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COMPOSITION AS IDENTITY:
A STUDY IN ONTOLOGY AND PHILOSOPHICAL LOGIC

A Dissertation Presented

by

EINAR DUENGER BOHN

Submitted to the Graduate School of the
University of Massachusetts Amherst in partial fulfilment
of the requirements for the degree of

DOCTOR OF PHILOSOPHY

September 2009

Department of Philosophy

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A STUDY IN ONTOLOGY AND PHILOSOPHICAL LOGIC

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EINAR DUENGER BOHN

Approved as to style and content by:

_____
Jonathan Schaffer, Chair

_____
Phillip Bricker, Member

_____
Lynne Rudder Baker, Member

_____
Angelika Kratzer, Member

_____
Phillip Bricker, Department Head
Department of Philosophy

To Karen, Bork, Ask, and Yme.

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ABSTRACT

COMPOSITION AS IDENTITY:
A STUDY IN ONTOLOGY AND PHILOSOPHICAL LOGIC

EINAR DUENGER BOHN, Ph.D., UNIVERSITY OF MASSACHUSETTS AMHERST

Directed by: Professor Jonathan Schaffer

In this work I first develop, motivate, and defend the view that mereological composition, the relation between an object and all its parts collectively, is a relation of identity. I argue that this view implies and hence can explain the logical necessity of classical mereology, the formal study of the part-whole relation. I then critically discuss four contemporary views of the same kind. Finally, I employ my thesis in a recent discussion of whether the world is fundamentally one in number.

PREFACE

Mereological composition and its converse *being a fusion of* are relations between an object and all its parts taken together (collectively). In the chapters that follow, I develop, motivate, and defend the view that these relations relate one and the same portion of reality, albeit conceptualized in different ways, and as such are relations of identity. But before we get to that I will make some of my working assumptions explicit.

First, I shamelessly employ plural logic without much defence. I treat our ordinary quantifiers '∃' and '∀' as unrestricted and capable of binding both singular variables x, y, z, … and plural variables xx, yy, zz, … I treat both kinds of variables as ranging over one and the same unrestricted domain consisting of all objects, albeit in two different ways. A singular variable takes one object as its value, while a plural variable takes a plurality of one or more objects as values. I also treat plural predication – collective as well as distributive – just as semantically and metaphysically serious as I do singular predication. A plural n-place predicate F is *distributive* in its ith place ($1 \leq i \leq n$) iff each one of xx_i is F (where xx_i is its ith value); and it is *collective* in its ith place iff it is not distributive in its ith place. I see no good reason to reduce plural predication to singular predication, nor do I see any good reason to accept singular properties and relations, while rejecting plural properties and relations. I thus accept collective and distributive plural properties and relations on a par with singular properties and relations. An n-place plural predicate thus takes an n-place plural property as its semantic value. Personally, I take plural logic to be part of logic proper, and as such have no calms with freely employing it in this way throughout my studies. Others might reject this general practice, perhaps on semantic grounds, or perhaps on metaphysical grounds. In either

case, I find such a position mostly unmotivated or too *ad hoc*. I will not defend this part of my overall philosophical position here, but merely be fair enough to make it explicit.[1]

Second, I will mostly not discuss issues in the intersection of Leibniz's Law, modality, and time. My thesis is committed to no particular views on these issues, but admittedly it looks the best in conjunction with *counterpart theory*, the view according to which no object exists in two distinct possible worlds, and *four-dimensionalism*, the view according to which an object is identical with the fusion of its numerically distinct temporal parts.[2] Given the bare bones of counterpart theory, we can for example accept that a composite fusion y could have lost some of its parts without ceasing to exist because there are other things in other possible worlds lacking the relevant parts, but nonetheless sufficiently resembling y such that they still represent the possibilities of y. This might be so even though it is not true of the plurality of y's parts. Given the bare bones of four-dimensionalism, we can accept that a change in parts consists simply in having different temporal parts at different times. As such there is no conflict between the whole and all its parts on the issue of losing and gaining parts/"members".[3] As a full replacement of counterpart theory and four-dimensionalism, we can instead accept, for example, the position found in Gallois (1998), according to which there are contingent identities within a framework of transworld identities and three-dimensionalism. My thesis that composition is identity would remain intact.

Third, in explicating the view that the one fusion is identical with its many parts I employ a notion of *a portion of reality*. I say the one fusion is the same portion of reality as its many parts. Though I have no non-circular definition of a portion of reality, I have

[1] For a defense of plural logic, see e.g. Boolos (1984), (1985); Oliver & Smiley (2001), (2006); Yi (2005), (2006); and McKay (2006). See also Burgess & Rosen (1997); Burgess (2004); and Linnebo (2008) from which I steal most of my terminology.

[2] For a discussion of counterpart theory, see Lewis (1986). For a discussion of four-dimensionalism, see Sider (2001). Neither is my account committed to any of the more particular features of Lewis's and Sider's own views on the matter. For example, my account is neither committed to possible worlds being concrete nor to temporal parts being instantaneous.

[3] For a criticism of composition as identity on these points, see Merricks (2003:20-28).

plenty of examples. My body is the same portion of reality as my arms, legs, head, and torso taken together (collectively). The table is the same portion of reality as the four legs and tabletop taken together (collectively). The world is the same portion of reality as all its parts taken together (collectively). Also, the world and the number 3 is a portion of reality, if the number 3 exists. The world and its singleton set is a portion of reality, if its singleton set exists. And so on. One might also say that a portion of reality is whatever exists *pre-set-like-conceptualized*, i.e. independently of certain ways of conceptualizing it (to be explicated); but what this really means can only become clear later on. In any case, the predicate 'is a portion of reality' is what we might call *strongly cumulative*: if each one of x, y, z, … is a portion of reality, then x, y, z, … taken together (collectively) is also a portion of reality. The predicate is also what we might call *strongly distributive*: if x, y, z, … taken together (collectively) is a portion of reality, then each one of x, y, z, … is also a portion of reality. The predicate is thus not dependent on a unique conceptualization of its subject, i.e. it is not what I later call a *set-like* predicate: if xx is a portion of reality, then however xx is divided, or conceptualized into parts, or whatever is added or subtracted from xx, they are also together (collectively) as well as individually a portion of reality. There is a *circular* criterion of identity for portions of reality at hand: something y is the same portion of reality as some things xx iff y is the fusion of xx. The reason this criterion is ultimately circular is that in chapter II below, I define composition and the fusion relation in terms of identity between one thing and many things, and I explicate such identity in terms of being the same portion of reality. I cannot thus also give a criterion of identity for a portion of reality in terms of the fusion relation without circularity. Nonetheless, a circular such criterion might still be somewhat informative One might also define a portion of reality in terms of space-time regions: xx is the same portion of reality as y $=_{df}$ xx and y occupy the same space-time region. But this prejudges

too many interesting metaphysical issues, e.g. the issue of spatiotemporal coincidence, as well as whether all things (portions of reality) are located in space-time. I don't say that there is no way out of this "problem", but just that *I* haven't tried to avoid it. I believe the underlying picture is clear enough, and that there is no real problem here.

Finally, in explicating my thesis that composition is identity, I employ a notion of different ways of *conceptualizing* one and the same portion of reality. The idea of being able to conceptualize something in different ways is implicitly accepted throughout the entire philosophical literature, and as such should be uncontroversial. But to partly explicate what it means I provide some canonical examples, in particular a famous example from Frege (1884). In the end we *all* need such a notion of conceptualization *somehow* since any informative identity statement of the form a=b somehow involves two different ways of conceptualizing one and the same portion of reality (cf. Frege 1892). That is why they are *informative* identity statements. I only extend this to cases of one thing being many things. Since I also explain what kind of conceptualization is involved in such hybrid cases as opposed to more traditional singular cases I see no good objection to this part of my thesis that doesn't come back to the objector with equal force. So, if there is a problem here, we are all companions in guilt. As should become clear, the conceptualizations are not assumed to be dependent on human psychology. Arguably, they somehow enter the semantics through context, though I intend to stay as neutral as possible as to exactly *how* they do so.

I end this preface by a brief overview of what follows: in chapter I, I develop, defend, and motivate the thesis that composition relates one and the same portion of reality, and as such is a relation of identity. In chapter II, I develop the underlying generalized plural logic of identity, and prove classical mereology as a mere definitional extension of such

identity. In chapter III, I discuss some other contemporary versions of composition as identity and briefly compare them to my account as developed in chapters I and II. In chapter IV, I assess a recently revived debate over Monism, the view according to which the world is really, most fundamentally one, versus Pluralism, the view according to which the world is really, most fundamentally many. Employing plural logic and my thesis of composition as identity, the debate seems to fall down on the side of pluralism, or at best/worst on the side of the contingency of monism.

TABLE OF CONTENTS

Page

ACKNOWLEDGEMENTS …….. v

ABSTRACT ……... vi

PREFACE …….. vii

CHAPTER

I. COMPOSITION AS IDENTITY ……1

1. Composition as Identity versus Composition as Non-Identity ……... 2
1.1. CI versus ~CI ……... 2
1.2. Some Objections to CI …….9

2. Mereological Necessity …….. 20

3. Three Arguments in Favor of CI …….22

3.1. The Argument from Necessity …… 22
3.2. The Argument from Abduction ……... 26
3.3. The Argument from Meta-Ontology ……33

4. Some Further Motivations ……. 41

4.1. Semantics ……41
4.2. Ontology …….. 44

4.2.1. Mereologically Coincident Objects …….. 45

II. MEREOLOGY AS A CALCULUS OF IDENTITY …… 46

1. The Logic ……46

1.1. The Language …….. 46
1.2. The Interpretation …… 48
1.3. The Axioms ……. 50
1.4. Some Theorems of Identity ……. 56

2. Classical Mereology as a Calculus of Identity ……... 57

2.1. Mereological Definitions ……. 58
2.2. Classical Mereology Derived ……...58

2.2.1. What exactly is Classical Mereology? ……. 61

III. A CONTEMPORARY INTERLUDE ……. 63

1. David Armstrong …… 63

2. Donald Baxter …….67

3. David Lewis ……75

4. Ted Sider …….88

IV: BUT *REALLY*, IS IT ONE OR MANY? ……. 95

1. The Debate ……. 96

1.1. Waiving an Assumption ……. 98
1.2. Grounding …… 100

2. Three Arguments in favour of Monism ……. 102

2.1. The Argument from Common Sense …….. 102
2.2. The Argument from the Possibility of Gunk …….. 104

2.2.1. A Dialectically Unfortunate Set-Up …… 110

2.3. The Arguments from Emergence …… 111

2.3.1. The Argument from Quantum Mechanics …… 111
2.3.2. The Argument from the Mere Possibility of Emergence …….. 114

2.3.2.1. The Possibility of Submergence …….116

3. Fundamental Cardinality is Contingent …….. 120

BIBLIOGRAPHY …….. 124

CHAPTER I

COMPOSITION AS IDENTITY

Any object y is said to be *the fusion of* all its parts xx collectively. Mereological composition is the converse: xx collectively *compose* y. For example, my body is the fusion of my arms, legs, head, and torso, and my arms, legs, head, and torso compose my body. Mereology is the formal theory of this part-whole relationship.

In this first chapter I will be interested in the following question: *are the relata of mereological composition sometimes numerically distinct or are they always numerically identical?* Call this the Mereological Question (MQ).

I will defend the answer that they are always numerically identical. We call this view *Composition as Identity* (CI).[4] We call the negation of this view *Composition as Non-Identity* (~CI).[5] I assume the principle of excluded middle: for each case of composition, either the relata are identical or they are not identical; it is not the case that they are neither identical nor not identical.[6] So, apart from rejecting the question as meaningless, MQ allows of two and only two answers. I will also assume that the question is a question of whether an object y is identical with all its parts xx *collectively*, not distributively. That is, assuming my arms, legs, head, and torso compose my body, either my body is identical with them *taken all together* or it is not so identical; it is never identical with each one of its proper parts individually.[7]

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[4] A similar position under the same name is suggested by Armstrong (1978), (1997), and Lewis (1991). A somewhat different view, but nonetheless under the same name, is defended by Baxter (1988a), (1988b). A different and much weaker view, but nonetheless in the same spirit is defended by Sider (2007).

[5] Proponents of this view are numerous. It is without doubt the default position. Some explicit proponents are van Inwagen (1990), (1994), Yi (1999), Merricks (2003), Hudson (2005), and McDaniel (2008).

[6] Needless to say, neither is it the case that they are both identical and not identical.

[7] Pace Baxter (1988a/b), neither is it ever identical with any one of those proper parts taken individually.

I will proceed as follows. In section 1, I explain the two positions to be discussed, namely CI versus ~CI. Since ~CI is the default position in the literature due to an almost universal rejection of CI as being either trivially false or simply incoherent, most work will naturally be spent on clarifying the content of CI and thus making it a coherent position, as well as defending it against some obvious objections. It will emerge that CI is and has been greatly underestimated as a viable position. In section 2, I explain and briefly defend the principle that whatever the truth about the nature and extent of mereological composition is, it is a matter of metaphysical necessity. This principle will be a premise in my later arguments. In section 3, I provide and defend three arguments in favor of CI to the exclusion of ~CI. These arguments rely on the premise defended in section 2. In section 4, I conclude by showing some further nice implications of CI, which I take to provide some further motivations for the overall position.

1. Composition as Identity versus Composition as Non-Identity

In sub-section 1.1, I explicate and explain the two (and only two) positions that emerge from answering MQ, namely CI versus ~CI. In sub-section 1.2, I reply to some objections to CI in particular.

1.1. ~CI versus CI

Relying on the legitimacy of plural logic, mereological composition is treated as a relation between an object and a plurality of one or more objects. Based on all our assumptions so far, MQ thus allows of two and only two answers, from which two mutually exclusive and jointly exhaustive positions emerge:

(~CI): the relata of some cases of mereological composition are numerically distinct

(CI): the relata of all cases of mereological composition are numerically identical

Letting 'f(xx)' represent the fusion of xx, we formalize the two positions as follows:[8]

(~CI): $\sim\forall$xx (xx=f(xx))

(CI): $\forall$xx (xx=f(xx))

Since mereological composition (henceforth: composition) is a two-place relation between an object and a plurality of one or more objects, the identity or distinctness between the relata must be an identity or distinctness between a plurality of one or more objects and an object. But since the classical logic of identity only admits identities and distinctness between singular objects, this implies a minor revisionary logic of identity. Given that MQ admits of an answer in accordance with our assumptions so far, this is required anyway. This is best seen by the fact that in order to accept one of ~CI and CI as an answer to MQ, the answer not accepted cannot be meaningless because if one of them is meaningless so is the other. That is, the meaningfulness of a well-formed formula Φ stand and fall together with the meaningfulness of its negation ~Φ. It thus follows that if one accept ~CI, which in fact seems to be the default position in the literature, one is forced to also accept that CI is meaningful. But then there must be some notion of identity and distinctness that concerns the identity and distinctness between a plurality and an object, and hence a minor revisionary logic of identity is already in play.

[8] Note that for all that has been said so far, both positions are neutral on the extent of composition. That is, the mere statements of the positions are so far logically compatible with some or all pluralities having no fusion. I will later argue, especially in section 3.2 and in chapter II, that CI is in fact not neutral on this issue after all.

Van Inwagen (1994) complains that CI is meaningless, or at least that he himself doesn't understand what it means. He goes on to argue that something like ~CI is in fact true. But it should now be clear that such a view is incoherent. Van Inwagen's complaint is thus neither a criticism of CI nor a defense of ~CI, and we can thus ignore it altogether, given that we take MQ to be a substantial question that admits of a unique answer.

I will now argue that the supposedly revisionary notion of identity and distinctness need not be so much a revisionary notion of identity as it can be a *broadened* or *generalized* notion of identity. It will not violate any classical laws of identity, but rather employ those very same principles more broadly to also account for the identity or distinctness between any two pluralities, each consisting of one or more objects. Though just like removing a bump in the carpet by stepping on it sometimes creates a bump elsewhere in the carpet, removing a bump in the metaphysical carpet by merely broadening our notion of identity without any other revisions in our logic of identity will create a bump elsewhere in the metaphysical carpet that implies some minor revisions concerning how we think of certain properties and relations in particular. Or at least this will be the case if CI is not trivially false. I will argue that CI is not trivially false, and that this exchange of bumps in the metaphysical carpet is worth the trouble.

In order to make the two positions coherent, we need a fully generalized predicate of identity capable of expressing the identity and distinctness between any pluralities, each consisting of one or more things. That is, we need for example all of the following formulas to be well formed: x=y, xx=y, y=xx, and xx=yy. In compliance with one of our earlier assumptions, we also want this predicate to be collective in both its places. In this regard I suggest we officially adopt a primitive two-place predicate '=' that is plural and collective in each of its two places. It allows any plurality of one or more things as its value in each of its two places, and is thus capable of expressing a relation of identity or

distinctness between any two pluralities, each of which consists of one or more things. We can thus let the following be the form of the official wff in our logic of identity: xx=yy. But occasionally, for ease of exposition, when both its values are singular objects, we call it an instance of one-one identity and formalize it as ‘x=y’; when both its values are pluralities of equal cardinality, we call it an instance of n-n identity and formalize it as ‘xx=yy’; and when one of its values is a singular object and the other is a plurality of two or more objects, we call it an instance of one-many identity and formalize it as either ‘x=yy’ or ‘yy=x’.[9]

Our official principles of identity are the standard ones, but appropriately generalized:

(R): $\forall xx(xx=xx)$

(GLL): $\forall xx\forall yy(xx=yy\rightarrow(\Phi xx\leftrightarrow\Phi yy))$

(GLL_{2nd}): $\forall xx\forall yy(xx=yy\rightarrow\forall X(Xxx\leftrightarrow Xyy))$[10]

But now, unless CI is trivially false, the bump appears elsewhere in our metaphysical carpet. This is best seen by the following example. Assume xx=y, where xx are two or more objects. Now, y has the property of being one in number while xx does not have this property, so, by LL, it follows that $xx\neq y$. The problem obviously generalizes such that it can never be the case that there are many-one identities. It follows that ~CI is trivially true to the exclusion of CI. Apart from the above-mentioned confusion of

[9] Though, strictly speaking, we only need ‘xx=yy’, the logic I develop in chapter II will make, for the sake of intuitive simplicity, all these cases official wffs.

[10] Again, we will often consider hybrid singular/plural cases of GLL, as well as singular cases of R. Such cases can simply be thought of as a restriction on the plural principles to the cases where the values are singular. Note also that from these principles we can easily deduce the symmetry and transitivity of identity, and thus prove our broadened notion of identity to be an equivalence relation governed by GLL, as any notion of identity must be. See chapter II for the full logic with relevant proofs.

accepting ~CI on the basis of believing CI to be incoherent, this kind of argument seems to be the second main reason that ~CI is the default position in the philosophical community. Proponents of CI might reply by tweaking with the logical structure of numerical properties; for example by roughly arguing with Frege (1884) that numerical properties are second-level properties of concepts, not first-level properties of objects. As Frege argued, if numbers are properties of objects, then, since zero is a number, zero is a property of objects; but zero cannot be a property of objects because no object is zero in number; so numbers cannot be properties of objects after all. Furthermore, as Frege (1884:59) pointed out:

> While looking at one and the same external phenomenon, I can say with equal truth both "It is a copse" and "It is five trees", or both "Here are four companies" and "Here are 500 men". Now what changes here from one judgment to the other is neither any individual object, nor the whole, the agglomeration of them, but rather my terminology. But that is itself only a sign that one concept has been substituted for another.

Frege concluded from such arguments that numbers attach to concepts, not objects. But such a reply from the proponents of CI is insufficient because the problem generalizes beyond mere numerical properties. Here are two further examples. Assume xx=y, where xx are two or more objects. Now, y is one of y, while y is not one of xx. It follows by GLL that xx≠y. Assume xx=y, where xx are two or more objects. Given standard set-theory, the set of xx is not the same set as the set of y because the one set has y as a member while the other doesn't. But then xx and y differ in properties, namely as to which sets they are members of. It follows by GLL that xx≠y. Hence, merely tweaking with the logical structure of numerical properties is not a sufficiently general solution to the seemingly trivial falsity of CI.

So let's see whether we can tweak with the logical structure of properties more generally, and it still being worth the trouble. I believe all the insight we need is in the above passage from Frege, but let's nonetheless consider a minor twist on it:

> While looking at one and the same portion of reality, I can say with equal truth both "It is a table" and "It is four legs and a tabletop", or "It is my body" and "It is my arms, legs, head, and torso". Now what changes here from one judgment to the other is neither any individual object, nor the whole, but rather my terminology. But that is itself only a sign that one concept has been substituted for another.

The insight is simply this: one and the same portion of reality can be conceptualized in different ways, and depending on how we conceptualize it, different predications come out as true or false of it. That is, much true predication of a portion of reality is *relative to how it has been conceptualized*. Call such predication *set-like*. Derivatively we say that a *predication* is set-like iff the predicate it employs is set-like in at least one of its argument-places. So, for example, consider the portion of reality that is my body/body-parts. Conceptualizing it as my arms, legs, head, and torso, it is true of it that it is six in numbers and false of it that it is one in number, but conceptualize it as my body and it is false of it that it is six in number and true of it that it is one in number. The truth-value of numerical predication is thus to be thought of as essentially dependent on a unique kind of conceptualization of the portion of reality that function as the subject of the predication. That is, if some things xx are n in number, the truth of this predication essentially depends on a unique decomposition of the portion of reality that is xx into n things.

Any proponent of CI should thus hold that the above Fregean arguments against numerical properties being intrinsic properties of objects *simpliciter* are sound, but *contra* Frege, they need not, and I believe should not, hold that such numerical properties

are properties of a concept, but rather hold that they are *relational* properties of the portion of reality functioning as the subject, with a conceptualization as the extra relational unit. Numerical predication would thus indeed be predication of the portion of reality itself, not of a concept, but it would be so relative to a conceptualization of it. In this way we preserve the, at least to many of us, strong intuition that my arms, legs, head, and torso, *those very things*, are six in number.

This Fregean insight now properly generalizes beyond numerical properties. Consider the property of being one of my body. The portion of reality that is my body/my body-parts has the property of having my body as one of it relative to being conceptualized as my body, and it has the property of not having my body as one of it relative to being conceptualized as my arms, legs, head, and torso. Finally, consider the property of forming the singleton set of my body. The portion of reality that is my body/body-parts has the property of forming the singleton set of my body relative to being conceptualized as my body, and it has the property of not forming this set relative to being conceptualized as my arms, legs, head, and torso.

The above strategy obviously generalizes to *any* set-like properties. All the cases we came up with above to the effect that a fusion differs in properties from its many parts collectively were set-like. Our strategy thus blocks the road to the trivial falsity of CI with sufficient generality. Neither do set-like properties differ between a fusion and its many parts collectively nor do set-like properties and their negations both apply to a fusion and all its parts collectively. In section 1.2 below, I will consider a recent attempt at finding a perhaps *non*-set-like property that differs between a fusion and its many parts collectively. I will show that this attempt fails, and it will be shown that this strategy too sufficiently generalizes such that it seems safe to claim that there simply are no properties that differ between the fusion and its many parts. If I am right, we thus have no

obvious reason to think that ~CI should be the default position. CI and ~CI are equally open possible answers to MQ.

1.2. Some Objections to CI

Let an *emergent* property F be an intrinsic property of a composite object f(xx) that is not in any way a logical product of the intrinsic properties of the perfectly natural intrinsic properties of each one of xx together with their spatiotemporal interrelations. That is, an emergent property F of f(xx) does not (logically) supervene upon the intrinsic natures of each one of xx together with their spatiotemporal interrelations. Fix the intrinsic natures of each one of xx together with their spatiotemporal interrelations and you haven't yet fixed the intrinsic nature of f(xx). Letting S be the set of intrinsic properties of each one of xx together with their interrelations, then the claim is that F is "something over and above" what you can get from S alone.

With something like this understanding of emergent properties in mind, McDaniel (2008) presents the following argument against CI:

1. Emergent properties are possible
2. If CI is true, emergent properties are impossible
3. Hence, CI is false.

McDaniel mostly assumes premise 1, but, as he briefly mentions, it might in fact hold in virtue of actual examples from Quantum Mechanics (QM). Roughly, according to QM, two (or more) particles xx are in a state of entanglement when they are perfectly anti-correlated in their properties of spin (along some dimension) independently of the

spatiotemporal distance between them.[11] For example, if one of xx has spin up, then the other is guaranteed to simultaneously have spin down, and vice versa. This state of entanglement is thus not in any way a product of the intrinsic properties of *each* one of xx together with their spatiotemporal interrelations. It should thus be thought of as an emergent property of f(xx).[12]

McDaniel justifies premise 2, roughly, by the following line of reasoning. Assume for *reductio* that CI is true and that emergent properties are possible. Consider some emergent property F of f(xx). Then F is not a property of xx since it is not in any way a logical product of their intrinsic natures and spatiotemporal interrelations. F is something novel compared to the intrinsic properties and spatiotemporal interrelations of xx. That is, the emergent property F is exclusively a property of f(xx), not a property of xx. But then xx and f(xx) differs in properties, and thus, by GLL, xx$\neq f$(xx).

Apart from the empirically risky and independently implausible solution of rejecting premise 1, the objection has two fairly obvious solutions. Each of the two solutions rejects premise 2. First, for any emergent property F of f(xx), one might postulate a perfectly natural singular relation R among xx such that R=F.[13] On this solution, one needs to further argue that R, just like F, is not in any way a product of the intrinsic natures of each one of xx together with their spatiotemporal interrelations. That is, R cannot for example be an *internal* relation like, say, the relation of *having the same color as*. In that case there would be no failure of supervenience. R must be a fundamental, non-supervening relation.

The second, and in my mind much simpler and more plausible solution is to take plural logic with its plural quantification and predication ontologically seriously. For any

[11] See Maudlin (1998) and (2002:266-267).

[12] For another interesting, but less scientific example of the possibility of emergent properties, see Prosser (2009). What I here call emergent properties is sometimes also called *strongly emergent properties*. Cf. McLaughlin (1997/2008) and McDaniel (2008).

[13] Or alternatively, such that $Ff(y_1,\ldots,y_n)\leftrightarrow Ry_1,\ldots,y_n$, where R is a singular n-place predicate.

emergent property F of f(xx), there is a fundamental plural, *collective* property F* of xx such that F=F*.[14] A virtue of this second solution over the first solution is that we better preserve the logical structure of F; i.e. both F and F* are one-place properties. It is also much easier and intuitively satisfying to switch between talk of a singular emergent property F of the whole and a plural emergent property F* of all the parts collectively. Speaking of some entangled particles, it sounds very natural indeed to say that *they* are in a state of entanglement. With R we have to switch between talk of an emergent property F of the whole and a relation R among all its parts. Does it sound equally natural to our *terminological* ears to say of some entangled particles that they stand in a *relation* of entanglement? If xx=f(xx), any *one-place property* of xx should be a *one-place property* of f(xx), and vice versa. At least, this seems somewhat closer to what GLL (and corresponding intuitions) dictates.[15] But in the end, I believe this becomes a matter of terminology, not a matter of metaphysics. In any case, McDaniel's argument from the possibility of emergent properties fails due to premise 2 being false. Emergent properties are possible even if CI is true. Any emergent property of the fusion is a fundamental plural, collective property of all the parts, and vice versa.

Yi (1999) provides the following argument against CI. Let Tom be a cat, Jerry be a mouse, and Genie be the fusion of Tom and Jerry. Then Genie is one of Genie, but Genie is not one of Tom and Jerry; so Genie is not identical with Tom and Jerry. This is the same problem that we discussed above, and as such has the same solution as above. The predicate 'is one of' is set-like, and as such its true applications depend on a unique kind of conceptualization of the relevant portions of reality. Tom and Jerry, that very portion

[14] Or alternatively, such that $Ff(y_1,\ldots,y_n)\leftrightarrow F^*y_1,\ldots,y_n$, where F* is a fundamental plural, collective one-place predicate. The plural properties must be *fundamental* to separate the emergent, or non-supervening ones from other more ordinary supervening plural, collective properties like 'surround'.
[15] Cf. section 2.3.1, chapter IV.

of reality, has the property of having Genie as one of them/it if they/it are conceptualized as Genie, and not otherwise; and likewise with Genie. Thus, Genie and Tom and Jerry do not differ as to true applications of ‘is one of’.

Sider (2007) greatly elaborates on this problem, and considering his elaborations one might believe the problem to be much more subtle and serious than what I have so far presented it as being. Sider provides what I take to be the following argument:

1. If CI is true, then standard applications of plural logic fails
2. Standard applications of plural logic do not fail
3. Hence, CI is false.

As should be obvious from the present paper, I accept premise 2, but deny premise 1. Sider’s defense of premise 1 relies on treating set-like predications as *not* being relational predication with a conceptualization of the relevant portion of reality as the relational unit. By thus ignoring the relational aspect to all set-like predications, one is able to derive a contradiction between CI and the standard semantics of ‘is one of’, and hence between CI and the standard semantics of plural logic more generally, where ‘is one of’ is the logical primitive. To this effect, Sider gives what I take to be the following argument. We let as before ‘f(xx)’ name the fusion of xx.

CI and LL imply the following principle:

(Parts↔One-of): y is part of f(xx) iff y is one of xx.

Proof: Left-to-Right: assume y is part of f(xx). The fusion f(xx) is composed of xx as well as y,f(xx); so given CI, f(xx)=xx and f(xx)=y,f(xx); and hence, by GLL,

xx=y,f(xx). y is one of y,f(xx); hence, by GLL, y is one of xx. Right-to-Left: assume y is one of xx. It is obvious that z=f(xx) iff each one of xx is a part of z and each part of z overlaps at least one of xx. But if each one of xx is a part of z, then since y is one of xx, y is a part of z; hence, y is a part of f(xx). Q.E.D.

But Parts↔One-of contradicts the following, arguably analytic truth about the behavior of the predicate 'is one of':

(Lists): x is one of $y_1,y_2,\ldots,y_n$ iff ($x=y_1$ or $x=y_2$ or … or $x=y_n$).

Proof: Assume Parts↔One-of. Then any part of the fusion $f(y_1,y_2,\ldots,y_n)$ will count as one of $y_1,y_2,\ldots,y_n$, but according to Lists, if x is one of $y_1,y_2,\ldots,y_n$, then x is one of the individual y_i's, not just any part of $f(y_1,y_2,\ldots,y_n)$. Q.E.D.

Thus, for example, it immediately follows from Parts↔One-of that if I am one of the faculty members, then my left arm is one of the faculty members. The problem spreads into all parts of plural logic such that its standard applications fail, or at least need highly non-standard revisions. Sider concludes that since CI implies that there can be no predicate that behaves the way 'is one of' is commonly assumed to behave (namely in the set-like way *a la* Lists), CI must be false.

But by taking the relational aspect to set-like predication more seriously we block this argument for premise 1 by the fact that CI does not imply Parts↔One-of. Consider the following steps in the first half of above proof of Parts↔One-of: *Assume y is part of f(xx). The fusion f(xx) is composed of xx as well as y,f(xx); so given CI, f(xx)=xx and f(xx)=y,f(xx); and hence, by GLL, xx=y,f(xx). y is one of y,f(xx); hence, by GLL, y is one of xx.* This part of the proof fails because consider the following instance of it:

assume my left arm is part of the fusion of the faculty members. The fusion of the faculty members is composed of the faculty members as well as of the faulty members and my left arm; so given CI, the fusion of the faculty members is identical with the faulty members and it is identical with my left arm and the faculty members; and hence, by GLL, the faculty members are identical with my left arm and the fusion of the faculty members. My left arm is one of my left arm and the faculty members; hence, by GLL, my left arm is one of the faculty members. The last application of GLL doesn't imply what the proof claims it implies. From the fact that the faculty members are identical with my left arm and the fusion of the faculty members together with the fact that my left arm is one of my left arm and the fusion of the faculty members, it doesn't follow by GLL that my left arm is one of the faculty members. The predicate 'is one of' is set-like, and as such its true applications depend on a unique decomposition of the portion of reality it is applied to. Though it is true that my left arm is one of my left arm and the faculty members, it is simply not true that my left arm is one of the faculty members. All that is true is that my left arm is one of the faculty members when that portion of reality is conceptualized as having a unique decomposition into things such that my left arm is one of them. When it is conceptualized as simply the faculty members, this is not so, and hence simply not true. The argument is thus unsound because the last step in the first half of the proof is false.

Sider (2007) has another objection to CI it is well worth considering. I take it to be something like this. Consider certain purely logical sentences of plural quantification. For example, consider this sentence: $\forall xx \exists y$(y is one of xx). This sentence says that any plurality has at least one "member" (there are no empty pluralities). The predicate 'is one of' is set-like. According to my version of CI, set-like predication is relational

predication with a conceptualization of the portion of reality that functions as the subject of the sentence as the relational unit. But in the above case, where, and of what is the conceptualization? And what mechanisms select the conceptualization involved in the statement? Where does the conceptualization come from? How plausible is it that there are relational units hidden in the logical structure of purely logical sentences of quantification?

There is of course no question of there being relational units explicitly present in the wffs, but rather implicitly so present. And as such, I believe their presence is plausible indeed, *especially* in purely logical wffs. The conceptualization functioning as the implicit relational unit in any wff in a formal language is of the portion of reality functioning as the value of the terms.[16] The relational unit is thus not hidden in the syntax of the wff itself, but rather in the *interpretation* of it over a given domain. When we assign values to a set of wffs of a formal language, the values (i.e. portions of reality, actual or possible) are *thereby* conceptualized. *That* is how we understand the meaning of the elements of the purely logical wffs, and hence the wffs themselves, what they are about, etc. Often the way a value or a portion of reality has been conceptualized is well reflected in the logical syntax. For example, a singular one-place predicate applies to a singular object, a portion of reality conceptualized as one object; it does not apply to a plurality of two or more things. But that should be thought of as mostly a conventional reflection of how the values are conceptualized. Arguably, there is no way of giving an interpretation of a formal language independently of thereby conceptualizing the portions of reality serving as its values. The conceptualizations of the values of the terms are presumably given in the interpretation by quantifying over contexts.[17] The

[16] In the case of wffs that are assigned values that don't exist, as often is the case in pure logic, it should be argued that the conceptualizations are still present; it's just that they don't have any actual instances.
[17] The logic developed in chapter II below is interpreted and understood in compliance with this response to Sider. For more details, see chapter II, section 1.2.

conceptualizations of the portions of reality we refer to in natural language (as opposed to a purely formal language) are presumably given by context itself (as opposed to the quantification over context). Arguably, context ultimately provides the implicit or hidden unit.

I anticipate another objection to CI. Consider a mereologically simple object. It is one in number. But if my version of CI is true, it is only one in number relative to being conceptualized such that it has a unique decomposition into one thing; it is not one in number *simpliciter* in the sense of having an intrinsic property of being one. But then it seems we should be able to conceptualize it such that it is n in number, where n>1. That is, why can it not be more than one in number if its cardinality is merely a matter of how we conceptualize it? What makes it impossible to conceptualize a simple as many?

Either a mereological simple is extended (one-or-more-dimensional) or it is non-extended (zero-dimensional). Assume the simple is extended. Then it *is* possible to conceptualize it as being more than one in number, e.g. by conceptualizing it as two halves. But then, according to CI, it has two proper parts, and hence is not a simple after all. So if CI is true, then extended simples are impossible. As far as I can see, this is not a vice, but rather a virtue of the theory.

Assume the simple is non-extended. Then it is pointy. In order to correctly conceptualize it as being composed of and hence identical with more than one thing, there would thus have to be spatiotemporal coincidence between two (or more) things in the sense of those two (or more) things occupying the same pointy region, i.e. since a pointy region has no extension, and hence no proper sub-region. One might simply deny the possibility of such spatiotemporal coincidence, for example by adopting supersubstantivalism, the view according to which objects are identical with their

spacetime regions.[18] This way there is an *explanation* for why a non-extended simple cannot be conceptualized as being composed of and hence identical with more than one thing. But this solution is inadequate because the same problem arises in connection with a pointy spacetime region: why can we not conceptualize *it* as being composed of and hence identical with more than one thing?

Denying that there could be any such simple, non-extended portions of reality would at this point commit one to the necessity of gunk, the view according to which it must be the case that everything has a proper part. It seems on its face as preferable to avoid such a commitment. One way out is of course to simply accept that non-extended simples, as opposed to extended and other composite objects, have their cardinal properties intrinsically. There are thus certain portions of reality, as opposed to others, that cannot be correctly or naturally conceptualized as being more than one in number simply because some instances of the cardinal property of being one in number are had intrinsically by certain portions of reality. But this seems *ad hoc*. If non-extended simples have their cardinal property of being one in number intrinsically, why can the entire world not have its cardinal property of being one in number intrinsically too? What makes non-extended simples thus privileged? I thus prefer to keep *all* numerical properties relational, including the property of being one in number.

Now, one might think there is something special about *non*-extended portions of reality. For example, being non-extended an object doesn't have two halves in the way it does if it is extended, and as such it blocks certain ways of correctly or naturally conceiving of it. There simply is no portion of reality there to be further conceptually carved up in any natural way. It is of course no implication of CI that any portion of reality can be truly or naturally conceptualized as anything, so in particular, some *set-like*

[18] See Schaffer (forthcoming).

conceptualizations of a portion of reality should be held to be objectively more natural set-like conceptualizations of it than others. Points might thus in virtue of their objective nature (structure) function as the objectively *natural limit* of set-like conceptualizations (perhaps more or less like the maximal fusion of everything function as the natural limit of set-like composition in the mereologically converse direction.) All this leaves open whether there actually are any points, and whether the world could have been gunky. Maybe the most natural set-like conceptualization of the world is in terms of simple points, maybe it isn't. On this picture, nothing need be held as having a numerical property intrinsically, only more and less naturally relative to a conceptualization of it. Any portion of reality *might* be conceptualized as being more than one in number, but for some portions of reality this might be such an *un*natural conceptualization of it that it would simply count as a wrong conceptualization of it.

There is another solution to this problem worth mentioning, but which I will not be able to adequately explicate here. Consider the distinction between the concrete and the abstract, whatever the distinction is.[19] Let simple points fall on the side of the abstract, not on the side of the concrete. Furthermore, we let simple points be abstract limits to infinite concrete division. We also let the nature of such abstract objects somehow be identified and exhausted by a unique set of concepts. One of the concepts from this set is not having proper parts, and hence being one in number. But if the nature of a simple point is thus identified and exhausted by certain concepts and being one in number is one of them, then we cannot without contradiction *re*-conceptualize it such that a concept of being more than one in number is also applicable to it. It simply wouldn't be the same abstract object anymore. This would explain why simples as opposed to extended and other composite objects *must* be one in number. The idea is

[19] For a critical discussion of this distinction, see Burgess & Rosen (1997:13-25).

Leibnizean/Whiteheadean in spirit: it amounts to a commitment to the necessity of concrete objects being gunky, but is not a commitment to the impossibility of simples as such; i.e. since simples are not concrete. Personally, I prefer something like the former solution.

I anticipate yet another objection to CI. If CI is true, then our final and complete fundamental theory of the world is only true relative to a conceptualization of the world, which means we cannot fully describe the world independently of a conceptualization of it. But that is false; so CI is false.

The first premise is true only if our final and complete fundamental theory of the world includes set-like predicates. Whether or not our final theory *will* include set-like predicates is of course an open question. The second premise is true only if it *is* false that we cannot fully describe the world independently of a conceptualization of it. So why is it supposed to be false? This is *not* a question of realism versus anti-realism, or realism versus idealism. I have made no commitment as to what a conceptualization is. I am more than willing to assume that it is not something dependent on the psychology of a certain type of cognizers. Plausibly, a conceptualization of a portion of reality involves concepts. Concepts might be genuine, objective parts of the world, and as such would have to be part of any realist's theory of the world too. But if so, why is it supposed to be false that the world cannot be fully described independently of such concepts? In fact, quite the opposite seems to be the case: if concepts are objective features of the world, then it seems concepts need to figure *somewhere* in the theory of the world. Why is it supposed to be false that it figures in the most fundamental theory of the world? At this point in our theorizing, I simply take it to be a completely open question whether concepts and relations to concepts are parts of our fundamental theory. But in any case, if

the fundamental base upon which all else supervenes contains relational properties with concepts as relational units, then so be it. I don't see the problem. This is no commitment to anti-realism, if that means denying that there are objective structures in the world independently of our cognitions.[20]

2. Mereological Necessity

The following principle will function as a premise in my arguments for CI:

(NMC): whatever the nature and extent of composition is, it is a matter of metaphysical necessity.

This principle is widely assumed in the metaphysical literature on mereology and composition.[21] So merely assuming it here would not take away the force of my arguments relying on it. But nonetheless, I believe there are some good reasons to believe it is indeed a good principle.

First of all, I take it to be simply obvious that whether composition is identity or not, it is necessarily so. It is not the case that it is identity in world w, but non-identity in some other world w*. That would be absurd. So, whatever its nature, it is necessarily so.

[20] Note also that there is an ambiguity here in how concepts are thought of as possibly figuring in our fundamental theory of the world. On the one hand, they might figure in the fundamental theory as things the theory implies *being* in the world. On the other hand, they might figure in the fundamental theory as things the theory *use* to talk about things in the world. Assume the fundamental theory includes the sentence 'Einar's body is one in number'. According to the first sense, this sentence would imply something like the world including my body and the *relational property* of being one in number between *my body* and *the concept in the world* that picks it out as being one. According to the second sense, this sentence would not necessarily imply that there are relational properties in the world between my body and a concept in the world picking it out, but rather the concept would be part of the terminology in which we state the fundamental theory. This second sense, depending on what one's account of theories are, might be thought of as flirting more with anti-realism than the first sense because according to it the (assumed) fundamental property of being one in number holding of my body wouldn't hold of my body independently of the *theory* in which it is *expressed* as holding of my body. According to the first sense, it *would* hold of my body independently of the theory in question. Personally, I favour the first sense in question.

[21] Some few recent critics of it are Rosen (2006) and Cameron (2007). See also Bohn (2009a), (2009b).

Secondly, whatever the extension of composition is, assume it is *contingently* so. That implies that composition occurs under conditions C in world w, but under different conditions C* in some other world w*. Now, note that the extension of composition is not fit for empirical study. One simply cannot figure out the extension of composition by measurement and observation. The extension of composition is at least partly an a priori matter. But since by assumption it is also a contingent matter, we are now dealing with a priori contingent matters. Classical examples of a priori knowledge of contingent matters are either *definitional* knowledge or *indexical* knowledge. Knowledge of composition is certainly not indexical knowledge. Is it definitional knowledge? We *can* simply stipulate what the extension of composition is and work accordingly, but that is certainly not what the metaphysicians studying composition take themselves to be doing. If stipulation were at issue, there would be no point to the ongoing debate over the extension of composition. If the debate is over what the *best* stipulation is, it is a merely pragmatic debate, which again is not what most metaphysicians take it to be. So, unless most metaphysicians participating in the debate over the extension of composition are utterly confused about what they themselves are claiming – which I take to be highly unlikely – knowledge of composition is neither indexical knowledge nor definitional knowledge. But then what kind of a priori contingent knowledge are we dealing with in the case of composition? With indexical and definitional knowledge we have at least a rough idea of *how* we can have such a priori contingent knowledge. But with a priori contingent knowledge that is neither indexical nor definitional it seems utterly mysterious how we can achieve it. Educated guessing does not amount to knowledge no matter how lucky we are. I thus claim that our initial assumption that the extent of composition is a contingent matter leads to a hopeless epistemology. To the extent that we can secure our a priori subject matter as dealing with necessary matters, we should. So, to the same extent we

should reject our assumption that the extension of composition is a contingent matter. Assuming it is not dealing with an impossible matter, we should assume it is dealing with a necessary matter. Anything else would simply take away our subject matter.

This is of course not a valid argument. We cannot thus move from epistemology to metaphysics. Maybe the debate over the extent of composition simply has no unified, necessary subject matter. Or maybe it is a contingent matter, and that our only hope is to make educated guesses as to what its actual extension is. But the first goes against the phenomenology of the debate and the second amounts to philosophical mysticism. In either case, we should do better, if we can do better. I will now argue that we can do better.

3. Three Arguments in favor of CI

In sub-section 3.1, I will present a *reductio* in favor of CI; in sub-section 3.2, I will present an abductive argument in favor of CI; and finally in sub-section 3.3, I will present an argument from meta-ontology in favor of CI. Each of the arguments relies on NMC.

3.1. The Argument from Necessity

From section 2, we get that whatever the nature and extent of composition is, it is a matter of necessity:

(1) NMC

For *reductio*, we assume:

(2) ~CI

It follows from (2) that:

(3) ~NMC

But 1 and 3 is a contradiction, so given 1, we must conclude:

(4) CI

Assuming 1, I will now defend the move from 2 to 3, and thus justify 4. In doing so I will rely on what I take to be a fairly weak version of Hume's Dictum (HD), but which I suspect certain others might take to be a somewhat strong version of it.

Often HD is treated as a denial of necessary connections between concrete objects that have no common parts, i.e. between disjoint concrete objects. The principle then reads something like this: if concrete objects a and b are disjoint, then it is possible for each one of them to exist without the other.[22] I find this version of the principle in one respect too strong, but in another respect too weak. It seems too strong, if it is treated as a fundamental metaphysical truth. Wilson (forthcoming) examines various versions of HD and find them all wanting. She concludes that there is no good reason to believe HD is true. If the principle is treated as a metaphysical truth, then I agree with her conclusion. But why think that HD is a *metaphysical* principle? In fact, why think HD is apt for truth and falsity at all? Consider Ockham's Razor: don't multiply entities beyond necessity! It

[22] One might also want to add that for any two disjoint, but possible concrete objects a and b, it is possible for both of them to exist together (in the same world). So, not only can disjoint concrete objects come apart, but they can also come together. Note that a much stronger version of HD might be a denial of necessary connections not only between non-overlapping concrete objects, but also between any non-overlapping entities whatsoever, e.g. between properties as well as between abstract objects. This stronger version of HD I see no reason to accept (cf. Wilson forthcoming), but in any case, I can for present purposes simply ignore it.

is not a metaphysical principle, but rather a methodological guide. As such it is not apt for truth and falsity, but rather for pragmatic evaluation. I believe one should treat HD in a similar way: don't multiply necessities beyond necessity! As such it is not a metaphysical principle, but rather a methodological guide. As such it is not apt for truth and falsity, but rather for pragmatic evaluation. Wilson never considers this way of treating HD, but it seems it is the overall moral one should draw from her discussion of it. As a metaphysical truth HD fails, but as a methodological guide it seems nonetheless undeniable. Holding that *mysterious* necessities are philosophically bad is not holding that necessities *simpliciter* are philosophically bad. In choosing between two theories that differ *only* in that one of them has an *unexplained*, *unnecessary* necessity where the other doesn't we should accept the one without the unexplained, unnecessary necessity. Nonetheless, we should accept a theory with necessities in it, if we cannot do without it.

With HD thus treated as a good methodological guide concerning concrete objects only, we have a considerably weakened version of it compared to how it is often thought of.[23] But there is another sense in which I believe HD as stated above concerning disjoint concrete objects is somewhat too weak. Why think that *overlapping* (non-disjoint) concrete objects are exempt from our good methodological rule? Partial or full identity would be a good explanation (cf. chapter II, section 2.1). But absent the view that mereological relations are relations of identity, what empowers overlap with such metaphysical glue that its relata cannot exist without each other? Assume aa,b are some distinct concrete objects that have the fusion f(aa,b) and that cc,b are some distinct concrete objects that have a different fusion f(cc,b). Then the two distinct fusions overlap by both having b as a proper part. Why think that f(aa,b) cannot exist without f(cc,b), or vice versa? After all, $f(\text{aa,b}) \neq f(\text{cc,b})$, so to the extent a necessary connection between the

[23] Cf. Wilson (forthcoming). Though I suspect, contra the impression one gets from Wilson, that it is often in fact implicitly treated as merely a methodological guide.

two distinct fusions is unexplained, it is mysterious and hence should by HD be eliminated from our theory. Furthermore, consider some things xx and their fusion. Why think that xx cannot exist without a fusion? After all, if a fusion is not identical with its parts collectively, why must they stand and fall together? Without an explanation, such a necessary connection between fusions and parts is highly mysterious, and hence should by HD be eliminated from our theory. So, I believe we should state HD in terms of *numerically* distinct objects, not merely in terms of disjoint objects. What is not the same should not be necessarily connected without need. After all, they are distinct things.

I can thus formulate in one sense a weaker, but in another sense a stronger version of HD than the one we considered above: if concrete objects a and b are *numerically distinct*, then it is possible for each one of them to exist without the other.[24] It is stronger in the sense that it is stated in terms of numerically distinct objects, not merely in terms of disjoint objects, but it is weaker in the sense that it is merely treated as a good methodological guide, not as a metaphysical truth.

Given assumption 2 in the above argument from necessity together with our version of HD, step 3 in the argument now follows. By 2, any fusion f(xx) is numerically distinct from its parts xx collectively. So, *absent the theoretical necessity of a necessary connection between fusions and their parts collectively*, any such necessary connection is mysterious, and hence by HD it should be eliminated from our theory. There is of course no reason to think there must be such a necessary connection between fusions and their parts, so we must conclude that the extension of composition is not a necessary matter. At least we must so conclude until we have been given a reason to think there *must* be

[24] Again, we should strengthen it such that any two numerically distinct possible concrete objects a and b can exist together as well as apart. In fact, I further believe the principle should be generalized to also account for any non-concrete objects there are. But I don't need to rely on such a generalization in what follows.

such a necessary connection. That is, line 3 in the argument from necessity follows. Hence, given 1, step 4 follows too: composition is identity.

Given the set-up in section 1, the only escape routes for the proponents of ~CI at this point is either (i) deny NMC, in which case one is, as mentioned in section 2, either left with a highly mysterious epistemology concerning what is at stake in the debate over the extension of composition or left with no metaphysical debate over the extension of composition at all, or (ii) accept the necessity between any xx and a fusion thereof, but explain why it is unavoidable. Apart from the on its face implausible claim that such necessities are *needed* in our theories, i.e. the claim that no equally good theory can succeed without such necessity, Cameron (2007) provides a tough case against this second option. I join Cameron in having no faith in this second escape route for the proponents of ~CI, especially given what I am about to argue.

3.2. The Argument from Abduction

Again, from section 2 above, we have:

(1) MNC

If the following claim is true:

(2) If CI, then MNC

then it follows by *ab*duction that:

(3) CI

Note that though 1-3 is *de*ductively invalid, it is nonetheless *ab*ductively valid: 3 is simply the inference to the best explanation, given 1 and 2. This move is of course further supported by the argument from necessity in section 3.1 above. There we saw that ~CI is incompatible with NMC, and *unable* to explain NMC. Of course, there might be some different explanation altogether for NMC, but absent any such explanation, we are, given 1 and 2, abductively forced to accept 3. So, from section 2, we assume premise 1, and go on to defend premise 2, from which 3 abductively follows.

One way to defend premise 2 is by a *reductio*. Assume CI and ~NMC. Assuming that composition is not impossible (which is indeed plausible given CI), and assuming that the contingency is not concerned with the nature of the composition relation other than its extension (i.e. whether it is identity or not), it follows that whatever the extension of composition is, it is contingently so. So, consider some xx that compose f(xx) in world w, but compose nothing in a different world w*. It follows that xx=f(xx) in w and that xx exist in w*. Assuming whatever is identical is necessarily identical, it follows that necessarily, xx=f(xx); and hence that xx=f(xx) in w*. By assumption it follows that xx compose f(xx) in w*, contradicting that xx exist without a fusion in w*. Hence, if CI, then NMC, which means that premise 2 in the argument from abduction is true. Hence, by abduction, CI is true.

This argument relies on the *de re* assumption that whatever is identical is necessarily identical. By that same assumption we also have the following argument in favor of mereological essentialism: assume CI and that whatever is identical is necessarily identical. Then, assuming my body is the fusion of my body-parts, my body is identical with its body-parts, say, its arms, legs, head, and torso.[25] It follows by

[25] Or pick any other composite object you believe exists.

assumption that my body is necessarily identical with its arms, legs, head, and torso and as such cannot survive the loss of its left arm. That is mereological essentialism, the view according to which no thing can survive the loss or change of its parts. Hence, if whatever is identical is necessarily identical, CI is false unless mereological essentialism is true.[26]

I take it that such an extreme mereological essentialism is false, and that to that extent it is desirable for any proponent of CI to dispel the assumption that whatever is identical is necessarily identical. By accepting counterpart theory, the view according to which nothing is identical across possible worlds, we can by well-known means avoid both such a mereological essentialism and the *de re* claim that whatever is identical is necessarily identical.[27] But then NMC must be had by other means.

There is a less extreme version of the argument not relying on the *de re* claim that whatever is identical is necessarily identical. Assume that (i) necessarily xx=xx, and that (ii) xx=f(xx). By Leibniz's Law (and perhaps a pluralized Lambda-abstraction), it follows that (iii) necessarily xx=xx iff necessarily xx=f(xx). By (i) and (iii), it follows that necessarily xx=f(xx).

This latter argument is not to be understood as making the *de re* claim that any fusion is necessarily identical with all its actual parts, but rather as saying that necessarily, any fusion is identical with all its parts. For example, it is not the case that for all the parts my body has in the actual world @, my body is identical with *those* @-

[26] There is an analogous argument seemingly committing CI to temporal mereological essentialism as well, the view according to which nothing survives a change in its parts over time. This argument is best blocked by accepting four-dimensionalism about objects, i.e. that objects are the fusions of spatial as well as temporal parts. For the argument, see Merricks (2003). For four-dimensionalism, see Sider (2001).

[27] See Lewis (1986). As said in the preface, one might instead of counterpart theory accept some other account of contingent identity, e.g. as found in Gallois (1998), but I find such a solution much less desirable, and will thus ignore this option here.

parts in any possible world w. Rather, the claim is, for any possible world w, my body is identical with all its parts in w (whatever those parts are).

But even this argument is questionable. It relies on the premise that whatever is identical share all modal properties. But counterpart theorists (and other contingent identity-theorists) deny this premise. For example, the plurality of all the particles composing my body cannot survive the loss of some particles. It just wouldn't be the same plurality anymore.[28] But according to counterpart theory, my body can survive the loss of some of its particles. My particles and my body need not have the same counterparts in all possible worlds. So, whatever is identical need not share all modal properties. But then, again, NMC must be had by other means.

Fortunately, there is a way. Assume CI. Then the extension of composition is the extension of identity. But the extension of identity is of course necessarily any portion of reality whatsoever, so the extension of composition is necessarily any portion of reality whatsoever. Thus, composition is necessarily unrestricted; hence, NMC. So, if CI, then NMC, which implies that premise 2 in the argument from abduction is true; hence, 3 follow by abduction.

This argument relies neither on the *de re* claim that whatever is identical is necessarily identical nor on the claim that whatever is identical share all modal properties; as was desired. In addition to securing the necessity of composition, it also provides an answer to the extension of composition. The argument is thus worth dwelling on in some depth. Recall what kind of identity composition is according to CI, namely the identity between a portion of reality and itself where it is conceptualized as n things on the one hand and as one thing on the other (i.e. an informative identity a la Hesperus is Phosphorus). So the question of the extension of the composition relation becomes the

[28] In fact, adopting counterpart theory, even this much might be questioned.

question of the extension of being able to conceptualize one and the same portion of reality both as n>0 things and as one thing. In other words, can there be a portion of reality that cannot be conceptualized as one thing? If not, composition must be unrestricted.

So we should ask: what could possibly prohibit us from conceptualizing a portion of reality as one thing? Surely not some missing parts in our ontology because all the portions of reality we need are the ones that in fact exist, *whatever they are*. Rather it must be some inherent impossibility of being conceptualized as one thing in a way analogous to the way it seems impossible to conceptualize a mereologically simple spatiotemporal point as having proper parts. If conceptualizations of portions of reality enter the semantics through context, i.e. is context-relative, then any prohibition on conceptualizing a portion of reality as one thing must be due to the impossibility of a suitable context. But even though we might have one such conceptual prohibition (perhaps due to naturalness) in the case of *de*composition (cf. section 1.2 above), there seems to be no such inherent impossibility in the case of composition because we clearly conceptualize two or more things as one thing in *some* cases and it is hard indeed to see what any non-arbitrary restriction could be. For example, we talk and think about our solar system, or our galaxy, as if they were singular objects, but of course they consist of many planets and stars (and much else) as well. Is a solar system, or a galaxy, one thing or many things? It seems it is more or less up to us to choose how to speak and conceptualize things in this case and hence that the singular as well as plural concepts are there to be freely used. We can conceptualize that portion of reality as one and we can conceptualize it as many. Denying such a possibility of distinct conceptualizations of one and the same portion of reality seems obviously wrong and completely ad hoc. We should also know better from the Fregean passages above. The point generalizes. We, or

at least some ideal cognizers, can easily speak and think of any portion of reality as one thing, say by treating it as a subject for singular predication; but that is all that is needed for composition to occur according to CI. That is why composition is unrestricted. The point generalizes to any arbitrary possible world, and hence composition not only is unrestricted, but *must* be unrestricted.

Note that the above worry about any restriction on composition being arbitrary and *ad hoc* is not the traditional Lewis-Sider worry about restricted composition being motivated by vague intuitions while composition cannot be vague.[29] The latter worry is easily answered by accepting the non-vague restriction that best matches our initial intuitions. There is no reason to think that our initial intuitions are infallible even though they might function as a good guide. Any such restriction thus need not in any way be arbitrary or *ad hoc*.[30] My above worry is that there is no plausible relevant restriction on how we can *conceptualize* a given portion of reality as being one in number when it is not a matter of there being enough things in one's ontology. We have all the ontology we need, so why can I not conceptualize any of it as one thing? Now, there might be various more or less natural ways of conceptualizing a given portion of reality, but that reflects no inherent impossibility of conceptualization as such, which is what would be needed for a restriction on composition as identity. So, CI implies that composition must be unrestricted.

I anticipate an objection. Consider the following analogy. Assume that all statues are made from pieces of clay and that any statue is identical with the piece of clay it is made from. It does of course not follow from that that any piece of clay is identical with a statue. But then by analogy it seems not to follow from the fact that any fusion is identical with some plurality (collectively) that any plurality is identical with some

[29] See Lewis (1986:211-213) and Sider (2001:120-132).
[30] See also Merricks (2005) and Nolan (2006).

fusion. In short, even if composition is identity it does not seem to follow that any plurality of things composes something, and hence even if composition is identity it might nonetheless be restricted.[31]

The analogy is not a good one for at least two reasons. First, the obvious reason why not any piece of clay is identical with a statue is that some conditions or other need be imposed on a piece of clay in order for it to constitute a statue. It needs to take on a particular shape, or acquire an artistic history, or be incorporated into the artworld, or be admitted into an art museum, or whatnot. But no conditions whatsoever need be imposed on a portion of reality in order for it to be self-identical and the only conditions needed for it to compose something is that it admits of conceptualization as one thing. But we need not take conceptualization to be a matter of human psychology (nor linguistics), so a portion of reality need neither take on a particular shape, nor to acquire any specific history, nor to be incorporated into any sociologically dynamic world, nor to be admitted into any social institutions, nor anything alike. A portion of reality is what it is and, as argued above, there can be no plausible prohibition on conceptualizing it as one thing. Take any portion of reality, predicate a singular property of it, and voila, you have conceptualized it as one thing! By existential generalization, there is thus some one thing it is identical with.

The second reason for why the analogy is not a good one is that even though there is a distinction between pieces of clay that are statues and pieces of clay that are non-statues due to the presence of some imposed conditions on some and only some of the pieces of clay, any imposed conditions on some and only some pluralities such that they and only they can be conceptualized as singular things are, due to our understanding of composition as identity, doomed to be conditions that have to do with conceptualizations

[31] See Cameron (2007) for some such argument.

of a portion of reality, not having anything to do with the existence of some entities in our ontology. Thus, to the extent one holds that a statue is some new entity in one's ontology in virtue of the relevant conditions imposed on a piece of clay, the analogy fails. On my understanding of composition as identity there is no new entity in ones ontology just because one can conceptualize a portion of reality differently. But to the extent one holds that a statue is *not* some new entity in one's ontology as soon as the relevant conditions are imposed on a piece of clay, but perhaps rather that we now just have another way of taking an interest in the same piece of clay by a different name, the analogy again fails in its purpose. Any piece of clay *might* be taken to be such a statue in the sense that our interests might change. Likewise, any plurality *might* be taken to be a singular object, if our interests changed. But then there is no inherent impossibility in conceptualizing a portion of reality as one thing, and that is all it takes on my understanding of composition for it to be necessarily unrestricted. Which pluralities *we* treat as many and which we treat as one is a contingent result of *our* interests, not an inherent impossibility in how they might be conceptualized.

I conclude that CI implies the necessity of universal composition, and hence implies NMC. Since, as was argued in sub-section 3.1, ~CI is incompatible with NMC, and no other explanation of NMC seems forthcoming, I conclude by abduction that composition relates a portion of reality with itself. CI is true.

3.3. The Argument from Meta-Ontology

Consider van Inwagen's (1990) famous Special Composition Question:

(SCQ): under what necessary and sufficient conditions do some things compose something?

A bit of thought will show that apart from rejecting the question as meaningless, SCQ allows of three and only three types of answers:

Nihilism: necessarily, all and only singleton collections compose something, where a singleton collection is a collection of one thing

Restrictionism: necessarily, all and only things meeting contrastive conditions C compose something, where contrastive conditions are conditions met by some collections of things, but not by all collections of things

Universalism: necessarily, any collection of things compose something

Let's call SCQ *insubstantial* iff it has no answer, i.e. iff nihilism, restrictionism, and universalism are all false. We say that SCQ is *substantial* iff it has a unique answer, i.e. iff one and only one of nihilism, restrictionism, and universalism is true. (Note that these are technical terms not meant to have general applicability beyond SCQ.) It follows that if SCQ is substantial, then premise NMC from section 2 above is true; and hence, by contraposition, that if NMC is false, then SCQ is insubstantial. This goes hand in hand with the fact that whichever answer is correct, it is usually assumed to be necessarily correct. The debate over SCQ is usually taken to be an a priori debate over a matter of necessity.

I assume in compliance with much of the relevant literature that SCQ is substantial, and hence again that NMC is true. I also assume HD as I explicated it in section 3.1 above. Based on these assumptions, I will now defend the following argument:

1.	SCQ is substantial	As
2.	~CI	As (for *reductio*)
3.	Possibly, the world is gunky	2,HD
4.	Possibly, the world is junky	2,HD
5.	Possibly, the world is hunky	2,HD
6.	SCQ is insubstantial	3,4,5, Def. of 'insubstantial'
7.	CI	1,6, *reductio*

Premise 1 is my assumption *simpliciter*. Premise 2 is my assumption for *reductio*. The conclusion 7 then follows by the fact that 1 and 6 amounts to a contradiction, given that 6 follows from 3-5. It thus remains to defend 3, 4, 5, and the implication to 6.

The world is *gunky* iff each part of it has a proper part. A gunky world thus has no simples (mereological atoms, objects without proper parts). A gunky world thus contains only composite objects. The idea that the world is gunky is logically consistent in the sense that there are mereological models of such worlds. It is also positively conceivable. Consider an infinite Russian Doll that never stops unpacking.[32] That is, for every doll you open, there is another smaller duplicate of the doll inside. Furthermore, there exists no limit to the unpacking of the doll. Our Russian Doll simply unpacks *ad infinitum*, without limit. A world with a mereological structure isomorphic to the infinite, limitless unpacking of this Russian Doll is a gunky world. That the world might be, or might have been gunky is thus independently plausible and, I claim, only theoretical prejudice can rule out the mere metaphysical possibility of such a world.[33]

[32] That is, think of it as one-one correlated with the half-open negative integers interval $\langle -\infty, 0]$ such that the doll -1 is in the doll 0, -2 is in -1, and so on; and where $-\infty$ doesn't exist.
[33] The possibility of gunk has been further defended in e.g. Sider (1993) and Schaffer (2003).

But that the world might have been gunky also seems to follow from premise 2 conjoined with HD (and some independently plausible possible scenarios). Assume ~CI and HD. Consider a world w consisting of mereologically simple spatiotemporal points, i.e. zero-dimensional objects. That the world at least might be thus pointy is justified by it being a dominating working hypothesis in both science and philosophy. Now let every *extended* (one-or-more-dimensional) object in w be infinitely divisible. The latter is plausible given that every extended object seems to have two halves.[34] Given our assumption ~CI, a plurality xx of continuum many points is not identical with its extended fusion f(xx). By a plausible methodological application of HD, the plurality xx need not by metaphysical necessity exist together with its extended fusion f(xx). So, possibly, the infinitely divisible fusion exists without the points. In such possible worlds the fusion f(xx) is such that every part of it has a proper part, and there exist no limit points at which there are no more proper parts. Such possible worlds are gunky worlds.[35] I take this to establish premise 3.

The world is *junky* iff each object in it is a proper part. A junky world thus has no objects not standing in the proper parthood relation to something, and hence no maximal object U having all things as parts. A junky world is thus an infinite plurality of things, and might, but need not contain simples. The idea that the world is junky is logically consistent in the sense that there are mereological models of such worlds. It is also positively conceivable. Consider an infinite series of Russian Dolls such that each doll in the series never stops being packed into another bigger doll in the series.[36] That is, for every doll in the infinite series, it is a smaller duplicate of the doll it is inside of.

[34] It also follows from a denial of the possibility of *extended simples*.

[35] Alternatively, going back to our earlier example instead, consider $[-\infty,0]$ and then remove $-\infty$, which leaves you with $\langle -\infty,0]$.

[36] That is, think of them as one-one correlated with the half-open natural number interval $[0,\infty\rangle$ such that doll 0 is in doll 1, 1 is in 2, 2 is in 3, and so on; and where ∞ doesn't exist.

Furthermore, there exists no limit to the packing of the doll. There is no maximal, biggest doll containing all the other dolls in the series. Our Russian Dolls simply packs each other *ad infinitum*, without limit. A world with a mereological structure isomorphic to the infinite, limitless packing of these Russian Dolls is a junky world. Or, simply consider the model in which we have infinitely many simples over which any *finite* collection of them composes something. Such possible worlds are junky worlds. That the world might be, or might have been junky is thus independently plausible and, I claim, *given ~CI*, only theoretical prejudice can rule out the mere metaphysical possibility of such a world.[37]

But that the world might have been junky also seems to follow from premise 2 conjoined with HD (and some independently plausible scenarios). Assume ~CI and HD. In section 3.1, I showed that these two assumptions jointly imply ~NMC. That is, given ~CI and HD, the extent of composition is a contingent matter that varies from world to world.[38] Given the logical consistency and positive conceivability of junky worlds, there is then no reason to deny the mere metaphysical possibility of such junky worlds. First, consider a possible world consisting of an infinite collection of simples xx, and where unrestricted composition is true. By ~CI, the infinitely many simples xx are not identical with their fusion f(xx). By HD, the simples need not by metaphysical necessity exist together with their fusion. So, possibly, the infinitely many simples exist together with all their fusions except the maximal fusion. In such possible worlds the infinitely many simples xx are such that each one of them is a proper part, and there exist no limit at

[37] So premised, the possibility of junk has been further defended in Bohn (2009a) and (2009b).
[38] Note that this already contradicts our premise 1. But let's in any case continue the argument to the bitter end.

which some one thing is not a proper part. Such possible worlds are junky worlds.[39] I take this to establish premise 4.

The world is *hunky* iff each object in it both is and has a proper part. A hunky world is thus a world that is both gunky and junky. The idea that the world is hunky is logically consistent in the sense that there are mereological models of such worlds. It is also positively conceivable. Consider an infinite series of Russian Dolls such that each doll in the series both is packed into another doll in the series and itself packs in another doll in the series.[40] A world with a mereological structure isomorphic to the infinite, limitless packing and unpacking of these Russian Dolls is a hunky world. Or, simply consider the model in which we have all the real numbers over which any non-co-finite sub-collection of them composes something, where a co-finite sub-collection of some things xx is a sub-collection of xx whose complement is finite. Possible worlds with such a mereological structure are hunky worlds. That the world might be, or might have been hunky is thus independently plausible and, I claim, *given ~CI*, only theoretical prejudice can rule out the mere metaphysical possibility of such a world.[41]

But that the world might have been hunky also seems to follow from premise 2 conjoined with HD (and some independently plausible scenarios). Assume ~CI and HD. We saw above that these assumptions jointly imply the possibility of gunky and junky worlds. So, first consider a gunky world w in which unrestricted composition is true. By ~CI, the maximal fusion in w is not identical with all its parts collectively. By HD, the maximal fusion therefore need not by metaphysical necessity exist together with the rest of the world xx. So, possibly, xx exist without the maximal fusion. In such possible

[39] Alternatively, going back to our earlier example instead, consider $[0,\infty]$ and then remove ∞, which leaves you with $[0,\infty\rangle$.

[40] That is, think of them as one-one correlated with the open integer interval $\langle -\infty,\infty\rangle$ such that doll 0 is in doll 1 and contains doll -1, 1 is in 2 and contains 0, -1 is in 0 and contains -2, 2 is in 3 and contains 1, -2 is in -1 and contains -3, and so on; and where ∞ and $-\infty$ don't exist.

[41] So premised, the possibility of hunk has been further defended in Bohn (2009b).

worlds the infinitely many objects xx are such that each one of them both is and has a proper part, and there exist no limit at which some one thing either is not or has not a proper part. Such possible worlds are hunky worlds.[42] I take this to establish premise 5.

That step 6 is an implication of 3, 4, and 5 can be best seen by the following. Premise 3 is incompatible with the necessity of nihilism: a nihilistic world contains no composite objects; gunky worlds contain only composite objects; so if nihilism is necessarily true, then gunky worlds are impossible; but we have seen that gunky worlds are indeed possible; so nihilism is not necessarily true. Premise 4 is incompatible with the necessity of universalism: a world in which universalism is true is a world in which there is a maximal fusion of everything; a junky world is a world in which there is no maximal objects of everything; so if universalism is necessarily true, then junky worlds are impossible, but we have seen that junky worlds are indeed possible; so universalism is not necessarily true. Premise 5 is incompatible with all plausible versions of restrictionism: a hunky world contains no simples, so the necessity of any version of restrictionism that implies that there is at least one simple[43] is incompatible with premise 5. Likewise, a hunky world contains no maximal fusion of everything, so the necessity of any version of restrictionism that implies that there is such a maximal fusion is incompatible with premise 5. In fact, the only plausible principle of composition compatible with the possibility of hunky worlds seems to be that any non-co-finite sub-collection of things composes something. But that this version of restrictionism is necessarily true is highly implausible, close to incredible. For example, the principle is incompatible with the possibility of finite worlds. Also, *given ~CI*, the possibility of gunky, junky, and hunky worlds stand and fall together. There is no non-*ad hoc* reason to

[42] Alternatively, going back to our earlier example instead, consider [-∞,∞] and then remove ∞ and -∞, which leaves you with ⟨-∞,∞⟩.
[43] For example, the versions of restrictionism defended in van Inwagen (1990) and Merricks (2003).

hold that only one of them represents a metaphysical possibility, but not all of them.[44] But then since nihilism, universalism, and restrictionism in their necessitated forms are all false, neither one of the three possible answers to SCQ can be necessarily true. Hence, SCQ is insubstantial, which establishes step 6 on the basis of premises 2, 3, 4, and 5. Since premise 1 and line 6 amounts to a contradiction, we reject premise 2, which completes our *reductio*: step 7 follows, and hence CI is true.

The main escape routes for a proponent of ~CI at this point is to either (i) reject premise 1, i.e. hold that SCQ is insubstantial, or (ii) reject HD and deny at least one of the premises 3-5. In my mind, the first route seems too deflationary, while the second route seems too theory-laden and *ad hoc*. But one man's Modus Ponens is another man's Modus Tollens, so the reader must ultimately judge for herself.

In section 3.2 above, we saw that CI implies the necessity of universalism. But universalism in its necessitated form implies that there has to be a maximal fusion of everything, which is incompatible with the possibility of junky and hunky worlds, according to which there could have been no such maximal fusion. So with CI being established in step 7 we must also reject premise 4 and 5. But the denial of 4 and 5 is no problem when conjoined with the truth of CI; it is only a problem when conjoined with ~CI. The latter has no non-*ad hoc* explanation for the denial of 4 and 5; while the former has *indeed* a non-*ad hoc* explanation for such a denial. Given CI, junky, and hence hunky worlds are impossible because the infinite plurality that is such worlds is *identical* with the maximal fusion of everything. There is nothing to recombine such that there is a possible world in which there is no maximal fusion of everything. The world is a portion of reality and *it/them* cannot be recombined such that it/them exists without itself/themselves. HD only applies to numerically distinct entities. Given ~CI, we have of

[44] See Bohn (2009a) and (2009b).

course no such explanation, and hence we are left with a mysterious necessity, which violates HD.

4. Some Further Motivations

In sub-section 4.1, I will show some nice semantic implications of adopting CI. In sub-section 4.2, I will show some nice ontological implications of adopting CI.

4.1. Semantics

Let *folk-ontology* be the set of basic, fairly uncontroversial postulates about what there is according to most people (i.e. non-philosophers), and which are capable of surviving some critical common sense (i.e. non-professional philosophical) reflection. Presumably, this set will include postulates to the effect that there are pebbles, tables, chairs, human bodies, planets, and stars. Presumably, this set will also include postulates to the effect that these things have parts such as left and right halves, legs, tabletops, seats, arms, mountains, and gases. I now assume as a good methodological guide that if a philosophical theory T is compatible with folk-ontology and another philosophical theory T* is not, then, *everything else being equal*, T is preferable over T*.

Consider nihilism, the view according to which there are only simples and no composite objects. If the simples are pointy (zero-dimensional), then this theory is incompatible with folk-ontology since the latter holds that there are extended (one-or-more-dimensional), composite objects like pebbles, tables, human bodies, and chairs. If the simples are extended, then this theory is equally incompatible with folk-ontology since the latter holds that there are parts of extended, composite objects like legs, seats, arms, and mountains. In short, according to nihilism it is false that there are composite

objects, but according to folk-ontology it is true that there are composite objects; hence the two theories are incompatible.

Consider a version of restrictionism according to which there are some simples and some composite objects. Assume the distinction between simples and composite objects does not line up perfectly with what composite objects there are according to folk-ontology. Then this version of restrictionism will violate folk-ontology. Assume the distinction between simples and composite objects does line up perfectly with what composite objects there are according to folk-ontology. Now, since folk-ontology is vague about exactly what composite objects there are, this version of restrictionism will also violate folk-ontology unless it postulates vague existence perfectly matching the vague line there is between simples and composite objects according to folk-ontology.[45] The latter is incredible, so I conclude that restrictionism violates folk-ontology.

Consider universalism, the view according to which any collection of things composes something. This theory is not incompatible with folk-ontology *unless* folk-ontology also contains postulates about which composite objects does not exist. But there is indeed a sense in which folk-ontology seems to deny the existence of some composite objects, e.g. the fusion of me, you, and some pebble. Intuitively, folk-ontology is at least *hesitant* to affirm the existence of some one object composed of these three things.

Thus, all three possible views on the extension of composition seem to violate folk-ontology, though universalism might be the view being the best off. Concerning nihilism and restrictionism, there have been attempts to provide conditions under which it is *appropriate* to express the postulates of folk-ontology, e.g. by providing paraphrases for folk-ontology meant to express the underlying propositions that are *really* (or perhaps

[45] This argument is a weaker version of the famous Lewis-Sider argument against restrictionism. While the Lewis-Sider argument concludes that restrictionism is false, I only conclude that restrictionism violates folk-ontology. See Lewis (1986:211-213) and Sider (2001:121-132). For a convincing reply to the Lewis-Sider version of the argument, but not to my weakened version of the argument, see Merricks (2005) and Nolan (2006).

more accurately) true.[46] For example, it is appropriate to utter that there are tables and chairs because it is true that there are simples arranged table-wise and chair-wise. But this technique has at least two problems. First, Uzquiano (2004) has shown that the technique is inadequately general unless one postulates more unexpected ontology.[47] But more unexpected ontology violates much of the initial motivation behind the technique to begin with, namely adopting a sparse ontology. Second, folk-ontology is not merely claiming that it is *appropriate to utter* that there are tables and chairs. Rather, it is claiming that tables and chairs *exist*. Thus, providing a paraphrase technique in terms of plurals still violates folk-ontology. Concerning universalism, there has been an attempt to explain why universalism does not violate folk-ontology after all.[48] Folk-ontology does not really contain postulates as to which composite objects do not exist, but instead it contains (mostly) restricted existential quantifiers such that its postulates are restricted to certain domains to the exclusion of others. By thus ignoring certain domains, it *seems as if* certain composite objects do not exist because they are not in our domain of quantification. But ignoring them does not make them go away. I am not sure whether this is the nature of folk-ontology, or whether there is a determinate fact of the matter here at all, but in any case, quantifier restrictions are common place (are there any beer left? Well it depends…), and does not face the logical problems that the above paraphrase technique does. Universalism thus seems overall the better off compared to nihilism and restrictionism.

Consider CI. As was shown in section 3.2 above, CI implies universalism. By adopting CI, we thus avoid all problems encountered with nihilism and restrictionism. Universalism verifies folk-ontology in the sense that it implies that there are composite pebbles, tables, chairs, human bodies, planets, and stars. According to universalism it is

[46] See van Inwagen (1990) and Rosen & Dorr (2003).
[47] It also faces the problem of the possibility of gunky worlds, where there are no simples.
[48] See Lewis (1986:213).

simply true that there are such things, just like folk-ontology says there are. Quantifier restriction explains why we mostly ignore most composite objects. I take this compatibility with folk-ontology to be a nice implication of, and hence further motivation for adopting CI. We simply avoid an error-based semantic for ordinary language and speech. But it gets even better. By adopting CI, as opposed to ~CI, we also avoid the (arguably still present) suspicion that there might be a conflict between universalism and folk-ontology after all. Let me explain.

4.2. Ontology

Universalism implies that for any collection of n simples, there are 2^n-1 composite objects.[49] Surely, it is no theorem of folk-ontology that there are that many objects based on any collection of n simples. So there seems to be a conflict with folk-ontology in the sense that universalism has a bloated ontology compared to folk-ontology. And, arguably, this suspicion is not relieved by quantifier restriction after all, so we seem to need a different explanation.

CI provides such an explanation. According to CI, the ontology is not really bloated after all because the fusions are identical with their parts collectively. So, given any collection of n simples, the 2^n-1 fusions are *nothing* over and above the n simples, and the n simples are *nothing* under and below (nor over and above) the 2^n-1 fusions. They are merely different ways of conceptualizing the same portions of reality.

~CI has no such explanation.

[49] Strictly speaking, this is a theorem of certain systems of mereology, e.g. classical mereology, not merely of unrestricted composition as such. For example, it needs to be assumed that there is no null object, an object overlapping all objects whatsoever.

4.2.1. Mereologically Coincident Objects

Let two objects y and z be *mereologically coincident* iff y and z have exactly the same parts xx, but are nonetheless numerically distinct. Thus, if xx compose y and xx compose z, but y≠z, then y and z are mereologically coincident. (Note that this notion of coincidence is not the notion of coincidence according to which two distinct objects can occupy the same region of spacetime; or if you want: be in the same place at the same time.) Mereological coincidence is incompatible with any extensional mereology, a mereology according to which whatever have the same parts are identical. CI logically implies the impossibility of mereological coincidence, so by adopting CI, we have an *explanation* for why extensional mereology must be true, and mereologically coincident objects are impossible. Assume CI, that xx compose y, that xx compose z, and that y≠z. By CI, xx=y and xx=z. By symmetry and transitivity of identity, y=z, which contradicts our initial assumption. So, if CI is true, mereologically coincident objects are impossible.

Now, one man's Modus Ponens is of course another man's Modus Tollens, but if you favor extensional mereology, what *better* explanation do you have of it, if you don't accept CI?

CHAPTER II

MEREOLOGY AS A CALCULUS OF IDENTITY

In chapter I, I argued that a whole object is the same portion of reality as its many parts. We also saw that this requires a generalized plural logic of identity. In section 1 below, I develop such a logic. In section 2, I logically derive, and hence logically reduce classical mereology from this generalized plural logic of identity. Full classical mereology can thus be understood as a mere definitional extension of our generalized plural logic of identity. This of course adds fuel to the fire that composition as identity implies the necessity of unrestricted composition.

1. The Logic[50]

In subsection 1.1, I provide a plural first-order language with adequately generalized plural identity. In subsection 1.2, I provide the interpretation of this language in terms of ordinary English. In subsection 1.3, I provide the axioms for the accompanying logic. In subsection 1.4, I prove some obvious theorems of this logic, which will be put to use in section 2.

1.1. The Language

Recall: an n-place predicate R^n is said to be *plural* in its ith place iff it can take a plurality of one or more things as value in its ith place; R^n is said to be *distributive* in its ith place iff each one of the entities in the plural value in its ith place is R; and R^n is said to be *collective* in its ith place iff it is not distributive in its ith place. (We have the obvious corresponding definition for the semantic value, or worldly correlate of R^n.) Furthermore:

[50] In what follows I use the terminology from Burgess & Rosen (1997), Burgess (2004), and Linnebo (2008).

an n-place predicate R^n is said to be *set-like* in its ith place iff the truth-value of any application of it is relative to a unique kind of conceptualization of its ith value such that it has a unique decomposition; and a wff is said to be set-like iff it involves at least one set-like predicate.

Syntactical Atoms:

- Singular variables $x,y,z,x_1,x_2,\ldots$
- Plural variables $xx,yy,zz,xx_1,xx_2,\ldots$
- Singular constants $a,b,c,a_1,a_2,\ldots$
- Plural constants $aa,bb,cc,aa_1,aa_2,\ldots$
- Existential quantifier $\exists$ and logical constants $\sim$ and $\wedge$
- A dyadic logical predicate '=' that is plural and collective in each of its places; and a dyadic logical predicate 'IsOneOf' that is singular and set-like in its first place and plural, collective, and set-like in its second place
- Non-logical predicates $R^n_1,R^n_2,\ldots$, for any adicity n, where some of them are standard singular n-place predicates; some of them are plural in one or more of their places, where among the plural predicates some are distributive in their plural places and some are collective in their plural places; and finally, some of the predicates are set-like in one or more of their places.

Formation Rules:

- '$R^n(t_1,\ldots,t_n)$' is a wff when R^n is an n-adic predicate and each one of $t_1,\ldots,t_n$ is a singular/plural term
- 't=r' is a wff when t is a singular/plural term and r is a singular/plural term
- 't IsOneOf r' is a wff when t is a singular term and r is a plural term

- ‘~Φ’ and ‘Φ∧Ψ’ are wffs when Φ and Ψ are wffs
- ‘∃vΦ’ is a wffs when Φ is a wff and v is a singular/plural variable
- The rest of the logical connectives (∨, →, ↔, and ∀) are defined and put to use in the obvious way

Note that the only revisionary aspect to our logical syntax is that each side of the identity-sign can be flanked by either singular or plural terms. We thus get wffs of the form x=y, xx=y, y=xx, and xx=yy, as well as mixtures involving singular and plural constants.

1.2. The Interpretation

We have a choice as to whether to mark the relational unit in set-like predication (i.e. the conceptualization of the relevant portion of reality) in terms of the semantics or in terms of the syntax. I do it in terms of the semantics as it is given in the meta-language (ordinary) English since this is the easiest and most intuitive way to go, i.e. keeps our language the least revisionary.[51] We let *Tr*[…] be a translation function from the predicates, terms, and wffs of our formal language into ordinary (albeit a schematized version of) intuitive English (and its worldly referents). We thus understand the values and truth-conditions of our terms, predicates, and wffs in terms of ordinary, intuitive English such that if, for some term t of our language, *Tr*[t] = ‘John’, then the value of ‘t’ is what the English word ‘John’ refers to; and if, for some wff Φ, *Tr*[Φ] = ‘snow is

[51] Doing it in terms of the semantics rather than the syntax is also how I suggested solving Sider’s objection concerning purely logical wffs in section 1.2, chapter I. Note that if we do it in terms of the syntax, then we need an additional place in all set-like predicates taking a conceptualization as its value. For example, intuitively, if R is a two-place plural predicate that is set-like in its second place, then it is really three place with a conceptualization of its second value as the third value. Marking this in the syntax gets ugly really fast. Just consider a four place predicate that is set-like in all its places. It would really be eight-place. We would also need to index the relational values so that they get connected to the right places.

white', then Φ has whatever truth-conditions 'snow is white' has. I will use 'C' as a schematic place-holder for whatever conceptualization is implicitly present in the English translation of the set-like predicate or wff. (In ordinary English, whatever is to be put in place for C is mostly obvious.) As above, I use 't' and 'r' as meta-variables for any singular/plural term.

Translation of atomic non-set-like wffs into ordinary English:

- $Tr[R^n(t_1,\ldots,t_n)] = Tr[R^n]Tr[<t_1,\ldots,t_n>]$
- $Tr[t=r] = Tr[t]$ is the same portion of reality as $Tr[r]$

Translation of atomic set-like wffs into ordinary English:[52]

- If $R^n(t_1,\ldots,t_i,\ldots,t_n)$ is set-like in its ith place, $Tr[R^n(t_1,\ldots,t_i,\ldots,t_n)] = Tr[R^n]Tr[<t_1,\ldots t_i,\ldots,t_n>]$ relative to $Tr[t_i]$ being conceptualized as C (where the instance of C is presumably provided by context).
- Tr[t IsOneOf r] = $Tr[t]$ is one of $Tr[r]$ relative to $Tr[t]$ being conceptualized as C and $Tr[r]$ being conceptualized as C* (where C and C* are presumably provided by context).

Translation of the non-atomic wffs into ordinary English:

- $Tr[\sim\Phi]$ = not $Tr[\Phi]$

[52] Though I here wish to remain as neutral as possible on the correct truth-conditions for the English counterparts of our formal language, a word or two should perhaps be said about how I envisage the truth-conditions for set-like sentences. In the case of ordinary English set-like sentences, I envisage the conceptualizations involved in their truth-conditions to be selected by context of use. In the case of sentences containing logical vocabulary such that there seemingly are no mechanisms for selecting a context (which is the problem posed in Sider (2007), discussed in chapter I, section 1.2 above), I envisage the truth-conditions to be *quantifying* over contexts (and thus provide the relevant relational units needed for its truth). For example, '∀xx∃y(y IsOneOf xx)' is true iff for any plurality xx, there is a y, and there is a context c, such that in c, y is conceptualized as being one of xx. We quantify over contexts which provide the conceptualization of y such that it is one of xx.

- $Tr[\Phi \wedge \Psi] = Tr[\Phi]$ and $Tr[\Psi]$
- $Tr[\exists t\Phi]$ = there is something/some one or more things such that $Tr[\Phi]$, where t is a singular/plural variable
- If $Tr[\Phi(t)]$ is set-like with respect to t, $Tr[\Phi(t)] = Tr[\Phi(t)]$ relative to $Tr[t]$ being conceptualized as C
- The rest of the wffs are translated in the obvious way

1.3. The Axioms

We accept a more or less standard set of axioms with only two minor revisionary aspects, the first of which is the natural consequence of our logical syntax, namely that Leibniz's Law allows hybrid singular/plural instances. This is not so much revisionary as it is just more general because, as will shortly become obvious, none of the classical laws of identity are violated; only properly generalized. The second revisionary aspect to our axioms is that the rules for the existential quantifier allow singular existential generalization into plural, collective places. As will shortly become clear, any possible controversy over these rules are taken care of either by the relational feature of set-like predication or simply by the collective feature of collective predication itself.[53]

Transformation Rules:

- All axioms and tautologies of an ordinary first order predicate calculus
- $\forall t(t=t)$, where t is a singular/plural variable (R)
- $\forall t \forall r(t=r \rightarrow (\Phi t \leftrightarrow \Phi r))$, where t is a singular/plural variable and r is a singular/plural variable

  (GLL)

[53] Some of the axioms will play no role in what follows, but I include them nonetheless, if not only for a feeling of more completeness.

- $\exists x\Phi(x)\rightarrow\exists xx\forall y[y \text{ IsOneOf } xx\leftrightarrow\Phi(y)]$
- $\forall xx\exists y[y \text{ IsOneOf } xx]$
- $\forall xx\forall yy[\forall z(z \text{ IsOneOf } xx \leftrightarrow z \text{ IsOneOf } yy)\rightarrow(\Phi(xx)\leftrightarrow\Phi(yy))]$
- From $\Phi(t)$ it follows that $\exists v\Phi(v/t)$, where v/t is v put in place for one or more occurrences of t in Φ, t is a singular/plural term, and v is a singular/plural variable

  (∃-in)
- From $\exists v\Phi$ it follows that $\Phi(d/v)$, where d/v is d put in place for all free occurrence of v in Φ, d is a previously unused singular/plural constant, and v is a singular/plural variable

  (∃-out)
- The rules for the universal quantifier are as expected

It will prove instructive to consider some simple derivations involving Leibniz's Law as well as the existential quantifier. (For ease of exposition, I make some obvious short-cuts from the above axioms to the conclusions.)

Consider the following valid derivation, where *Tr*[Three] = being three in number, and *f*() is the fusion operator:

1.	$a,b,c=f(a,b,c)\rightarrow(\text{Three}(a,b,c)\leftrightarrow\text{Three}(f(a,b,c)))$	GLL
2.	$\sim\text{Three}(f(a,b,c))$	As
3.	$\therefore a,b,c\neq f(a,b,c)$	1,2,MT

This derivation is *unsound* in our system: premise 2 is false. *Being three in number* is set-like in its one and only place, and as such, according to our translation rules above,

Tr[Three(a,b,c)] = *Tr*[Three]*Tr*[a,b,c] = *Tr*[a,b,c] are three in number relative to *Tr*[a,b,c] being conceptualized as C, where C is a conceptualization according to which *Tr*[a,b,c] has a unique decomposition into three things (which is the kind of conceptualization that is the relational unit in the predicate 'are three in number'). But then likewise: *Tr*[Three(*f*(a,b,c))] = *Tr*[Three]*Tr*[*f*(a,b,c)] = *Tr*[*f*(a,b,c)] is/are three in number relative to *Tr*[*f*(a,b,c)] being conceptualized as C, where C is the same as before, namely a conceptualization according to which *Tr*[*f*(a,b,c)] has a unique decomposition into three things. But *Tr*[*f*(a,b,c)] conceptualized such that it is uniquely decomposed into three things *are* three in number. Thus, premise 2 is false, and hence the conclusion doesn't follow. The fusion and its parts collectively both have the property *Tr*[There] relative to being conceptualized as C, and both lack it relative to being conceptualized as some other C*.

Now consider the following valid derivation, where *Tr*[IsOneOf] = being one of:

1.	a,b,c=*f*(a,b,c)→(*f*(a,b,c)IsOneOf*f*(a,b,c)↔*f*(a,b,c)IsOneOf(a,b,c))	GLL
2.	~*f*(a,b,c)IsOneOf(a,b,c)	As
3.	∴a,b,c≠*f*(a,b,c)	1,2,MT

This derivation too is *unsound* in our system: premise 2 is false. *Tr*[IsOneOf] is set-like in both its places, so as in the previous argument involving the numerical predicate 'Three', our translations make premise 2 false because *Tr*[a,b,c] in fact *has* the property of having *Tr*[*f*(a,b,c)] as one of them relative to being conceptualized such that it has a unique decomposition into the one thing *Tr*[*f*(a,b,c)].

The point generalizes: no set-like predication will differ between a fusion and all its parts collectively due to set-like predication being relational. Whatever is identical share all properties!

Consider the following derivation, where *Tr*[FormSet] = forming the set…, which is collective in its first place:

1.	(a,b,c)FormSet(d)	As
2.	∴∃x((x)FormSet(d))	1,∃-in

This derivation is *valid*: if premise 1 is true, then the conclusion must be true too. Why? Well, assume premise 1 is true, but the conclusion 2 is false. Note that *Tr*[FormSet] is set-like with respect to its first place, and hence that *Tr*[2] is set-like with respect to *Tr*[x]. By assumption this then means that *Tr*[x] relative to being conceptualized as some things that form the set *Tr*[d] does not form the set *Tr*[d], which is absurd, given the other assumption that *Tr*[a,b,c] form the set *Tr*[d]. *Tr*[x] = *Tr*[a,b,c] (albeit conceptualized differently!), so of course *Tr*[x] conceptualized as *Tr*[a,b,c] form the set *Tr*[d], if *Tr*[a,b,c] form the set *Tr*[d], which it does by assumption. Otherwise we reach an absurdity a la the morning star conceptualized as the evening star not being Venus even though the evening star is Venus. In yet other words, *Tr*[2] is true iff there is at least one thing in our domain which satisfies the predicate '…form the set *Tr*[d]'. But the portion of reality that is *Tr*[a,b,c] satisfies the predicate by assumption 1, so of course that same portion of reality

when conceptualized as a singular thing also satisfies it relative to being conceptualized as *Tr*[a,b,c]. It is thus impossible for 2 to be false, if 1 is true.[54]

There is no question here of *Tr*[x] being any *one* of a,b,c, since that would violate the collective feature of FormSet. The traditional ban on singular distributive quantification into collective places is accepted and upheld. (Of course, if some things form the set s, then no one of them form the set s; they do it together!) But this traditional ban is silent on singular *collective* quantification into plural collective places, which is what we allow in virtue of the same portion of reality simply being conceptualized in different ways.

Consider the following derivation involving the above numerical predicate 'Three' such that *Tr*[Three] = being three in number:

1.	Three(a,b,c)	As
2.	$\therefore \exists x$Three(x)	1,$\exists$-in

This is also a valid argument in our system much for the same reasons as above. Assume 1 is true, but 2 is false. Then it is false that *Tr*[x] relative to being conceptualized as being three things, e.g. as being *Tr*[a,b,c], is three in number. But *Tr*[x] conceptualized as those three things has a unique decomposition into *Tr*[a,b,c], which by assumption 1 are three in number. So *Tr*[x] relative to being conceptualized as *Tr*[a,b,c] must be three in number too, contradicting that it is not.

There is again no question of any one of *Tr*[a,b,c] being three in number. Such a move is not admitted in our system. Singular existential generalization into plural,

[54] The only way for this to be possible is if it is impossible to *re*-conceptualize the portion of reality. But I argued in chapter I that there is no reason to think that such re-conceptualization is impossible.

collective places is collective singular existential generalization. That is, it is singular existential generalization over the plurality collectively, but conceptualized as a singular portion of reality. This singular portion of reality has many set-like properties relative to being conceptualized as many, being three is one of them. But that does not stop the portion of reality from being a singular portion of reality being one in number (and not being three) relative to another conceptualization of it. Thus, what partly secures the validity of singular existential quantification into plural collective places is that many (though not all) plural collective places are set-like, and the one and only way to understand or interpret such predicates in our system is as relational predicates with a conceptualization as the relational unit. Set-like predicates do not ascribe intrinsic properties to things, only relational properties, and with no shortage on the (relevant contexts by which we get the) relevant conceptualizations, there is nothing in these cases that invalidates the ∃-in-rule.

What about the plural collective predicates that are non-set-like? Consider *having mass m*. It can (though need not) be understood collectively. That is, a,b,c can have mass m collectively in the sense that m is the sum of all the individual masses of a, b, and c. Nonetheless, we can re-conceptualize the portion of reality such that it has a different unique decomposition, say as *f*(a,b),c, without altering its mass. So, *having mass m* is non-set-like, but (possibly) collective.

Such predicates create no problems in our system. Consider the following derivation, where *Tr*[MassM] = collectively having mass m:

1.	MassM(a,b,c)	As
2.	∴∃xMassM(x)	1,∃-in

Since premise 1 is non-set-like, no *unique* decomposition needs to be attached to its one and only place in order to make it true of a portion of reality. The predicate holds of the portion of reality under *any* way of conceptualizing it; as long as it is collective. (*Having mass m* is thus arguably an intrinsic feature of the portion of reality, not a set-like relational feature.) The singular existential generalization in 2 is collective too. This is simply required by the fact that the very understanding of the predicate MassM is as being collective in its one and only place. Thus, again, absent the lack of possible conceptualizations there is nothing to invalidate the existential move from 1 to 2. In fact, since 'MassM' is collective, but *non*-set-like, holding 1 to be true, but 2 to be false is arguably incoherent. Thus, what finally secures the validity of our ∃-in rule is simply the collective feature of collective predication itself.

Identity is absolute, not relative. So, interestingly, '=' is like 'MassM': collective, but non-set-like. If a,b,c are identical with d, then *f*(a,b),c are also identical with d, but d is not identical with any one of a,b,c,*f*(a,b). As a result, we can derive some interesting immediate theorems, and ultimately full classical mereology.

<u>1.4. Some Theorems of Identity</u>

(Symmetry): $\forall xx \forall yy\ (xx=yy \rightarrow yy=xx)$

Proof: assume xx are identical with yy. Then, by GLL, xx are identical with xx iff yy are identical with xx. By R, xx are identical with xx, so it follows that yy are identical with xx. Q.E.D.

(Transitivity): $\forall xx \forall yy \forall zz\ ((xx=yy \wedge yy=zz) \rightarrow xx=zz)$

Proof: assume xx are identical with yy and yy are identical with zz. By Symmetry, yy are identical with xx. Then, by GLL, yy are identical with zz iff xx are identical with zz. Since yy are identical with zz (by assumption) it follows that xx are identical with zz. Q.E.D.

Since any of our plural variables can take singular values, these theorems also cover the singular and hybrid cases of '='.[55]

(T1): $\forall xx \exists y(xx=y)$

Proof: By R, xx=xx; by existential generalization, $\exists y(xx=y)$; and by universal generalization, $\forall xx \exists y(xx=y)$. Q.E.D.

(T2): $\forall xx \forall y((xx=y) \rightarrow \forall z(xx=z \rightarrow z=y))$

Proof: assume xx=y and that xx=z, but that $z \neq y$. Then, by symmetry of identity, z=xx, and hence by the transitivity of identity, z=y, which contradicts our initial assumption. Q.E.D.

2. Classical Mereology as a Calculus of Identity

In subsection 2.1, I provide some definitions in terms of identity. In subsection 2.2., I derive classical mereology from our logic of identity.

[55] In fact, our system could overall be much simplified by only having plural terms, and then define the singular wffs out of our plural wffs. But I aim for intuitive obviousness rather than terminological minimality.

2.1. Mereological Definitions

Given our plural identity from section 1, we have no need for a mereological primitive. All mereological predicates can be defined out of identity. The mereological predicates we need in what follows are the following:

(D1): xx *compose* y $=_{df}$ xx=y

(D2): y is *the fusion of* xx $=_{df}$ xx compose y

(D3): y is a *part* of x $=_{df}$ x is the fusion of y and some z

(D4): y is a *proper part* of x $=_{df}$ y is a part of x but is not identical with x

(D5): x *overlaps* with y $=_{df}$ some z is part of both x and y

(D6): x is *disjoint* from y $=_{df}$ x does not overlap with y

Having thus understood composition and fusion as identity we must furthermore, on pain of incoherence, understand all other relations involving overlap, e.g. D3-D5, as *partial identity*/*distinctness*. If *full* overlap a la composition (and hence fusion) is full identity, then *partial* overlap a la parthood (and other kinds of sharing of parts) must be partial identity. If my body parts are collectively identical with my body, then it simply makes no sense, or it is at least completely *ad hoc* to simultaneously hold that my arm is a fully distinct portion of reality from my body. And of course, what's only partially identical with something is also partially distinct from it. Full distinctness between portions of reality is disjointness as per D6.

2.2. Classical Mereology Derived

(T3): any xx compose some y

Proof: immediate from T1 and the definition of composition. Q.E.D.

(T4): if xx compose y, then any z that xx compose is identical with y

Proof: immediate from T2 and the definition of composition. Q.E.D.

(T5): if x is part of y and y is part of z, then x is part of z

Proof: assume x is part of y and y is part of z, but x is not part of z. Then, by the definition of parthood, x and some r compose y, and hence by definition of composition are identical with y: x,r=y. Also, y and some v compose z, and hence are identical with z: y,v=z. But then, by GLL, x,r,v=z. By T1, r,v=d, and hence by GLL, x,d=z. But then there is some w such that x,w=z, and hence by the definition of parthood, x is part of z. But this contradicts our initial assumption that x is not part of z. Q.E.D.

(T6): if x is part of y and y is part of x, then x is y

Proof: assume x is part of y and y is part of x. Then, by T5, whatever is part of x is part of y and whatever is part of y is part of x. That is, x and y share all their parts. Letting dd be all these shared parts of x and y it follows that dd compose x and dd compose y. Then, by the definition of composition, dd are x and dd are y. By symmetry and transitivity of identity, x is y. Q.E.D.

(T7): x overlaps y iff x is not disjoint from y

Proof: assume x overlaps y. Then by our definition of disjointness, x is not disjoint from y. Assume x is not disjoint from y. Then again by our definition of disjointness, x overlaps y. Hence, x overlaps y iff x is not disjoint from y. Q.E.D.

(T8): x is part of x

Proof: assume x is not part of x. Then by definition, there is no z such that z,x compose x. But by R, x=x, and hence by definition of composition, x composes x. But then trivially, x,x compose x, and hence there is some z such that z,x compose x. Contradiction. Q.E.D.

(T9): if x is proper part of y and y is proper part of z, then x is proper part of z

Proof: assume x is proper part of y and y is proper part of z, but that x is not proper part of z. Then by definition, x is part of y and y is part of z. By T5, x is then part of z. By assumption, x is either not part of z or x is identical with z. But since x is part of z, x must be identical with z. Then, since x is part of y and y is part of z, by GLL, x is part of y and y is part of x; so by T6, x is identical with y. By assumption, x is proper part of y, and hence by definition, x is not identical with y. Contradiction. Q.E.D.

(T10): if x is proper part of y, then y is not proper part of x

Proof: assume x is proper part of y and that y is proper part of x. Then x is part of y, but not identical with y and y is part of x, but not identical with x. But then by T6, x is identical with y. Contradiction. Q.E.D.

(T11): if x is proper part of y, then there is some z that is part of y, but disjoint from x

Proof: assume x is proper part of y and that there is no z that is part of y but disjoint from x. Then x is not identical with y and whatever is part of y overlaps x. Assume that whatever is part of x overlaps y. Then, since nothing is part of one and disjoint from the other, x and y share all parts, and hence, by T3 and T4, x and y are identical. Contradiction. So some z, call it a, is part of x, but disjoint from y. But x is proper part of

y, and hence part of y, and hence, by T5, whatever is part of x is part of y. So a is part of y. But then, since a and y share a part, namely a, a is, by T7, not disjoint from y. Contradiction. Q.E.D.

Classical mereology as it is given in e.g. Tarski (1929), Leonard & Goodman (1940), Simons (1987), Lewis (1991), and Casati & Varzi (1999) amounts to various subsets of T3-T11. So, classical mereology follows from our generalized plural identity. Hence, classical mereology can be thought of as a mere definitional extension of the logic of identity, and as such is universally applicable, ontologically innocent, and a part of logic proper.[56]

2.2.1. What exactly is Classical Mereology?

It turns out that exactly what is to count as *classical* mereology is a terminological mess. Lewis (1991:74) says that *mereology* amounts to T1-T3 'besides whatever it may take to close the circle of interdefinition'. He lists various works by Lesniewski as well as for example Tarski (1929) and Leonard & Goodman (1940) as other expositions of what he calls 'mereology'. Lewis does not say what exactly he means by 'whatever it may take to close the circle of interdefinition'; nor does he use the term 'classical mereology'. It is nonetheless clear that he intends his system to be equivalent to that of classical mereology (whatever exactly that is). Now, Tarski (1929) himself only provides T1-T3, does not mention any further axioms, and claims that T1-T3 is equivalent to Lesniewski's system. Tarski thus sees no need for anything besides T1-T3. Casati & Varzi (1999:47) claims that Tarski (1929) is equivalent to what they call *classical*

[56] In Bohn (2009a) I argue that if composition is *not* identity, then classical mereology is not necessarily true. Its contraposition is: if classical mereology is necessarily true, then composition is identity. The present paper argues that if composition is identity, then classical mereology is necessarily true. Putting things together we get: composition is identity iff classical mereology is necessarily true.

extensional mereology, which is a *strengthening* of what they call *classical mereology* by adding either T9; or a principle of *strong supplementation*: if x is not part of y, then there is a z that is part of y, but that does not overlap x. What Simons (1987:1) calls *classical extensional mereology* on the other hand, is the system in Leonard & Goodman (1940), and when Simons (1987:37) states it axiomatically himself (ambiguously under both the title 'classical extensional mereology' and 'classical mereology'), T9 is included as an axiom.

I have not tried to figure out exactly how the terminology should be used, nor have I tried to figure out which systems are equivalent and which are not.[57] In fact, as proven in Hovda (2009), it turns out to also depend on how we choose to define the mereological predicates to begin with. But in any case, I simply use the term 'classical mereology' for any of the systems above.

[57] The way to prove such equivalence is of course to prove each axiom set in terms of each other.

CHAPTER III

A CONTEMPORARY INTERLUDE

So far I have argued that mereology, and in particular classical mereology, is best understood as a generalized calculus of plural identity. Any plurality is identical with one thing. But the idea that mereological relations are relations of identity is not new. For example, according to Plato in the Theaetetus (204a), Socrates says: *if a thing has parts, the whole thing must be the same as all the parts*.

In this chapter I will discuss four contemporary attempts at articulating this ancient philosophical idea by David Armstrong, Donald Baxter, David Lewis, and Ted Sider, respectively. Throughout I compare and assess their accounts in relation to mine.

1. David Armstrong

Armstrong (1978:36-39) starts out by divorcing the part-whole relation from space and time, or spacetime. Not only is my left arm a part of my body and the earth a part of the universe, but the terror is a part of the French revolution, the class of all women is a part of the class of all human beings, the property F is a part of the conjunctive property F&G, and the proposition P is a part of the conjunctive proposition P&Q. Armstrong goes on to suggest that the part-whole relation is thus ubiquitous because it is an instance of *partial identity*, and identity is indeed ubiquitous. Partial identity is the intermediate cases of complete identity and complete distinctness. For example, while my body is completely identical with itself, my body except my head is partially identical with my body, my body except my head, legs, and arms, are also partially identical with my body (though less so identical than in the earlier case), and finally my body is completely distinct from anything not overlapping my body. In short, the mereologically bigger part one takes of

something, the more identity one gets, and the lesser mereological part one takes of something, the less identity one gets. But then parthood cannot be the only such relation of partial identity. Any two things that share a part are thus partially identical with each other, so not only parthood, but composition and overlap must be relations of identity as well. Armstrong thus finally suggests that 'the so-called "calculus of individuals" together with "mereology" are thus simply developments of the logic of identity"' (1978:38).

So far, Armstrong's idea is exactly what I have tried to develop in chapters I and II above. But a problem is that Armstrong (1978) provides no arguments in favour of this thesis, only some scattered suggestions. He does put the thesis to use, and hence might be thought to thus at least indirectly motivate it, but he does so mostly concerning issues internal to his own (controversial) account of properties as Aristotelian universals. There is thus so far no immediate reason for someone not already convinced by the thesis (nor of his thesis of properties) to become convinced by what he has said so far. Now, later Armstrong (1997:12-13,17-18) might be taken to somewhat substantiate the main idea. In fact, though he presents it as a preliminary doctrine, or a mere working assumption, we can from these more recent remarks extract something of an argument for composition being identity.

The first premise is that whatever supervenes on something, or some things, is no addition of being; it is an "ontological free lunch", or "nothing over and above" the subvenient entities; where (in the case of objects, which is our main interest here) Armstrong understands supervenience as something x, or some things xx, supervening on something y, or some things yy iff it is impossible for y, or yy to exist, but not x, or xx (with y and yy being possible). The second premise is that a fusion f(xx) supervenes on its parts xx and xx supervenes on their fusion f(xx). It thus follows that in the case of a

fusion and its parts we have symmetrical supervenience, and given premise one it thus follows that a fusion and its parts are no addition of being compared to each other, and hence identical with each other. Thus, for Armstrong 'symmetrical supervenience yields identity' (1997:12).

Now, given that they are only presented as preliminary remarks, Armstrong should not be taken as trying to convince anyone by these remarks, but rather to be merely making his assumptions explicit. But nonetheless, both premises are so easily rejected that it casts some doubt on the plausibility of the thesis even as a working hypothesis. First of all, it is highly unclear what the first premise even means. What is it to be no addition of being compared to something else? Furthermore, Armstrong's principle of supervenience is a principle of necessitation. But then it follows in connection with premise one that mathematical objects, if they exist necessarily, are no addition of being compared to me. That seems strange. Armstrong provides an example of something that is no addition of being compared to something else, namely *internal relations*. An internal relation is a relation between n things that obtains in virtue of the natures (perhaps the sum of their intrinsic properties) of the n things alone. For example, two red things are internally related by the relation of similarity in color. Their similarity in color obtains in virtue of the color of the two objects alone: the natures of the two objects necessitate the similarity relation. The similarity relation thus supervenes on the two objects. According to Armstrong, we are intuitively inclined to judge that this similarity relation is no addition of being compared to the two objects: if we have the objects we *thereby* have the similarity relation. All we need to get the similarity relation to hold is the two objects and nothing else. But the problem here is of course to understand how this intuition generalizes beyond internal relations, and especially how it generalizes to account for *objects* being no addition of being compared to other objects.

Now, having already taken the main idea on board, there *is* of course a way of understanding what 'no addition of being' means: 'no addition of being' just means *being the same as*. For example, my body parts are no addition of being (as well as an ontological free lunch and nothing over and above) compared to my body in the sense that they collectively are my body. But of course this is of no help above since it presupposes what it is taken to explain. Also, it might completely destroy the more or less illuminating example of internal relations since an internal relation is presumably not the same as the objects it relates. (Though Armstrong (2004:46-47) provides the hint towards a solution of this latter problem: internal relations are *partially* identical with the objects they relate. This of course raises a host of new problems, but in any case, I will leave this matter here.)

One might also easily reject the second premise of the above argument. If one thinks that a whole can survive the loss of some parts and that some parts of a whole can survive not being parts of their whole, then there simply is no symmetrical supervenience between wholes and their parts. And of course, common sense intuitions tell us that composite objects as well as their parts *can* so survive: my body would remain the same body despite the loss of a finger and a wheel of my car could have been the wheel of a different car. (Note also that classical mereology is itself completely silent on this matter.)

Armstrong further claims that the doctrine of the ontological free lunch provides a reason to accept unrestricted composition, i.e. that any plurality composes something (1997:134). But even accepting the above argument, there is still no immediate reason to think that this is the case. Just like the following conjunction is coherent: all statues are identical with the piece of clay they are made from (assuming for the moment that all statues are made from pieces of clay), but not all pieces of clay are identical with a

statue; so the following conjunction is coherent as well: all fusions are identical with their parts collectively (i.e. some plurality), but not all parts collectively (i.e. pluralities) are identical with some fusion. Armstrong has no rebuttal to such an argument. In chapter I, I argued that my account is not affected by such an argument. I am not sure to what extent Armstrong can adopt a similar reply.

I conclude that though Armstrong has provided us with the bare bones of a very intuitive and attractive idea indeed, he has provided us with little by reasons for how to understand what this intuition more exactly amounts to, not to mention by reasons for believing it true. I take my account in chapters I and II above to provide the missing links.

2. Donald Baxter

Drawing on work by Joseph Butler, Baxter (1988a) starts out by making a distinction between two kinds of identity – one-one identity between one thing and one thing versus many-one identity between many things and one thing – as well as between two standards on which identity might hold – a strict standard versus a loose standard. One-one identity holds on both standards, while many-one identity only holds on the loose standard. What is strictly distinct can be loosely identical, so what is strictly many can be loosely one, and hence what is strictly many can be many-one identical. With this distinction in mind, Baxter then makes a further distinction between three notions of the part-whole relation: (i) the non-identity view, (ii) the identity view, and (iii) the combination view. The non-identity view, or what Baxter also calls 'the more familiar view', is that 'the whole is numerically distinct from each of its parts' (1988a:578). The identity view is the view that 'the whole is the many parts counted as one thing' (ibid). On this latter view, 'there is no one thing distinct from each of the parts which is the

whole. Rather the whole is simply the many parts with their distinctness from each other not mattering' (ibid). That is, the whole is loosely, but not strictly identical with the parts. Now, it might seem as if the identity view is notoriously ambiguous between a distributive and a collective reading of being the parts. Nonetheless, if there is no one whole that is distinct from each of the parts, but there nonetheless is a whole (Baxter (ibid) says that the identity view 'is not to deny the existence of the whole'), then this whole must be identical with each of its parts, and hence the many-one identity is distributive in its many-place. It thus follows that on the identity view I am identical with my left arm. That this is indeed what Baxter has in mind with the identity view becomes clear by the fact that he distinguishes it from the third view, namely the combination view: 'the parts are each distinct from the whole and yet the parts collectively are identical with the whole' (1988a:579). The only way to make sense of the identity view as opposed to both the non-identity view and this combination view is as saying that it holds the whole to be identical with each of its parts.

Note that the non-identity view and the combination view are not necessarily in competition. They both agree that the whole exists and is numerically distinct from each of its parts. The difference is that the non-identity view, at least as stated by Baxter, leaves it open whether the whole is identical with all its parts collectively, while the combination view makes the further claim that it is so identical. Baxter goes on to defend the identity view by providing an argument against the combination view. Since the combination view roughly corresponds to the view I defend in chapters I and II, I will now assess this argument.[58]

[58] Baxter also provides a nice motivation (in fact, an argument) for the non-identity view and claims to show how the identity view can accomodate this motivation. Unfortunately I am unable to make coherent sense of how this is supposed to work according to Baxter. Everything he says in this regard seems to me to rather reflect well on the combination view, not the identity view. But be that as it may.

Baxter starts out by making two assumptions. First (ibid:580): ‘something can be one thing without being a single thing’. Presumably he here makes a distinction between two kinds of objects, namely *Multitudes* and *Single Things*. Multitudes can be one thing, namely a multitude, but cannot, being the multitude it is, be a Single Thing; while a Single Thing can be one thing and of course a Single Thing. For example, a family is a Multitude that can be one thing, namely the family, but it cannot be a Single Thing, while perhaps my body can be one thing and a Single Thing. Second assumption (ibid:580): ‘any single thing is not a multitude; and any multitude is not a single thing’. That is, Multitudes and Single Things are two different kinds of things, never the same (just like cats and dogs are different kinds of things, never the same). Now here is the argument against the combination view (or at least the best I can make of it): according to the combination view, a whole is identical with all its parts collectively. Assume f(xx) is an arbitrary composite object, i.e. an arbitrary thing composed of two or more parts xx. Then xx is a Multitude. By the laws of identity, f(xx) is a Multitude. Generalizing, any composite object is a Multitude. Then, equivalently, any non-Multitude is not a composite object. Let y be a Single Thing. Then, by the second assumption, y is a non-Multitude. But then y is not a composite object, i.e. y is a mereological simple, an object without proper parts. Then, given that Multitudes consist of many Single Things, which are not Multitudes themselves, the Single Things must be mereological simples. The combination view thus implies that if there is a composite object, then there are mereological simples. Hence, to the extent that one’s theory of the part-whole relation should remain neutral on whether there are mereological simples or not, the combination view is not the right view to hold of the part-whole relation.

As I have construed the argument it is logically valid (or can at least by conditionalizing be easily made so). Thus, by denying the conclusion one is forced to

deny a premise. But note that in addition to the two assumptions that Baxter lists, there is a hidden assumption he doesn't (but I did) explicitly mention, namely that all Multitudes consist of Single Things. We thus have three options for denial, not just two. I believe *all* three options are worthy of denial. Very plausibly, anything that is one thing is a single thing and anything that is a single thing is one thing; i.e. there are no distinction between two kinds of objects, one being a Multitude and another being a Single Thing. There are just objects, some composites and perhaps some simples, but they are all of the same kind, namely *objects*. Now, there are pluralities and objects making up those pluralities, but that is no distinction between two kinds of objects since a plurality is not an object, but many objects. The second assumption is thus denied as well since there are no objects that are Multitudes as opposed to Single Things. I thus of course also deny the third assumption for the same reason: there are no such objects as Multitudes that are made up from Single Things. Again, there are pluralities that consist of single things, but pluralities are not single objects, but rather many objects. All in all, there is thus no compelling reason to accept Baxter's conclusion. The combination view is a fine view as far as Baxter's argument is concerned.[59]

Baxter (1988b) provides a seemingly different, but more detailed theory of many-one identity than the one found in his (1988a). In this second theory we are introduced to three notions that are more or less taken as primitives and which provide the backbone of a theory of many-one identity that is meant to solve many metaphysical puzzles. We will again focus only on how the theory is meant to reflect on the part-whole relation. The first notion we need is the notion of a *count*. A count is simply the result of some rules for (or a way of) counting things (1988b:200). Since how many things there are is relative to a count, existence is relative to a count as well. That there are four legs and a

[59] Some version or other of the combination view is also what Armstrong, Lewis, and Sider all have in mind by the name 'composition as identity'.

tabletop (i.e. five things) is relative to one count and that there is a table (i.e. one thing) is relative to another count. No count is objectively *the correct* count, but some counts are pragmatically better for some purposes and pragmatically worse for others. The value of a count is thus relative to interest, or the use it is put to. Baxter further 'make[s] it a principle that there is a count which includes the several parts and a count which includes the whole, but no count which includes both' (1988b:201). Baxter's justification for this principle eludes me. Why can I not prescribe rules for counting such that all the parts and the whole are included in the result of the counting? In any case, we'll accept it here for the sake of argument (since as we will see below, he does, in a way, *account for* the intuition that they can exist in one and the same count). The second notion we need is the notion of *intra-count identity* versus *cross-count identity*. The intra-count identity is just the ordinary one-one identity that we all know and love. The cross-count identity is n-one identity across counts, for any number n greater than zero. That is, one thing in one count can be identical with one thing in another count and many things in one count can be identical with one thing in another count. The third and final notion we need is the principle of *discernibility of identicals*. What is one and the same thing can nonetheless be discernible from itself. That is, one and the same thing can differ in properties. The way Baxter (ibid:203-6) understands such a principle so as not to come out contradictory, I believe, is as follows: consider my body. Qua left arm it is typing on a computer, but qua left leg it is not typing on a computer; hence one and the same thing, namely my body, is both typing and not typing on a computer. We can thus discern my body in two different ways such that as so discerned it differs from itself, but is nonetheless one and the same body. Though Baxter thus denies our ordinary principle of indiscernibility of identicals, he is only denying it whenever the relata of the identity relation are considered qualifiedly (i.e. qua F and qua G); he is not denying it when the relata are considered

*un*qualifiedly: 'Identicals considered unqualifiedly are indiscernible. But identicals considered qualifiedly may be discernible' (1988:206). Exactly what Baxter means by considering something *un*qualifiedly eludes me. It cannot mean to consider some x such that for no F is x thought of, or considered as F. That seems impossible. It might mean that for some x and y and some kind F, x and y are both considered as being of kind F, and when so considered they are indiscernible. For example, the morning star and the evening star, when both are considered as a planet, are indiscernible, but when one of them is considered as a star and the other is considered as a planet, then they might be discernible. But the more general coherency of this way of thinking of it depends on how we restrict or understand the kind F. In any case, I will accept here for the sake of argument, perhaps *per impossible*, that something can be considered unqualifiedly and when so considered are indiscernible.[60]

We now, presumably, have the tools for understanding how many things can be identical with one thing, but in particular for our purposes here, how many parts can be identical with the one whole they are parts of. Consider a plurality $x_1,x_2,\ldots x_n$ of n things (n>1), abbreviated by the plural variable xx, and its one fusion f(xx). The plurality xx exists relative to one count C_p and the fusion f(xx) exists relative to another count C_f (and by the principle that no fusion exists relative to the same count as its many proper parts, C_p is not C_f). Now consider C_f according to which the fusion f(xx) exists, but not the plurality xx. Recall that we can consider the fusion qua various things, including qua any of its parts. We can thus consider the fusion f(xx) qua any x_i. Though the fusion and the various ways it is thus considered as are discernible, they are nonetheless the same (recall that only one thing exists in the count C_f under consideration). The fusion f(xx) is thus discernible from but identical with x_i as well as x_j. By symmetry and transitivity of

[60] For my way of understanding what seems on its face as a difference in predication between identicals, but without invoking a principle of discernibility of identicals, see chapter I above.

identity, x_i is thus identical with x_j as well. Now consider the count C_p according to which the plurality xx exists, but not their fusion f(xx). We can now map each one of xx in C_p into some ways of considering the fusion f(xx) in C_f, namely the ways corresponding to each one of xx in C_p. Call the way of considering the fusion f(xx) that a thing in xx is mapped onto, its *image*. Baxter then says that 'there is a perfectly good sense of identity in which each part is identical with its image. This is what I am calling 'cross-count identity'' (1988:208). We thus finally invoke our notion of many-one cross-count identity to understand how a fusion is identical with its parts: the fusion f(xx) in C_f is intra-count identical (though discernible) with each of its ways x_i of considering it, but the notion of cross-count identity says that x_i in C_p is identical with the way x_i of considering the fusion f(xx) in C_f, i.e. with its image, so by the transitivity of identity, f(xx) is identical with x_i. There is also a way in which the fusion f(xx) is identical with all of xx collectively, namely in the cases where the image of the fusion is the fusion considered unqualifiedly. That is, we map all of xx in C_p collectively onto the fusion considered as itself in C_f. xx collectively are cross-count identical with its image, namely f(xx) considered as f(xx), and since f(xx) is identical with itself, it follows by transitivity of identity that xx collectively are identical with f(xx). Generalizing, it follows that any fusion is identical with each of its parts. Instantiating, it follows that I am identical with my left foot, and that the world is identical with my brain.

That is simply an incredible result and something has to go in order to avoid the conclusion. I believe all three background notions are worthy of denial. First, I believe I can trivially provide different ways of counting something. For example, on the one hand, I can count only the four legs and the tabletop and not the table. This provides me with five things. While on the other hand, I can count only the table and not any of its parts. This provides me with one thing. But none of this has the power to rule that

existence is relative to such counts. I might nonetheless hold that both the four legs and the tabletop exist *simpliciter* and that the table exists *simpliciter*. A count is simply a restriction on what to count, not a restriction on what exists. Baxter has done nothing to justify the thought that a count is a restriction on existence rather than a restriction on what to count among all the things that exist. True, he says of a theory that assumes that the way we count should not be taken as an indication of how many things there are: 'Why assume this?' (1988:201). Now, we should *of course* assume that the way we count is an indication of how many things there are; but we should likewise *of course not* assume that the way we count according to *any particular* rule of counting for some *particular purpose* of so counting should be a good indication of how many things there are. We simply often (in fact, almost always) restrict what to count, which reflects nothing on what there is. We thus have no reason to think that existence is relative to count. But most importantly, that existence is not relative to a count is much more plausible than that I am identical with my left foot.

Second and third, I see no good reason to accept that there are *two* notions of identity, namely cross-count versus intra-count identity as long as it involves also accepting a principle of discernibility of identicals. Identity is the simple equivalence relation governed by a principle of *in*discernibility of identicals that everything bears to itself and to nothing else. Thus, any notion that involves a principle of discernibility of identicals is arguably a notion of non-identity. To the extent that I understand this latter principle of discernibility at all, me discerned as, considered as, or qua my left foot, simply seem to be my left foot, not me (for example because I also have a right foot, which my left foot doesn't have). I would thus happily reject this principle of discernibility of identicals *before* I accepted the incredible conclusion that I was identical with my left foot.

I would thus reject any of the three background notions before I accepted the conclusion. As for the possible motivations for the view, namely that it can solve some metaphysical puzzles, I would look to other independently motivated solutions to many of these puzzles before I accepted that I am my left foot, But also, in chapter I, I provide much independent motivation for a fusion being identical with all its parts collectively, though not distributively, and I do so in a way that avoids the highly counterintuitive result of Baxter's account, e.g. that I am my left foot.[61]

I conclude that Baxter's account is radically different from mine, and that my account is much preferred over his, especially on intuitive grounds of coherence.

3. David Lewis

Lewis (1991:75&81) famously claims that classical mereology is 'perfectly understood, unproblematic, and certain', that 'all suspicions against it are mistaken', and that it is 'ontologically innocent'. The reasons he goes on to provide for this 'minority opinion' (ibid) are somewhat mysterious. That all suspicions against mereology are mistaken he partly justifies by appealing to four-dimensionalism concerning objects and spacetime as well as counterpart theory concerning our understanding of modality. Both these positions are of course highly controversial, so that they can provide a ground for something that is perfectly understood, unproblematic, and certain, as well as ontologically innocent, is a bold claim indeed. We should thus perhaps best understand these claims as being internal to a philosophical picture that includes counterpart theory and four-dimensionalism. That is, classical mereology is perfectly understood, unproblematic, and certain, as well as ontologically innocent, *within* this philosophical

[61] Baxter might be thought to remain silent on the extent of composition and as such many of my examples, or counterintuitive results, might be thought to be irrelevant. But if so, simply pick any composite object that exists according to Baxter. The same general points apply.

picture, not external to it. In any case, assessing the general position here would be to go too far off track for present purposes. Therefore, in what follows I will mainly be concerned with Lewis's articulation of the view as being ontologically innocent, but internal to his philosophical picture that includes counterpart theory and four-dimensionalism. As mentioned in the preface, the account I develop and defend in chapters I and II above is also perhaps best viewed within such a general philosophical picture. That is not to say that there is any particular genuine commitment involved. There is not.

Here are the first essentials of Lewis's view (ibid:81-82):

> To be sure, if we accept mereology, we are committed to the existence of all manner of mereological fusions. 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. Take them together or take them separately, the cats are the same portion of Reality either way. … If you draw up an inventory of Reality according to your scheme of things, it would be double counting to list the cats and then also list their fusion. … For the most part, if you are committed to the existence of a certain thing or things, and then you become committed to the existence of something that bears a certain relation to it or them, that is indeed a further commitment. … But the relation of identity is different. If you are already committed to the existence of cat Possum, and then affirm that there exists something identical to Possum, that is not a further commitment. I say that composition – the relation of part to whole, or, better, the many-one relation of many parts to their fusion – is like identity. … Call this the Thesis of *Composition as Identity*. It is in virtue of this thesis that mereology is ontologically innocent: it commits us only to things that are identical, so to speak, to what we were committed to before.

It should be fairly clear what Lewis is saying here. Being already ontologically committed to the existence of an object, say Hesperus, it is no further ontological commitment to affirm the existence of something identical with it, say Phosphorus. In fact, it is a theorem of the standard logic of identity that whenever something exists there exists something identical with it too (i.e. from x=x it follows by existential generalization that there is some y such that y=x). If my domain of ontological commitment is the singleton plurality of Hesperus, then affirming that Phosphorus exists as well is not changing my domain of commitment. I don't thereby get a doubleton plurality as my ontological commitment, but rather I just get two names for one and the same object in my singleton plurality commitment. Lewis claims that mereological composition shares this feature of ontological innocence with identity. Being ontologically committed to the existence of n objects, say the eight planets in our solar system, it is no further commitment to affirm the existence of their fusion. That is, the mereological theorem of unrestricted composition[62] according to which whenever there are some things, there exists a fusion of those things is the analogue of the theorem of identity mentioned above according to which whenever there is a thing, there exists something identical with it. If composition and identity is the same in this respect, then in both cases it is (in fact, must be) the case that one's domain of ontological commitment remains the same under both these theorems.

But though it is clear how this happens in the case of identity, how can this be in the case of composition? Consider an ontological commitment to the existence of n things. It is then a theorem of (classical) mereology, mainly in virtue of the theorems of unrestricted and unique composition (and the lack of a null element), that there are 2^n-1 objects. But then our domain of ontological commitments seems not to have remained

[62] It is usually taken as an axiom, but axioms are of course theorems as well. I use 'theorem' mainly to compare it with identity according to which there usually is no axiom of there always being something identical with any x.

the same under the theorem of unrestricted composition, which it seemed above it had to in order to be like identity in this respect. It might thus seem as if we have reached absurdity concerning the one respect in which composition was said to be like identity. But Lewis is of course not making a silly mistake concerning the theorems of mereology here. Later on he says this concerning a piece of land divided into six parcels (ibid:83-85):

> Indeed! I grant that no one of the six parcels *by itself* is identical to the original block of land. Still, there is a good sense in which the six parcels and the original block are the very same thing. They are it, it is them. You can't sell *them* without selling *it*, because you can't sell *it* without selling *it*. … Never mind that mereological relations can be equivalently restated so as to drag in identity. Anything can be … The real point is that the mereological relations (however restated) are something special. … they are strikingly analogous to ordinary identity, the one-one relation that each thing bears to itself and to nothing else. So striking is this analogy that it is appropriate to mark it by speaking of mereological relations – the many-one relation of composition, the one-one relation of part to whole and of overlap – as kinds of identity. Ordinary identity is the special, limiting case of identity in the broadened sense.

It is clear from this passage that Lewis is not just thinking of composition as being like identity in the *one* respect mentioned earlier. Rather he is making a much stronger and perhaps more radical claim, namely that there are different *kinds* of identity in addition to the ordinary one-one identity we all know and love. There is a *good sense* in which the six things are the *very same thing* as some one thing, or as he says in the first passage mentioned above, is the same *portion of Reality* as the one thing. You can't sell them without selling it *because* you can't sell *it* without selling *it*. Ordinary identity is the special limiting case of identity in *this broadened sense*. The way to understand Lewis, I

believe, is thus that the good sense in which *they* are the same as *it* is the broadened sense in which they are the same portion of reality. That is, there is a broadened notion of identity that contains other instances of identity besides the ordinary one-one identity, and according to this broadened sense six things can be identical with one thing by being the same portion of Reality.

So far, Lewis's idea seems to be exactly the idea I have tried to develop and defend in chapters I and II. But if so, in answer to the absurdity mentioned above, Lewis would, as I do in chapter I, say that the domain of ontological commitment remains *the same* under the theorems of identity as well as mereology not in the sense of 'the same' as it is understood according to ordinary one-one identity alone, but rather as it is understood according to a broadened notion of identity according to which ordinary one-one identity is merely one out of several instances of identity. Our domain of ontological commitments remains the same under the theorems of identity and mereology alike in the sense of remaining the same portion of Reality independently of how it is conceptualized.

Lewis goes on to provide some further respects in which composition and ordinary one-one identity are analogous, but it should by now be clear, contra what almost all his commentators seem to think,[63] that Lewis is, as I was in chapters I and II, making a much stronger claim than the claim that composition is merely *analogous* to identity in some few respects. As we saw above, Lewis himself points out that anything is analogous to anything in some respect or other, but the real point is that mereological relations are *special*: they are *of a kind* with ordinary identity, not merely analogous. Lewis's talk of analogy is thus best understood as an attempt to articulate why there is a *broadened* sense of *identity*. Ordinary one-one identity is merely a restriction on it; it is not all there is to what it is to be the same.

[63] E.g. van Inwagen (1994), Yi (1999), Sider (2007), and Schaffer (forthcoming,a), as well as all philosophers I have personally talked to about this matter. Exceptions in print might be Merricks (2003) and (2005).

Nonetheless, Lewis (1991:87) goes on to articulate two ways in which he takes composition *not* to be like ordinary one-one identity. First, ordinary one-one identity can be defined or understood in terms of plural logic: x is y $=_{df}$ for any things zz, x is one of zz iff y is one of zz.; but there seems to be no obvious way to generalize this definition such that we can equally understand how many things xx can be identical with their one fusion. As Lewis points out (ibid:87), not any plurality that contains each of xx is one that contains their fusion, and not any plurality that contains their fusion is one that contains each of xx. For example, according to our ordinary understanding of 'is one of' (x is one of y_1,y_2,… iff $x=y_1$ or $x=y_2$ or…), each of you and me is one of you and me, but our fusion is not one of you and me; and also, our fusion is one of our fusion, but neither you nor me is one of our fusion.

This first aspect in which composition is not like identity should not be taken as showing that composition is not identity, but only as showing the obvious fact that composition is not ordinary one-one identity. Why think that however one can define a restricted version of a concept is also a way one can define the unrestricted version of the concept? Also, the logical primitive 'is one of' in standard plural logic is a set-like predicate. There is thus no reason to expect it to be able to define a *non*-set-like concept of identity.

The second respect in which Lewis claims composition is not like ordinary one-one identity comes out in the following passage (ibid):

> Even though the many and the one are the same portion of Reality, and the character of that portion is given once and for all whether we take it as many or take it as one, still we do not really have a generalized principle of indiscernibility of identicals. It does matter how you slice it – not to the character of what's described, of course, but to the form of the description. What's true of the many is not exactly what's true of the one. After all they are many while it is one. The number of the many is six, as it might be, whereas the

> number of the fusion is one. And the singletons of the many parts are wholly distinct from the singleton of the one fusion.

Understanding Lewis's distinction between the character of what is described versus the form of the description as the intrinsic nature of a portion of reality versus how it is conceptualized or described, this second disanalogy should, just like the first disanalogy, not be understood as showing that composition is not really identity after all, but rather as showing the obvious fact that it is not ordinary one-one identity. The example used earlier is illustrative. Consider my body. It, that portion of reality, can on the one hand be conceptualized as one body, and it can on the other hand be conceptualized as two legs, two arms, a head, and a torso. In both cases one and the same portion of reality has been conceptualized in a certain way, or under a certain "form of description". Though it is true of it under both ways of conceptualizing it ("forms of description") that it has, say, mass M, in the first way it is true that it is one in number, not six, but in the second way it is true that it is six in number, not one. Thus, the intrinsic character of it remains constant across different ways of conceptualizing it, but more relational (or perhaps conceptually dependent) characteristics of it change. The simple fact that a portion of reality differs as to what can truly be said of it under different ways of conceptualizing or describing it, does not imply that we are really dealing with more than one portion of reality. The differing properties are simply relational properties, not intrinsic properties.

So understood, my account from chapter I is merely an articulation of Lewis's account; except that Lewis never explicitly mentions set-like predication and properties. The ambiguity we find in Lewis's (1991) remarks on composition as identity is thus not that between a weak (analogous) and a strong (identity) sense of the thesis, as most of his commentators argues, but rather in how exactly to understand the properties that seem to differ between the one fusion and its many parts, and hence how exactly to understand a

generalized principle of indiscernibility of identicals. Lewis suggests on the one hand that there is no such generalized principle, but insists on the other hand that the one fusion and its many parts are nonetheless the same portion of reality. On its face that is simply incoherent. Whatever is the same must share all properties. But appreciating the relational aspect to set-like predication and properties as we did in chapter I is a way of resolving this ambiguity such that there is no threat of incoherence in the neighborhood. Arguably, the latter passage from Lewis seems to suggest that he too had something like this in mind: *it does matter how you slice it – not to the character of what's described, but to the form of the description.*

As a final strengthening of my interpretation of Lewis's position as falling somewhere in between a weak version (of analogy) and a strong version (of identity) of composition as identity, consider some of the things Lewis says elsewhere. In his discussion of E. J. Lowe's position on intrinsic change as a mere rearrangement of particles, Lewis (1988:195) first says:

Surely I am nothing over and above my particles: I am them, they are me. The 'are' of composition is just the plural of the 'is' of identity. So if it's settled what they do, there can't be any further question what I do. You might as well say: I know all about the life of Cicero, now what about Tully?

This does *not* seem like a weakened version of composition as identity. Rather, it is suggesting a composition relation that simply is a plural version of the singular identity relation, much like my account in previous chapters. In the same discussion, Lewis (ibid) goes on to say:

> I think he [i.e. Lowe] has no other way to make sense of saying that I just *am* my particles. Composition as identity is not for him. He will need, instead, to understand composition as a one-many relation of things that are in no sense identical. … The relation of me to my particles is an interesting and intimate one, no doubt. But if it is not

> identity, then to say that my particles endure is simply not to address the question whether *I* endure…

Again, Lewis seems to clearly be putting forth a much stronger claim than that composition is merely analogous with identity. Composition is a generalized plural identity.

Finally, in a discussion of one of his solutions to the paradox of the 1001 cats, Lewis (1993:177-179) says:

> [T]he real opposite of identity is … distinctness in the sense of non-overlap … We have a spectrum of cases. At the one end we find the complete identity of a thing with itself: it and itself are entirely identical, not at all distinct. At the opposite end we find the case of two things that are entirely distinct: they have no part in common. In between we find all the cases of partial overlap: things with parts in common and other parts not in common. … It's strange how philosophers have fixed their attention on one end of the spectrum and forgotten how we ordinarily think of identity and distinctness.

This passage makes no sense if one thinks of composition, the one end of the spectrum of overlap, as merely *analogous* with identity. It is simply impossible to coherently understand this passage without thinking of composition as simply being identity in the sense of relating one and the same thing/things, and perhaps roughly so in the way I understand it in chapters I and II above.

Before I end this section, I want to consider some explicit criticism of Lewis's position coming from van Inwagen (1994) and Yi (1999).

Van Inwagen (1994), as I see it, provides three kinds of criticism. The first kind is mostly a refusal to understand the thesis of composition as identity based mainly on the

assumption that many-one identity statements make no syntactical sense. Singular logic allows wffs of the form ‘x=y’ and plural logic adds to this defined wffs of the form ‘xx=yy’, where xx and yy are of the same cardinality, but there is no room in these logics for hybrid wffs of the form ‘xx=y’. My own account of composition as identity developed in chapter I and II above might be taken as designed to explain all the “puzzling” features that van Inwagen doesn’t understand about Lewis’s position, so for this first kind of criticism I here simply refer the reader to these chapters.

The second kind of criticism I find in van Inwagen (1994) is of the idea that composition as identity makes mereology ontologically innocent. In this regard, he considers two (slightly paraphrased) passages from Lewis (1991:81) in particular:

(i) Commit yourself to the existence of the xs all together or one at a time, it’s the same commitment either way… the new commitment is redundant, given the old.

(ii) If you draw up an inventory of Reality… it would be double-counting to list the fusion of the xs and also list the xs.

Concerning (i), van Inwagen doesn’t understand how committing oneself to xx all together is committing oneself to *an object* that is identical with xx, rather than just committing oneself to xx all at once without there being any one object there. He claims this notion of commitment is just as much in need of explanation as the thesis of composition as identity itself. But as should be clear by now, the proper understanding of ontological commitment at play here is in terms of a broadened or generalized notion of identity, not in terms of classical singular identity. The fusion of xx is the same portion of reality as xx, but conceptualized in two different ways, so counting ontological

commitment in terms of classical singular logic and conceptualized individuals will not provide the notion of ontological innocence that Lewis talks about, but counting ontological commitment in terms of a generalized logic allowing many-one identities can.

Concerning (ii), van Inwagen considers a composite fusion. For simplicity we assume that all there is in our domain is a fusion and its six proper parts and nothing else. Now assume we are to consider the truth-value of some existentially quantified statements over this domain. How many things must we consider in order to evaluate the truth-values of our statements? Van Inwagen (1994:103) says:

> Seven, right? That is, there are seven objects, and not six objects or one object, that are possible values of our variables, and which we must take account of when we are determining the truth-values of our sentences. But if counting both the xs and their fusion is "double-counting", then why [is our domain] seven-…membered rather than six-…membered?

The answer is of course as explained above: it is seven-membered because it is counting by our ordinary one-one notion of identity, but it is double-counting because as such it counts overlapping portions of reality. Double-counting, i.e. counting the same portion of reality twice, is only avoided when counting in terms of our broadened or generalized notion of plural identity. I of course doubt that van Inwagen will become convinced by this explanation, but I also doubt he doesn't understand what is being said.

The third kind of criticism I find in van Inwagen (1994) is of a weakened version of the thesis of composition as identity which according to van Inwagen is the version that Lewis finally adopts. This weakened version is supposed to be a thesis I mentioned earlier, namely that composition is merely analogous to identity, but not really identity

proper. Van Inwagen is unconvinced by this weaker thesis because he is unconvinced by the respects in which composition is said to be analogous to identity.

True, Lewis (1991:84fn12) says that his version 'as just stated, is analogical' and that he 'rest[s] content with mere analogy', but, as I take our interpretation of Lewis above to show, the talk of analogy and disanalogy is just to explicate that composition is of a kind with ordinary one-one identity, but while at the same time to separate composition from ordinary one-one identity. When Lewis says that he rests content with mere analogy that is in the context of separating his own account from Baxter's (1988a & 1988b) account, which is, according to Lewis, an account according to which composition is our ordinary one-one identity. Lewis is thus explicitly saying that composition is not one-one identity, but he is *not* thereby saying that composition is not identity at all or not of a kind with ordinary one-one identity. In fact, as we saw above, he is *explicitly* saying the exact opposite, namely that composition is of a kind with ordinary one-one identity, and that the latter is a special, limiting case of identity in the broadened sense. I thus believe it is a mistake to focus on the talk of mere analogy to the exclusion of everything else he says about composition. Thus, if one is unconvinced by the analogy-talk, one needs to consider everything else said about composition as identity as well. Even if some of the analogies were to fail, there might still be a case to be made for composition being identity in a more general sense, i.e. in the broadened sense. In chapters I and II above, I develop the thesis of composition as identity without relying on anything being analogous.

Yi (1999), like van Inwagen before him, claims to find in Lewis (1991) a distinction between a weak and a strong version of composition as identity. According to Yi, the strong version is the view according to which 'are' can be used to indicate composition

and as such literally stands for a relation of identity. That is, if xx compose y, then we might say that xx are y, and the 'are' employed in saying so literally stands for identity. This 'are' of identity is just another form of the singular and ordinary 'is' of identity, analogous to how the copula 'are' in 'we are human' is another form of the copula 'am' in 'I am human'. According to Yi, the weak version is the view according to which composition is merely analogous to identity (and hence is neutral on whether there is genuine hybrid identities of the form 'xx=y'). Yi, like van Inwagen before him, claims that Lewis in the end endorses the weak version and rejects the strong version. Yi himself argues against both versions.

I have already argued that there is no such distinction between a strong and a weak version of composition as identity to be found in Lewis (1991), one of which he rejects and one of which he adopts. Rather we find one coherent view according to which the truth lies somewhere in between the two versions described by van Inwagen and Yi: composition is not one-one identity, but it is identity proper nonetheless because identity is not merely one-one. Identity is a relation that comes in many different such syntactical forms. Concerning Yi's distinction between the two versions of the view, I thus believe, as indicated in the above interpretation of Lewis's position, that it is more closely related to Yi's strong version than to his weak version, as Yi himself claims.

I reply to Yi's objection to the strong version of the view in chapter I above, and I believe Lewis should give the same reply. Concerning Yi's objection to the weak version of the thesis, I wholeheartedly agree with him, and I think Lewis should too. According to Yi, the weak version of the thesis of composition as identity is *not* ontologically innocent as Lewis argues that *his* thesis in fact is. And indeed, the weak version is not ontologically innocent in the way the strong version is. The sole reason that committing oneself to a fusion is no further commitment compared to being committed to its parts is

that the fusion *is* the parts (collectively).[64] Committing oneself to something that is *not* the things one is already committed to is to be sure a further commitment. That shouldn't even need any argument; after all, if it's not identical with it, it is not what you already were committed to!

4. Ted Sider

Sider (2007), like van Inwagen and Yi before him, draws a distinction between a strong and a weak thesis of composition as identity. Sider, like van Inwagen and Yi before him, rejects the strong version, but, unlike van Inwagen and Yi before him, accepts a weak version of the thesis.

The weak thesis of composition as identity says that parthood is a relation as intimate as it can be without being identity and that composition is as close to being identity as possible without actually being identity. Sider accepts this rather metaphorically formulated view by an inference to the best explanation of several theses he finds plausible. These theses are not logical consequences of any particular set of axioms, but are said to "flow from" a common source, and is thus best explained by that common source, namely the picture of mereological relations involving overlap as especially intimate compared to most other relations.

Sider (2007) characterizes the thesis of strong composition as identity by the following two principles:

(SCI): $\forall xx \forall y$(xx compose y iff xx are identical with y)

(GLL): $\forall xx \forall yy(xx=yy \rightarrow (\Phi xx \leftrightarrow \Phi yy))$,

[64] Yi (1999:155) seems to recognize the point that the strong version is ontologically innocent, but he (wrongly in my mind) rejects it for the independent reasons we saw above.

where each of the plural variables allow singular as well as plural values, and the identity sign is irreducibly plural and collective in both its places. SCI is meant to articulate the view that we 'take the identification of things with their parts at face value, as the strict and literal truth' (ibid:5). Also: the identity predicate thus characterized is irreducibly plural, 'even when that predicate expresses identity in the strictest sense' (ibid:6). GLL is taken as a part of the thesis of strong composition as identity because the defenders of the view 'must accept this version of Leibniz's Law; to deny it would arouse suspicion that their use of 'is identical to' does not really express identity' (ibid:7).

In chapters I and II above, I develop and defend roughly what corresponds to Sider's strong composition as identity. In chapter I, I also reply to his main reasons for rejecting SCI. The reply turned on appreciating the relational aspect to set-like predication and properties. I will not repeat my reply here. In what follows I will instead first assess Sider's explication of the strong version of composition as identity. Then I will assess what Sider argues is an advantage of the weak version over the strong version. I find this advantage to be no advantage at all. I end by some general remarks against the weak version.

There are some immediate problems with Sider's explication of strong composition as identity. First of all, as we have seen several times already, for all SCI is concerned, there might not be any composition taking place at all. That is, one might accept mereological nihilism, the view according to which there are only simple objects with no proper parts, and also accept SCI. But that makes strong composition as identity uninteresting. That composition does takes place at all, and hence that strong composition as identity is interesting after all, is therefore something that needs further argument. Sider is of course aware of this fact, and does indeed provide some arguments

for composition being unrestricted.[65] But a related problem which Sider is not directly addressing is that given that SCI provides an equivalence relation rather than an identity relation between two relations, it is not clear what is meant by saying that composition *is* identity in the *strictest sense* of the term, or that a thing is *strictly and literally* identical with all its parts. SCI is simply not saying anything that strong, so how exactly should we articulate and understand the rest of this stronger claim? Furthermore, given the falsity of nihilism, composition is *not* in general relating one thing to one thing, but rather often many things to one thing, but identity as we all know and love it *is* only relating one thing to one thing, never many things to one thing. So in what strict and literal sense is composition *identity* according to Sider? Maybe part of the clue is provided by GLL, where, at least on its face, we are dealing with many things being identical with one thing. But, as we have seen several times already, without an appreciation of the relational aspect to set-like predication, this principle has problems of its own. First of all, as we have seen several times already, much true predication will differ between the one fusion and its many parts, which violates indiscernibility. That is, SCI seems simply incompatible with GLL unless we appreciate the relational aspect to set-like predication and properties. Second, many predicates substitutable for Φ are irreducibly singular and many are irreducibly plural and collective, which results in ungrammatical sentences. For example, if my arms, legs, head, and torso are identical with my body, then since my body is human, it follows that my arms, legs, head, and torso is human. But the sentence 'my arms, legs, head, and torso is human' is ungrammatical due to the singular copula followed by the plural term. But even changing it to the plural copula results in a weird sentence: my arms, legs, head, and torso are human. Generalizing, we of course also get sentences like 'my cells are running', 'my atoms are thinking', etc. Sider is of course

[65] See also Lewis (1986:211-213) and Sider (2001:120-132) for an independent argument for composition being unrestricted. Against this argument, see Merricks (2005) and Nolan (2006).

aware of this fact. He suggests that grammatical revisionism was in the offing at the very outset, and shouldn't be too surprising. We might simply be dealing with metaphysical discoveries unrefutable by grammar. Though I am sympathetic to not letting grammar affect our metaphysics too much, I nonetheless believe there is a deeper problem here which Sider is not directly addressing. Coupled with the above mentioned fact that SCI is too weak as an articulation of strong composition as identity, the fact that GLL implies fairly strong grammatical revisions seems to leave us with no clear way to *understand* what strong composition as identity exactly amounts to. I believe this is a thread running through everything Sider (2007) says about composition as identity: we are left with a threat of an underlying metaphorical obscurity. True, we do have *intuitions* (perhaps partly captured by some metaphors) about what the thesis is trying to say, but I believe we should and could do better. For the most part, my account in chapters I and II above does not rely on metaphorical explications.

In my mind, Sider's explication of strong composition as identity is thus inadequate, too metaphorical, and as a result rather obscure. But in any case, Sider himself accepts the weaker version of composition as identity, what he calls a *watered down version for the faint of heart*; or the thesis of *moderate composition as identity* (MCI). He also claims there is an independent advantage to MCI over SCI. I will now argue against this supposed advantage.

Recall the weak version of composition as identity:

(MCI): parthood, and hence composition as defined in terms of it, is an especially intimate relation compared to most other relations, being as close to being identity as it can without actually being identity

Now consider the following two principles of inheritance, namely Inheritance of Intrinsicality and Inheritance of Location, respectively:

(IoI): if property P is intrinsic, then the property *having a part that has P* is also intrinsic

(IoL): if x is part of y, then y is located wherever x is located

According to Sider MCI can *explain* these two principles in a way SCI cannot, and that is an advantage of MCI over SCI. The two principles are explained by MCI in virtue of the intimacy of parthood. The property of *having a part that has P* is an intrinsic property if P is because the property involves nothing "external" to, or outside of the subject of P. If I have the intrinsic property P, then some part of me must have the intrinsic property P (or if some part of me has it, then I have the corresponding intrinsic property of having a part that has it), but nothing external to, or outside of me need have it, or be what I or my part has it in virtue of. But then having a part that has P is an intrinsic property of me. Similarly with the inheritance of location: if I am located in region R, then so is some part of me (or if some part of me is, then so am I). With other relations (other than identity and other relations of overlap) this is not so. Bearing some other relation to a thing that is P (e.g. *standing next to*, or *being the brother of*) is not an intrinsic property of me (or it). Likewise, bearing some relation other than identity and parthood to some thing that is located in region R is no guarantee of being located in R.

According to Sider, this preservation of intrinsicality and location is supposedly *not* explained by SCI because while SCI is articulating a plural relation between a thing and all its parts *collectively*, not distributively, the inheritance principles deal with a distributive relation, not a collective relation. So SCI leaves it open what explains the inheritance principles, while MCI does not.

I believe understanding the proper and needed articulation of composition as identity beyond what is given by SCI alone will make this supposed advantage be no advantage at all. As I argued in chapter II above, a natural corollary of composition as identity is to understand the various mereological relations involving overlap as *partial identity*. This we should also have learned from Armstrong in section 1 and from Lewis in section 3 above. If my body is identical with all my body parts, then it seems simply incoherent to think that one of my body parts are not partially identical with my body. In this sense it is a natural implication of composition as identity that my arm, being a part of my body, is *partly* identical with my body. As I argued in chapter II, talk of partial identity is just a different *terminology* for talk involving relations of overlap. Thus, *partial identity* is of course just as good an explanation of the inheritance principles as any weaker notion of the *intimacy* of parthood.

I will now end this section by two general complaints concerning Sider's weaker version of composition as identity, i.e. MCI. The first such complaint is that it is hard to understand exactly what MCI is. What does it mean for a relation of parthood to be *especially intimate*? What accounts for the intimacy in question? Sider provides no explanation. But clearly intimacy is not a good candidate for being theoretically primitive. The stronger version of composition as identity, according to which composition is identity in a broadened or generalized sense of the term, much like my own account as well as my interpretation of Lewis's view above, has of course a perfectly good explanation of the intuitively felt intimacy of composition and parthood: it is full or partial identity, and identity is of course the most "intimate" relation there is. MCI is thus threatened with being obscure and vacuous. There simply seems to be no clear room for the fainted heart on this point.

Second, as was shown in chapter I and II, we *can* do better than the rather metaphorical and perhaps vacuous MCI. For example, classical mereology is logically implied by my (strong) account of composition as identity, it doesn't merely "flow from" a "picture of intimacy". Furthermore, we need hardly any metaphorical expressions to explicate the stronger thesis. Thus, since Sider's objections against this stronger version of composition as identity fail, we *should* do better by rejecting MCI and accepting my stronger version of composition as identity.

CHAPTER IV

BUT REALLY, IS IT ONE OR MANY?

Consider the ancient, pre-Socratic debate over whether the world is one or many. While Philolaus says: *the world is one*, and Heraclitus says: *listening not to me but to the account, it is wise to agree that all things are one*, Ion of Chios says: *all things are three, and there is nothing more or fewer than these three things*. Zeno was a bit more ontologically promiscuous, albeit conditionally: *if more things than one exist, the things which exist are limitless. For there are always others between the things which exist, and again others between them. And in this way the things which exist are limitless.* Melissus disagree: *for if it is limitless it will be one. For if there are two, they cannot be limitless, but will have limits against one another. … there exist just one thing.*[66]

I say: the world is identical with all its parts collectively. Thus listening to *my* account, it is wise to agree that all things are one *and* many: it is one relative to one conceptualization, but it is many relative to another conceptualization. Listening to my account, the pre-Socratics seem confused.

But in saying that the world is one, does Philolaus really mean to deny the ordinary claim that it has proper parts, e.g. pebbles, stars, and himself? In saying that all things are one, does Heraclitus mean to deny the ordinary claim that he and I are two different things? It is highly uncharitable to interpret them as denying such obvious facts.

Schaffer (forthcoming,a) has pointed out that there is a much more charitable way of understanding the debate. In saying that the world is of a certain cardinality we should not understand Philolaus and the other pre-Socratics as denying the obvious fact that pebbles stars, you, and I are many distinct existing things, or that the world is one.

[66] As in Barnes (2001: 179,50,182,103,95-97)

Rather, we should understand them as making claims about how many things there *really* are. They argue about the *ontologically privileged* or most *fundamental* way to describe the world and all things in it. And on such an interpretation of the debate, I have no right to claim that the pre-Socratics are confused because they don't (need to) disagree with me in that all things are one and many. What they want to know is what really or most fundamentally the cardinality of the world is. To that question, I have not yet said anything.

In this last chapter, I will join this ancient debate over the fundamental cardinality of the world. But since the pre-Socratics are long gone, I will take as my starting point the most recent, charitable interpretation of the debate as per Schaffer (forthcoming,a). In section 1, I will consider the way Schaffer sets up the debate, and argue that it needs improvement. Composition as identity theorists should be allowed to enter the scene as well. In section 2, I consider three main arguments from Schaffer (forthcoming,a) to the conclusion that all things are fundamentally one. I argue that all three arguments fail. In section 3, I argue that the ultimate cardinality of all things depends on which world is the actual world. The fundamental cardinality of the world is a matter of contingency.

1. The Debate

Schaffer (forthcoming,a) first of all restricts the debate to be over the fundamental cardinality of the *concrete* world in terms of the *parthood* relation: how many concrete parts does the world really have? Just itself? Or does it really have concrete *proper* parts as well?

Note that in order for this to make any sense, the first assumption in the debate needs to be that the world exists as one concrete thing. If this assumption is waived, the world can ultimately be a plurality of two or more concrete things, not a single concrete

thing, and hence not have any parts whatsoever (i.e. since pluralities of more than one thing don't have parts). As such the debate wouldn't get off the ground as to whether the world is fundamental. A second assumption in the debate needs to be that the one existing concrete world has at least one concrete proper part. Waiving this assumption, the debate wouldn't get off the ground as to whether the proper parts are fundamental.

We thus note the first two assumptions of this most recent version of the debate, where 'U' denotes the concrete world:

(1) U exists

(2) U has a proper part

According to our Schafferean version of the debate, we also need two constraints on the fundamental objects, namely that the fusion of all fundamental things is identical with U and that no two distinct fundamental things share a part. Waiving the first constraint, the view that the world's parts are really one wouldn't get off the ground since there could always be more fundamental things than what's part of U. Waiving the second constraint, there would be much ontological redundancy among the fundamental objects, but there would also be necessary connections among fundamental objects since one cannot freely recombine overlapping objects. But fundamental objects should be freely recombinable. A fourth assumption we need is that there is a meaningful notion of fundamentality at hand, and which tracks the mereological hierarchy. Whichever parts are more fundamental, grounds whichever parts are less fundamental. Waiving this assumption we have no way of making sense of the question as to how many parts the world *really* has. Thus, some way of counting the world's parts needs to be objectively better than, ontologically privileged over, and somehow ground the other ways of counting them.

Schaffer further assumes that this notion of grounding among objects is a well-founded, partial ordering: irreflexive, asymmetric, transitive, and with minimal elements.

We thus note the last two assumption of the debate:

(3) (i) the fusion of all fundamental objects is identical with U; (ii) if x and y are two distinct fundamental objects, then they are disjoint.

(4) We have a meaningful notion of a well-founded, partially ordered grounding among concrete objects, and which tracks the mereological hierarchy.

With assumptions 1-4, we can finally meaningfully ask: is the world really, most fundamentally one, or many?

By our assumptions 1-3, there are two and only two answers:

Monism: there is exactly one fundamental object and it is the world.

Pluralism: there are more than one fundamental object and neither one of them is the world.

1.1. Waiving an Assumption

According to Schaffer, in order to get the debate off the ground we also need the assumption that it is not the case that composition is identity:

(5) $\sim\forall xx\ (xx = f(xx))$

Schaffer's (forthcoming,a: 3) rationale behind assumption 5 is that 'if the one literally *is* the many, then monism and pluralism would no longer be opposing views – indeed both sides would turn out to be right.'[67]

I'm not sure what this rationale amounts to. What does it mean to say that if composition is identity, then both sides would turn out to be right? Would the world most fundamentally be both one and not one? Is the world most fundamentally contradictory then? On my account of composition as identity, it might mean that the world is one relative to one conceptualization, but many relative to another conceptualization, and without anything deciding which one is the most fundamental way of conceptualizing it. But it would then be indeterminate which side is right, which is perhaps not so much saying that they are both right as it is saying that neither one is right.

In any case, I claim 5 should be dropped because it excludes positions that can make good sense of the debate. By 5, all composition as identity theorists, myself included, are simply excluded from the debate at the very outset, and that is wrong. Surely, as a composition as identity theorist I can wonder whether the world is most fundamentally construed as having one part, namely itself, or as having many proper parts. Surely, it is possible to construe one and the same portion of reality in different ways, some of which are better than or ontologically privileged over others. I simply ask: is it objectively better or more natural to conceptualize the world as having one part, namely itself, or as having many proper parts? Which way of conceptualizing it best aligns with the objective structure of the world? We should of course not assume that

[67] In his footnote 8, Schaffer says that Lewis and Armstrong only hold the view that composition is *analogous* to identity, not identity itself. He further claims that he does not assume the falsity of such a view, but only assumes the falsity of the view that composition is identity. In chapter III above, we saw that this interpretation of Armstrong and Lewis is wrong. Armstrong and Lewis hold composition to relate one and the same portion of reality, and in *that* sense composition *is* identity according to them; though it is of course not traditional one-one identity, if not only by syntactical reasons alone. I'm thus not sure what exactly it is Schaffer is assuming. In any case, I will argue that he shouldn't assume that *my* version of composition as identity is false.

composition *is* identity since that would perhaps be the most exclusive, but rather we should not assume that composition is not identity.

Do we not then encounter a problem with the notion of grounding as per assumption 4?

1.2. Grounding

Grounding is irreflexive; but if xx=f(xx), then if either one grounds the other, something grounds itself, which contradicts that grounding is irreflexive. As such, it is not, as Schaffer argued, that both sides are right, but rather that neither side is right: grounding wouldn't hold at all between wholes and their parts. The debate simply evaporates, leaving no winner behind.

This argument assumes that grounding is a two-place *plural collective* relation between objects that stand in the parthood relation to each other, not a singular such relation. This is best seen as follows. Assume grounding is a two-place singular relation between objects. Then whether f(xx) grounds or is grounded in *each one of* xx is logically silent on whether f(xx) is identical with all of xx *collectively*. That is, the world could simply be grounded in each of its ultimate parts, but not in all of them collectively, and grounding could thus irreflexively hold between objects even though xx=f(xx). In order for the above argument to carry any weight, we must thus take grounding to be a plural collective relation. In fact, this seems so even independently of the above argument. Otherwise, the world could have n>1 basic proper parts and be grounded in *each one of them*, but not in all of them, which is absurd. If atomistic pluralism is true,

the world is surely not (fully) grounded in *one* of the many mereological atoms that ground it, but rather it is grounded in *all* of them taken together.[68]

In any case, in order to get back on track, we need to be clearer as to how we understand our notion of grounding as per assumption 4. On pain of the above contradiction, we cannot let grounding be a *fundamental* (plural collective) relation holding among objects in the mereological hierarchy. Rather, we must think of it as only so holding between objects *derivatively*. That is, we must somehow *define*, or *understand* the grounding between parts and wholes in terms of some other more general notion of grounding. There are perhaps several different ways to do this, but in what follows I will simply pick up on a suggestion of Lewis (1983)/(1986:59-69) and many others[69] conjoined with continuing something I have flirted with in earlier chapters already. The rough idea is that the world has more and less objective, natural, mind-independent joints. As such, some ways of conceptualizing it is objectively better than others in the sense that they get at the real structure of the world better than others. These more and less natural ways of conceptualizing the world are thus not based on pragmatic considerations, but rather are a matter of objective worldly structure.[70] Now consider the *most* natural way of conceptualizing the world. The objects or parts of the world involved in *that* way of conceptualizing it are the *fundamental* objects of the world. *That's* how

[68] Note that Schaffer (forthcoming,a) only explicitly considers singular mereological grounding, and hence he might not have any logical resources to defend assumption 5, but in particular, if so, he cannot use the latter argument to defend 5. But Schaffer (2009:376fn34) makes a distinction between partial and total grounding, admitting the need for plural grounding in order to account for total grounding, which is the grounding I consider above. We should thus read Schaffer (forthcoming,a) as only discussing partial grounding, but admitting the need for plural logic and full, or total grounding. Lacking plural resources, one excludes many pluralists at the outset since none of them, I take it, would accept that the world is fully (totally) grounded in *each* one of the many ultimately fundamental proper parts. I further doubt that set theory can come to the rescue in this case since, I take it, neither the world nor its many parts are grounded in a set. Schaffer might thus need plural logic for his notion of grounding. This might prove somewhat important in the argument from the possibility of emergence below. Note that Rosen (ms) too considers a relation of total grounding in terms of plural logic, and seems to consider a notion of partial grounding as being insufficient. Finally, Schaffer (ms:section 1.2) seems to think partial grounding *is* sufficient, but his reasons elude me.
[69] E.g. Bricker (2006) and Sider (2009).
[70] See Sider (2009) for a further defence of this idea.

many objects there really are. Furthermore, one might think of the most fundamental objects as the supervenience base of the less fundamental objects: any possible world with the most fundamental objects also have the less fundamental objects. This is rough, but I believe it suffices for what follows.[71]

Note that as per assumption 4, our notion of grounding is transitive since supervenience is transitive. As per assumption 4, it can also be thought of as asymmetric, since, as Bricker (2006) points out, one might take the naturalness of the world itself to be the symmetry-breaker: the most natural objects serve as the supervenience base upon which the less natural objects supervene, not vice versa. But then, on pain of contradiction, our notion of grounding is, as per assumption 4, irreflexive: if xx ground xx, then, by asymmetry, xx don't ground xx, which contradicts that they do. Furthermore, on pain of mysterious necessary connections, the fundamental objects don't supervene on each other, so they don't ground each other. Finally, as per assumption 4, one might hold that grounding must terminate in some things which are the most fundamental things. That is, one might hold that there can be no endless grounding.

2. Three Arguments in Favour of Monism

Schaffer (forthcoming,a) presents and defend three kinds of arguments in favour of monism.[72] I will now argue that they all fail to favour monism.

2.1. The Argument from Common Sense

Schaffer provides the following argument from common sense:

[71] Cf. Rosen (ms:5-6).

[72] Schaffer (forthcoming,a) also discusses and dismiss the problem of how one fundamental object can be heterogeneous in the way the world obviously seems to be. I agree with his conclusion that this problem can be handled by the monist. But since his argument is not an argument in *favour* of monism, but rather a reply to an objection to monism, I will simply ignore this argument/problem here. About this problem, see also McDaniel (forthcoming).

1. According to common sense, integrated wholes are prior to their arbitrary portions
2. According to common sense, the cosmos is an integrated whole
3. According to common sense, the many proper parts are arbitrary portions of the cosmos
4. Hence, according to common sense, the cosmos is prior to its many proper parts

In defence of the premises, Schaffer consults his own intuitions and provides some quotes and citations from other philosophers.

As far as I can see, there are two ways to best evaluate these premises. First, consult our own intuitions. I have done that, and unfortunately found myself highly divided. But even if I had come to clear answers, what worth would it have had? I don't see any reason to think that my intuitions (whatever those are) provide a reliable guide to fundamental ontology. Also, I take it *philosophers* are not the authority on common sense. Our intuitions are corrupted. Second, presumably common sense is the collection of platitudes accepted by most people. Thus, I should do a survey among most people as to whether they accept 1, 2, and 3. But apart from the obvious economic and logistic problems alone, such a survey is problematic for several reasons. First, should the subjects be allowed to think hard about the matter before responding? Or should it be based on an immediate, gut reaction? If they are allowed to think very hard about it, I suspect there will be vast disagreement, and no clear answer overall (just like with professional philosophers). But if they are not allowed to think very hard about it, what worth do their answers have? Again, I see no reason to think such opinions provide a reliable guide to fundamental ontology.

In any case, Schaffer himself hastens to add that he thinks this argument from common sense counts for little. I agree: though common sense carries some weight towards what ordinary objects there are, it should carry little or no such weight towards what objects there *really* are. Fundamental ontology is not up to the common man.

2.2. The Argument from the Possibility of Gunk

Schaffer provides the following argument from the metaphysical possibility of gunk:

1. If pluralism is true, then mereological atomism is true
2. If mereological atomism is true, then mereological atomism is necessarily true
3. If mereological atomism is necessarily true, then it is impossible that the world is gunky
4. It is possible that the world is gunky
5. Hence, pluralism is false

Premise 1 is justified by assumption 4 above: grounding must terminate, i.e. there can be no endless grounding; together with the fact that the view according to which grounding terminates somewhere in the middle of the mereological hierarchy is objectionably arbitrary and too *ad hoc*. For the sake of argument I accept this premise. Premise 2 is justified by the assumption that *grounding must terminate in the same way in all possible worlds*. That is, if grounding terminates in the many parts, then it necessarily terminates in the many parts, and if grounding terminates in the one whole, then it necessarily terminates in the one whole. That is, whichever position is true is necessarily true. Premise 3 is provable: gunky worlds have no mereological atoms; hence if they are possible, there is at least one possible world without such atoms, which means that it is

not necessarily true that there are mereological atoms; and by contraposition: if it is necessarily true that there are mereological atoms, then gunky worlds are impossible. That gunky worlds are metaphysically possible was defended in chapter I, section 3.3, so I will not repeat that defence here. Conclusion 5 logically follows.

Given that monism and pluralism are the only options on the table, which is provable from assumptions 3(i) and 3(ii) in section 1,[73] it follows from conclusion 5 together with the assumptions that grounding necessarily terminates in the same way and that there is a concrete object U that is the world (i.e. assumption 1 from section 1 above), that monism is necessarily true.

I believe this argument fails for several reasons. First, as Schaffer points out, one might accept that monism is true in gunky worlds and that pluralism is true in atomistic worlds. Though this violates the assumption that grounding terminates in the same way in all possible worlds, I am not sure why it is objectionable. Schaffer provides very little, if no defence of the assumption that grounding must terminate in the same way in all possible worlds. Schaffer calls the solution 'objectionably disunified'. But why so? Mereological grounding takes place in all possible worlds, and as such it is certainly unified. That the termination ends in different mereological directions in different possible worlds might be less unified than that it terminates in the same direction in all possible worlds, but why is this slightly disunified aspect *objectionable*? Is it also objectionably disunified to hold that a causes b in one possible world and that b causes a in another possible world?

Second, as Schaffer also points out, one might reject that grounding must terminate. One might simply accept endless grounding. Schaffer says that on this solution, 'being would be infinitely deferred, never achieved'. But *why* would being

[73] See Schaffer (forthcoming,a:section 1.4).

never be achieved just because it is endlessly grounded? Is it simply an intuition we are supposed to trust? But intuitions are unreliable when it comes to fundamental ontology. Also, assuming it terminates, consider the most fundamental entities of them all. How are *their* beings achieved any less mysteriously?

Finally, and most importantly, I believe the argument begs the question against many pluralist. Let *mereological Uism* be the view according to which there exists a maximal fusion U with everything as its parts. Assume composition is not identity. Now consider the following *perfectly analogous* argument against monism:

1. If monism is true, then mereological Uism is true
2. If mereological Uism is true, then mereological Uism is necessarily true
3. If mereological Uism is necessarily true, then it is impossible that the world is junky
4. It is possible that the world is junky
5. Hence, monism is false

The justification for 6-9 is *perfectly analogous* to the justification for 1-4. So why should the pluralists fear 1-4, if the monists don't equally fear 6-9? In fact, the pluralists should fear 1-4 *iff* the monists fear 6-9.

Schaffer provides five sets of considerations for why there is an asymmetry here such that 1-4 has force, while 6-9 doesn't. The considerations are all meant to show that 4 is true, while 9 is false: gunk is possible, while junk is impossible.

First, intuitively, 'world' seems to be a singular term standing for an object. As such, worlds could not be junky since a junky world is not an object, but rather a plurality of objects. But there is no good reason for the pluralist to believe that 'world' behaves

this way, far less to believe it *must* behave this way. The term 'world' might simply be a plural term standing for all concrete existing things. Whether the world is a singular or a plural term depends on whether the world is a singular object or a plurality of objects. It is not the other way around![74]

Second, possible worlds are understood as concrete possible objects, and as such junk cannot exist *at a possible world*. The world would "top off" the junk. Schaffer treats this as a platitude about possible objects.[75] But there is no reason for the pluralist to believe that possible worlds must be singular concrete objects. Possible worlds might simply be possible concrete pluralities of objects. And as such the pluralist is free to believe that *a* possible object must exist *at a possible world* in the sense that it must exist at a plurality of objects.

Third, U is 'the primary subject matter of physical cosmology'. In support of this, Schaffer provides a quote from Hawley and Holcomb (2005:5), where they define cosmology as 'the study of the formation, structure, and evolution of the universe as a whole'. But of course, a junky pluralist will simply understand 'the universe as a whole' as meaning *the plurality of all things*. I further doubt that cosmology would collapse, or even change any of its ways, if the world turned out to be an infinite plurality without a maximal fusion.[76]

Fourth, classical mereology logically guarantees the existence of U, but not that of mereological atoms. That is, classical mereology has gunky models, but no junky models. But then why should the pluralists accept classical mereology? In fact, the pluralists could argue perfectly analogously from some non-classical junky mereological

[74] In fact, there might be some reasons to think that 'world' *is* a plural term. See van Fraassen (1995) and Simons (2003). Note also that any mereological nihilist must accept that 'world' is a plural term.
[75] This is of course merely a metaphysical version of the first semantic consideration against the possibility of junk.
[76] In fact, whether there are fusions is at least partly an *a priori* matter, and as such physical cosmology, as an *empirical* discipline, should be neutral on whether there are any fusions at all. Cosmologists shouldn't care about what philosophers figured out a priori.

system JM containing atoms: JM logically guarantees the existence of mereological atoms, but not that of U. That is, JM has junky models, but no gunky models.

Fifth, Schaffer argues that 'virtually no plausible accounts of when composition occurs allow for junky models'. But if unrestricted composition is a plausible account of when composition occurs: *any xx has a fusion*, then certainly the following is also a plausible account of when composition occurs: *any x and y has a fusion*. (At least this is so for a pluralist!) Over a domain of infinitely many simples, this principle of composition provides a junky model.[77]

I conclude that 1-4 stand and fall together with 6-9, and that the monist thus has no upper hand here.

Schaffer (forthcoming,a:fn41) also says that

> the arguments for the possibility of gunk … prove crucial. For they provide *independent* rationale for inferring the falsity of pluralism from the possibility of gunk, rather than turning the argument around and inferring the impossibility of gunk from the alleged truth of pluralism.

But, as I have argued elsewhere,[78] as well as in chapter I, section 3.3 above, given ~CI, the possibility of junk is *independently* plausible to the exact same extent as the possibility of gunk is *independently* plausible, where by 'independent' we mean only independently of any particular mereological system. Both possibilities are logically consistent in the sense that they have mereological models,[79] and *independently* both possibilities are equally positively conceivable. Admittedly, the possibility of gunk might

[77] This is so because by this principle there are only finite fusions. As stated, the principle simply provides no way of fusing *all* the infinitely many simples at once. It can fuse more and more things, two and two at a time, and as such get bigger and bigger composites *approaching* infinity, but it can never fuse infinitely many things at once.
[78] Bohn (2009,b).
[79] One can of course not here assume mereological models to be *classical* mereological models. That would obviously be begging the question.

be and have been taken more seriously in physical science,[80] but that is no good guide to mere *metaphysical possibility*. Thus, the pluralist can give a perfectly analogous argument:

> the arguments for the possibility of junk … prove crucial. For they provide *independent* rationale for inferring the falsity of monism from the possibility of junk, rather than turning the argument around and inferring the impossibility of junk from the alleged truth of monism.

The pluralist should thus remain completely unmoved by the argument from the possibility of gunk. There simply are certain mereological scenarios that the monists and the pluralists have no way of handling.

But there is another way of securing an asymmetry such that 1-4 is sound, but 6-9 is not. Assume composition *is* identity as per chapter I. Then, by chapter II, classical mereology is true. But then gunk is still possible, while junk is impossible, and hence 1-4 remains sound, while 6-9 is unsound. Composition as identity provides the needed *independent* support for Uism, and as such does not beg the questions. Of course, Schaffer assumed that composition is *not* identity, so *he* cannot secure the asymmetry in this way. But if he revises his way of setting up the debate in the way I roughly suggested in section 1.1 and 1.2, then he stands free to accept that composition is identity and thus employ the argument from the possibility of gunk to support his monism. But there is of course still the problem of why we should believe that grounding must terminate in the same mereological direction in all possible worlds. *Why* couldn't it be the case that some possible worlds are most naturally conceptualized as atomistic, while others are most naturally conceptualized as monistic?

[80] Cf. Schaffer (2003).

2.2.1. A Dialectically Unfortunate Set-Up

It now emerges that the way the debate was set up in section 1 above was dialectically unfortunate. There it was assumed that U exists. From the argument 1-4 it followed that monism is necessarily true. But this begs the question against many pluralists. It is as if the pluralist assumed at the outset that there are mereological atoms. From 6-9, given ~CI, it would analogously follow that pluralism is necessarily true. But then the monist should not accept the assumption of atomism, just as the pluralist should not accept the assumption of Uism.

But without one of these assumptions the debate would never get off the ground, at least not if the answer is to be a matter of necessity. Rather, the debate would have to be over a matter of contingency. Having already questioned the assumption that grounding must terminate in the same mereological direction in all possible worlds, it should come as no surprise that I don't see this contingency as objectionable. But there is a way of repairing the debate such that it is capable of getting off the ground and be about a matter of necessity. It must be assumed at the outset both that U exists *and* that there are mereological atoms. Then the possibilities of gunk and junk provide equally valid objections, and as such can be equally rejected. As such, grounding can terminate in necessarily one and only one of the two mereological directions. But having rejected the possibilities of gunk and junk, as well as having rejected the argument from common sense in favour of monism, which direction is it? Is it towards the one whole, or is it towards the many parts?

2.3. The Arguments from Emergence

Finally, Schaffer provides two arguments from emergent properties to the actuality of monism, one from certain interpretations of Quantum Mechanics, another from the mere possibility of emergent properties. Let's consider them in turn.

2.3.1. The Argument from Quantum Mechanics

Let's first of all, if not only for the sake of argument, assume that Quantum Mechanics (QM) is the best theory of the fundamental structure of the world. As briefly discussed in chapter I, section 1.2, from QM we learn that two or more particles are in a state of *entanglement* just in case they are perfectly anti-correlated with respect to their properties of spin. For example, considering two entangled particles x and y, QM implies that x has spin-up iff y has spin-down, and it does so independently of their spatiotemporal distance from each other. While the spin of *each one* of the two particles might be non-zero, the total spin of the system consisting of the two particles *together* can nonetheless be zero. The perfect anti-correlation between the two particles can thus cancel out each other's spin properties. The further crucial point is that there is no way in the mathematical formalism of QM to always calculate the individual spin properties of either x or y independently of the other. Thus Maudlin (2002:266) says: *the quantum state of the composite system cannot always be considered to be merely the logical sum of the individual quantum states of its components. This is the source of the holism and interconnectedness of quantum states*…

Where U is the fusion of everything (what Schaffer calls *the cosmos*), and entangled systems are as just described, Schaffer now provides the following argument:

1. U is an entangled system
2. Entangled systems are fundamental wholes
3. Hence, U is a fundamental whole

Premise 1 is justified by appeal to Big-Bang theories about the beginning of the universe (or U) together with certain interpretations of QM. I grant premise 1 for the sake of argument.

Schaffer justifies premise 2 as follows. Assume mereologically atomistic pluralism is true.[81] Then since U is an entangled system and an entangled system is such that it cannot always be considered to be merely the logical sum of the individual quantum states of its components, i.e. the system as a whole is not reducible to its individual components, but rather has an ineliminable wholeness to it, it follows that a mereologically atomistic ground is not sufficient for U. That is, mereological atoms cannot serve as the ground of the world. But then pluralism is false. Hence, monism is true.

Schaffer (forthcoming,a:15) says:

> In general, duplicating the intrinsic properties of the particles, along with the spatiotemporal relations between the particles, does not metaphysically suffice to duplicate the cosmos and its contents. The intrinsic correlational properties of entangled wholes would not be duplicated. So on the assumption that the basic actual concrete objects must be complete …pluralism is ruled out.

But this argument is unsound. Consider again two particles in a state of entanglement. Though each individual particle has a non-zero spin, the system as a whole has a zero spin. Taking plural logic seriously, it is simply false that duplicating the intrinsic

[81] Recall that we have rejected non-atomistic forms of pluralism as too *ad hoc*.

properties of these particles, along with their spatiotemporal relations, does not metaphysically suffice to duplicate the cosmos and its contents.[82] The pluralist should simply say of the two particles that *they* have a total spin zero. Having total spin zero is a *plural*, *collective* intrinsic property of the two particles. *They* have it due to *their* nature. Thus, the mereological atoms together with *their* spatiotemporal relations and intrinsic plural properties *do* metaphysically suffice to duplicate the cosmos and its contents. There is simply no need for the maximal fusion U to ground anything.[83]

Schaffer considers a slightly different reply. Instead of accepting a plural, collective *property* of entanglement, one might accept entanglement *relations* among the entangled particles. He rejects this solution for two reasons. First, on some interpretations of QM, there simply are no *individual* particles at all, and if so, there wouldn't be any relata to serve as the value for the relation. Second, moving to relations we would have to accept a *new* relation for any set of entangled particles. The relation of entanglement between n particles is not the same relation as the relation of entanglement between n+1 particles. They differ in their addicity, and hence must be different relations.

Accepting plural, collective properties of entanglement solves both problems. First, a plural, collective property of xx is not a property of each one of xx, but rather a property of all of xx collectively. It can thus be an open question whether each one of xx exist independently of having the plural, collective property. Second, accepting plural, collective properties of entanglement we don't need a new property for any new "member" of xx. *Being classmates* is a plural collective property of some people xx. If

[82] In the preface I simply assumed the legitimacy and seriousness of plural logic. This is thus where the fact that we need plural logic in order to fully understand the grounding relation, and as such are *antecedently* committed to the *legitimacy* of plural logic, might prove somewhat important. Note also that this reply is roughly the same reply we gave to McDaniel's (2008) objection to composition as identity in chapter I, section 1.2.

[83] In fact, looking at parts of the formalism of QM (cf. Albert (1992) or Maudlin (2002)), it seems *more* natural to read some of the formulas as being plural formulas holding collectively of many particles, rather than as being singular formulas holding of a composite. But let that be as it may.

one of xx drops out, the rest of xx keeps the very same plural, collective property. No one dropout can keep the rest of us from being the same classmates as before!

How did we get from many entangled particles to a composite object composed of them anyway? There is simply no valid move in the neighbourhood from the entanglement of *some things* to the fundamentality of some *one whole*. We only get the fundamental *interconnectedness* of some things, not the fundamentality of some one whole.

2.3.2. The Argument from the Mere Possibility of Emergence

The validity of the argument in the last section depends on certain interpretations of QM. But the underlying idea is much more general. Thus, Schaffer also gives the following argument:

1. It is metaphysically possible for U to have emergent properties
2. It is metaphysically possible for U to have proper parts and be a fundamental whole
3. Either it is metaphysically necessary that U is a fundamental whole or it is metaphysically necessary that U is not a fundamental whole (i.e. is instead itself grounded in something fundamental)
4. Hence, it is metaphysically necessary that U is a fundamental whole
5. Hence, U is (actually) a fundamental whole.

An emergent property of a whole is as before, namely a property that is not a logical product of the set of intrinsic properties of its proper parts together with their spatiotemporal interrelations (as well as any other fundamental interrelations there might

be). Quantum entanglement was supposed to be an actual example of such an emergent property. Premise 1 is thus just a metaphysical weakening of our case above where we argued that there actually are such emergent properties. Now we only assume that there *could* be such emergent properties of the whole. But as I argued then, such emergent properties need not be understood as properties of a composite whole, but can rather be understood as a fundamental plural, collective property of the many ultimate parts. The pluralist is thus free to treat 'U' as a plural term, and emergent properties as fundamental plural, collective properties. As such, she is also free to accept premise 1 under one interpretation (namely, the plural one), but reject it under another interpretation (namely, the singular one). Many pluralists are thus also free to reject premise 2. They might simply be mereological nihilists, only accepting many mereological simples and no composites.[84] Or if they have agreed to assume that U as well as mereological atoms exist as per section 2.2.1, pluralists can instead simply deny premise 2 on the basis of denying the singular interpretation of premise 1: it is impossible for U as a composite singular object to have an emergent property. Emergent properties are necessarily fundamental plural, collective properties of the many proper parts of U. The composite U is thus always and necessarily fixed in terms of its many proper parts and their (singular and plural) properties and interrelations. In duplicating the many proper parts (and preserving their interrelations) one must always duplicate them plurally as well as individually, and as such it always and necessarily suffices for duplicating the one whole. For the pluralists, the one whole is thus necessarily grounded in its many parts, and premise 1 and 2 are both false, and hence the conclusion doesn't follow.

Now assume composition is identity. Then we must deny premise 1 because, by Leibniz's Law, any properties of the many proper parts collectively must be a property of

[84] Though see Schaffer (2007).

the one whole, and vice versa. The fundamental plural, collective property of the many parts of U is thus the same property as the singular emergent property of U, and vice versa.[85] It is merely two different ways of conceptualizing one and the same intrinsic nature of one and the same portion of reality. But, as per section 1.2, even composition as identity theorists will accept that there are more and less natural ways of conceptualizing a portion of reality. So maybe the most natural way to conceptualize U is in terms of the plural, collective properties of its many parts, or maybe the most natural way to conceptualize U is in terms of the singular emergent properties of its one whole. The latter seems at least metaphysically possible, so we should accept premise 2. But there is no reason to accept premise 3. Why think that the world metaphysically *couldn't* have been more naturally conceptualized as having a different cardinality from the one it actually has? Again, why think that grounding must terminate in the same mereological direction in all possible worlds? From all the arguments we have considered so far, we have seen no reason to think that the world *must* be one way or the other. Premise 3 is thus false, and hence the conclusion doesn't follow.

Hence, whether composition is identity or not, the argument from the mere possibility of emergence is not compelling.

2.3.2.1. The Possibility of Submergence

As a result of the arguments from emergence, Schaffer (forthcoming,a:18) says:

> An underlying mereological asymmetry comes to light: *the asymmetry of supervenience.* The asymmetry is that the proper parts must supervene on their whole, but the whole need not supervene on its proper parts. In other words, though emergence is metaphysically possible, *submergence* – the converse of emergence – is metaphysically impossible.

[85] Cf. the objection from emergent properties in chapter I, section 1.2.

But is this true? Certainly not if composition is identity. Then any property of the whole is a property of its many parts collectively, and vice versa, so in a sense, both emergence *and* submergence are impossible, and hence there is no asymmetry. Just like any emergent property of the whole is a fundamental plural, collective property of its many parts, and vice versa, so any submergent property of the many parts is a fundamental singular intrinsic property of their one whole. If composition is identity, then the whole is *nothing* over and above its many parts collectively and its many parts collectively are *nothing* over and above their whole; rather they are the same portion of reality and as such share all properties.

But let's assume composition is *not* identity. Let's assume the one whole and its many parts collectively are distinct portions of reality and as such (might) differ in their properties. Why then should emergence be possible and submergence *im*possible?

Schaffer (ibid) says the following:

> For submergence, the intrinsic properties of the proper parts, along with the fundamental relations between these parts, must fail to supervene on the intrinsic properties of the whole. This is impossible because (i) any intrinsic property of the proper parts *ipso facto* correlates with an intrinsic property of the whole, namely the property of having-a-part-with-such-and-such-intrinsic-property; and (ii) any relations between the parts also correlates with an intrinsic property of the whole, namely the property of having-parts-thus-and-so-related. Fix the whole, and all of its part are fixed.

That is, while emergence violates metaphysical supervenience of the one whole upon the many parts, submergence violates metaphysical supervenience of the many parts upon the one whole. Thus, if emergence is metaphysically possible, then fixing the intrinsic properties and interrelations of the many parts does not always suffice for fixing the one

whole; and if submergence is metaphysically possible, then fixing the intrinsic properties and interrelations of the one whole does not always suffice for fixing the many parts.[86] *Intuitively*, as per (i), any intrinsic property of the parts must correlate with an intrinsic property of the whole. For example, if a part has the intrinsic property F, then the whole it is a part of has the intrinsic property of *having a part that has F*. It thus seems one need never look outside the "skin" of the whole in order to fix the intrinsic nature of the parts, and hence that the intrinsic nature of the parts supervene on the intrinsic nature of the whole. But if a part has the intrinsic property F, and hence the whole has the intrinsic property *having a part that has F*, it seems that one might nonetheless need to look outside the "skin" of the part in order to fix all *other* intrinsic properties of the whole. It thus seems that fixing the intrinsic nature of the parts does not necessarily suffice for fixing the intrinsic nature of the whole. So, emergence is possible, but submergence is impossible.

But *as stated* this is false. Just because for any intrinsic property F of a part, the whole has a corresponding intrinsic property of *having a part that has F*, it doesn't follow that fixing the whole is fixing the parts. Consider a world consisting of two simples x and y and their fusion f(x,y). Let x have an intrinsic property m to degree 1, and y have the same property m to degree 2. Let m be the only intrinsic property of the objects that we care about. Assume further that m is additive in the following way: if x has m to degree 1 and y has m to degree 2, then f(x,y) has m to degree 3. Then, obviously, fixing the intrinsic properties of x and y suffice for fixing the intrinsic property of f(x,y). But the converse is not the case. Assume we instantiated m to degree 3 in f(x,y). Nothing is yet fixed as to the intrinsic nature of x and y individually. For all that's been said and done so far, x might have m to degree 1 and y have it to degree 2, or

[86] For a further discussion of emergence, see McLaughlin (1997/2008). I know of no further discussion of submergence. I hope to be able to further discuss submergence elsewhere. See Bohn (ms).

y might have m to degree 1 and x have it to degree 2, or x might have it to degree 1.5 and y have it to the same degree, or … and so on for at least continuum many different combinations. Fixing the intrinsic nature of *f*(x,y) has left it indeterminate what the intrinsic natures of x and y are. So how can fixing the whole metaphysically suffice for fixing the parts individually? In fact, it seems, in one sense, submergence *is* metaphysically possible. But only *in one sense* because by propertizing *f*(x,y) with m to degree 3 we might have thereby also propertized x and y with m to *some degree or other*; it's just that we haven't *determinately* fixed their individual intrinsic natures with respect to m. But not having *determinately* fixed the intrinsic nature of x is not having fixed the intrinsic *nature* of x. So, being more precise by assuming 'fixing the intrinsic nature' means 'determinately fixing the intrinsic nature', submergence is metaphysically possible, and hence the parts individually might thus fail to supervene on the whole.

There is an obvious reply. We simply fix the whole in the most specific way possible. For any part x having an intrinsic property F, the whole has the intrinsic property of *having x as a part that has F*. Thus, by fixing the intrinsic nature of the whole, one thereby fixes its intrinsic property *having x as a part that has F*, and one thereby fixes x with F. One similarly fixes the relations among the parts as per (ii) above. Thus, in our world above, we simply propertize *f*(x,y) with the three intrinsic properties (p1) *having m to degree 3*; (p2) *having x as a part that has m to degree 1*; and (p3) *having y as a part that has m to degree 2*. By thus fixing the whole, we have *thereby* fixed the many parts. As such, submergence is impossible.

But there might still be at least two problems. First, (p1) seems redundant given (p2) and (p3). That is, by fixing (p2) and (p3), (p1) is *thereby* fixed. Thus, in simple worlds where there is no emergence, steps *a la* (p1) can be dropped altogether and we thereby save us a lot of constructional work. But then, to what extent are we really fixing

the *whole* rather than the *parts* in such worlds? Aren't we simply fixing the parts and thereby fixing the whole under the guise of fixing the whole with dummy-properties like *having x as a part that has F*?

A second problem with the above reply might be that it rests on a very fine-grained criterion of identity for worlds (or wholes). In fact, it must rest on *the most* fine-grained such criterion possible. Otherwise, fixing the whole would leave indeterminacy in the parts as above, and thus violate supervenience of the parts on the whole. Submergence is thus impossible only if wholes are identified in the most fine-grained way possible. This might not be objectionable at the end of the day, but it is definitely a cost worth considering. I doubt all pluralists are willing to so commit themselves.

3. Fundamental Cardinality is Contingent

In this last section, I will discuss why we should think that the debate over monism versus pluralism is over a matter of necessity. I conclude that we shouldn't.

Assume composition is *not* identity: any fusion *f*(xx) is a numerically distinct portion of reality from xx collectively. Then, as far as I can see,[87] simple recombination principles imply that there is a world in which xx exist without any fusion. The fact that xx must compose something in all possible worlds becomes a highly mysterious form of necessity, and should by our employment of HD (cf. Ch. I, section 3.1) be eliminated from our theory.[88] *Two distinct* kinds of portions of reality shouldn't be necessarily connected without an explanation. Note that mere overlap provides no such explanation unless it is thought of as partial identity a la chapter II. Consider what Schaffer (forthcoming,c:6) says in this regard:

[87] I argued for this in chapter I, section 3.1. I have also argued for this in Bohn (2009b).
[88] See also Cameron (2007).

> To a first approximation – and in metaphorical causal language – two entities x and y are freely recombinable iff either can be moved, altered, or erased (consistent with its own internal essence), without requiring any change to the other. … the root idea should be intuitive enough to work with – *you can do almost anything you like to the one entity, without touching the other*. Identity and mereological overlap may serve as clear cases of constraining relations. Obviously a given entity x cannot be moved, altered, or erased, without changing x itself. In the overlap case, if x and y have a common part and you erase x, or alter that part of it, then you've changed y by erasing or altering one of its parts.

Why is overlap such a constraining relation? Well, because you cannot eliminate one of the overlapping entities without affecting the other. But *why* is that? They are *not* the same portions of reality, so *why* can we not eliminate one of them without altering the other? There simply is no explanation. The necessity involved is thus highly mysterious, and should by HD be eliminated. Thus, if composition is not identity, then, as far as I can see, there are possible worlds in which there is no maximal fusion U. But then monism cannot be a matter of necessity. Since, for a monist, everything turns on whether U exists, she cannot merely assume it does, far less that it has to exist.

But assume composition *is* identity. Then since we cannot eliminate one thing without altering whatever is partially/fully identical with it, we *have* in fact an explanation for the necessity involved. There is no possible world in which there is no maximal fusion U because U is identical with all things at that world. We thus cannot eliminate U without eliminating everything. U must exist if its parts do on pain of contradiction. That is of course as good an explanation as one gets in philosophy.[89] So, if

[89] That composition as identity implies the necessity of U was formally proved in chapter II.

a monist wants to preserve the debate as being over a matter of necessity, she is best advised to accept composition as identity.

Unfortunately, even this will not help. With composition as identity on board, grounding is not really a question of which one of xx and f(xx) is the more fundamental because they are the same portion of reality, and hence, in a sense, must be equally fundamental. Rather, it becomes a question of which way of conceptualizing that portion of reality is the most natural such way. Is it most naturally conceptualized as being one fusion, or as being many parts?

But on this picture, there is no reason to think that all possible worlds are most naturally conceptualized in the same way, mereologically speaking. For example, a possible world consisting of one and only one simple is most naturally conceptualized as being one, while a possible world consisting of only two disconnected simples and their fusion might seem the most naturally conceptualized as being two. Furthermore, a possible world consisting of only two entangled simples and their fusion might seem the most naturally conceptualized as more monistic in nature than the possible world where the two simples were disconnected. But even so, there is no reason to think that all metaphysically possible worlds are entangled; and, as I argued above, even entangled worlds might be more naturally conceptualized as pluralistic, though with fundamental plural, collective properties. On the other hand, though I haven't yet seen a convincing argument for it, I don't see any reason to deny the mere metaphysical possibility of the world being the most naturally conceptualized as the maximal fusion of everything. How to most naturally conceptualize something shouldn't be a restriction on modal space. But then again I see no reason to accept the necessity of monism from the mere possibility of monism.

Finally, the mere fact that both positions seems coherent – the negation of neither one of them seems incoherent – creates, I think, a default position according to which they are both possibly true. So I must conclude that, absent other reasons for thinking that whichever side in the debate is right is necessarily right, the debate is over a matter of metaphysical contingency. More generally, the fundamental cardinality of things is a matter of contingency, depending on which conceptualizations, or relational units, are the most natural for the portion of reality in question. Anything else would of course be surprising, given that cardinal properties are *relational* properties.

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