distinct stages (note the similarities to modal counterpart relations in accounting for *de re* modal ascriptions).[14]

One of the many costs of both perdurantism and stage theory is, according to some, the denial of genuine alteration itself, and hence **Change** in its widest possible application to concrete particulars.[15] On perdurantism, while distinct temporal parts of the candle bear intrinsic properties at different times—straight-at-t_1 and bent-at-t_2—it is not the case that *one and the same* thing loses a property and gains another at a later time. But the thesis that persistence through time involves the strict continuity of at least something or other is one that is firmly entrenched.[16] Perdurantism seems to substitute the successive *replacement* of temporal parts for the notion of genuine change or alteration over time.

On stage theory, since ordinary material objects are identical to instantaneous stages, we thereby lose the ability to speak of diachronic sameness in terms of strict numerical identity. Here we have an account of 'persistence' that precludes one and the same thing existing at distinct times; it's just one numerically distinct instantaneous stage after another. The plausibility of the stage theorist's solution to the present puzzle of Goliath and Lumpl rests entirely on their analysis of *de re* temporal ascriptions in terms of temporal counterpart relations. Its being true that 'S will exist at t^*,' they argue, *just is* S's

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[14]I take Sider (2001: 200) as representative of a stage-theoretic solution to Goliath and Lumpl.

[15]This is a much broader thesis than my claim that substantial priority entails the denial of **Change** for the proper parts of substances. For those who press this line see McTaggart (1927), Mellor (1998, section 8.4), Oderberg (2004), and Simons (1987).

[16]Note that the strict continuity involved here need not apply to the object of change itself, as in the case of substantial change.

being related to some numerically distinct statue counterpart that exists at t^*. For those who already harbor a deep-seated suspicion as to whether modal counterpart theory is well-suited to capture *de re* modal ascriptions will, most likely, have the very same reservations about its temporal application in the case above. For philosophers in this camp, myself included, the reductive base of the *de re* temporal ascription 'S will exist at t^*' must somehow be intrinsically linked to S. But how does a numerically distinct temporal counterpart satisfying the predicate 'is a statue' at a later time have *anything* to do with whether or not S itself will exist at t^*? The analysans appears to be wholly irrelevant to the existence and identity of S.[17] It is for these reasons and others scattered throughout the literature that I set aside a four-dimensional solution to the puzzles at hand.

These, of course, are in no way novel criticisms of the two variants of a four-dimensional ontology, but are ones to which both perdurantists and stage-theorists have lodged detailed responses. In the end, however, I am inclined to think that these rejoinders serve to further underscore the deeply revisionary nature of change on a four-dimensional metaphysic. As others have so aptly put it, serious metaphysics ultimately proceeds not from the head, but from the gut.[18]

Perhaps the most widespread three-dimensionalist solution offered in response to the puzzle of Goliath and Lumpl (often called the 'standard' solution) is to reject C2 (**No Coincidence**) and endorse *constitutionalism*: while Goliath and Lumpl are non-identical complex objects in virtue of having different properties (C3 and C4), the latter nonetheless *constitutes* the former. Albeit weaker than identity, constitution is an intimate relation which serves to facilitate mutual property inheritance between that which constitutes and that which is constituted. It is, according to Baker (2002: 593), "the metaphysical glue of the natural world:" lumps of bronze constitute statues, portions of steel constitute battle-axes, bodies constitute human persons, chunks of wood constitute chairs. This line sacrifices **No Coincidence** in order to secure **Existence** for statues and lumps of bronze.

Embracing constitutionalism is not the only three-dimensionalist denial of C2, however. Substantial priority also denies **No Coincidence**, for reasons resembling those offered on behalf of constitutionalism as well as those intrinsic to the view itself.[19] Substantial priority and constitutionalism agree in that statues and lumps of bronze are non-identical in virtue of their exemplifying different modal properties and having distinct persistence conditions. It is precisely *because* Goliath and Lumpl are different kinds of mereological wholes that they exhibit distinct modal properties and persistence conditions. On substantial priority, however, the difference in category between Goliath and

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[17]This is forcibly pressed by Merricks (2003).

[18]Heil (2012: 9).

[19]I should note that the defender of substantial priority *need* not reject **No Coincidence** as a solution to the puzzle. Toner (2007), for example, offers an alternative substantial priority solution to the problem without denying **No Coincidence**, although one that relies heavily on the notion of a dominant kind.

Lumpl is one that tracks not only a difference between the kinds *bronze* and *statue*, but also a deep difference in the ontological categories of *substance* and *non-substance*, which therein gives rise to a difference in grounding structure for each spatially co-located object in question. As was the case with the puzzle of Tibbles the Cat above, the present conundrum trades on taking statues (artifacts in general) and their matter as being material objects of the same ontological category. Goliath is an artifact and thus, on this view, a type of grounded whole. Lumpl, on the other hand, is a composite substance, and hence a grounding whole. On substantial priority, the primary reason why C2 is false is that no grounded whole is (or could be) identical to a grounding whole.

If Goliath and Lumpl are non-identical as per the denial of C2, what exactly is the relationship between statues and their matter according to substantial priority? Must we resort to a *sui generis* constitution relation? Here I think substantial priority offers a more defensible denial of **No Coincidence** than constitutionalism in that it lends a straightforward *mereological* account of the relationship between Goliath and Lumpl. Note first that on substantial priority, while Goliath and Lump may be plausibly said to occupy one and the same region, they do not share all and only the same proper parts (i.e. they do not *exactly* mereologically coincide with one another); indeed they *cannot* given the different grounding structure that characterizes grounded and grounding wholes in general.[20] As per the nature of grounded wholes, Goliath must have at least one substantial proper part at a level of decomposition that is included among its total grounds. By contrast, in virtue of being a substance, Lumpl is essentially such that it lacks substantial proper parts altogether. While both Goliath and Lumpl exhibit a significantly high degree of mereological overlap, substantial priority offers a principled reason for thinking that they do not share *all* of their proper parts in common.

On the view I am recommending here, one such proper part of Goliath that Lumpl lacks would be Lumpl itself (although Lumpl has itself as an improper part).[21] Lumpl, I

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[20]Of course, assuming the *non*-identity of Goliath and Lumpl, they cannot share all and only their parts, proper *and* improper. To mereologically overlap with respect to their improper parts would be to identify Goliath and Lumpl. Hence the restriction to proper parts. Some may quibble that to occupy one and the same region entails the having of all and only the same proper parts. I disagree. For one, to assume that sameness of region *entails* sameness of proper parts is to assume the truth of DAUP (or something in the vicinity to DAUP), a thesis we have seen little reason to accept (see §4.3). Again, we need not think of the mereological structure of a whole as being isomorphic to the mereological structure of its occupying region. It seems perfectly respectable to think that Goliath and Lumpl could differ with respect to their proper parts yet occupy the very same region (especially if we say that extended simples are possible), at least to me. Second, the denial of *exact* mereological overlap between Goliath and Lumpl with respect to their proper parts is independently motivated in so far as it preserves *extensionality*: that wholes with all and only the same proper parts are identical. See Paul (2006) and Bennett (2004) for an insightful and thorough treatment of the relationship between occupying the same region and having the same proper parts.

[21]Following the terminology of Wasserman (2002), Goliath and Lumpl *weakly materially coincide* with one another in that while every part of Lumpl is a part of Goliath, not every part of Goliath is a part of Lumpl. Wasserman raises an important objection to the notion of weak material coincidence. Suppose Goliath and Lumpl weakly materially coincide in the above sense. Call the part of Goliath that is not a part of Lumpl, Righty. Now take the part of Lumpl that coincides with Righty, call it S-Righty. He asks:

submit, is best construed as a substantial proper part of Goliath, albeit a very large one indeed. As a bronze statue, the nature of Goliath is defined (grounded in) by both the bronze out of which it is made as well as the particular structure or organizing principle that makes it a statue of a (giant) human person instead of, say, a statue of a turnip.[22] Substantial priority, then, rejects **No Coincidence** and maintains the non-identity of Goliath and Lumpl (and artifacts and their matter in general) without introducing a *sui-generis* constitution relation to explain the relationship between the two spatially co-located material objects. I take this to be a mark in favor of substantial priority in so far as it offers a more ideologically parsimonious rejection of **No Coincidence** (C2) than constitutionalism in positing less primitive structure in the world.[23] If one opts for a mereological analysis of constitution, then the advantage of parsimony on behalf of substantial priority here would be its positing less world-structure *per se*, and not necessarily less *primitive* world-structure.

But what about the fact that Goliath and Lumpl occupy one and the same spatial region? Is not the admittance of spatial co-location between distinct material objects itself a mark against substantial priority? In response we must remember that on certain widespread views in metaphysics, spatial co-location *per se* is ubiquitous such that regions of substantival space are exactly co-located with their occupants and tropes are co-located with their bearers (as well as other tropes). But here the worry is the exact co-

what is the relationship between Righty and S-Righty? They cannot be identical, he argues, in so far as we are assuming that Righty is not a part of Lumpl (and hence something that is not a part of Lumpl cannot be identical with a part of Lumpl). Righty and S-Righty are therefore non-identical. Here we have the problem of Goliath and Lumpl all over again, only on a much smaller scale (what accounts for the difference in modal properties between Righty and S-Righty? Answer: there is a part of Righty that is not had by S-Righty. One can continue this line until one reaches the smallest atomic parts of Goliath and Lumpl). In the end, Wasserman argues, the weak material coincidence view will be committed to saying that Goliath and Lumpl are entirely spatially coincident yet fail to share *any* parts at all, a view he takes to be absurd. My proposal here, I think, simply sidesteps Wasserman's worry. For one, given that we are assuming the *non-identity* of Goliath and Lumpl (as do all views that posit coincidence), weak material coincidence only applies to the *proper* parts of Goliath and Lumpl on pains of identifying the two objects. Second, on my view, the proper part of Goliath that is not a proper part of Lumpl *just is* Lumpl *itself*. Goliath has Lumpl as a proper part but Lumpl does not have itself as a *proper* part, although it does have itself as an *improper* part. That is, for me, Righty *just is* Lumpl in its entirety. Hence (if Righty = Lumpl) the only part of Lumpl that *exactly* spatially coincides with Righty is its improper part, i.e. Lumpl itself. There is, then, no *proper* part of Lumpl that exactly spatially coincides with Lumpl. To say that Goliath and Lumpl weakly materially coincide requires only that Righty not be a *proper* part of Lumpl. Righty, however, is free to be an improper part of Lumpl and hence identical to it, which is precisely what I say.

[22]The view afforded by substantial priority is structurally similar to the one put forward in Fine (1982: 100-101). By Fine's lights, Goliath is what he calls a 'qua-object,' a distinct whole that is the result of a *basis*, in this case Lumpl, being structured by a *gloss*, in this case a Goliath-type spatial arrangement. Fine's qua-objects are a species of what I am calling grounded wholes. Fine takes qua-objects to be governed by the following axioms: *Existence*: the qua-object x-qua-ϕ exists at a given time iff x exists and has ϕ at the given time; *Identity*: (i) two qua-objects are the same only if their bases and glosses are the same, and (ii) a qua-object is distinct from its basis; *Inheritance*: at any time at which a qua-object exists, it has those normal properties possessed by its basis.

[23]The ideological parsimony here depends, of course, on how the constitutionalist understands the constitution relation. Some, like Markosian (2004) take it as primitive, others, such as Zimmerman (2002), analyse the notion in mereological terms, and others still, Baker (2007: 32), in non-mereological terms.

location of distinct *material objects*. Here I think substantial priority has the resources to help soften the charge of objectionable overlap between Goliath and Lumpl. One could argue that what is objectionable in countenancing spatially overlapping material objects is not the overlapping of such objects *per se*, but the overlapping of *fundamental* or *basic* material objects in one and the same region. Here we might follow Schaffer (2009a: 361) in endorsing a revised gloss on Occam's Razor in terms of substances: "Occam's Razor should only be understood to concern substances: do not multiply basic entities without necessity." As Lumpl is the sole substance within the boundary of the region occupied by Lumpl and Goliath, no substances are multiplied in the case at hand (let alone without necessity). While substantial priority in this case rejects **No Coincidence** regarding Goliath and Lumpl, it affirms what we might call **No Basic Coincidence**; since regions of space are unrelentingly monogamous when it comes to hosting *fundamental* material objects, the defender of substantial priority is innocent of ontological excess where it matters most. Substantial priority, in sum, provides a solution to the puzzle of Goliath and Lumpl which preserves **Existence, Survival, Identity**, and **Change** for ordinary material objects, and upholds **No Basic Coincidence** in the place of **No Coincidence**.

5.1.3 The Problem of the Many

First ushered onto the contemporary scene by Peter Unger (1980), the Problem of the Many has proven to be an intractable puzzle that has led many philosophers to endorse some radically counterintuitive views about the nature of material objects. Hud Hudson, in his *A Materialist Metaphysics of the Human Person*, provides what I believe to be the definitive explication and treatment of the Problem of the Many in the literature. As a result, I take his treatment of the problem as my guide in what follows.[24]

To begin, consider Socrates, a human animal sitting in a chair that is composed of all and only those bits of matter that compose Socrates at the present moment (t), call these bits 'The Primary Set.' For illustrative purposes, suppose that the bits of matter that compose Socrates are particulate and that the world ultimately terminates in mereological simples. Now, consider some outermost simple in the region of Socrates' left hand that is not a member of The Primary Set at t, call it 'Lefty.' Consider once more some outermost simple on Socrates' right hand which is a member of The Primary Set at t, call it 'Righty.' Now, suppose we take the all the simples in The Primary Set at t except Righty and no other simples, save Lefty. We now have what we can call 'The Secondary Set' at t. Taking $x_1 \ldots x_n$ to signify mereological simples, we may signify The Primary Set (which includes

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[24]It should be noted that POM has traditionally been understood as another variant on the sorites paradox. I take it here as a *metaphysical* paradox whose conclusion (that there are a great many non-identical person-candidates overlapping one another at the same time), seeks to make a claim about the *nature and structure of reality* (as opposed to the linguistic vagueness of either the application of predicates or how the proper name 'Socrates' denotes one particular object).

Righty) as $\{x_1 \dots x_n, \text{R}\}$ and The Secondary Set (which includes Lefty) as $\{x_1 \dots x_n, \text{L}\}$:

> **The Primary Set:** $\{x_1 \dots x_n, \text{R}\}$
> **The Secondary Set:** $\{x_1 \dots x_n, \text{L}\}$

Furthermore, suppose we allow for the rather liberal composition principle that any collection of things composes a further thing (mereological universalism roughly stated). If so, then it follows that there is an object that is composed of all and only the members of The Secondary set at t. So, just as Socrates' being a human animal was said to supervene on the environment, histories, types, and arrangement of the simples that are members of The Primary Set, in the same way, we now have a second human animal composed of all and only the members of The Secondary Set, call these 'P1' and 'P2' respectively. Consequently, we now have two alleged human-candidates, P1 and P2, occupying Socrates' chair at t. But the problem gets worse. We can, in fact, continue the very same process with other simples resembling Lefty or Righty, generating a host of equally plausible human-candidates, all of which presently occupy Socrates' chair. Herein lies the Problem of the Many.

Here we might suppose that the generation of the many is due entirely to the admittance of mereological universalism, the view that any collection of things composes a further thing. Why not take the Problem of the Many as a reductio of mereological universalism? This would be too quick I think. Many are of the opinion that the intuition driving the problem of the many human-candidates within Socrates' boundaries is not so easily disposed of. What is needed here is not merely a denial of mereological universalism, but rather the positive thesis that *there is* no object that is composed of all and only the members of the Secondary Set at t. But what principled, non-ad hoc reason could be offered in favor of such a view? If the members of The Primary Set compose a human animal, and the difference between the Primary Set and the Secondary set trades on a single point-sized bit of matter, then it seems equally plausible that the members of The Secondary Set are situated to compose a human animal as well. Without a well-motivated reason for such an exclusion, composition looks intolerably arbitrary. Consequently, without such a reason to think that P1 is a person and P2 is not, even the denial of mereological universalism leaves the original intuitions that generated the problem in tact.

5.1.3.1 A Sampling of Solutions: Historical and Contemporary

Solutions to the above puzzle abound, some more revisionary than others. Hudson highlights nine different solutions (excluding his own) ranging from the elimination of Socrates altogether, to identifying Socrates with an immaterial substance, to employing the machinery of fuzzy sets, to altering classical identity in some way, to distinguishing between the one person and its many person-constituters, or simply biting the wildly

counterintuitive bullet and admitting a plenitude of persons in Socrates' chair. Here my aim is only to offer a brief survey of a few of the more interesting and prominent solutions on offer to the Problem of the Many, and attempt to show how substantial priority offers a novel solution to this vexing problem.

Perhaps a rather straightforward reaction would be to simply bite the bullet of the many and, contrary to our common sense intuitions, countenance a multiplicity of persons occupying Socrates' chair at the time in question. Where we originally thought there was only one person in Socrates' chair, there are an innumerable number of non-identical persons each with their own respective conscious lives. **No Coincidence**, in effect, is false. After all, this line reasons, we have little reason to put too much epistemic weight on our common-sense intuitions; it is, then, no surprise that such intuitions fail to track the many. For obvious reasons, there are very few, if any, who endorse such a no-holds-bared inclusion of the many.

One rather revisionary way of including the many candidates while, at the same time, claiming that there is 'one' person in the chair, namely Socrates, is to reevaluate our standard thinking about the identity relation in some form or other. Some have argued that the culprit for the generation of the many in Socrates' chair is a commitment to classical identity; discharge **Identity** and the many are evicted. There are multiple forms this route may take, here I focus on a medieval and contemporary variant of this style of response to the problem.

Peter Abelard, the pre-eminent philosopher-theologian of the twelfth century, had a ready solution at hand for the many person-candidates in Socrates' chair, one that stems from his wider views regarding the concept of identity in general. Abelard famously distinguished between *sameness in essentia* and *numerical sameness*.[25] A and B are the same in *essentia* if and only if they have exactly the same proper (integral) parts; distinct in essentia if they do not. If A and B are the same in essentia, then they are numerically the same entity. For Abelard, while being numerically distinct entails being distinct in essentia, the converse does not hold. That is, A's being distinct from B in essentia does not entail that A and B are numerically distinct. Such a relation may hold between A and B if they exhibit a high degree of mereological overlap. While A and B differ in some respect in their proper parts, they nevertheless share a great many proper parts and thus are numerically the same entity. Consequently, Abelard countenances a relation of numerical sameness without what we would call classical or absolute identity. Thus each of the many overlapping human-candidates in the Problem of the Many, though different in essentia in virtue of their failure to exactly mereologically overlap, are nonetheless numerically one and the same human animal.

Abelard's solution to the problem of the many shares many similarities with David Lewis' (1999e) response to the puzzle. While Lewis sees no problem in admitting the

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[25] For more on Abelard's account of identity statements see King (2004).

many candidates, he maintains that there is a natural sense in which there is but one person in Socrates' chair at the moment. We often, Lewis claims, count by relations other than strict absolute identity. Suppose we take numerical sameness and distinctness to be a spectrum consisting of absolute identity on the one end and absolute distinctness (or what Lewis calls 'disjointness') on the other. Occupying the middle of the spectrum will be cases where two things are not entirely identical, nor entirely distinct in so far as they exhibit a high degree of mereological overlap. Thus, we ought to think of overlap as a species of identity, what we might call 'partial identity.' Any two of our equally plausible human candidates will almost completely overlap, differing in only a few skin cells or other for example. While the human-candidates fall short of complete identity, they fare nicely when it comes to being partially identical to one another in virtue of overlapping to a significant degree; as Lewis puts it, P1 and P2 are 'almost-identical.'

Another radical response is to identify Socrates with an immaterial object, his soul for instance.[26] The defender of this line of reasoning takes the generation of the many human-candidates to apply to any material object whatsoever. For *any* material occupant of spacetime you choose, the many can be generated by arbitrarily selecting a material simple just beyond the spatial boundary of that object in precisely the same manner as above. Solution: human persons fail to be composed of any material occupants of spacetime. They are, instead, immaterial souls causally related to a particular human animal. Persons are immune to the generation of the many precisely because they are immaterial, or so the argument goes.

The last solution I survey here trades on a distinction between persons and person-constituters, between Socrates and those Socrates-constituting collections of simples or portions of matter. Given that these two sorts of entities have different identity and persistence conditions, it would be a category mistake to identify persons with the portions of matter that constitute them (the statue and the lump of bronze for instance). While there are a multiplicity of Socrates-constituting aggregates of simples in the region at which Socrates is located, Socrates is the sole human animal that each of them constitutes.

Enter substantial priority. Suppose now that Socrates, qua biological organism, is a composite substance understood along the lines of a grounding whole. The proponent of such a fundamental mereology would question the underlying assumption that generates the multiplicity of overlapping persons occupying Socrates' chair; that there can be genuine mereological overlap between substantial wholes in virtue of sharing $x_1 \ldots x_n$ as proper parts. The above formulation of the problem of the many construes the common material simples occupying the compositional base ($x_1 \ldots x_n$) as separable parts and thus capable of being proper parts of numerically distinct substances at t. According to the view of substantial wholes on offer, if the simples within the boundaries of P1 compose a

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[26]See Unger (2006) for a defense of this view.

substance qua grounding whole, then the natures of those simples are totally grounded in the substance of which they are a part and thereby *cannot* be proper parts of any distinct alleged human-candidate at t.

On this view, while Socrates (i.e. P1) is composed of the Primary Set at t, there is no numerically distinct substance that intersects his compositional base at t given a whole-priority grounding description. Once we reject the thesis that the Primary Set $\{x_1 \ldots x_n, R\}$ and the Secondary Set $\{x_1 \ldots x_n, L\}$ consist of metaphysically fundamental entities in their own right, we thereby avoid the worry of the many overlapping person-candidates in Socrates' chair. While we may not be able to determine *which* parts in the vicinity of Socrates' boundaries are his parts by simple inspection, there is a fact of the matter as to which simples compose him at t (perhaps those whose causal dispositions are directed toward the manifestation of the dispositions of the whole) in so far as there is a fact of the matter as to when grounding obtains (more on this below). For any subset of material simples occupying the compositional base at t, either the nature of those simples (or bits of gunk if there are no such things) are grounded in Socrates or they are not; if they are proper parts of Socrates, then they will be grounded in Socrates. Consequently, viewing Socrates as a substance qua grounding whole provides a principled, non-arbitrary reason to deny that the members of the Secondary Set (or any resembling set) compose a distinct substantial entity (P2), one that is independently motivated by the considerations offered in the preceding sections as well as chapter 4.

5.1.4 Vagueness and Composition

The question concerning the conditions under which composition occurs (if ever) has dominated the contemporary mereological landscape. Roughly, three general answers have reigned supreme in the literature as to when composition occurs: *never* (nihilism), *sometimes* (moderatism), and *always* (universalism). By all appearances, liberalism with respect to composition has won the day. Mereological universalism, more precisely, is the view that for *any* non-overlapping xs, there is a y such that y is composed of the xs. On this view, *any* two non-overlapping objects, no matter how gerrymandered or causally disconnected in spacetime, compose a distinct object with those two objects as proper parts. Thus the coin resting on my desk, together with one of Hillary Clinton's grey hairs, compose an object—coin-hair—that is a genuine constituent of reality. Reality truly is, on this view, much more than meets the eye. How could such a radically counterintuitive view win the favor of so many contemporary metaphysicians?

Perhaps the strongest argument in favor of universalism is *the argument from vagueness*, first advanced by Lewis (1986a: 212-213) and later developed in more detail by Sider (2001). Strictly speaking, the argument from vagueness takes aim at the notion of moderatism in general and is thereby consistent with both nihilism and universalism,

although the majority of its adherents wield the argument in defense of the latter. The argument from vagueness crucially hinges on the denial of both borderline cases of composition as well as sharp cut-offs on the spectrum of composition.

The *argument from vagueness* can be stated more clearly as follows:

V1. If composition sometimes does and sometimes does not occur, then there is a sorites series for composition, i.e. a pair of cases connected by a continuous series such that in one, composition does not occur, but in the other, composition does occur.

V2. Every sorites series for composition contains either borderline cases of composition or a sharp cut-off with respect to composition.

V3. There are no borderline cases of composition.

V4. There are no sharp cut-offs with respect to composition.

V5. Therefore, composition either always occurs or never occurs.[27]

Take V1 first. If composition is restricted in any sense then we have a pair of cases ϕ and ψ that are connected by a continuous series such that in ϕ (for instance) composition does not occur, where in ψ composition does occur. The thrust of V2 is simply the claim that any such continuous composition series involves the transition from non-composition (ϕ) to composition (ψ), which therein involves cases where it is either determinate or indeterminate as to whether or not composition occurs on the spectrum. But borderline (indeterminate) cases of composition seems to render it vague as to whether certain objects compose a further object (V3) and hence vague as to how many objects exist *per se*. But it is equally implausible to think there are a pair of immediately adjacent cases on the continuous series, say α and β, such that in α composition occurs and in β it doesn't; that such minuscule differences on the continuous series accounts for such radical compositional differences seems to be without explanation (V4). Consequently, to maintain that composition sometimes does and sometimes does not occur is an unstable position. So argues the universalist.

The premises that have generated the most discussion are, of course, V3 and V4. Sider's main argument for the truth of V3 rests on the non-vagueness of claims concerning numerical sentences of the form "there are n concrete objects" (for some finite value of n). If there were borderline cases of composition–cases where it is indeterminate whether the xs compose y–then "there are n concrete objects" would lack a determinate truth-value. But in so far as such expressions can be formulated in terms of a purely logical vocabulary (utilizing the existential and universal quantifiers, logical connectives, and the identity relation), they are devoid of vague terms.[28] Hence, there can be no borderline cases of composition.

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[27] Adapted from Sider (2001: 120-125).

[28] For instance, where $n=2$, the expression "there are n concrete objects" can be formulated as follows: $(\exists x)(\exists y)(Cx \wedge Cy \wedge x \neq y \wedge (\forall z)(Cz \rightarrow (x = z \vee y = z)))$.

But as others have been keen to point out, Sider's defense of V3 above turns on the fact that whether or not statements of the form "there are *n* concrete objects" have a determinate truth value depends on the size and extent of the relevant domain of existential quantification and hence one's views regarding *which objects exist in the first place*. That is, the truth-value of the numerical statement hinges on the question of *how many things exist*, which is the very question at hand between the universalist and the defender of moderatism.

More to the point, however, are the various denials of V4 on offer in the literature as well as the prospect of substantial priority lending a novel solution to the argument from vagueness. A denial of V4 amounts to identifying a *non-arbitrary* cut-off with respect to composition, a sort of non-arbitrary compositional 'difference-maker' when it comes to α and β on the continuous series described above. The sharp cut-off in question serves as the first instance on the continuous series where composition occurs. But what might account for such a sharp cut-off on the spectrum of composition? What (non-arbitrary) metaphysical feature of composites (α) marks them off from non-composites (β)?

Trenton Merricks (2005) has argued, persuasively in my opinion, that the emergence of irreducible features of composites can serve as a non-vague compositional difference-maker and hence a relevant sharp cut-off on the continuous series. He illustrates this by the following story of 'whistling composites:'

> Moreover, pretend the following story is true. Necessarily, simples are silent but composite objects emit a loud whistling noise. (That's right, they whistle.) Their whistling, according to this story, is not reduced to the collective activity of their parts. For example, it is not reduced to the spatial interrelations among the composite's parts, as it would be if the wind's blowing through the composite caused the whistling. Instead, whistling is a necessary result of composition itself. The whistling of composites, according to this story, is in some sense 'emergent.' And, finally, let us add that it cannot possibly be vague whether the whistling occurs. (2005: 628)

If we were to move along the continuous series spanning from α to β, it is clear when β obtains—just listen! Note the similarity here between the emergence of 'whistling' and our discussion of the failure of *The Plural Duplication Principle* (PDP) for certain mereological wholes in chapter 4. In essence, Merricks is suggesting that PDP fails with respect to whistling composites, wholes that instantiate properties that are irreducible to the properties of their proper parts together with their basic arrangements. Since it is presumably a non-vague matter as to when such properties are instantiated, their instantiation provides a sharp cut-off as to when composition occurs.

As a more substantive stand-in for 'whistling,' Merricks proposes the emergence of non-redundant causal powers (what I referred to as 'perfectly natural properties' in chap-

ter 4) to provide the metaphysical underpinning for the non-arbitrary cut-off on the continuous series. He states,

> In particular, a composite object causes an effect E non-redundantly only if E is not caused by that object's parts working in concert. Thus a composite object's exercising non-redundant causal power–an object's causing something non-redundantly–cannot be reduced to what its parts cause working in concert. In this way, an object's exercising non-redundant causal power is irreducible to its parts (and their features and interrelations, etc.). I think that each and every composite object has non-redundant causal powers. So I think that composites have irreducible features. (2005: 631-632)

Merricks goes on to state that, by his lights, the most likely candidate objects that exhibit the above non-redundant causal powers are objects with a rich and qualitative conscious life (including sentient higher-order animals such as dogs and dolphins). Since *being conscious* for Merricks, is a non-vague matter (there are no borderline cases of consciousness), its presence on the compositional series constitutes the sharp-cut off that undermines V4.[29] It follows from this, however, that the only *composite* objects that exist are those that possess mental properties.[30] Accordingly, Merricks' denial of V4 leaves him in the untoward position of rejecting **Existence** for large classes of composite objects such as artifacts, non-conscious living organisms (cells, bacteria, plants, etc.) and non-living substances (gold, H_2O, DNA, electrons, etc.), many of which play an integral role in some of our best empirical theories about the natural world.

Here I think substantial priority offers several theoretical advantages over Merrick's own response to the argument from vagueness. To see this, note first that substantial priority can offer a structurally similar denial of V4 in terms of the emergence of non-redundant causal powers or, as I prefer, perfectly natural properties. In chapter 4 we highlighted several empirical cases from physics, chemistry, and systems biology which seemed to assign perfectly natural properties to composite objects (both micro and macro), which suggested the failure of PDP for such objects. With Merricks, then, substantial priority is well-positioned to affirm that the instantiation of perfectly natural properties (non-redundant causal powers) can serve as the requisite sharp cut-off on the continuous series of composition (at least for certain kinds of wholes), therein blocking the argument from vagueness.

But here an important difference arises between the two views. Where Merricks endorses the failure of PDP solely for *conscious* composite wholes, the defender of substantial priority, as we have seen, makes no such restriction. The examples previously offered

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[29]This route is also taken by Hawthorne (2006: 106-109).

[30]Although, to be fair, Merricks is clear that he remains agnostic about non-conscious composites exhibiting non-redundant causal powers.

in favor of the failure of PDP for certain composites (see §4.4.1 to 4.4.3) were those involving both *non-living* composite wholes (quantum entangled wholes and chemical compounds such as HCl, NaCl, and HeH) as well as *non-conscious* biological organisms (cells). As it stands, substantial priority is well-suited to affirm *both* a non-arbitrary cut-off for composition via the failure of PDP as well as **Existence** for large classes of composite objects commended by the sciences and common sense. Of course, the difference between Merricks' view and the one I am commending here is one of mere degree and not kind. As such, Merricks is entirely within his rights to appropriate the failure of PDP for non-conscious composites as well (though, as we will see in the sequel, his view that non-conscious composites are causal overdeterminers will prohibit him from taking this route). As it stands, however, in so far as substantial priority is better situated in accounting for non-arbitratary cut-offs for composition with respect to a much broader class of composite objects, I take that to be a mark in its favor.

The attentive reader will note that the above rejection of V4 on behalf of the defender of substantial priority holds only for composite wholes for which PDP fails and thus objects that fit the description of a grounding whole. In so far as the above story is incapable of being generalized to grounded wholes, the defender of substantial priority is left without a sharp cut-off for the composition of grounded wholes. Although my aim in this chapter is focused solely on the theoretical advantages of *substantial* priority (and hence grounding wholes in particular) as applied to conundrums in material objects, let me say a few words in response to this charge, which will bring us to the second consideration in favor of substantial priority over Merricks' own denial of V4.

Recall the relevant grounding descriptions that characterize grounding wholes (substances) and grounded wholes (non-substances): the former ground the existence and identity of their proper parts and vice versa for the latter. Presumably, grounding is a non-vague notion. Whether the existence and identity of x being grounded in the existence and identity of y is a vague matter hinges, I suspect, on whether existence and identity are themselves vague notions.[31] But here, with a host of others, I must confess that I find the notions of vague existence and vague identity to be strange indeed. By my lights, the only forms of vagueness are either epistemic or semantic, either the result of gaps in our knowledge or semantic indecision. While this bit of autobiographical detail is certainly no argument against the exclusion of a variety of metaphysical vagueness, and many philosophers to whom I greatly admire think otherwise, I must leave my denial of vague existence and identity at the level of autobiography at this stage.

To be safe: *if* grounding is non-vague and thus it is determinate whether x is grounded in y, then the proponent of substantial priority has available to them yet another non-

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[31] One could, however, leave open the possibility of vague identity and existence for things like clouds or heaps of sand, i.e. non-basic entities. However, in so far as all grounding chains include at least one substance as part of its well-founded ground (see G9 in §2.1.4), the non-vagueness of grounding would hinge directly on the non-vagueness of the identity and existence of basic substances.

arbitrary cut-off on the compositional series, one that applies to the composition of both grounding and grounded wholes alike. Take the composition of a grounding whole first. If one were to move along the continuous series (say from α to β) connecting cases of the non-composition with cases of the composition of a grounding whole, the sharp-cut off as to when certain parts compose a such whole would be sharp indeed: when the existence and identity of the parts become grounded in a common whole. Another way to put this would be in terms of the *interdependence* between the parts: where parts x and y are *interdependent* just in case $x \neq y$ and both x and y are each totally grounded in a common whole.[32] The parts being grounded as such is a necessary result of the composition of a grounding whole.[33]

The case is analogous for the composition of a grounded whole, simply reverse the direction of grounding from whole-to-parts to parts-to-whole. The non-arbitrary cut-off for when parts on the continuous series compose a grounded whole is when the existence and identity of the parts collectively serve as the total ground of a common whole (the whole being partially grounded in each individual part). The existence and identity of the parts serving to collectively ground the existence and identity of the whole is a necessary result of the composition of a grounded whole. This further story, which is part and parcel of a substantial priority fundamental mereology (and hence not an ad hoc response to the argument from vagueness), allows one to admit sharp compositional cut-offs for both kinds of mereological wholes, thereby rejecting V4 of the argument from vagueness while preserving **Existence** in its broadest application.[34]

5.1.5 Causal Overdetermination

Considerations from causal overdetermation constitute a family of arguments aimed at the denial of **Existence** for either the entire class or a particular subset of the class of composite objects. We commonly take ordinary complex wholes to be causally effica-cious in that their activity constitutes the causal fabric of the world. Electrons spin, radium atoms decay, cells undergo protein synthesis, aqua regia dissolves gold, biologi-cal systems self-regulate, humans engage in the scientific enterprise, etc. Yet at the same time, we take such wholes to be causally relevant *in virtue* of the causal powers of their parts together and their structural arrangements. In this sense, the *primary* actors on the world's stage are the (ultimate) parts of complex wholes and not the wholes themselves: wholes do things in virtue of their proper parts arranged thus and so. If so, does this not render complex wholes causally redundant and thus epiphenomenal for any given

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[32] The notion of *interdependence* here is from Schaffer (2010a: 347).

[33] Though I do not think the obtaining of such structure is sufficient for composition to occur.

[34] That is, assuming that every mereological whole is either a grounding or grounded whole. Artifacts, on this view, would count as grounded wholes in so far as the case can be made in favor of the fact that their causal profiles can be accounted for entirely in terms of the causal profiles of their proper parts and their basic arrangements.

causal event to which they contribute? If the causal activity of composite objects are rendered explanatorily redundant by the activity of their proper parts, to include them in the exhaustive inventory of reality would be superfluous, a violation of Occam's razor par excellence. Hence, parsimony suggests the elimination of mereological wholes as additional items of the world's furniture over and above their proper parts and the arrangements thereof.

I will work with the following formulation of *the argument from causal overdetermination* against the existence of ordinary composite objects (where 'x' stands for any composite object, 'E' for any event involving a composite object, and 'atoms' as a placeholder for whatever it is our best physics tells us is at the fundamental physical level, whether atomic or atomless):[35]

> O1. Every E either is, or is not, caused by atoms arranged x-wise.
>
> O2. If E is caused by atoms arranged x-wise, then it isn't caused by an x.
>
> O3. If E isn't caused by atoms arranged x-wise, then it isn't caused by an x.
>
> O4. If no events are caused by x's, then there are no x's.
>
> O5. Hence, there are no x's.

The conjunction of O1 through O3 entail that no events are the result of the causal activity of x's which, together with O4, serve to call into question the existence of ordinary composite objects. For some philosophers, few (if any) composites survive the argument from causal overdetermination. Merricks (2001), for instance, contends that the argument winnows away *all* non-conscious composite objects as 'overdeterminers,' we are left only with higher-order sentient organisms.[36] In like manner, van Inwagen (1990: 122) remarks:

> ... all the activities apparently carried out by shelves and stars and other artifacts and natural bodies can be understood as disguised cooperative activities [of simples properly arranged]. And, therefore, we are not forced to grant existence to any artifacts or natural bodies.

In Merricks and van Inwagen we have, once again, the denial of **Existence** for a large class of mereological wholes commended by science and common sense.

I take the most contentious premises in the argument from causal overdetermination to be O2, O3, and O4. Let's start with O4. The premise derives its warrant from a modified form of Alexander's Dictum (Eleatic Principle) which states "to be a composite material object is to have causal powers."[37] If x's do not cause anything *tout court* (and if

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[35] Here I follow Korman's (2011) formulation of the argument as well as the clarificatory points below.

[36] See Dorr (2005) for a full-scale rejection of composite objects on similar grounds.

[37] See Merricks (2001: 81). Note the qualification to exclude alleged abstracta like numbers, sets, and propositions.

we have no other reason for including them in an exhaustive inventory of reality) then we ought to hedge ontological commitment to x's. As many philosophers are sympathetic to Eleatic Principle in its full-strength (i.e. to be *per se* is to have causal powers), very few are inclined to object to this rather weak modified version in terms of composite material objects.

Turn now to O2. At its core, O2 hinges on the denial of causal overdetermination with respect to x and its composing atoms. Say an event E is *causally overdetermined* by objects o_1 and o_2 iff (i) o_1 causes E, (ii) o_2 causes E, (iii) o_1 is not causally relevant to o_2's causing E, (iv) o_2 is not causally relevant to o_1's causing E, and (v) $o_1 \neq o_2$. There are a host of ways for o_1 and o_2 to be *causally relevant* to each other's bringing about E. One such way would be where o_1 and o_2 serve as two individual members of the total cause of E (along with o_3, o_4, o_5, etc.) such that the objects in the class jointly suffice to bring about E. Yet another would be where o_1 causes o_2 to cause E or o_1's being caused by o_2 to cause E. With the above notion of causal overdetermination in hand, the argument for O2 proceeds as follows: if E is caused by atoms arranged x-wise then E is caused by x only if E is causally overdetermined by x and the atoms arranged x-wise; but no event is causally overdetermined by an x and atoms arranged x-wise; therefore, O2.[38]

But what exactly is problematic with saying E is causally overdetermined by x and the atoms arranged x-wise? The widespread rejection of causal overdetermination, it seems, stems from its being an overt violation of Occam's razor, a theoretical principle that has held sway in the history of metaphysics. If there is no explanatory need to posit some entity x, then one (rationally) ought not posit x. Thus, considerations from ontological and ideological parsimony drive the widespread rejection of E's being causally overdetermined by x and the atoms arranged x-wise. Since both x and the atoms arranged x-wise are causally irrelevant to one another's causing E, and the behavior of x can be explained entirely in terms of the behavior of the atoms arranged x-wise, then positing the existence of x in addition to the atoms would be to multiply entities beyond necessity.

Here the defender of composite objects might reject O2 and argue that not all causal overdetermination is created equal. That is, we must distinguish between *objectionable* and *unobjectionable* overdetermination. One might argue that the sort of overdetermination at play between x and the atoms arranged x-wise is of the unobjectionable variety in that the two causal agents in question in the production of E are *not entirely independent from one another*. An example of two independent causal agents would be two police snipers causing the death of one and the same suspect at the exact same time, each individual shot being sufficient to cause the death of the suspect in question. Here the death of the suspect would be objectionably overdetermined in that there are two, independently related causes of the death, each being sufficient to bring about the event in

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[38]I set aside a rather obvious, though not uncontroversial, way to deny O2: that x *just is* the atoms arranged x-wise.

question.

But, it is argued, the relationship between a whole and its proper parts is crucially dissimilar to the relationship between the two police snipers in the above example. The intimacy of the composition relation that obtains between a whole and its proper parts is such that the former (albeit numerically distinct) is not entirely independent of the latter. There are, it is claimed, plausible lines of inheritance that run between a whole and its parts and vice versa. Mereological wholes, for instance, appear to inherit their spatial location from their proper parts. Moreover, it is plausible to think that when certain proper parts of a whole undergo alteration, the whole undergoes alteration.[39] As a result, the intimacy (albeit non-identity) of the composition relation renders the instance of overdetermination in the argument unobjectionable. Thomasson (2006), for instance, argues along these lines:

> But this independence seems to be lacking between the causal claims of the baseball and the atoms arranged baseballwise. So it is not at all obvious that, in cases in which independence does not hold between objects A and B, A and B either provide double the amount of causation or are causal rivals.

With Thomasson, one could argue that given that composite objects and their proper parts fail to be entirely independent from one another, there is nothing problematic about saying that E is overdetermined by x and the atoms arranged x-wise and thereby endorse the denial of O2.

Yet another way to draw the line between objectionable and unobjectionable overdetermination would be in terms of metaphysical *fundamentality* or *basicness*. Schaffer (2007: 189) has argued that the overdetermination between x and the x-wise arrangements of atoms would be rendered objectionable only if both causal agents in the production of E were metaphysically basic or fundamental. For Schaffer, it is the multiplication of basics (and their causal activity) without necessity that gets to the heart of Occam's Razor. He argues, "[r]edundancy is tolerable provided the redundant entities are properly grounded in what is basic. What is intolerable is redundancy in what is basic." If Schaffer's 'mitigated redundancy' qualifies as overdetermination of the unobjectionable variety, then this route affords yet another way to reject O2 of the argument in question. For Schaffer, given his adherence to the view that the cosmos is the sole fundamental entity and thus neither x (where x is taken as any sub-world entity whatsoever) nor the atoms arranged x-wise are basic, there is no objectionable overdetermination and thus no need to eliminate the existence of ordinary composite objects.

A much neglected rejection of O2 stems from the endorsement of *causal pluralism*: the view that there are multiple kinds of causes and causal relations.[40] If so, then the

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[39] Of course, this route would need to be a bit more precise as to how to unpack the notion of 'independence' (whether counterfactual, causal, metaphysical independence, etc.).

[40] It is a further question as to the precise formulation of causal pluralism. Some present the view as

causal activity of the atoms arranged x-wise and the causal activity of x do not compete for *one and the same causal role in the production of E*. A view of causation that accords nicely with causal pluralism is one that consists in the (mutual) manifestation of causal powers.[41] Suppose E stands for the event of hydrogen chloride's dissolving methanol. On this view, E's obtaining is the result of the joint manifestation of the molecule's power of acidity as well as the causal powers belonging to its constituents atoms, perhaps chlorine's being negatively charged and hydrogen's being positively charged (which therein gives rise to a polar covalent bond). *The* cause of E—that which is sufficient to bring about E—will involve reference to the manifestation of the causal powers of hydrogen chloride qua whole as well as the powers belonging to hydrogen and chloride. Our selection of a *single* causal factor in the production of E is more of an expression of our pragmatic interests than one that cuts metaphysical ice, or so it is argued.

In essence, this route denies that if E is caused by atoms arranged x-wise (hydrogen and chlorine standing in a polar covalent bond to one another) then E is caused by x (hydrogen chloride molecule) *only if* E is causally overdetermined; the reason being that *all* causal production is the result of the joint activity of the manifestation of powers. Since, as we noted above, an event E is overdetermined only if both causal agents are causally *irrelevant* to each other's causing E, and since all instances of causal production involve the joint manifestation of powers, it follows that *no* event is causally overdetermined in the objectionable sense.

O3 has been challenged on the grounds that some events that are caused by composite objects (x's) are not caused by their composing atoms. One notable rejection of O3 argues that some composite objects exhibit non-redundant casual power in virtue of instantiating emergent causal properties (perfectly natural properties) that are not attributable to their proper parts nor the relations between them.[42]

As with the paradox of Tibbles the Cat, Lumpl and Goliath, the Problem of the Many and the Argument from Vagueness, substantial priority affords a solution to the argument from causal overdetermination for composite substances in particular. Suppose we take x to range over composite substances qua grounding wholes along the lines of substantial priority, wholes that ground each of their proper parts. Perhaps the most direct way of blocking the above argument from the perspective of substantial priority is to underscore the fact that the view entails a denial of O3 in its rejection of the thesis that *all* mereological wholes are such that they adhere to *The Plural Duplication Principle* (PDP): that to duplicate the perfectly natural properties of the parts and their basic ar-

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claiming multiple kinds of causes and causal relations, each of which are defined in terms of a single fundamental relation, while others take the view to mirror debates in compositional pluralism and thus claim that the view is committed to there being multiple *fundamental* causal relations. For purposes of illustration here I adopt the first reading.

[41]See Anjum & Mumford (2011) for a recent full-length defense of this view. This is obviously not an analysis of causation as the notion of 'causal power' invokes the notion of causality.

[42]See Elder (2007) and Lowe (2005a).

rangements suffices to duplicate the perfectly natural properties of the whole. As we have seen, according to substantial priority, there are mereological wholes for which PDP fails in that they instantiate perfectly natural properties and thus bring about non-redundant causal effects in the world. According to O3, if E fails to be caused by the proper parts of a whole, then that whole is causally irrelevant to the production of E. This, of course, assumes that the perfectly natural properties (non-redundant causal powers) are instantiated *exclusively* by the proper parts of a mereological whole, something the friend of substantial priority denies.

But the resources of substantial priority afford a much deeper reason to reject O3 than the fact that some mereological wholes exhibit non-redundant causal powers. The reason is unique to substantial priority and stems from the distinctive grounding structure of substances. To see this, recall our previous discussion of the argument from vagueness, in particular, the continuous composition series which connects cases of the non-composition to cases of the composition of substances, i.e. grounding wholes. Upon the composition of a grounding whole, we noted that the parts are grounded in a common substantial whole. When this occurs, the relevant grounding description of a substance is such that *there is no individual dependence base at a level of decomposition in which the newly generated substance is essentially grounded.*[43] For the proponents of substantial priority, this is precisely what it means to be metaphysically fundamental! The various levels of decomposition for substances contain only grounded entities, i.e. inseparable parts; there are no metaphysically basic entities that make up a substance's compositional base (**No Parthood**).

That is, substantial priority construes composite substances as not only instantiating ontologically emergent *properties*, but also as ontologically emergent *wholes* in their own right. Following Kronz and Tiehen (2002: 346), substantial wholes exhibit 'dynamic emergence' with respect to the existence and identity of their proper parts. Recall Kronz and Tiehen's characterization of a whole (a quantum entangled whole in particular) being dynamically emergent with respect to its proper parts:

> Emergent wholes have contemporaneous parts, but these parts cannot be characterized independently from their respective wholes...it does not make sense to talk about reducing an emergent whole to its parts, since the parts are in some sense constructs of our characterization of the whole... Emergent wholes are produced by an essential ongoing interaction of its parts, and *when that interaction ensues the independent particles become dependent.* But, if some of those parts are identical particles, then *they cannot be identified with those that existed prior to the interaction,* as a result of Pauli's exclusion prin-

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[43]This is, in fact, is precisely what Humphreys (1997) takes his concept of *fusion emergence* to entail with respect to avoiding causal overdetermination, albeit applied to the emergence of property-instances instead of mereological wholes.

ciple. That is to say, *the independent parts cease to exist and the dependent parts come into existence.*[44]

On this proposal, grounding wholes are wholes that exhibit dynamic emergence in the above sense and thus are ontologically prior to their proper parts. As such, they do not 'compete' with their proper parts in being the cause of E in so far as none of their parts are metaphysically fundamental entities, entities with non-redundant causal powers with which they rival in bringing about E (although they do exhibit causal powers per se). That is to say, for any region of space hosting a substantial whole, the sole bearer of perfectly natural properties in that region is the composite substance itself (although this is entirely consistent with saying that the parts of substances may instantiate natural properties *per se*).

Consider once again the example of an entangled quantum whole. Recall that upon the composition of an entangled whole, "it is not permissible to consider the parts of a quantum whole as self-autonomous, intrinsically defined individual entities."[45] The causal activity of the particle-parts of an entangled whole do not threaten to render the activity of the entangled whole redundant precisely because their nature and existence now depend on the unified entangled whole. Once they compose an entangled whole, neither particle instantiates a pure spin state, that is, a state that can be individuated apart from the entangled whole. Since entangled wholes serve to ground the intrinsic properties of their particle-parts, including their causal powers and capacities, they can no more be eliminated in favor of such parts and their collective activity any more than the members of a set can be eliminated in favor of the set itself or that which is bound can be eliminated in favor of its accompanying spatial boundary.

The main point here is that substantial priority takes aim at the hegemony of the underlying fundamental mereology that serves to generate the argument from causal overdetermination in the first place. Merricks (2001: 60) refers to the rejection of a whole's exhibiting grounding constraints on its proper parts (what I have been calling whole-priority) as "part of the 'scientific attitude' and 'bottom-up' metaphysics, according to which the final and complete causal stories will involve only the entities over which physics quantifies." We have already examined *empirical* reasons from quantum mechanics, chemistry, and systems biology for thinking that a 'bottom-up' metaphysic (what I am calling part-priority and priority microphysicalism) is inadequate to capture the structure of certain mereological wholes. In addition, we have encountered empirical cases where certain composite objects plausibly (though not conclusively) conform to a grounding whole description in virtue of constraining the existence and identity of their proper parts (§4.3). Hence, to equate the rejection of a bottom-up metaphysics with the rejection of the 'scientific attitude' is much too strong.

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[44]Emphasis mine.
[45]Karakostas (2009: 14).

As was highlighted in the previous section concerning the argument from vagueness, Merricks takes conscious composites to survive elimination precisely *because* they defy a bottom-up metaphysic in virtue of instantiating non-redundant mental properties (hence Merricks resists O3 for such composites). However, as has been previously pointed out, things do not look nearly as promising for many of the composite objects that play an integral role in some of our best scientific theories such as non-conscious living organisms (cells, bacteria, plants, etc.) and non-living substances (gold, H_2O, DNA, electrons, etc.). According to Merricks, a denial of **Existence** for such wholes is warranted in so far as they fail to instantiate non-redundant causal powers in their own right.

We have seen that substantial priority rejects a bottom-up metaphysic for substantial wholes in two distinct ways, thus lending a two-fold denial of O3 in the argument from causal overdetermination. First, O3 is false for substantial wholes in virtue of their instantiating perfectly natural properties. More importantly, however, is the fact that substantial priority construes composite substances *themselves*—the bearers of the perfectly natural properties—as being ontologically prior to their proper parts such that they serve to constrain the identity of their parts. As such, the causal activity of the proper parts of a substance do not threaten to render the causal activity of the substance redundant (and thus susceptible to elimination) precisely because the identity and existence of such parts *depend* on the substantial whole in question. As mereological wholes which lack bearers of non-redundant causal powers as proper parts, substances in no way 'compete' or rival their parts for the causal production of E. While we need not deny that a bottom-up fundamental mereology applies to *some* mereological wholes (perhaps artifacts such as baseballs and billard tables, as well as aggregates such as heaps of sand), endorsing substantial priority for ordinary substances (and hence rejecting part-priority for such wholes) offers a solution to the argument from causal overdetermination that preserves **Existence** for a host of scientifically serious composite objects. And this in addition to the solutions afforded to the puzzles in the previous sections.

Substantial priority, we have seen, lends a unified solution to a host of conundrums in material objects: Tib and Tibbles, Goliath and Lumpl, The Problem of the Many, The Argument from Vagueness, and The Argument from Casual Overdetermination. It's virtues, I have argued, are many. Firstly, substantial priority is *unifying* in that it offers a single overarching solution to the multifarious of puzzles in the literature. In addition, the view has broad *explanatory power*; it explains both a wide range and variety of puzzles about material objects. Thirdly, substantial priority is (comparatively) *plausible* in that while calling into question some of common-sense intuitions about the *parts* of composite substances, it does not require a radical revision to our most cherished ordinary beliefs about composite substances themselves. Substantial priority is also *simple* in that its explanatory work is achieved by the application of just a few metaphysical resources, namely **No Parthood** for substances and the grounding structure of composite objects

(both grounding and grounded wholes). Lastly, as was noted in chapter 4, the view also accords with facts about the structure of composite objects in the natural sciences, it is *well-entrenched*.

5.2   Why I Am Not a Priority Monist

Let me conclude this chapter with a few reflections as to why I do not endorse priority monism. Assuming the machinery I do which serves as a constraint on options in fundamental mereology, specifically **No Parthood** (see §3.2.1.1), whether intermediate wholes can be classified as substances depends on whether such wholes belong to the compositional base of an even higher-level substantial whole. If it can be shown that intermediate substances are themselves proper parts of a larger substantial whole–the cosmos for instance–then substantial priority would be rendered false assuming **No Parthood**. Schaffer's main line of approach here is to show that the cosmos does in fact exhibit what we might call 'signs of substantiality,' most notably its instantiating ontologically emergent properties such that it constitutes one vast entangled system.

Here we have a kind of dialectical standoff between the defender of priority monism and substantial priority. The priority monist takes the fact of the cosmos' being a substantial whole to thereby undermine the existence of intermediate substantial wholes. The proponent of substantial priority takes the fundamentality of intermediate basics such as electrons, cells, and living organisms, you and I included, as thereby undermining the truth of priority monism. How might the defender of substantial priority break the deadlock here?

For one, they might underscore (as we did in §4.3) the fact that the mere *existence* of the cosmos or universe considered as a single mereological whole is, as Simons (1987: 15) notes, only "slightly less controversial than the existence of arbitrary sums." As we previously noted, if controversy surrounds the very *existence* of the maximal mereological whole as an individual entity, how much more so around its being *metaphysically fundamental*. Some, like Simons (2003: 249), take the view that "The universe is not an individual: monism is false. It is a multiplicity." On this view, 'the universe' no more refers to a single unified entity than does 'Sherlock Holmes;' as a singular referring term, it is semantically empty (though as a plural referring term 'the universe' is not empty as such). But perhaps this line is too strong. Perhaps we ought construe the cosmos as did Leibniz (1989: 537) in that "[s]urely the fact itself shows the world to be an aggregate, like a herd or a machine," that is, as a singular whole, albeit one that resembles the likes of a grounded whole more than a substantial whole. Either way, the cosmos would fail to be substantial in its own right.

A second way to break the deadlock here between substantial priority and priority monism would be to appeal to the considerations in the previous section regarding the ex-

planatory power of substantial priority concerning prominent puzzles in the metaphysics of material objects. As we have seen, the resources of substantial priority offer a unified solution to a host of conundrums that preserves many of our well-entrenched ordinary beliefs about material objects. By contrast, in so far as there simply *are* no fundamental substances other than the cosmos on priority monism, none of the above solutions to the preceding puzzles in material objects are at the disposal of the priority monist.

Lastly, the defender of substantial priority might point to a weak link in Schaffer's reasoning in defense of priority monism. To see this, we must pry a bit deeper into what exactly Schaffer means by 'the cosmos' in his formulation and defense of priority monism. One of the only explicit statements as to what Schaffer means by the term is as follows: "[w]hen I speak of the world–and defend the monistic thesis that the whole is prior to its parts–I am speaking of the material cosmos and its planets, pebbles, particles, and other proper parts." Fortunately, we are offered a bit more insight into the exact nature of Schaffer's cosmos in his defense of a version of a substantivalist view of spacetime he dubs 'monistic sustantivalism.' Monistic substantivalism says that there is only one substance—the general relativistic spacetime manifold itself—where the material contents of spacetime such as planets, pebbles, and particles are to be identified with their occupying regions. People and pebbles *are* spacetime regions on this view.[46] In the course of defending monistic substantivalism, Schaffer argues that such a view entails priority monism, that "the whole material cosmos is ontologically prior to any of its parts." His reasoning, in his own words, is as follows: "Given the priority of the whole for spacetime, and the monistic identification of material objects with spacetime regions, the priority of the whole for material objects follows immediately." He sums up his defense of monistic substantivalism as follows: "So I conclude that there is one and only one substance, and that substance is spacetime. To make the world, God only needed to create spacetime, and pin the fundamental fields directly to it." From this it is clear that Schaffer takes the spacetime manifold and the cosmos to be *one and the same thing*.

But Schaffer's identification of the cosmos with the spacetime manifold itself raises the following worry that threatens to severely weaken the independent plausibility of priority monism as a fundamental mereology. In order for Schaffer to infer from the metaphysical fundamentality of the cosmos that sub-world objects are not fundamental substances in their own right (as per the application of **No Parthood**), he must first show that sub-world objects are, strictly speaking, proper parts of the cosmos. This is precisely because **No Parthood** is a thesis about the *mereological* ordering of substances, that no substance has another substance as a proper part. But if the cosmos *just is* the entire spacetime manifold (2009: 135), then it follows that the cosmos has the same mereological structure as the manifold itself. But the proper parts of the manifold are commonly thought to be

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[46]This particular part of monistic substantivalism is known as 'supersubstantivalism.'

regions (whether extended or unextended), not the *occupants* of those regions. For many, there is a fundamental difference between regions and region-occupiers, between the container and that which is contained. Thus for any view that holds to the non-identity of material objects and their occupying regions, it follows that the ordinary material occupants of spacetime such as people, pebbles and particles are not, strictly speaking, *proper parts* of the cosmos. While material objects stand in the primitive occupation relation to spacetime regions which are themselves proper parts of the manifold, such objects are not included among the compositional base of the manifold itself.

If so, then Schaffer's arguments in favor of the cosmos being a substantial whole in no way undermines the existence of intermediate (i.e. non-monistic) substances as per substantial priority. If intermediate substances are not strictly speaking proper parts of the cosmos, then they fail to fall within the purview of **No Parthood** and thereby rendered non-substantial. Consequently, *unless we assume the truth of supersubstantivalism*—a controversial thesis if there ever was one—substantial priority remains untouched by Schaffer's arguments for priority monism. This, I think, leaves Schaffer in a rather untoward dialectical position. Without building supersubstantivalism into his fundamental mereology from the outset, he is left without any principled objections to priority microphysicalism or substantial priority.

Be that as it may, perhaps the potential drawbacks of substantial priority far outweigh its proposed advantages. Maybe the view suffers from counterbalancing philosophical or scientific deficiencies, say, its inability to 'save the phenomena' concerning our ordinary and scientific beliefs about the structure of material objects. We will look at the potential drawbacks of substantial priority in the next chapter. At the very least, then, substantial priority deserves a place at the table alongside the likes of mereological essentialism, eliminitivsm, constitutionalism, stage theory, perdurantism, dominant kinds, and relative/temporal identity as a live option in answering the above puzzles in material objects.

Chapter 6

Objecting to Substantial Priority

"I consider the two halves of a part of matter, however small it may be, as two complete substances." –Descartes, Letter to Gibieuf, 19 January 1642

In this last chapter I want to consider a few objections that the reader has no doubt entertained throughout the discussion up to this point. Any package of metaphysical views about the fundamental structure of the world ought to be able to carry its weight in light of impending objections. And substantial priority is no exception here. If the advantages of substantial priority highlighted in the previous chapter are far outweighed by its drawbacks, then we ought to abandon the view in favor of an alternative ontology of material objects. While I do believe that substantial priority is in fact a remarkably fruitful theory about the structure of substances, I do not want to give the impression that it is not without its own problems and counterintuitive consequences. At the very least, then, my aim in this chapter is to demonstrate the view's *defensibility* and show that despite its costs, substantial priority is worth taking seriously and thus deserves a place at the table as a viable yet under appreciated metaphysic of material objects.

6.1   Substantial Priority is Empirically Inadequate

Perhaps the most glaring objection to substantial priority is that it is empirically defective in its inability to capture the fundamental causal activity of what appear to be substantial proper parts of composite substances. If substantial priority is true and no composite substance has substantial proper parts, and substances are the sole bearers of perfectly natural properties, then *none* of the proper parts of such wholes instantiate perfectly natural properties. But is it not true that some of our best empirical theories involve reference to fundamental or irreducible causal properties of the proper parts of composite substances? That is, does not the truth of scientific explanations require the existence of substantial proper parts of substances qua bearers of causally fundamental properties? Biological explanation, for example, is replete with the attribution of seemingly

irreducible causal powers and dispositions to the proper parts of substances.

Take the example of gene transcription. Many would see DNA as being the fundamental unit of life in that there is a correspondence between the genotypic and phenotypic traits of a living organism, with the direction of determination proceeding from the former to the latter. Strands of DNA, together with their constituent genomic sequences, are the primary units of inheritance and thus play the primary causal role in the growth and evolutionary development of living organisms. Surely if *any* causal powers are perfectly natural it would be the dispositional properties of genes. And since DNA molecules and their genomic sequences are, strictly speaking, proper parts of substantial living organisms, this would appear to call into question the grounding structure attributed to composite substances as per substantial priority.

This is a formidable objection indeed, one that has no doubt helped foster the widespread acceptance of a part-priority fundamental mereology in contemporary metaphysics. At the very least, the objection presses those who espouse substantial priority to offer a story as to how it's *as-if* the proper parts of substantial wholes are themselves substantial and instantiate perfectly natural properties. If the class of *fundamental* facts are those that specify which objects possess the perfectly natural properties, and this role belongs exclusively to substances qua metaphysically basic entities, then the defender of substantial priority needs to explain how facts about substances and their qualities can ground what appear to be metaphysically fundamental facts about their underlying mereological structure. And surely they must tell some story or other if they want to avoid the charge of espousing an ontology that is detached from both the world of science and common sense. Of course, how *detailed* such a story needs to be in order to satisfy the objector is another story altogether. I surmise that given how entrenched part-priority and priority microphysicalism are in contemporary metaphysics, no such strategy aimed at reconstructing scientific and ordinary discourse will convert the objector to over to the side of substantial priority. In what follows, then, my aim is to offer substantial priority a defense before the tribunal of empirical adequacy.

Here I offer four different strategies available to the defender of substantial priority in explaining it's being *as-if* the proper parts of substantial wholes are basic in their own right and instantiate *perfectly* natural properties. The phenomena to be 'saved' here is that the causal powers of the proper parts of substances–hydrogen atoms, electrons, and genes for instance—-appear to be fundamental or basic in virtue of their playing an integral causal role in our best empirical theories. The task before us here is to say *why*, on substantial priority, things *seem* this way.

The first four strategies in responding to the objection from empirical inadequacy grant that the causal powers at work in bottom-up scientific explanations–such as the *power of gene transcription* in our example–are indeed *perfectly* natural properties, while the fifth argues that the naturalness of such properties per se suffices for their playing a

causal and explanatory role in scientific explanation. Let me sketch each route and then offer some reasons for preferring one over the others.

In order to better grasp the first four options, some stage setting is in order. There has been a rather lively and interesting discussion in the recent literature as to whether extended mereological simples–non-point sized material objects devoid of proper parts–are metaphysically possible.[1] One major obstacle for friends of extended simples involves solving *the problem of spatial intrinsics*: explaining how extended simples can exhibit qualitative heterogeneity given their lack of proper parts. We often think of an object's having spatial qualitative variation, such as being blue on one side and red on the other, in terms of its having distinct proper parts that instantiate different intrinsic qualities. The foe of extended simples, then, rightly demands a story as to how material simples can be anything but qualitatively homogenous.

Defenders of extended simples have answered the charge by offering a host of ways to ground the variation of an object's intrinsic properties without pinning such properties to its proper parts (since it has none). As it turns out, many of these accounts can be wielded by the proponent of substantial priority in response to the objection at hand. Of course, the parallel here between extended simples and complex substances as per substantial priority is not precise in that the objects under consideration are not mereologically simple; unlike the defender of extended simples, substantial priority has at least *some* decompositional structure (albeit non-basic) to work with in attempting to reconstruct appearances. On substantial priority, composite substances have proper parts, just not ones that are metaphysically basic or fundamental.

6.1.1   Power-Distributions

Once again, our aim is to reconstruct what appears to be a datum of science and experience: that there are *fundamental* causal properties distributed over the parts of complex substances. The first approach to solving the problem of spatial intrinsics I want to explore here, with the aim of applying it to the objection to substantial priority at hand, borrows some machinery from Parsons (2004) and appeals to what he calls 'distributional properties.' As an informal gloss on distributional properties, Parsons notes "[i]ntuitively, though, a distributional property is like a way of painting, or filling in, a spatially extended object with some property such as colour, or heat, or density." Roughly, distributional properties are fundamental or basic in that an object's instantiating such a property does not obtain in virtue of its instantiating any distinct feature or quality.

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[1] For discussion see Simons (2004), Zimmerman (1996b), and Schaffer (2007a). The debate has centered around both the maximally small (extended fundamental particles with no proper parts) and the maximally large (monistic ontologies which say the cosmos has no proper parts).

Distributional properties can be either *uniform* or *non-uniform*. Examples of uniform distributional properties include *having a uniform density of 1 kg/m throughout* (a density-distributional property) and *being uniformly gunky* (a gunk-distributional property); examples of non-uniform distributional properties are *being polka dotted* (a color-distributional property) and *being hot at one end and cold at the other* (a heat-distributional property). What's more, distributional properties admit of a determinate-determinable ordering such that *having a color distribution* is a determinable, *being polka dotted* or *being uniformly red all over* being several of its determinates. In addition, there can be further determinates of determinate distributional properties: *having red polka dots on a white background* and *being uniformly scarlet all over* being determinates of the former determinates.

In addition, it is important to note that distributional properties are *monadic*, they are not polyadic or relational. They are basic intrinsic monadic properties that involve reference to both intrinsic properties and regions of space. On this view, a metal rod's instantiating *being hot at one end and cold at the other* is not a polyadic *relation* that holds between the rod and the hot-region and the rod and the cold-region (that is, the regions where *hotness* and *coldness* are located) with the logical form '$rRh \land rRc$' such that the distributional property *just is* the conjunction of two dyadic relations. Instead, the form of statements involving the instantiation of distributional properties is 'x is F.'

For an extended simple to be qualitatively heterogeneous, on this view, is for it to instantiate a *non-uniform* distributional property. To illustrate, suppose that an object x is exactly located at a non-point sized region R, where x is simple and thus lacking proper parts. Take further the fact of x's being qualitatively heterogeneous: that x is both *hot* and *cold*. Such intrinsic variation cannot be attributed to x's having proper parts, each of which occupy distinct proper sub-regions of x, the one being hot and the other being cold. We can, however, say that x instantiates the non-uniform temperature-distributional property *being hot at r_1 and cold at r_2*, where r_1 and r_2 are disjoint proper sub-regions of R. Due to the primacy of distributional properties in accounting for qualitative variation, it is *in virtue of* x's instantiating the above temperature-distributional property that it has the spatially indexed properties of *being hot at r_1* and *being cold at r_2*.

In fact, Parsons goes on to *define* spatially indexed properties like *being hot at r_1* and *being cold at r_2* as disjunctions of temperature-distributional properties, particularly those whose instantiation results in the distribution of *hotness* over r_1 as well as *coldness* over r_2, respectively.[2] The spatially indexed property *being hot at r_1*, for example,

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[2]Parson (2004) argues that distributional properties cannot be reduced to non-distributional properties as follows: suppose gunk is metaphysically possible. If so, suppose we attribute a distributional property P to a hunk of gunk x. On this scenario, it is metaphysically possible that every proper part of x instantiates a distributional property such that there is no non-distributional reductive base for which P to be defined in terms of. Since there is a possible world where there is no non-distributional reductive base for

can be defined as the disjunction of the following temperature-distributional properties whose instantiation suffices for the distribution of *hotness* to r_1: *being hot at r_1 and cold at r_2*, ∨ *being uniformly hot* ∨ *being hot at $r_1 - r_4$* ∨, ...[3] Since these spatially indexed properties are disjunctions of (intrinsic) distributional properties, they too are intrinsic (non-relational) by Parson's lights. In this way, the intrinsic qualities of x that account for its heterogeneity can be distributed over its proper sub-regions in virtue of instantiating non-uniform distributional properties, yet without attributing such qualities to any proper parts occupying r_1 and r_2 (as there are none). The proponent of this route can generalize this line of reasoning such that any qualitative variation in some property F of an extended simple can be accounted for in terms of the object instantiating a non-uniform *F-distribution*. Distributional properties, in sum, can be put to work in offering a solution to both the problem of temporal and spatial intrinsics.

How might we appropriate the above machinery to the objection leveled against substantial priority? Note first the fact that the use of distributional properties in responding to the above objection grants that the causal properties that are commonly attributed to the proper parts of substances are perfectly natural or causally fundamental. However, this route goes on to claim that while these properties are distributed over a substance's proper sub-regions, they are not instantiated by the proper parts that occupy those proper sub-regions. Second, since the objector demands a grounding story concerning the appearance of fundamental causal activity at a substance's level of decomposition, the distributional properties at work in this response would need to be irreducibly *powerful* and capable of grounding irreducible scientific facts about the world.

Hence, adopting this first route involves ascribing *perfectly natural* distributional properties to the substantial whole, i.e. ones that distribute irreducible causal powers over its proper sub-regions. Call these perfectly natural distributional properties: *power-distributions*. The instantiation of a particular power-distribution by a substance guarantees that the substance will have a certain distribution of causal powers over its proper sub-regions, whether biological (*power for gene transcription*), chemical (*being disposed to form covalent bonds*), physical (*power to repel like charges*), or perhaps psychological (power for intentional action). The important thing to point out here is that a basic causal power's being located at a particular sub-region obtains *in virtue of* the substance instantiating a certain power-distribution.

Return again to our original example involving scientific experience: *the power for gene transcription* is instantiated by a DNA sequence, a proper part of a living organism. The sequence's having the *power for gene transcription* (what I am assuming to

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distributional properties, then the latter cannot be reduced to or be 'nothing over and above' the former.

[3] In his own words, Parsons notes (albeit with respect to temporally indexed properties): "To generalize: wherever we have a temporally indexed property of being X-at-t, we have a number of corresponding permanent distributional properties: the X-ness distributions. X-at-t is a disjunction of some of those X-ness distributions, the ones that are compatible with being X-at-t."

be a perfectly natural property) can be recast in terms of its higher-level substance, a cell, instantiating a distinctively *biological power-distribution* such as *having the power for gene transcription at* $r_1...r_n$ or perhaps *having the power for gene transcription at* r_1 *and having the power for neurotransmission at* r_4 (where $r_1...r_n$ and r_4 are disjoint proper sub-regions of the cell). The instantiation of each of the above biological power-distributions individually suffices to distribute the *power for gene transcription* to one of the cell's proper sub-regions, namely r_1. The thought is that by instantiating a power-distribution, a complex substance can have perfectly natural properties distributed over its proper sub-regions $r_1...r_n$ without having *substantial* or *basic* proper parts that occupy $r_1...r_n$ and instantiate such properties. This route is generalizable in that for any perfectly natural property F, appearances involving the proper part of a substance instantiating F can be accounted for in terms of the instantiation of a power-distribution by the substantial whole, namely one whose instantiation suffices to locate F to one of the substance's proper sub-regions. It's *as-if* living organisms have proper parts that bear perfectly natural properties precisely because of their having power-distributions which assign such properties to their respective proper sub-regions.

6.1.2 Localized Powers

A second albeit similar line of response to the objection at hand would be to agree that the exclusive bearer of the perfectly natural properties is the substantial whole, but assign a much greater explanatory role to the properties located at the whole's occupying sub-regions. Where this route differs from the first is in its denial of the claim that the region-indexed properties are instantiated solely in virtue of the whole's instantiating distributional properties.

McDaniel (2009) endorses this route as a unified solution to both the problem of temporal and spatial intrinsics.[4] Properties such as *being F*, on this view, are maximal fusions of exactly resembling tropes. Tropes, according to McDaniel, are intrinsically *regionalized* and thereby located at the various sub-regions that make up the underlying spatiotemporal structure of the substantial whole (are intrinsically *localized* in that they are defined in terms of the region at which they are located).[5] In contrast to the distributional route which analyzes spatially indexed properties in terms of disjunctions of distributional properties, this route assigns pride of place to the localized tropes themselves.[6] As a solution to the problem of spatial intrinsics, an extended simple is qualitatively heterogeneous in virtue of instantiating non-resembling localized tropes at distinct proper

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[4]McDaniel follows Ehring (1997) here.

[5]This of course implies that all particularized properties have a spatiotemporal location, a thesis some may not be ready to accept.

[6]This is not to say that this route excludes the machinery of distributional properties *tout court*. As McDaniel points out, the proponent of this route may define distributional properties as sums of localized tropes.

sub-regions. More precisely: *x is F-at-r* just in case x exemplifies an F-trope existing at r.

Here we must proceed with caution. In claiming that localized tropes are defined in terms of their occupying regions (what is commonly symbolized as *F-at-r*), proponents of this view do not mean to introduce an extra argument place to stand between localized tropes and their occupying regions (where F bears the *located-at* relation to a region of spacetime: *located-at(F,r)*). Localized tropes are not relations. They are, rather, *regionalized monadic properties* whose logical form, like that of distributional properties, involves a single argument place. As Ehring (1997) points out, building region-location into the nature of properties (or temporal-location in his case) does not, by itself, convert properties into relations.[7] If it did, then the appeal to localized tropes would, as is familiar, have the untoward consequence of turning all intrinsic properties into relations and hence *extrinsic*, thereby doing away with perfectly natural properties altogether.[8] But just as the temporal part of a perduring spacetime worm can be time-indexed (or better, *temporalized*) without itself being a two-place relation that links the worm to a particular time, so too a localized trope can be region-indexed (or better, *regionalized*) without itself being a two-place relation that relates its bearer to a region.[9] In light of this, perhaps it would be better to symbolize localized tropes as F_r instead of *F-at-r* to avoid confusing them with relations to regions (where r is the region that enters into the real definition of F).

Again, the application of localized tropes to the objection against substantial priority is straightforward. This move allows the defender of substantial priority to attribute all of the fundamental joint-carving causal properties to the substance as a whole without relying on the machinery of distributional properties in the above capacity. It is in virtue of a substance instantiating a localized perfectly natural property that it's *as-if* a proper part that occupies one its sub-regions instantiates that property.

Consider, once again, our example of the *power for gene transcription*, a perfectly natural property that, by all appearances, is instantiated by a proper part of a living organism (a gene). This datum of scientific experience can be reconstructed in terms of the substantial whole possessing a fundamental causal property that is located at one of its occupying sub-regions. In the same way that an extended simple may instantiate a localized trope F at one of its proper sub-regions without a proper part at that region

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[7]Consider the similarity here between McDaniel's localized tropes with what Davidson (2003) calls 'relational properties.' Davidson offers the following as examples of relational properties *being taller than Tom* or *being meaner than Leroy* and goes on to state: "Relational properties aren't relations. They're possessed by a single individual in the same sort of way as non-relational properties like *being blue* are possessed. They don't 'hold between' individuals in the way that relations do; rather, they're exemplified by a single individual—they're monadic."

[8]Well, not all intrinsic properties would turn out intrinsic on this line. One might think that there are *relational intrinsic* properties such as *having a proper part that is F*.

[9]Again, see Ehring (1997) for more on this line.

instantiating F, so too a substantial whole may instantiate a localized irreducible causal power P at one of its proper sub-regions without having a *substantial* proper part that occupies the sub-region where P is localized and that bears P (although, in contrast to the extended simple, it may have a non-substantial proper part that occupies the sub-region and bears P). By invoking localized perfectly natural properties, the defender of substantial priority has a way of grounding scientific appearances.

6.1.3 Regionalized Instantiation

A third alternative would be to shift our focus from the perfectly natural properties themselves to the *having* of such properties, that is, indexing the *instantiation relation* (copula) to regions of space: x *is-at-r* F. This route has been labeled 'spatial adverbialism' (McDaniel 2007b) and is, of course, the spatial analogue of the adverbialist solution to the problem of temporary intrinsics. On this view, the instantiation relation itself is region-indexed in that it is a three-place relation between an object, a property, and a region of spacetime; regions are built right into the copula itself. This route allows the friend of substantial priority to reconstruct science and common sense by the use of spatially indexed adverbs regarding a substance's being modified *F-ly* at one of its particular sub-regions. For instance, we might say that while it is, strictly speaking, false that the properties *being negatively charged* and *being positively charged* are instantiated by *substantial* proper parts of a hydrogen chloride molecule (viz. chlorine and hydrogen, respectively), it is true however that 'HCl is r_1-*ly negatively charged*' and 'HCl is r_2-*ly positively charged*' (where r_1 and r_2 are disjoint regions).

6.1.4 Stuff-Occupants

Lastly, Markosian (2004) has proposed a solution to the problem of spatial intrinsics that turns on there being two irreducible kinds of entities that occupy regions of space. There are two fundamental kinds of region-fillers on this view: *objects* and *stuff*. Generally, objects or things are referred to using count nouns such as 'tree,' 'mouse,' and 'gene' while the latter are picked out using mass nouns such as 'wood,' 'steel,' and 'bronze.' While stuff comes in portions or quantities, it is argued that objects have an intrinsic unity that makes them *individual* and hence *countable*.[10] Material objects such as trees, turnips, and tyrants are constituted by their portions of material stuff and are non-identical to

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[10]See Laycock (2006: 95) and Lowe (1998: chapter 3) for more on the connection between individuality, unity, and countability. Consider Laycock: "Since the concept of an object is the concept of a unit or a unity, the concept of a physical object is the concept of a physical or spatiotemporal unity; and the loss of a physical object's unity is thus the loss of its physical objecthood. To possess a physical unity is precisely to possess a physical form or spatiotemporal structure ('however scattered or diffused,' as Quine might say); hence formlessness is not to be distinguished from disunity." Also, Lowe (1998: 77), "It is the formlessness of parts of matter which deprives them of individuality and makes them uncountable as such."

such portions.

According to this response to the problem of spatial intrinsics, while an extended simple may be lacking proper parts entirely, the portion of stuff that constitutes the object may exhibit a complex mereological structure in that it decomposes into further sub-portions of stuff.[11] If so, even if we cannot directly pin the distinct intrinsic properties to the proper parts of the simple (as there are none), we can pin them directly to the sub-portions of stuff that constitute the simple. Markosian (2004: 406) puts it as follows:

> But I said that we can capture what is literally true in the intuitive claim that the statue has a right arm that is made of a different type of matter from the rest of it by talking about the arm-shaped sub-region of the region occupied by the statue, and the fact that the matter occupying this sub-region differs from the matter occupying the rest of the region occupied by the statue. Thus my reply to the statue objection committed me to saying that, at least in some cases, talk about matter, or *stuff*, is not reducible to talk about *things*. And I think it is clear that anyone who believes in the possibility of extended simples must also take a similar line.

Markosian's solution will find favor with those friends of substantial priority who are apt to endorse a mixed ontology of objects and stuff as well as the *constitution* relation that obtains between the two region-occupiers. On this approach, while no proper part *per se* of the substantial whole instantiates perfectly natural properties, we can say that the stuff that constitutes its parts are the bearers of fundamental causal powers. It is precisely because portions and sub-portions of stuff are not *proper parts* of substances (rather they constitute them) that they are capable of bearing perfectly natural properties *simpliciter*. As a result, it is not the substantial whole *itself* (i.e. qua entity that is non-identical to its stuff) that instantiates the perfectly natural properties that are thought to be distributed among its proper parts. Rather, such properties are pinned directly to the distinct sub-portions of its constituting material stuff.

One potential worry with this line of response is that it seems to go contrary to our initial claim that substances are the exclusive bearers of the perfectly natural properties. If the stuff out of which an object is constituted is able to instantiate the perfectly natural properties we would commonly attribute to the object itself, then does this not render stuff *substantial*? There is, however, nothing in principle that would require that stuff be characterized as non-substantial. I see no problem with including within the class of substantial entities portions of stuff (i.e. entities with determinate identity conditions yet lacking determinate countability).[12]

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[11]Whether such decomposition is endless will, of course, depend on whether material stuff is gunky or non-gunky.

[12]See Lowe (1998: 66-67).

Of course, in order to remain consistent with **No Parthood** and substantial priority in general, a great deal of weight has to be placed on the *irreducibility* of constitution to the relation of composition. If the substantiality of stuff is not to call into question **No Parthood** and thereby the fundamentality of substances, a portion of stuff's constituting its object *cannot* be analyzed in mereological terms (even a partial mereological overlap between substantial stuff and a substantial whole would violate **No Parthood**). The defender of substantial priority may find this burden too heavy to bear in so far as a mereological gloss on constitution is both natural and straightforward.[13] Others will remain undeterred given that constitution is best construed as either primitive (Markosian 2004) or as capable of being analyzed in *non-mereological* terms (Baker 2007: 161).Whether the relation is taken as primitive or analyzable in non-mereological terms, those congenial to constitutionalism will see the appeal to a mixed ontology of objects and stuff as no additional cost to the defender of substantial priority in responding to the foregoing objection from material inadequacy.

In adopting a mixed ontology of objects and stuff, the above solution, in contrast to the above three, makes no reference to either individual occupants of regions or proper sub-regions occupied by the substantial whole in accounting for the distribution of perfectly natural properties among its proper parts. Rather, the fundamental causal properties that are distributed among the proper parts of a substance are instantiated by one of the *stuff-occupants* of those regions, occupants which lack the intrinsic unity and countability that constitute objects or individuals.[14]

We have, at this point, examined four different routes available to the defender of substantial priority in response to the objection from material inadequacy. All begin by granting the objector that the properties distributed among the proper parts of a substance (those which factor into 'bottom-up' scientific explanations) are indeed *perfectly* natural. What unites the above responses is their common denial of the following principle that undergirds the objection at hand:

> **Property-Part Distribution:** If a composite substance has perfectly natural properties distributed among either its non-overlapping proper sub-regions or the stuff-occupants of those regions, then it has non-overlapping substantial proper parts that occupy or are constituted by the stuff of those regions that instantiate the properties in question.

The first three responses to the charge of material inadequacy–power-distributions, localized tropes, regionalized instantiation–are alike in that they all attribute the perfectly natural properties directly to the substance *as a whole* yet go on to tell a further story as

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[13]See in particular Sider (2002), Zimmerman (2002).

[14]This is not to say that all natural properties per se must be attributed to the stuff that constitutes the proper parts of substance and the not the proper parts themselves. Here we are only dealing with the fundamental or perfectly natural properties.

to *how* these elite joint-carving properties of the whole can be located at or distributed among its proper sub-regions. The final appeal to a mixed ontology of objects and stuff predicates the perfectly natural properties directly to the sub-portions of stuff that constitute the substance, where portions (and sub-portions) of stuff and their occupying regions are numerically distinct.

In short: all of the above responses to the charge of material inadequacy are of the opinion that a substantial whole x or its constituting portion of stuff S can instantiate an irreducible causal power P at either (i) one of its sub-regions r or (ii) at one of its sub-portions of stuff s, without having a *substantial* proper part y either located at r or constituted by s such that y instantiates F. As a result, all would agree in denying that propositions of the form <x is F at sub-region r> and <x is F at sub-portion s> entails propositions of the form <y is F>, where $y < x$.

6.1.5   Comparative Naturalness

There is, however, one last response to the objection from material inadequacy that I'd like to consider, mainly because it is the route that I currently favor. Recall that the charge in question is that substantial priority is empirically inadequate due to its inability to reconstruct the phenomena of science and common sense. What's more, recall that we have been granting the objector the fact that the causal powers at work in bottom-up scientific explanations–such as the *power of gene transcription* in the original formulation of the objection–are indeed *perfectly* natural properties. This last route denies that such properties need be perfectly natural in order to play a causal and explanatory role in our best empirical theories.

For one, it is entirely consistent with substantial priority that the proper parts of substances instantiate *natural properties*, that is, causal powers that genuinely carve the causal structure of the world and factor into scientific explanations. The objection seems to harbor the following dilemma: either the causal powers of the proper parts of composite substances are not causally relevant in our best scientific theories or they are causally *fundamental*. But the dilemma is a false one. Why think that we ought to attribute perfect naturalness to the powers and dispositions at work in complex substances in order for such dispositions to carve the causal structure of the world? It seems like the only pressure to ascribe causal fundamentality or perfect naturalness to lower-level causal mechanisms (and hence metaphysical fundamentality to the bearers of such mechanisms) stems from the lure of part-priority and priority microphysicalism, in particular the thesis of *micro-causation* (MC). Surely, the objector retorts, the lower-level causal mechanisms are perfectly natural, how could they *not* be given that mereological wholes are built up out of ontologically prior parts? Given the grounding structure that characterizes mereological wholes on part-priority and priority microphysicalism, the worry would hit its

mark. But of course the objector is not *given* part-priority and priority microphysicalism. If the objector wants to avoid begging the question against the proponent of substantial priority, then they need to offer some *independent* reason for thinking that the lower-level causal mechanisms at work in bottom-up explanations are perfectly natural.

Recall that naturalness is commonly thought to be a degreed notion in that certain causal properties are *more natural* than others. But a causal power's failing to be perfectly natural in no way undermines its naturalness *per se*, i.e. its ability to play a causal and explanatory role in carving nature's joints (that is, just because they don't carve nature at her *fundamental* causal joints in no way means that they are not joint-carving at all). Now, it is certainly true that one often (always) finds properties such as *velocity, energy-mass*, and *charge* as topping the list of perfectly natural properties. And indeed this '*fundamental* conception of sparse properties,' as Schaffer (2004: 92) calls it, is by far the predominant view among philosophers working closely with the notion of naturalness in the wake of Lewis (1986, 1999), most notably Sider (1995).[15] For Lewisian-inspired metaphysicians, the total class of *causally* fundamental properties, i.e. perfectly natural, and the class of *(micro) physically* fundamental properties (i.e. those in the domain of microphysics) are *one and the same*.

It is, however, difficult to succumb to the widespread temptation of locating the elite causal properties at the level of fundamental physics apart from a commitment to the *ontological* (as opposed to the *physical*) primacy of physics in the first place. Apart from endorsing priority microphysicalism, as does Lewis (1999:66) when he states "physics discovers which things and classes are the most elite of all," we are offered little reason to side with the presumption that all chains of naturalness terminate in the highly elite and metaphysically privileged properties of microphysics.[16]

Not all, however, share this penchant for the metaphysical fundamentality of physics when it comes to the causal properties that carve nature at its joints. Hawthorne (2006: 205) states,

> Sider, like many of us, believes in some objective ranking of properties on a scale of naturalness, with perfectly natural properties at one end and utterly gerrymandered properties at another. But he also tacitly accepts another commitment—namely that a property's naturalness is given by its ease of definability in terms of fundamental microphysics. This is far from obvious.

Hawthorne goes on to contrast two fundamentally different views as to the naturalness

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[15] See also Sider (2012). For a nice discussion on the distinction between the fundamental and scientific conception of sparse (natural) properties see Schaffer (2004).

[16] See also Lewis (1986: 60-61): "Physics has its short list of 'fundamental physical properties': the charges and masses of particles, also their so called 'spins' and 'colours' and 'flavours', and maybe a few more that have yet to be discovered…What physics has undertaken, whether or not ours is a world where the undertaking will succeed, is an inventory of the sparse properties of this-worldly things."

ordering we find in the world, what he calls 'austere physicalism' and 'emergentism:'[17]

> Which are the natural properties? Even supposing that we think that every-thing supervenes on physics, the issue is not settled. For if we accept a nat-ural property framework, we must choose between an austere physicalism on the one hand and what might be called an 'emergentist' framework on the other... According to the austere physicalist, the perfectly natural prop-erties will only be found at the microphysical groundfloor, relative natural-ness being a matter of definitional distance from the perfectly natural proper-ties... The 'emergentist' by contrast, believes that naturalness is not a matter of mere definitional distance from the microphysical groundfloor... Perhaps being a cat is far more natural than certain properties far more easily defin-able in Lewis' canonical language. On the emergentist conception of things, there is no algorithm available for calibrating naturalness in terms of a perfect microphysical language. (2006: 206)

This conception of naturalness comports nicely with what Schaffer (2004: 92) calls 'the *scientific* conception of sparse properties' which are "drawn from all the levels of na-ture—they are those involved in the scientific understanding of the world." At the very least, then, the question as to whether the causal powers at work in bottom up scientific explanations need be *perfectly* natural is by no means independent of the question of fundamental mereology.[18]

But not only are we offered little reason to think that the causal properties possessed by the proper parts of substances are perfectly natural apart from the truth of part-priority and priority microphysicalism, the objector's own example in terms of DNA and its constituent genomic sequences acting as the primary causal agent in the growth and evolutionary development of living organisms suggests otherwise. There has been a great deal of work in developmental biology that supports the thesis that the living organism as a whole, together with its causal powers and dispositions, is the primary causal factor in activating and regulating gene expression and morphogenesis.[19] While

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[17]Note the qualifier 'austere' in Hawthorne's characterization of a framework which locates the perfectly natural properties at the microphysical groundfloor of reality. As I argued in chapter 4, a 'non-austere' physicalism is a variety of physicalism nonetheless.

[18]The recent work by Anjum and Mumford (2011) on the metaphysics of causation has been a welcome corrective to the tacit commitment to the ontological primacy of physics in philosophical reflection on the nature of causation. They take causation in the biological domain as their base for developing a theory of causation that accords with total science. They state: "To take all our examples from physics, or disproportionately so, is thus to prejudge as to the sole importance of physics to causation. Causation in psychology or sociology may be just as important to us and their neglect seems justified only if physical fundamentalism [the claim that all other sciences are ultimately reducible to physics] is true. We have no strong reason yet to believe that it is. In fact, its the very issue in question."

[19]As a sample, consider Moss (2003: 3) on the widespread causal primacy ascribed to genes in contem-porary molecular biology (which he rigorously argues against), "as an entity, its existence is now widely believed to be somehow temporally, ontologically, and causally antecedent to organismic becoming. The

genes are the fundamental units of life in the sense that they are the suppliers of the materials required for transcription and organismal development, "the protein and cell machinery works to stimulate and control transcription and all the post-transcriptional modifications. This is what 'plays' the genes…clearly, then, the expression of a gene (in the rather misleading jargon) will involve levels of activity that are determined by the system as a whole."[20] Along similar lines, Noble (2006: 51) notes that while "the genome is sometimes described as a program that directs the creation and behaviour of all other biological processes in an organism. But this is not a fact. It is a metaphor. It is also an unrealistic and unhelpful one."

All of the above reconstructions are intended to help the proponent of substantial priority assuage some of the rather untoward consequences of affirming **No Parthood**. The above strategies aim to reconstruct the appearances regarding both ordinary as well as scientific discourse concerning the causal powers and substantiality of the proper parts of substances. My aim has been simply to show that *there are* such strategies, and that while some are more defensible than others, they nevertheless go some way toward dissolving the objection that substantial priority is in direct conflict with scientific appearances.

6.1.6 Scientific Appearances Once More

At this juncture, the objector from empirical inadequacy might press further: "Alright, you've highlighted a few strategies to save the scientific and common sense phenomena, fair enough. I grant that there is at least *some* way to plausibly reconstruct its being *as-if* the proper parts of substances are substantial bearers of perfectly natural properties. But in so far as substantial priority entails that statements like "Human beings have H_2O molecules among their substantial proper parts" and "A sodium atom is a substantial proper part of Sodium Chloride" are literally false in the case of substances and their proper parts (assuming that all the objects in question are substances), it is simply too radical a departure from what we know from science to be taken seriously."

By way of response, let's take the following datum as our target statement:

DATUM: Cells have genes as substantial proper parts.

The objector is correct in pointing out that if cells are substantial wholes then, strictly speaking, DATUM is false on substantial priority. Note that DATUM is false on substantial priority in precisely the same way that "genes encode proteins" is false on mereological nihilism (or eliminitivism), and "genes are non-instantaneous" is false on stage theory, and "genes survive the removal of introns in the splicing process" is false on mereological

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gene (or genetic program) envisaged as context- independent information for how to make an organism appears to have become the new heir to the mainstream of western metaphysics." For defenses of the centrality of the biological organism in morphogenesis see Moss (2003), Wilson (2005), and Noble (2006).

[20]Noble (2006: 45).

essentialism. All four of the above ontologies must engage in the project of reconstructing scientific appearances, substantial priority is not alone in this regard.

The mereological nihilist or elimintivist (van Inwagen 1990: 109) offers the following paraphrase in place of the empirical claim that "genes encode proteins": "there exist xs and ys such that the xs are arranged gene-wise, the ys are also arranged protein-wise, and the xs encode for the ys." The stage theorist (Sider 2006; Hawley 2006), a bit less clumsily, offers the following paraphrase in the place of "genes are non-instantaneous:" "there are distinct instantaneous gene-stages that are related by temporal counterpart relations." Finally, in the place of "genes survive the removal of introns in the splicing process" the mereological essentialist (Chisholm 1976: 99-103) holds that "there exist successions of numerically distinct, but appropriately related, genes with different proper parts throughout the splicing process."

First of all, why follow the objector in thinking that DATUM is a deliverance of science in the first place? If the above strategies for reconstruction cut any ice at all, then DATUM cannot simply be 'read-off' of our knowledge of molecular biology. As stated, DATUM is a *philosophical* claim regarding the *ontological category* of one of the proper parts of a cellular whole. Questions of high-level categorial classification have traditionally fallen within the purview of metaphysics. While one's view concerning the composition, structure, and persistence of material objects ought to be informed and constrained by the content of our best empirical theories, they do not 'fall out' of such theories. Mereological nihilism, for example, is not directly refuted by the empirical claim that "genes encode proteins" precisely because the question of whether atoms arranged gene-wise compose a gene and whether atoms arranged protein-wise compose a protein is not straightforwardly empirical. This is to repeat the familiar maxim that metaphysics, in our case the question of the ontological category of the proper parts of substances in general, is *underdetermined* by science; molecular biology doesn't wear its metaphysical commitments on its sleeve.[21]

If the above strategies for reconstructing scientific appearances carry any weight whatsoever, the evidence that would lead the objector (as well as any metaphysically inclined molecular biologists) to posit genes as *substantial* proper parts of cells can be adequately accounted for by the strategies below. Any one of the following reconstructions of DATUM would be available to the proponent of substantial priority (recall from chapter 1 section 2.3.1 that the *causal profile* of x is the range of properties and powers x has in

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[21]For an excellent treatment of this see French (1998). Note that this is not to say that empirical data cannot serve as either a potential defeater or as positive warrant in favor of a metaphysical theory. Rather, the claim here is that empirical considerations cannot *force* one to either endorse or abandon a particular metaphysical model; there is no one model that is consistent with the observable data. In fact, I have tried to show in chapter 4 that there are good empirical considerations which suggest that part-priority and priority microphysicalism fail to adequately capture portions the mereological structure we find in the world. I also noted that there are empirical reasons that point in the direction of (albeit not conclusively) a substantial priority fundamental mereology.

every world in which it exists):

Power-Distribution: For every power $p_1 \ldots p_n$ included among the causal profile of a gene, there is a power-distribution D (or class of power-distributions) that assigns $p_1 \ldots p_n$ to at least one proper sub-region of the cell C's occupying region R, and D is instantiated by C.

Localized Powers: For every power $p_1 \ldots p_n$ included in the causal profile of a gene, there are localized powers $f_1 \ldots f_n$ that are instantiated by a cell C located at region R, and $f_1 \ldots f_n$ exactly occupy at least one of R's proper sub-regions.[22]

Regionalized Instantiation: For every power $p_1 \ldots p_n$ included in the causal profile of a gene, there is a cell C located at region R such that for at least one proper sub-region r of R, C is *r-ly* $p_1 \ldots p_n$.

Stuff-Occupants: For every power $p_1 \ldots p_n$ included in the causal profile of a gene, there is a portion of stuff S located at region R such that S constitutes a cell C, and $p_1 \ldots p_n$ are instantiated by least one sub-portion s of S.

Comparative Naturalness: For every power $p_1 \ldots p_n$ included in the causal profile of a gene, $p_1 \ldots p_n$ are natural properties and there is at least one proper part y of a cell C such that y instantiates $p_1 \ldots p_n$.

With the above reconstruction strategies in place, even if we *were* (contra my proposal above) to follow the objector's lead in taking DATUM as a deliverance of molecular biology, the defender of substantial priority (like the proponents of nihilism, stage theory, and mereological essentialism) might argue that while DATUM is strictly speaking false, it is nevertheless 'correct' in so far as it satisfies the semantic standards for ordinary and scientific discourse. On this view, the *correctness* of ordinary and scientific assertions (in contrast to those uttered in the ontology room) are insensitive to the truth of particular metaphysical positions in fundamental mereology. By way of analogy, we might say that the *correctness* of the common, everyday assertion "There are prime numbers" is insensitive to the truth of Platonism or nominalism in the philosophy of mathematics; we normally would not (should not) chide the school-teacher in her maths lesson or the theoretical physicist in their mathematical modeling of the physical world for uttering such a statement. Yet when uttered in the ontology room as a distinctively metaphysical assertion, the *truth* of "There are prime numbers" is indeed sensitive to the truth of Platonism and nominalism; on nominalism, for instance, such a statement is false. The precise boundary separating correctness-conditions from truth-conditions is a difficult

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[22]Where $(p_1 \ldots p_n = f_1 \ldots f_n)$.

question in metasemantics that need not be settled here.[23] The underlying point here is that it may well be the case that various types of discourse and contexts are governed by different semantic standards. The defender of substantial priority might argue that even if DATUM were in fact part and parcel of our ordinary scientific discourse, such a statement is 'correct' if and only if one of the foregoing strategies obtains in the world (i.e. **Power-Distribution, Localized Powers, Regionalized Instantiation, Stuff-Occupants,** and **Natural**), even if DATUM is not strictly true.[24]

6.1.7   A Lingering Worry

But a lingering worry remains. If the causal profile of a gene $p_1 \ldots p_n$ is located within the boundaries of the cell, whether the bearer of this profile be the substantial whole itself, a sub-portion of its constituting stuff, or one of its proper parts, why not think that *there is*, in fact, a gene within the boundaries of the cell? All of the foregoing reconstructions assume that the accompanying necessary properties and dispositions of an object o can be instantiated in a region without there being an o in that region.[25] But is this not absurd?

Well, it depends. If you think that being a particular kind of entity K is nothing more than possessing all the properties that particular Ks have in every world in which they exist, then it is absurd indeed to think that a region can contain $p_1 \ldots p_n$ without containing a K; being a K *just is* having $p_1 \ldots p_n$! We have examined this package of views in detail in chapter 1 under the guise of modal essentialism (in particular ME1 and ME2$_b$), the theses that x is essentially Φ if and only if it is necessarily the case that if x exists then it is Φ (ME1), and that the essence of x is identical to the sum or collection of those properties satisfying Φ (ME2$_b$). There, I offered the now familiar line that the mere possession of properties satisfying Φ is not sufficient to capture x's fundamental identity. There must be something more, then, to being a tiger than having the properties that accompany individual tigers in every world in which they exist. As was pointed out, the 'something more' is being something whose fundamental nature (as stated by its real definition) involves reference to the kind *tiger*. While the KIND-POWER CONNECTION (see chapter 1 section 2.3.1) requires that $\Box(Kx \to \Phi x)$, the denial of ME2$_b$ entails that the converse $\Box(\Phi x \to Kx)$ does not hold.

In addition, I argued that fundamental natures are *irreducible* to properties *per se* in that if a substance's nature were reducible to mere collections of powers and properties we would be left without an explanation as to why such powers and properties systematically cluster to form an integral unity and not a mere accidental grouping of features (recall CLUSTER). Without appealing to gold's being an irreducible *kind* of substance, for example, one is hard-pressed to explain what grounds the uniform and systematic pos-

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[23]For an interesting discussion here on the difference between correctness and truth see Chalmers (2009).

[24]For a similar line see van Inwagen (1990) and Horgan & Potrč (2000).

[25]To say that o is not the possessor of the causal profile is not to say that it has no possessor at all.

session of the properties of *being malleable* and *having high lustre* by distinct isotopes of gold.

But we have seen reason to think that both tenets of modal essentialism are ill-suited to capture the modal structure of the world. If we resist the temptation to identify a thing's essence or kind with the sum of its necessary properties, as I think we should, then there is no absurdity in claiming that the causal profile of a gene can be instantiated within the boundaries of a cell and yet those boundaries fail to contain an object whose fundamental identity (as stated by its real definition) involves reference to the kind *gene*.[26]

As noted by Toner (2007) in his own defense of substantial priority, the particular machinery required to make sense of such a claim is already present in the literature on material constitution.[27] Recall that the defender of spatiotemporal coincidence maintains that while both the statue and the lump are non-identical, their qualitative profiles are nevertheless empirically indistinguishable during their time of spatiotemporal overlap. But while the lump of bronze and the statue are *qualitative* duplicates at the time of overlap, they are not *classificatory* duplicates in that one is a member of the kind *lump of bronze* and the other is a member of the kind *statue* given their distinct persistence conditions. Here we have exact qualitative resemblance and yet what appears to be a difference in classificatory kind-membership.

Michael Rea (2000a), following Burke (1994b), proposes a solution that distinguishes between two fundamental ways of satisfying a sortal or kind:

> Thus, proponents of the standard account might hold that there are two ways of satisfying a sortal. They might say that an object satisfies a sortal in the *classificatory way* just in case that sortal gives the metaphysically best answer to the 'What is it?' question for that object, and an object satisfies a sortal in the *nominal way* just in case the object exemplifies the distinctive qualitative features of those things that satisfy the sortal in the classificatory way. (Rea 2000a: 172)

At the heart of the distinction between satisfying a kind (sortal) in a *classificatory* versus a *nominal* way is that the latter involves possessing all of the properties that accompany entities whose fundamental nature (as stated by their real definition) involves reference to the kind in question. Note that this route entails that the instantiation of the necessary properties that characterize the members of a particular kind is not sufficient *to be* a classificatory member of that kind, "Having one's matter arranged in such a way as to

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[26]Consider Loux (2006: 112) "[O]nce we recognize that the attributes of concrete objects include not merely their properties, but also the kinds to which they belong, the possibility of numerically different, yet qualitatively indiscernible objects ceases to be a problem for us."

[27]In what follows I am heavily indebted to Toner's (2007) application of the following nominal/classificatory kind distinction to the fundamentality of substances. For the distinction at work in material constitution see Burke (1994) and Rea (2000a) in particular.

exemplify the distinctive qualitative features of the members of a kind is not sufficient."[28]

Rea's own solution to the problem of material constitution involves identifying the statue and lump of bronze, arguing that the proponent of coincidence mistakenly assumes that a difference in kind-membership between the statue and the lump of bronze entails a difference in *classificatory* kind-membership. It is possible to be a K nominally without being a K in the classificatory sense (although the converse does not hold as we will see). By Rea's lights, there is a *single* material object occupying the region in question, albeit one that satisfies the kind *statue* in a classificatory way and one that satisfies the kind *lump of bronze* in a nominal way given its possessing all of the qualitative properties that characterize things that belong to the kind *lump of bronze* in the classificatory way. Since the real definition of the object in question is best picked out by the kind *statue*, it inherits the persistence conditions of the members of the kind *statue*. Rea (2000a: 169) notes "I ... deny that in saying that there is a lump of bronze in the region we are committed to the claim that there is something in the region that has the essential properties associated with the kind *lump of bronze*."

In addition to the literature on material constitution, just about all of the predominant species concepts at play in the philosophy of biology—biological, ecological, cladistic, etc.—are committed *in principle* to the idea of sameness of qualitative properties without sameness of biological classification. As we discussed in chapter 1, since all of the above species concepts characterize biological species as purely relational and extrinsic, whether or not two members of a species are intrinsic qualitative duplicates is irrelevant to whether or not they belong to the same biological species. Okasha (2002: 201), for instance, maintains that the purely relational nature of biological species (whether determined by interbreeding, occupying a particular ecological niche, or being a member of a segment of the genealogical nexus, respectively) entails the denial of the principle that sameness of qualitative properties equals sameness of species-membership: "Two molecule-for-molecule identical organisms could in principle be members of different species, on all of these species concepts." Sober (1993: 148) makes the very same point, albeit in terms of life forms that (hypothetically) originated independently of life on earth (and thus independently of the global genealogical nexus according to cladism): "[I]f we discovered that other planets possess life forms that arose independently of life on earth, those alien organisms would be placed into new species, *regardless of how closely they resembled terrestrial forms*. Martian tigers would not be tigers, even if they were striped and carnivorous. Similarities and differences among organisms are *evidence*

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[28]See Rea (2000b). Along the same lines, consider Rheins (2011: 257),"Yet the realist claims that what makes all instances of gold really gold is not that they satisfy the formula, 'soft, shiny, yellow metal', but rather that the atoms of such samples share the common essential property of having atomic number 79. If, say, pyrite has all other outward properties in common with real gold, but its atomic or molecular microstructure is different, then realists (at least the modern Putnamian sort) deny that it is real gold."

about whether they are conspecific, but a species is not defined by a set of traits."[29]

If we apply this machinery to our example of a gene within the boundaries of a cell, we might say that if the kind *gene* enters into the real definition of an object *o* (where, as per §1.2.3, *gene* is a constitutive predicable of *o*), then *o* satisfies the kind *gene* in a classificatory way and is what we might call a *classifiable gene*. As per the KIND-POWER CONNECTION espoused in chapter 1, an object's belonging to the kind *gene* in a classificatory sense *necessitates* its having a particular range of causal properties and dispositions; there is, in other words, a direct explanatory relation linking its fundamental nature with its characteristic operations as specified by $p_1 \ldots p_n$. Classifiable genes, *in virtue of what they are*, are disposed to behave in such and such a manner in every world in which they exist.

Alternatively, if the kind *gene* fails to enter into the real definition of *o* (i.e. does not answer the 'What is it fundamentally?' question for *o*) yet *o* is characterized by the properties included in $p_1 \ldots p_n$ (among others), then *o* satisfies the kind *gene* in a nominal way and is what we might call a *nominal gene*, a gene 'in name only.'[30] A nominal gene's instantiating $p_1 \ldots p_n$ is not a consequence of what it is fundamentally; there is no direct explanatory relation between its having $p_1 \ldots p_n$ and its fundamental nature. Again, the notion is stated nicely by Harré (2005) when he states, "The nominal essence of a type, kind or sort is the cluster of properties selected as necessary and sufficient at some historical epoch for a being to be assigned to a certain type or kind and so *to be called by* a certain kind name... In practice, the properties comprising the nominal essence of a kind are observables, including occurrent properties, dispositions and affordances." While nominal genes are qualitatively similar enough to classifiable genes to be called 'genes,' they nevertheless lack the relevant explanatory connection between *what* they are fundamentally and their possessing $p_1 \ldots p_n$ to be properly classified as genes.

We can illustrate the notion of a nominal gene within the boundaries of a cell in terms of the localized powers strategy above. On this route, $p_1 \ldots p_n$ are localized dispositional tropes that are instantiated by the cell and occupy at least one of its proper sub-regions, call it r.[31] Since the powers that make up the causal profile of a gene are integral to cellular functioning, it is plausible to think that the region r which hosts $p_1 \ldots p_n$ is occupied by a proper part y of the cell.[32] We can refer to the proper part (y) which occupies the region

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[29]Emphasis mine.

[30]Compare with van Inwagen's (1990: 112) notion of a 'virtual object' and a 'virtual part.' Although I, in contrast to van Inwagen, think that nominal objects exist.

[31]Of course, there will be a vast number of the cell's sub-regions that each host a class of tropes that resemble $p_1 \ldots p_n$.

[32]If not every occupiable sub-region of a substance corresponds to a proper part of that substance (rejection of DAUP), then this route offers a nice way to distinguish between those occupiable sub-regions of a substance that do in fact host a proper part and those that do not. Philosopher of biology William Bechtel (2007) puts it as follows: "the component parts of a mechanism are the entities that perform the operations which together realize the phenomena of interest. A structure within the mechanism may be well delineated (it has boundaries, continues to exist over time, is differentiated from the things around it,

where $p_1 \ldots p_n$ are located as a 'gene' in so far as it is qualitatively similar to a classifiable gene (in the same way that we can refer to the statue of Goliath as a 'lump of bronze' in so far as it is qualitatively indiscernible from a classifiable lump of bronze).

Consequently, while DICTUM is strictly speaking false in that classifiable genes are not proper parts of cells (assuming that it is part of the essence of classifiable genes and classifiable cells to belong to the category of *substance* if they exist), it is true that cells have nominal genes included in their underlying mereological structure. Scientific explanations in molecular biology that appeal to the causal powers of genes are entirely compatible with substantial priority, in so far as we don't build into such explanations the *metaphysical* assumption that the irreducible causal work is being done by *substantial*, classifiable genes qua proper parts of the cell.[33] It is open to the defender of substantial priority to say that a cell can undergo gene regulation in virtue of having a nominal gene as a proper part, or perhaps, in virtue of being *nominally gened-at-r_1*, *nominally-gened-at-r_2*, etc (where r_1 and r_2 are occupied by two non-overlapping proper parts of the cell).[34] And, one might argue, statements in molecular biology that apparently involve quantification over classifiable genes can instead be reformulated into statements that quantify over nominal genes only.

Consequently, in light of the above strategies available to the proponent of substantial priority, I take the view to withstand the objection of empirical inadequacy; science in no way renders substantial priority empirically defective. While some of the foregoing ways to save the scientific phenomena are more or less plausible than others, they go some way, at the very least, toward offering a story as to why it's *as-if* the causal activity of the parts of substances is fundamental assuming the truth of substantial priority.

6.2 The Argument from the Possibility of Junk

Perhaps another worry for substantial priority is the metaphysical possibility of worlds that fail to have a mereological 'top-level,' that is, worlds that consist of what has been called 'mereological junk.'[35] A junky world is a world every member of which is a proper part and thus is marked by an infinite ascent of mereologically nested particulars. We may think of mereological junk as the compositional analogue to atomless gunk.

Bohn (2009) has argued that the very same reasoning that bolsters the possibility of

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etc.). However, if it does not perform an operation that contributes to the realization of the phenomena, it is not a working part of that mechanism. For example, while the gyri and sulei of the brain are well delineated, they are not working parts of the brain but byproducts of the way brains fold to conserve the length of axons."

[33] Here again I am indebted to Toner (2007) for this insight.

[34] Here I illustrate scientific explanations involving the causal powers of genes in terms of the localized powers strategy. However, the approach can be easily generalized to any of the above reconstruction strategies as well as any higher-level substantial whole.

[35] Bohn (2009).

gunky worlds undergirds the possibility of junky worlds. If junky worlds are possible, and if wholes are ontologically prior to their parts as per substantial priority, then it is possible that there are no metaphysically basic entities in junky worlds as the grounding sequence from whole-to-part would exhibit endless upward complexity. But this clearly violates the well-foundedness of grounding (G9 of §2.1.4), the intuition that for any non-empty grounding domain there is of necessity at least one ungrounded entity in that domain. Consequently, the mere possibility of junky worlds poses a threat to any species of a whole-priority fundamental mereology, both priority monism and substantial priority alike.

The argument is structurally identical to the one I offered against part-priority in §4.3:

J1. Necessarily, proper parts are rigidly grounded in the mereological wholes of which they are a proper part (assume whole-priority for reductio).

J2. Junky worlds are possible.

J3. If junky worlds are possible, then it is possible that there are no basic entities in such worlds.

J4. It is not possible that there are no basic entities in such worlds (G9).

J5. Therefore, it is false that necessarily, proper parts are rigidly grounded in the mereological wholes of which they are a proper part.

Even granting the truth of J2, I think the defender of substantial priority is uniquely situated to answer the above worry from the possibility of junky worlds.[36] Note first that J1 is stated in terms of mereological wholes *per se* and thus intended as a global thesis concerning the grounding structure of all mereological wholes. As such, the objection assumes what substantial priority denies: that there is a single kind of mereological whole and thus a single grounding description that applies to all composite objects *tout court*. While substantial priority is a species of whole-priority in that it countenances a kind of whole that is ontologically prior to its proper parts (grounding whole), it admits more besides, namely grounded wholes.

To illustrate the relevance of positing both grounding and grounded wholes, consider a junky world w, a world with limitless upward mereological complexity. Note that on substantial priority there is nothing about w as such that excludes one of the links in the limitless upward chain in w from being metaphysically basic in its own right. Certainly, if *all* composite objects were grounding wholes, then all of the links in the upward chain in w would, in fact, be non-basic in virtue of being inseparable parts of their higher-level whole (ad infinitum). But it is part and parcel of substantial priority to distinguish between grounding wholes and grounded wholes, the proper parts of each kind of whole conforming to distinct grounding descriptions. The proponent of substantial priority can affirm that it is possible for junky worlds to contain at least one grounding whole,

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[36] See Schaffer (2010b: 64-65) for reasons to deny J2.

which itself is a proper part of an infinite upward series of grounded wholes (and hence J3 would be false).[37]

6.3 Mooreanism Revisited

But isn't the fact that substances have *substantial* proper parts a Moorean fact, only to be denied at the expense of common sense? We have already examined this line of thinking in our discussion of the various reasons offered in favor of part-priority and priority microphysicalism (see §4.2). But perhaps there are worries here that remain unresolved. For, one might argue, it is possible to construct plausible scenarios where one and the same proper part of a substance survives (*as such*) minute compositional alteration. It is not uncommon to hear the following objection to substantial priority along these lines: "Do you mean to tell me that the microscopic skin cell that was once a proper part of me is therefore a numerically distinct entity when it is no longer included among my compositional base? How can facts about the mereological structure of fundamental wholes be so sensitive to such minute differences? Surely the skin cell is able to retain its numerical identity upon ceasing to be a proper part of me!"

The intuition-pump is a powerful one, I admit. But as I emphasized in chapter 4, while it is plausible to think that we are able to perceive some degree of continuity or other between material objects over time, experience alone doesn't deliver the further thesis that what we perceive is strict *numerical identity*. In this sense, the proponent of substantial priority is in the same position as those who deny that material objects in general maintain strict numerical sameness through time, particularly stage theory and mereological essentialism (although substantial priority restricts this denial to the proper parts of substances only). Most philosophers who reject these views do not rest their case on strictly empirical or observational grounds: "We can just *see* that material objects survive part replacement!" or "Isn't it empirically obvious that I am the very same person that you greeted this morning? One thing's clear from experience: I am no instantaneous stage!" Rather, most would admit that metaphysical theses regarding the nature and persistence of material objects aim to capture fine-grained structural features of the world and thereby fall outside the immediate purview of ordinary perceptual experience.

Robert Pasnau (2011: 24-25) emphasizes this point nicely with respect to whether observation alone can settle whether there is one and the same subject that exists throughout an instance of change:

> In fact, however, this is surely a case where observation offers no help at

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[37]In fact, it is possible that the very same scenario apply even in worlds that were both junky *and* gunky (and hence lacked both a top and a bottom level). Even in worlds consisting of infinite upward and infinite downward mereological complexity, it is possible that there exists a substance, S, every entity of which S is a proper part is a grounded whole, and every entity that is a proper part of S is likewise a grounded whole.

all. What we *see* occurring, through substantial change, is some amount of sensible continuity: more-or-less the same bulk, with more-or-less the same sensible qualities, seems to endure. But it is a further substantive step, a step that requires metaphysical rather than empirical argument, to show that these constant appearances are supported by some ongoing substratum. An enduring subject of change is simply never observed ... Questions of identity over time—whether a thing endures, or is succeeded in time by something new and perhaps qualitatively quite similar—are metaphysical questions that can never be decisively settled by observation. (Pasnau 2011: 24-25)

I agree with Pasnau: whether the skin cell that was once a proper part of me at one time is *numerically* identical to the object now lying in a petri dish is beyond the ken of experience; one must resort to philosophical considerations concerning the nature and persistence of material objects to settle the score. And, according to substantial priority, what it means for a substance to be metaphysically basic or fundamental is that it is not 'built up' out of further fundamental parts (parts from which it derives its identity and existence) and that it serves to ground each of its respective proper parts. From this particular conception of substantiality, it follows that even the smallest spatial parts of complex substances, in this case one of my skin cells, is such that it is rigidly grounded in the substantial whole of which it is a part. I have offered philosophical considerations (as well as empirical suggestions) that aim to show how thinking of ordinary composite substances as matching this particular grounding description yields a unified solution to a host of puzzles in material objects. Given that numerical identity is arguably not a datum of experience, and since the very issue at hand is a *metaphysical* thesis regarding whether the proper parts of fundamental substances are best construed as separable or inseparable, the above intuition that it is *one and the same* skin cell that survives removal carries little weight in the absence of supporting philosophical considerations in favor of a part-priority fundamental mereology.

In addition to the above reply, the defender of substantial priority can emphasize that while the deep ontological story about the identity of the object in the petri dish does not, strictly speaking, involve strict numerical continuity with the skin cell that was once a proper part of me, this does not mean that absolutely *nothing* remains numerically identical throughout the removal of the skin cell. Recall once again our formulation of a grounding whole in §3.4 as a whole that serves to ground the existence and identity of each of its *individual* or *objectual* proper parts. As such, it is perfectly consistent to maintain that while the skin cell that was once a part of me is not one and the same *object* that now occupies the petri dish, there is one and the same *portion of matter or stuff* that underlies or composes each numerically distinct object. While I will not argue for the fundamental distinction between objects or individuals and portions of stuff here, the distinction allows the proponent of substantial priority to maintain, in

good Aristotelian fashion, the strict numerical continuity of something or other (but not some 'thing')—namely portions of stuff—in cases involving compositional alteration as above.[38]

But perhaps I am being uncharitable to my interlocutor here. Perhaps the Moorean objection is more of a *conceptual* worry—"I just can't *conceive* of how the skin cell could fail to survive removal; how *could* facts about the decompositional structure of fundamental substances be so sensitive to such minute differences?" This is indeed a different objection than the one above, but one that I think carries little force in the end. The inconceivability in question would equally apply to a non-transferable F-trope's ceasing to exist upon its bearer ceasing to be F (where F might refer to *being uniformly red*), a spatial boundary's ceasing to exist upon the slightest topological change in its host, or a material object's ceasing to exist upon the loss of one of its minute proper parts (a carbon atom) as per mereological essentialism. In all three cases we have grounded entities (tropes, boundaries, and composite objects) whose existence is highly sensitive to minute alterations in their grounds. In so far as these cases are clearly conceivable as evidenced by their being widely discussed in the literature (particularly the case involving mereological essentialism), I fail to see the conceptual difficulty in endorsing the view that a minuscule inseparable part of a fundamental substance ceases to exist upon ceasing to be a proper part of that substance.[39]

Moreover, the conceptual worry neglects the fact that skin cells and the epidermis in which they are embedded play a vital functional role in sustaining and regulating the life of the biological organism. For example, the epidermis and individual skin cells act as a barrier that protects the organism from the invasion of pathogens, provides insulation and helps with overall temperature regulation, aids in the production of vitamin D, and prevents unregulated loss of water and solutes.[40] I surmise that the Moorean objection stems more from the habit of conceiving of the generation of composite substances more along the lines of the summation of tiny Democritean atoms or Lewisian point-sized masses that are ontologically *separable* from one another than any inherent conceptual problem with substantial priority.

Suppose at this point that the objector grants substantial priority for entangled systems at the quantum level, "Sure" they might argue, "substantial priority may very well apply to the structure of entangled quantum wholes, but why think such grounding structure applies to larger objects like trees, people, and poodles?" This is a rather unstable move in my opinion, for two reasons. One, substantial priority is a categorial thesis

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[38] See Scaltsas (1994) for an excellent discussion of Aristotle's thinking on this particular matter, as well as Kronen et al. (2000: 879) where such a view is attributed explicitly to Aquinas (under the guise of what the authors refer to as 'gamma').

[39] This is precisely the reverse of what the mereological essentialist holds: instead of the whole ceasing to exist upon losing one of its parts, the part ceases to exist upon being separated from its whole.

[40] See for instance Proksch et al. (2008).

aimed at capturing one particular feature of a substance *qua* metaphysically fundamental entity: for any x, if x is a composite substance, then x is ontologically prior to its proper parts. If so, then the objector's rejoinder amounts to saying that either the only existing substances are quantum entangled systems or that there are multiple and distinct sets of existence and identity conditions for substances, those that apply to entangled quantum wholes and those that apply to higher-level (non-quantum) substantial wholes. The former route faces the foregoing objections in chapter 4 to priority microphysicialism for higher-level wholes (viz. the failure of whole-part supervenience). The latter route forfeits an important theoretical unity to the category of substance.

To illustrate, consider two substances x and y, where x is an entangled quantum whole and y is Schrödinger's cat. If x is a grounding whole and thus ontologically prior to its proper parts (metaphysically fundamental), and y is a grounded whole (on objector's assumption) and thus ontologically posterior to its proper parts (and thereby metaphysically derivative), in what sense are x and y entities of the *same* category?[41] If x and y have such distinct existence and identity conditions, then it seems as if we lose all grounds for affirming that they belong to the very same category, i.e. substance. As a result, bifurcating the existence and identity conditions of substances forfeits a crucial theoretical unity concerning the category of substance.

But doesn't the same charge apply to the proponent of substantial priority in so far as they admit both simple and composite substances? No. Recall that the definition of a substance employed by substantial priority (see **Substance** in chapter 3) is such that it captures the existence and identity conditions of both simple and composite substances. According to **Substance**, x is a substance if and only if (a) there is no y such that (i) y is concrete, (ii) y is not identical with x, (iii) x is rigidly essentially grounded in y and (b) x is unified in the right kind of way, where the unity ascribed in clause (b) is such that a substance lacks separable parts. It was pointed out that there were two distinct ways a substance might lack separable parts, either by lacking parts altogether or having only inseparable parts. Simple substances (if there are any) lack separable parts in the first sense, complex substances in the second. Hence, **Substance** offers a unified account of the nature of substances, both simple and complex. But the objector is in no similar position regarding the unity of the category of substance.

Moreover, arguing that substantial priority applies exclusively to quantum systems places a great deal of weight on the divide between the small objects of quantum mechanics and the large objects of ordinary experience, one that some might think unwarranted. Lowe's (2008: 66) remarks are insightful:

> All we can say with any confidence, indeed, is that quantum physics aspires
> to offer a general explanatory framework for all physical phenomena, not

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[41]This point has been forcefully pointed out by Toner (2010) and discussed in Koslicki (unpublished-b).

just physical phenomena which occur on the very small scale. Any attempt to segregate physical phenomena in a principled way into those that are 'small-scale' and submit to the principles of quantum physics and those that are 'large-scale' and do not submit to those principles is doomed to failure, as the very example of Schrödinger's cat demonstrates: for, by any standard, a radium atom is a 'small-scale' phenomenon and a cat is a 'large-scale' phenomenon, and yet in this case we have a single physical system embracing them both and subject to the principles of quantum physics.

If there is good reason to think, as the objector grants, that substantial priority governs small microphysical systems, then what principled reason is there to think that the grounding structure it ascribes to very small physical systems fails to obtain for larger physical systems such as trees, people, and poodles (a principled reason other than the fact that there are no such substances)? To hold that substantial priority applies exclusively to small physical systems is to neglect the *metaphysical* import of the view as concerning the grounding structure of complex material substances per se, whether small, medium or very large indeed.

6.4 Spacetime Substantivalism and Ubiquitous Mereological Overlap

There is one final objection to substantial priority lurking in the background that I'd like to consider. One might argue that substantial priority is incompatible with substantivalism regarding the nature of spacetime. Like their material occupants, regions are said to exhibit mereological structure, whether such structure is atomic or gunky is beyond our concern here. If regions are substances as per spacetime substantivalism, and the substantial occupants of regions are not identical to those regions (denial of supersubstantivalism), then the substantial occupants of substantival regions will mereologically overlap *to some degree or other*. But this violates **No Parthood** and hence substantial priority. Note, all that is needed here is the minimal claim that the occupant and its region are not mereologically disjoint, a single shared part between a substantial region and a substantial occupant of that region will suffice to undermine substantial priority. Given that substantivalism appears to be somewhat of a consensus among contemporary philosophers of physics, this spells trouble for substantial priority. As a result, the defender of substantial priority is forced to either *identify* substantial occupants with their occupying regions and thus endorse supersubstantivalism, or reject substantivalism outright, neither of which (in my opinion) are attractive options.

Let's assume the truth of spacetime substantivalism for the sake of argument.[42] The

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[42]For reasons John Earman (1989, p. 173) has summed up nicely: "The absolutist can point to three

objection harbors both a fundamental confusion and a precarious assumption. Let's start with the confusion: ordinary material objects do not *mereologically* overlap their occupying regions, rather, they stand in the primitive *occupation* relation to them. My occupying my current region in no way means that I share my region's proper parts or vice versa, i.e. that *its* proper parts are *my* proper parts. But it is plausible to think that my proper parts do, however, *mirror* the proper parts of my occupying region to some degree or other. That is to say, there is a mereological harmony between the proper parts of my occupying region and my proper parts.[43] The region that is occupied by my hand, for instance, appears to be hand-shaped and thus perfectly mirrors one of my proper parts. This mereological harmony between me and my occupying region, as has been previously pointed out, need not be taken to be *isomorphic* such that I decompose into proper parts in *any* and *every* way in which my region decomposes into proper parts.[44] The point remains: *mereological overlap* is one thing, *region-occupation* another. Since substances do not *mereologically* overlap their substantial regions, substantial priority remains unscathed.

But suppose the objector presses the following line in response:

> Granted, mereological overlap and region-occupation are two different relations. But is it not strange that a substance can exactly occupy a region and either perfectly or near-perfectly mirror the parts of that region and yet not share *any* of that region's mereological structure? What exactly *explains* the mereological harmony between my proper parts and the proper parts of my occupying region? Surely *something* must explain this fact. Some would take such correlation as reason to *identify* occupants with their underlying regions. But such an extreme move would be hasty. Suppose instead we explain mereological harmony in terms of the fact that material occupants inherit their mereological structure from their occupying regions, and hence possess such structure *extrinsically*. Only spacetime regions have their parts intrinsically. On this view, the parts of material occupants of spacetime mirror the parts of their occupying regions precisely because they inherit one and the same compositional structure from them. Accordingly, the phenomena of mereological harmony offers reason to think that material objects not only occupy their regions, but also mereologically overlap their regions in sharing the same compositional structure.[45]

reasons for accepting a substratum of spacetime points: the need to support the structures that define absolute motion, the need to support fields, and the need to ground the right/left distinction when parity conservation fails."

[43] See Schaffer (2009b) and Uzquiano (unpublished) for more on the notion of mereological harmony.

[44] This principle is called *arbitrary partition* in Uzquiano (unpublished) and bears a resemblance to DAUP.

[45] This speech was inspired by Schaffer (2009: 138-139) but has been adapted to the present context. For the claim that material occupants inherit their geometrical, topological, and metrical features from their occupying regions, see Hudson (2006: 111).

Suppose we grant for the sake of argument the highly controversial assumption that the material occupants of spacetime not only occupy but also inherit their mereological structure from their regions. What follows from this? In order for the objector here to infer the falsity of substantial priority from the mereological overlap between occupants and their regions they need to build in some rather precarious assumptions regarding the precise formulation of spacetime substantivalism.

For one, the substantivalist camp in the philosophy of physics is a rather diverse lot.[46] In particular, substantivalism per se is *neutral* as to the precise nature and structure of general relativistic spacetime, namely between those that identify spacetime with the manifold alone ('manifold substantivalism') and those that take spacetime to be identical with the manifold together with the metric field ('metric field substantivalism'), the latter being essentially a set of points with a topological and differential structure.[47] On manifold substantivalism, the entire manifold exhausts the nature of physical spacetime and functions as a substantial substratum which supports fields, geometric, and topological properties. Metric field substantivalists, on the other hand, argue that spacetime itself cannot be identified as such in so far as a bare manifold alone, i.e. one devoid of metric structure, is unable to possess crucial properties such as distance, the difference between spatial and temporal intervals, and light-cone structure that make it distinctively *spatiotemporal*.

More importantly, contemporary substantivalists are sharply divided as to whether the manifold (or the manifold together with the metric field) is a *single* substantial whole or whether each individual sub-region (or point) of the manifold is itself a substance (i.e. spacetime being an aggregate or collection of regions *qua* basic substances). Maudlin (1988: 86) has argued that a general-relativistic reconstruction of Newton's conception of absolute space and time would yield a single substantial metrical whole, such that "spacetime is an essentially metrical object and that the points of space-time bear their metrical relations essentially." Two formidable contemporary variations of such a view are *moderate structural realism* as defended by Esfeld and Lam (2008) and *metric essentialism* as put forward by Maudlin (1988) and Hoefer (1996), both of which hold that spacetime is a *single* substance whose structure is defined by the metric field and whose sub-regions (whether zero-dimensional points or extended regions) are individuated in terms of their place within the metric.[48] In fact, these two versions of substantivalism

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[46] For an excellent introduction to the metaphysics of spacetime see Dainton (2010).

[47] Earman (1989) and Norton (2011) defend manifold substantivalism, while (Maudlin (1993) and Hoefer (1996) defend the metric field variety. Healey (1995: 288) suggests that such views are united under the label 'minimal substantivalism,' the view that spacetime exists over and above any 'material' objects or events which exist within it.

[48] Interestingly enough, the particular understanding of spacetime as per moderate structural realism and metric essentialism resembles the nature of what I have been calling a grounding whole. For instance, Esfeld and Lam (2008: 38) state: "The bare manifold points (or rather the sets of manifold points) only get their–structural–physical identity and meaning through the specification of the metric tensor field (turning them into space-time points)...any attempt to identify and to individuate the space-time points

have a particular advantage over others in so far as they offer a straightforward solution to *the hole argument*–one of the most pressing objections to standard variations of substantivalism. As such, moderate structural realism and metric essentialism are well-motivated ontologies of spacetime.

The view that substantival spacetime (or space *per se* regarding the first quote below) is viewed as a single, unitary substance along similar lines as substantial priority is not uncommon in the literature. Consider the following representative samples:

> In describing space as being, on this view, 'unitary' or 'singular', I mean that it is conceived as a whole which has ontological priority over its parts–that is, as a whole which, while it undoubtedly *possesses* parts (at least, the three-dimensional parts that are its 'regions'), is not in any sense *composed* of those parts, since its parts cannot exist independently of space as a whole. Thus, for the absolutist, space is no mere aggregate or plurality of entities, in the way that a heap of sand is an aggregate or plurality of grains, something whose existence and identity depend on the existence and identity of the things which constitute its parts. This is because, according to the absolutist, the parts of space are necessarily related to one another in an unchangeable order or arrangement, unlike the grains in a heap of sand—and the very identity of each part of space depends upon its position in this order or arrangement of all the parts, rather in the way in which the very identity of a natural number depends upon its position in the entire series of natural numbers. In sum, for the absolutist, space is a substance, in one technical metaphysical sense of the term in which it denotes an entity which does not depend for its existence or identity upon the existence or identity of any other entity. Hence, the absolutist conception of space may also–and perhaps more perspicuously–be called a *substantivalist* conception of space. (Lowe 2002: 271-272)

Again, Healey (1995: 300) remarks that "the serious spacetime substantivalist believes not only that spacetime exists, but also that it is a substance," he then goes on to add the following regarding the structure of spacetime as a single substantial whole:

> The substantivalist needs to realize that even if spacetime is a substance composed of parts (spacetime points and/or regions), it does not follow that these parts are equally substantial. The parts of spacetime are not like classical atoms, which retain their individuality no matter how they are arranged to compose material substances. They are rather to be individuated by means of their properties, their relations to the rest of spacetime, and their relations to the material contents of spacetime. (Healey 1995: 300)

independently of the space-time structure provided by the metric tensor field has no physical meaning."

Nerlich (2005: 13), in addition, asks us to "[a]ssume that space itself is real, but it is not *made up* of its parts, nor yet *analysable into* parts with any kind of ontic *independence*. Perhaps, even, that spatial parts and their relations are, ontologically, *supervenient* on the structure of space. Space, not its parts, is the foundation of spatial relations."[49] And lastly, after highlighting the virtues of metric essentialism regarding its ability to sidestep the hole argument, Dainton (2010) remarks:

> The important point is that metrical essentialism, however the fine print is formulated, seems a clear and well-motivated form of substantivalism. There is a cost. Spacetime points lose the ontological autonomy they have in manifold substantivalism and, to this extent, the substantialist's position might be thought weakened: an attribute of traditional 'substances' is their ability to exist independently of all other entities. It is not clear, however, that the loss is to be regretted. *The doctrine that spacetime is a real entity does not in itself entail the view that this entity has component parts that are capable of independent existence.*[50]

The issue as to whether spacetime as a whole is a single substance is not orthogonal to the objection from ubiquitous mereological overlap against substantial priority. If the entire manifold (or manifold plus the metric field) is a substance in its own right, then it is, according to substantial priority, a grounding whole as per the nature of substances in general. As such, each of its proper sub-regions (extended or unextended) are inseparable parts of it and thereby not fundamental substances in their own right (**No Parthood**). If so, then the regions that you, I, and every other composite substance occupy will be rendered non-substantial and thus the problem of ubiquitous mereological overlap between distinct substances disappears.

The objection from ubiquitous mereological overlap ultimately equates substantivalism per se regarding spacetime with a particular *interpretation* of substantival spacetime, namely one that denies that the manifold (or manifold plus metric field) is a single substantial whole in its own right. But the defender of substantial priority who is inclined toward substantivalism is free to endorse an interpretation of substantivalism that is in accord with their wider metaphysical views concerning the nature and structure of substances in general, such as moderate structural realism or metric essentialism.

As it turns out, it is rather ironic that what appear to be the most well-motivated versions spacetime substantivalism are those that construe substantival spacetime along the very lines I have defended in this essay for substances qua grounding wholes. This point deserves underscoring. Many philosophers of physics who are inclined toward substantivialism about spacetime are *already* fond of explicating the substantiality of spacetime

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[49]Emphasis in original.
[50]Emphasis mine.

in terms of the grounding description captured by substantial priority. This, I think, shows that the core commitments of substantial priority as a fundamental mereology are not without precedent in the contemporary literature in philosophy of physics and metaphysics. It also provides motivation for those who are inclined to accept ordinary composite substances in addition to a substantival spacetime to utilize a *single* notion of substance in order to preserve ideological economy in fundamental metaphysics. If one is inclined to think that both spacetime as a whole and an elite subset of its intermediate occupants are substances, then why *not* think that the very same whole-priority grounding description applies to each?[51]

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[51]As I pointed out in the previous chapter, this does not collapse into priority monism in so far as substantial priority retains the fundamental distinction between the relations of parthood and occupation; while spacetime qua singular substance has its dependent sub-regions as proper parts, the occupants of those sub-regions are not proper parts of spacetime. The only way to move from substantivalism to priority monism is to adopt supersubstantivalism and thus *identify* the occupants of spacetime and their underlying regions. You and I, on this view, *are* identical to regions of spacetime. This is precisely the route taken by Schaffer (2009).

Conclusion

My aim in this essay has been to explore the intersection of metaphysical grounding and mereology, what has recently been dubbed *fundamental mereology* in the contemporary metaphysics literature. In doing so, I join the age-old conversation, taken up by the likes of Plato, Aristotle, Aquinas, Scotus, Spinoza, Leibniz, Husserl, and Bradley, regarding the question of whether wholes or their parts are ontologically prior. The question of fundamental mereology naturally rests on wider issues in fundamental ontology, in particular the notions of essence, grounding or dependence, fundamentality, and substance. It is vital, then, that in order to begin exploring the question as to whether wholes or their parts are ontologically prior, one must inevitably begin with fundamental ontology.

My aim in chapters 1 and 2 was precisely this, to formulate and defend a fundamental ontology with a neo-Aristotelian, non-modal conception of essence at its core. I argued in chapter 1 that the modal structure we find in reality is best accounted for by the fact that reality's joints consist of entities that are identifiable and definable; *what* a thing is fundamentally, as specified by its real definition, ground modal facts about what that thing *could* or *must* be in every world in which it exists. I argued, against the tide of recent grounding literature, that the kind of metaphysical grounding that tracks asymmetric relations of metaphysical priority and posteriority is best analyzed in terms of the aforementioned non-modal account of essence. In addition to its having able contemporary defenders in Fine (1994a, 1995) and Lowe (1998, 2005b), I attempted to show in §2.1 that the concept of essential grounding has a rich historical precedent in the medieval Aristotelian tradition, most notably in the thought of Duns Scotus.

Fundamental ontology naturally gives rise to the question of how certain items in one's ontology are generated or 'built-up' out of other more basic items. In chapter 3 I turned to such a task, arguing that the coming together of the mereological (part-whole) and the metaphysical (grounding) ordering of reality yields the question of fundamental mereology, i.e. what are the metaphysically basic items on the hierarchy of composition. Here I utilized Schaffer's (2010b) recent formulation of the constraints and options in fundamental mereology as my guide and sought to show that his particular formulation of the question of fundamental mereology threatens to exclude what I take to be a natural and philosophically respectable position: that some ordinary medium-sized composite objects are ontologically prior to their proper parts. I then offered an alternative

formulation of the question of fundamental mereology (whether wholes *per se* or their proper parts are ontologically prior?), which therein gave rise to two general views in fundamental mereology: *part-priority* and *whole-priority*.

After unpacking the particular commitments of part-priority and whole-priority, I suggested that they need not be mutually exclusive fundamental mereologies in so far as one recognizes different kinds of mereological wholes, each governed by different grounding descriptions. In good Aristotelian fashion, I indicated that the question of whether wholes or their parts are ontologically prior is best answered in light of the ontological category of the whole in question, whether a substance or a non-substance. I then outlined some of the details of substantial priority, particularly the notion of substance defined in terms of a grounding-based conception of structure and unity. At the heart of substantial priority is the claim that substantial wholes are 'grounding wholes,' wholes that are metaphysically basic and ontologically prior to their proper parts in that they serve to ground each of their proper parts. According to substantial priority, there are grounding wholes that are neither identical to the cosmos (priority monism) nor occupants of the microphysical level of reality (priority microphysicalism).

Chapters 4 and 5 considered various arguments for and against part-priority and whole-priority in general, with a particular focus on individual variants of each (priority microphysicalism and substantial priority, respectively). Arguably, the predominant fundamental mereology that informs contemporary analytic metaphysics is a species of part-priority known as 'priority microphysicalism,' the view that the microphysical (smallest) parts of composite wholes are metaphysically basic and are ontologically prior to their wholes. I argued first that part-priority in general was ill-equipped to handle possible mereological structures, e.g. atomless gunk, while preserving well-entrenched intuitions about the well-foundedness of grounding. The mere possibility of gunky worlds entails the denial of the well-foundedness of grounding on a part-priority fundamental mereology. Not only does part-priority fail to account for *possible* mereological structures, I contended that it (along with priority microphysicalism) was unfit to account for what appear to be *actual* instances of mereological structure taken from the natural sciences. The domain of quantum physics, chemistry, and systems biology provide plausible examples of mereological wholes that fail to supervene on their proper parts and their basic arrangements which, I argued, entails the failure of part-priority for such wholes. Not only do such cases indicate the failure of part-priority and priority microphysicalism, they suggest the presence of a whole-priority grounding description at work.

Chapter 5 was a direct attempt to motivate substantial priority on the grounds that it offers a unified solution to a host of puzzles in the metaphysics of material objects. I attempted to show how viewing ordinary composite substances along the lines of grounding wholes yields both an elegant and a novel solution to Tibbles the Cat, Goliath and Lumpl, The Problem of the Many, The Argument from Vagueness, and the Argument

from Causal Overdetermination. Although it has its own counterintuitive consequences as with any proposed solution to the above conundrums, I maintained that substantial priority was, at the very least, a plausible contender to such alternatives as mereological essentialism, eliminitivism, constitutionalism, stage theory, and perdurantism (to name a few).

I concluded the essay in chapter 6 by responding to several pressing objections to substantial priority which trade on its alleged empirical inadequacy, its inability to account for the possibility of junk (worlds with no 'top-level'), its being contrary to Moorean facts about mereological wholes, and its being incompatible with spacetime substantivalism. Perhaps the most notable of the above objections was the worry that the view is empirically inadequate due to its being inconsistent with a 'bottom-up' scientific metaphysic. I contended that substantial priority can save the ordinary and scientific appearances and offered five different ways the proponent of such a view might account for how it's *as-if* the properties and powers of the whole obtain in virtue of the properties and powers of each of the parts. All in all, I contend that substantial priority is defensible and is, by any standard, worth taking seriously. It deserves a place at the table as a viable yet under appreciated metaphysic of material objects.

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