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The Bundle Theory, Substance and Spacetime

by

Glenn Gerard Parsons

A thesis submitted to the Faculty of Graduate Studies and Research in partial fulfillment of the requirements for the degree of Doctor of Philosophy

Department of Philosophy

Edmonton, Alberta

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University of Alberta

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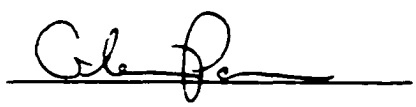

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14 August 2001

Bundle theorists are a resilient lot.

Michael Loux, 1998

University of Alberta

Faculty of Graduate Studies and Research

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled *The Bundle Theory, Substance and Spacetime* submitted by Glenn Gerard Parsons in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

Dr. Alexander Rueger

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Date: 13 August 2001

For my Mom,
and for Richard Morgan

Abstract

The past thirty years has witnessed a resurgence of interest in 'realist ontologies': views that treat properties and relations realistically. Such views necessitate a metaphysical account of the structure of concrete particulars. One such account is the Substratum theory of concrete particulars, on which concrete particulars are composed of their properties together with a substratum that individuates them and bears these properties. A traditional objection to this account is that the substratum would be unknowable. Recently, several philosophers supporting a realist ontology have argued for versions of this traditional Substratum theory, insisting that this epistemic objection to the substratum can be overcome. I argue that this cannot be done. Specifically, I claim that either the substratum leads to a vicious regress or else it fails to meet epistemic constraints widely enforced in metaphysics. Therefore, realist ontologies must provide a Bundle theory of concrete particulars (i.e. one that does not employ substratum).

Consequently, the traditional version of the Bundle theory, which construes properties to be universals, is assessed. The main objections that have been raised against this version of the theory are rejected; this includes what has been traditionally the most prominent objection, the charge that it is committed to the necessitation of the Identity of Indiscernibles. However, I also show that

the theory requires applying the notion of bi-location to concrete particulars. I claim that this violates strong pre-theoretic intuitions about concrete particulars and renders the traditional Bundle theory inconsistent with a view attractive to contemporary realists, spacetime substantivalism. For these reasons, it is argued that the realist should adopt a Bundle theory that treats properties as tropes, rather than as universals. A Bundle theory formulated using tropes does not face the above limitations because it does not require the bi-location of concrete particulars. I also argue that the Bundle of tropes view has a further advantage over competing accounts of concrete particulars: it defuses the most serious theoretical obstacle to spacetime substantivalism: the notorious 'hole argument'.

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I. The Analysis of Concrete Particulars

This chapter introduces the metaphysical issue under consideration, the analysis of concrete particulars, and the two dominant contemporary accounts of that issue: the Substratum theory and the Bundle theory (section 1). The Substratum theory has been defended recently by philosophers working within the epistemological framework of scientific realism. In section 2 of this chapter, however, I offer three reasons for pursuing a Bundle theory of concrete particulars, as opposed to a Substratum theory, within that framework.

1. Substrata and Bundles. The subject of this study is a class of entities that, following a common usage, I call "concrete particulars". [1] Concrete particulars, as I shall use the term, are concrete in the sense that they have more or less definite location in space and time and are capable of participating in causal interactions. They are particular in the sense that they exemplify, or have, properties whereas they themselves are not had or exemplified by anything else. Examples include Pierre Trudeau, a certain helium atom, the planet Jupiter, and my cat. The philosophical study of concrete particulars, or at least something roughly analogous to them, appears to go back to Aristotle's *Categories* and its 'primary substances' (Lowe 1999, 371). In contemporary philosophy concrete particulars go by many different names: very often they are said to be "things" (Van Cleve 1985, 95; Armstrong 1989a, 60; O'Leary-Hawthorne 1995, 191),

sometimes "objects" (Zimmerman 1997, 305; Loux 1998) and at other times "substances" (Loux 1978, 107; Hughes 1999, 149). Although perhaps not the most elegant, I use "concrete particular" rather than these other terms, because the alternatives are either so broad in meaning or so laden with technical philosophical connotations that they unnecessarily complicate discussion.

From the description and examples given above, it should be clear that concrete particulars are a very widespread species of entity, and one with which we are perennially confronted in experience. In one sense, therefore, there is nothing at all opaque about the notion of a concrete particular. Familiar philosophical concerns about it, however, are easily generated; they arise naturally out of our talk of the *properties* of concrete particulars. "Pierre Trudeau has the property of being wise"; what does this mean? Surely Trudeau is a concrete particular; but does this mean that there is something, 'being wise', or perhaps Wisdom, that is in some sense connected to Trudeau, or affiliated with him? If so, then how is it connected to, or affiliated with him? If we accept that properties exist, and are somethings, then it is natural to try to answer the second question by giving an *analysis* of concrete particulars. By "analysis" I mean some metaphysical account of what concrete particulars are and how they are 'put together', or structured, in terms of other, more fundamental sorts of items, such as properties. These other items I shall call, again following a common usage, the 'constituents' of concrete particulars.[2] Because my notion of analysis is vague, so must be my notion of constituent; on some particular analysis, 'constituent' may

be refined, for example into the notion of 'a part of (a whole)', or 'a member of (a set)'. However, to allow scope for these different accounts as analyses of concrete particulars, we should leave "constituent" itself, as it occurs in the definition of "analysis", vague.

There is a traditional analysis of concrete particulars known as the Substratum/Property theory, or as I will call it, simply the Substratum theory. According to this theory, each concrete particular in the world has, in addition to the properties which characterize it, a *substratum.* Typically the substratum serves as the bearer of those properties. For example, Trudeau might be constituted by the properties wisdom, humanity and arrogance, together with a substratum that supports those properties (note that this substratum is taken to be a non-spatial constituent of Trudeau).[3] In the typical version of this theory, the properties inhering in the substratum are *universals;* this means, among other things, that they are properties capable of inhering in more than one substratum at the same time. So the very same property, Wisdom, which inheres in Trudeau's substratum in 1984, for example, might also inhere in that of the Dalai Lama that same year.

This traditional understanding of properties leads to a second function for the substratum, that of *particularizing* distinct concrete particulars: making them the particular entities that they are, as opposed to some other one. It seems possible, in theory, for two numerically distinct concrete particulars to have all of the same properties. If properties are universals, however, then such particulars

would have the very same constituents, and it seems hard to see how the assemblage of the very same constituents could produce two distinct items (Loux 1998, 235). Yet our concrete particulars are, by hypothesis, distinct items. The different substrata that, on the Substratum theory, are constituents of each can be invoked here to particularize, or differentiate them, metaphysically, one from the other. Thus there are (at least) two possible roles for substratum to play in an analysis of concrete particulars: being property bearers and being particularizers. Though some versions of the Substratum theory assign both roles to substratum (e.g. Armstrong 1997) some assign only one or the other (e.g. Bergmann 1967).

This description of the Substratum theory suggests an alternative analysis of concrete particulars: leave out the substratum and employ properties only. This kind of view is generally known as a Bundle theory, insofar as it construes concrete particulars as merely some sort of collection or 'bundle' of properties, and nothing more. On the Bundle theory, then, Trudeau would be constituted by some sort of combination of the properties wisdom, humanity and arrogance. No additional component, in which these properties inhere, or which serves to particularize him or individuate him from other French-Canadian intellectuals, is posited. The work assigned to the substratum by the Substratum theory is distributed elsewhere in the scheme of the bundle theorist.

The vague notion of "some sort of combination" alluded to above is usually glossed as the relation generally called, following Bertrand Russell, *compresence* (Russell 1948, 321-322). Some bundle theorists take compresence to

be a primitive relation: it is whatever relation it is that properties have to other properties just in case they are all properties of the same concrete particular (see Van Cleve 1985, 97; Armstrong 1989a, 70). For others, it is not understood as a primitive, but taken to be a special sort of spatiotemporal relation, such as 'being at no distance away from' (Williams 1953; O'Leary-Hawthorne, 1995). Bundle theorists also differ over which properties are properly considered candidates for inclusion in the bundles that constitute concrete particulars. Although some allow all properties such access, the class of admissible properties is usually delimited. It is widely agreed, for example, that properties such as 'being identical with oneself' should not be allowed to enter into bundles, on the grounds that they are closer to being substrata than to being genuine properties (see Black 1952, 153-155). Some bundle theorists wish to include only intrinsic properties in bundles, whereas others involve relational as well as intrinsic properties (see Armstrong 1989a, 64-70).

These two views, the Substratum theory and the Bundle theory, are the two main competitors in the analysis of concrete particulars in twentieth century analytic philosophy (Armstrong 1989a; Loux 1998; Lowe 1999). In this chapter, I will argue that, within the contemporary epistemological framework of scientific realism, the Bundle theory is a better analysis of concrete particulars than the Substratum theory.

Before I begin that argument, however, I want to note that some philosophers respond to the sorts of musings about Trudeau engaged in above

by saying there is not something, Wisdom, which is connected to Trudeau in some way, because there simply is not something, Wisdom. There is simply Trudeau. We can say of Trudeau, truly even, that he is wise, but this does not entail that there is a *something*, a property, which is somehow associated with him. This position is often called "Nominalism", and it amounts to a rejection of the possibility of an analysis of concrete particulars. According to nominalists, this category should be treated as primitive, not analyzable in terms of more fundamental entities. In fact, such ostensible entities as properties are usually analyzed by nominalists in terms of concrete particulars. Throughout this study I simply assume that Nominalism is not a plausible position, and that some analysis of concrete particulars that admits properties as real constituents of them is required. Others have argued for this claim at length, persuasively in my opinion, and I have nothing to add to their case (for reviews see Armstrong 1978 and 1989a).

2. Motivations for the Bundle Theory

2.1. The Unknowability of Substratum

2.11. The Epistemic Objection. The general idea that we called "the Bundle theory" above is quite vague, and something analogous to it can be found in many very different philosophical ontologies, going all the way back to the Pre-Socratics, according to one commentator (Denkel 1996). The roots of formulations of the Bundle theory found in contemporary analytic philosophy, however, are usually traced back to the work of the British Empiricists (see e.g., Loux 1978, 107-115).[4] John Locke notoriously accepted the need for a notion of substratum, but himself admitted that "we have no idea of what it is, but only a confused, obscure one of what it does" (1690, 175). His successors Berkeley and Hume pressed the latter concern as reason for abandoning the notion, Berkeley for physical substratum and Hume for both physical and mental substratum.

In twentieth century philosophy, similar worries about the epistemic status of the substratum have again motivated philosophers sympathetic to various varieties of Empiricism to reject it. Russell, who derided the substratum as "a peg on which to hang predicates", insisted that

> the particular cannot be defined or recognized or known; it is something serving the merely grammatical purpose of providing the subject in a subject-predicate sentence such as "this is red". And to allow grammar to dictate our metaphysic is now generally recognized to be dangerous. It is

> difficult to see how something so unknowable as such a particular would have to be can be required for the interpretation of empirical knowledge. (1948, 311)

Though Russell saw such epistemic concerns as sufficient reason to reject the Substratum theory, not all his contemporaries shared this view. The school of Gustav Bergmann, for example, despite empiricist sympathies, insisted that a sort of substratum, which they called the 'bare particular', was necessary in order to deal with certain issues involving individuation. Nonetheless, Bergmann and his followers were, like Russell, quite sensitive to the epistemic obscurity of the bare particular. One of them, Edwin Allaire, tried to avoid it by arguing for a claim that is counterintuitive, to say the least: bare particulars are, after all, presented in sensory perception (Allaire 1963). Allaire's argument, however, has been heavily criticized, even by defenders of bare particulars.[5]

The failure of this line of argument notwithstanding, there appears to be growing sentiment that the elusive character of the substratum is no longer any serious obstacle to the Substratum theory. Although some contemporary philosophers continue to cite epistemic concerns as at least potential reasons for rejecting the substratum (Campbell 1981, 131; Armstrong 1997, 110), such concerns are more often now seen as misguided. "Only the philosopher in the grips of an outmoded empiricism", claims Michael Loux in a 1998 review, "is likely to be sympathetic with the objection" (239). J.P. Moreland calls the

epistemic objection the weakest of all the objections to the substratum, explaining that

> this objection was a forceful one in the days of Bergmann and his disciples because they lived in a time when forms of positivism were still alive and, in fact, they themselves subscribed to a version of empiricist epistemology. . . . . Today, most philosophers would not place the type of empiricist constraints on analytic ontology that was present in Bergmann's day. (1998, 255-256)

The general idea here seems to be that (i) whatever force the epistemic objection against substrata may have rests upon positivist assumptions, (ii) positivist assumptions are not plausible, and so (iii) epistemic objections against substrata have no force.

What are the 'positivist assumptions' referred to here? Moreland takes the relevant assumption to be that we should allow no "ontological posits that go beyond what is empirically sensible or testable" (1998, 255). Allaire formulated the relevant assumption as Russell's Principle of Acquaintance ("the undefinable terms of any 'ontological' description must refer to entities with which one is directly acquainted") which he calls a "basic tenet of empiricism" (Allaire 1963, 248 and 253n2). In both formulations, the key assumption is that we should accept only entities that can be the direct object of sensory experience or of some other primitive form of experience. The idea behind the argument sketched above for the inefficacy of the epistemic objection is that most contemporary scientific realists would reject this constraint: theoretical entities which are not

directly observable are respectable, so long as they play an essential part in a successful scientific explanation. So if we treat the substratum like a quark or the electromagnetic field, then we will have no further troubles with its epistemic credentials. Just as we are justified in believing in the existence of quarks because of the role they play in explaining certain physical phenomena, we are justified in believing in the existence of substrata in virtue of the essential part they play in the best explanations that we have for some metaphysical phenomena involving concrete particulars (see e.g., Loux 1998, 239; Moreland 1998, 256).

Personally, I am not yet convinced that epistemic suspicion of the substratum is merely a prejudice from benighted times. I think this because the above refutation of the epistemic objection to the substratum hinges on an analogy between the substratum and other theoretical entities in empirical science and in metaphysics, when in fact there is a crucial disanalogy between the two. The difference lies in how the substratum and well-accepted theoretical entities like quarks meet certain constraints on explanation. One such constraint in natural science is what I will call the constraint of *Independent Characterization*: any entity introduced to explain a phenomenon should be capable of characterization in a manner that is independent of the theoretical role it plays in said explanation. The Independent Characterization constraint, manifested in natural science, prohibits using occult or ineluctably mysterious entities to explain empirical phenomena: whenever a theoretical entity is posited to explain

some such phenomenon, it must be capable of some sort of characterization independent of that phenomenon. I think that the Independent Characterization constraint is enforced very widely in natural science. Here is one example of it in action, from a recent critique of quasi steady-state cosmological models:

> An important prediction of hot Big Bang models is that the cosmic background radiation will have a near-perfect blackbody spectrum, as is indeed observed. The upper limits on departures from blackbody are so stringent that it is difficult for other models to satisfy this requirement. The authors make their quasi-steady state satisfy it, but only by tuning a newly postulated parameter: the optical depth of the universe in a very special kind of thermalizing dust. This dust has to be given quite different properties from the dust mixed among the gas and stars in our own and nearby galaxies. Because the blackbody spectrum requires the introduction of new parameters, it cannot be counted as an explanatory success of their model, until that thermalizing dust is observed *in some other way*. (Hogg and Zaldarriaga 2000, 2079; my italics)

What Hogg and Zaldarriaga are saying is that even though this dust explains the blackbody spectrum, this explanation is not a successful one until some independent characterization of the dust is made.

The example of quasi-steady state cosmological models only shows that the Independent Characterization constraint is applied to explanations in natural science. More importantly for our purposes, however, I wish to claim that the constraint is appropriate for explanations in metaphysics as well. Unfortunately, a general argument for this claim would be problematic, since explanation in metaphysics does not seem to be well understood (Oliver 1996).[6] Nonetheless,

there are some clear examples of the constraint in action, even where it is not explicitly invoked. Take, for example, Loux's discussion of universals (1978). Loux takes universals to provide the best explanation of certain phenomena involving aspects of language use, including abstract reference. This explanatory success grounds his belief in universals. However, Loux concludes his argument for universals by saying:

> The topic of universals could lead one in a variety of different directions. It could lead one into the area of epistemology, where one might ask how we come to have knowledge of universals and how universals figure in our empirical knowledge about the world. It could lead one into the area of philosophical theology, where questions about the relations of God to universals and questions about the role of universals in His creative activity have always been central. It could also lead one into the area of aesthetics, where questions would arise about the role of universals in the production of artifacts and their role in aesthetic judgements. It could also lead us into the areas of ethics and political philosophy where questions about the role of universals as moral standards have vexed philosophers since at least the time of Plato. (1978, 102-103)

The point of this passage, as far as I can tell, is to show that, even after they have been invoked as explaining the phenomenon of abstract reference, there is a lot left to be said about universals. They can be characterized in many ways - epistemological, theological, moral, and aesthetic - which are *independent* of their role in accounting for linguistic or semantic phenomena. The reason for saying this, I take it, is to demonstrate that universals are not ad hoc posits designed to fix only one problem: they can play roles in explaining many distinct

phenomena, and, consequently, it is possible to characterize them in many distinct ways. This fact, when coupled to their initial explanatory success, gives us more warrant to believe in them than we would have otherwise.

Another nice example of the Independent Characterization constraint in use is afforded by David Armstrong's discussion of higher-order universals (i.e. properties of properties). Armstrong feels pressure to adopt higher-order universals in order to explain the resemblances between universals (Question: why is the property 'being scarlet' more like the property of 'being magenta' than that of 'being green'? Answer: there is a higher-order, three-place relation of 'being more like than' in which these properties stand). He is reluctant to accept them, however, one of his reasons being that "we seem to have no independent grip on these properties besides their role in solving our present problem" (1989a, 105). This particular use of the Independent Characterization constraint is especially significant to my present argument that this constraint is plausible as a constraint within metaphysics. Since I have given no general argument for this claim, if my examples showed only that the constraint was thought plausible by those who reject the substratum and similar entities, then in impugning substratum theorists for failing to meet this constraint, as I am about to do, I would be at risk of begging the question. However, this is not the case, because although Armstrong upholds the constraint, he himself is a substratum theorist.

It is also important to stress that I am claiming that the Independent Characterization constraint is a plausible one to apply *within metaphysics*. Some

philosophers would enforce the constraint in the following way: all entities posited by metaphysicians must be capable of independent characterization by natural science. This position is just a slightly reformulated version of Naturalism: what exists is only that which is identified as existing by the natural sciences, or certain of those sciences. The Independent Characterization constraint, however, which is weaker than this claim, is plausible even for non-Naturalists. In the examples given above, for instance, Loux is not insisting that any theoretical posit in metaphysics must be characterizable by some branch of natural science; rather he is (tacitly) making the weaker claim that any theoretical posit must also be characterizable by some other branch of metaphysics or philosophy. Even philosophers with no sympathy for Naturalism will shrink from positing entities which are completely ad hoc in the sense that they explain only one phenomenon and are completely opaque to *any* further theoretical scrutiny. Finally, it is perhaps appropriate to re-emphasize that the Independent Characterization constraint is different from and weaker than the 'positivist assumptions' that we discussed above. An entity could satisfy the Independent Characterization constraint and yet not be directly available to sensory experience or another primitive form of experience. Therefore, rejection of the positivist assumptions does not imply rejection of the Independent Characterization constraint.

What I want to argue now is that since the substratum fails to meet the Independent Characterization criterion, explanations involving it are not

successful explanations. Therefore, they do not provide justification for believing in substratum. On occasion, philosophers have noted that explanations involving substratum seem somehow empty. Michael Loux, for example, writes:

> We are confronted with a phenomenon - that of the existence of diverse, yet indiscernible objects; the phenomenon needs explanation; and along comes the substratum ontologist, who, upon examining the phenomenon declares, "And so substances incorporate substrata among their constituents." But when asked just what substrata are, he tells us that substrata are the entities in substances which ground the numerical diversity of indiscernible objects; and he refuses to say any more. It is difficult not to doubt his claims to have provided a genuine explanation of the phenomena in question. (1978, 150)

The problem here is that the substratum, in itself, appears to have no properties. Certainly, the concrete particular of which the substratum is a constituent has properties, but the substratum itself is just the non-property bearer of these properties: when all of the properties of the concrete particular are enumerated, the substratum is that which is left over. Having no properties itself, the substratum seems barren of any qualitative nature. If this is the case, however, then it seems that there is literally nothing that can be said about it, except perhaps that it is that which bears properties and individuates concrete particulars.[7] Because of this, the prospects for characterizing it in any way independent of its role in the analysis of concrete particulars seems dismal. The substratum stands apart in our ontology, not meshing with other areas of metaphysics in any natural way.

The substratum theorist might reply that the objection here only works by trading on an ambiguity in the notion of 'entity'. If we take the notion of entity at the *type* level, then indeed we find that there is little if anything to say about the entity type substratum. However, if we take the notion at the *token* level, we find that there will be plenty of independent characterization available for substratum tokens. For example, of some substratum we might be able to say that it was in St. John's on April 1, 1949, or that it was causally related to the death of Franklin, or that it is a constituent of a famous goaltender. Furthermore, it seems, indeed, that in the examples considered above, such as that of the quasi-steady state cosmological models, the Independent Characterization constraint appears to be formulated for tokens, not types (i.e. we principally speak of characterizing this particular dust, not such dust in general). If all of this is correct, however, then it appears that once we formulate our constraint in the proper way, then substrata do satisfy it after all.

It may be that the Independent Characterization constraint is best put in terms of particular entities posited, rather than types, but I do not think that this provides the substratum theorist with an adequate response to the objection. The reason for this is that these sorts of 'features' of particular substrata, such as being located at a certain place at a certain time, follow *automatically* from their being posited as constituents of concrete particulars: since the latter are located, or involved in causation, then so are their constituents. Hence pointing out these 'features' hardly counts as characterization of them independent of their initial

role in the analysis of concrete particulars. Contrast with this the characterization of mass as a quantitative property, or of a certain form of virtue as the foundation of moral law; such facts about properties in no way follow merely from their being constituents of concrete particulars.

At this point a defender of the substratum may well question my claim that satisfaction of the Independent Characterization constraint really represents a necessary condition for accepting a theoretical entity, even in natural science. This might be done by pointing to a notorious case in cosmology, that of the so-called 'dark matter' (Turner, 2000). According to contemporary cosmology, matter of the sort that we typically observe in physics is present in insufficient amounts to explain certain cosmological phenomenon (e.g. the dynamic behaviour of galaxies). In order to account for these effects, a much larger source of mass is required. This prompts cosmologists to posit dark matter, some sort of matter which, though hitherto undetected and as yet uncharacterized, exists and is responsible for the observed cosmological phenomena. The defender of substrata might well point out that most cosmologists accept the existence of dark matter without having the slightest bit of characterization of it from any other branch of physics (Turner, 2000). This shows that Independent Characterization is not even a general constraint applied in natural science, let alone one applied in natural science *and* metaphysics.

In response to this, I think that one needs to distinguish carefully between theory acceptance in the short run and theory acceptance in the long run. In the

short run, scientists may well embrace dark matter, without having any idea of what it is, beyond that which explains certain phenomena. The Independent Characterization constraint does not apply in the short run; indeed, if it did, then like many other theoretical constraints, it would have the pernicious effect of killing off new theories before they have a chance to prove themselves. However, in the long run, dark matter will not survive unless more can be found out about it; presumably this is part of the reason that studying it is a pressing concern in contemporary cosmology. Independent Characterization is a constraint applied to theoretical entities in the long run, or, one might also say, to research programs. Research programs that fail to provide independent characterization of the entities they postulate stagnate and die off. Even if the constraint is relaxed in this way to apply only to research programs, however, this is little comfort to the substratum theorist. For the substratum *must* fail to be independently characterized, no matter how much time or effort is dedicated to studying it. For these entities, Independent Characterization fails *in principle*, not merely because of inadequate resources or lack of ingenuity. Again, this is because they do not seem to have any properties or qualitative nature that could sustain such characterizations. If this is true, then substrata, like other unhappy entities that failed to find independent characterization, must ultimately become victims of their own aloofness.[8]

2.12. Two Responses. I have argued that, contrary to the opinion of some contemporary thinkers, epistemic reservations about the substratum do not depend on positivist assumptions. In keeping with the epistemology of contemporary scientific realism, these reservations may be reformulated in terms of a plausible constraint on explanation. I now want to consider two replies to my argument that are open to the substratum theorist, one developed, but now abandoned, by David Armstrong, the other advocated by C.B. Martin.

Though he advocates an acceptance of substratum, Armstrong has always been alert to their problematic epistemic status. In his *Universals and Scientific Realism* (1978), Armstrong tries to avoid this difficulty by identifying substrata with spacetime locations (1978 I, 118-125). He states the idea a bit more clearly elsewhere: "Properties, according to this suggestion, including maybe spatial and temporal properties (shape, size, duration), are supported by, inhere in, or qualify places or place-times" (1989a, 61). This move would undercut the epistemic objection to the substratum because the latter is thereby identified with a reputable and independently characterized entity: the spacetime point. This view is sometimes called 'supersubstantivalism', because it not only takes spacetime to be a real entity (a view loosely called "substantivalism") but takes it to be, in an important sense, the *only* real entity. What we normally call material objects, concrete particulars, are simply parts of spacetime exemplifying certain properties.[9]

This suggestion, however, faces a number of difficulties, one of which is that if the identification of substrata with spacetime points is conceded to be the only way to admit substrata, then, assuming we know that concrete particulars exist, we appear to have philosophical justification, without further argument, for the existence of substantival spacetime. The existence of substantival spacetime, however, is prima facie a substantive question to be settled within the philosophy of space and time (Campbell 1981, 132-133). Furthermore, supersubstantivalism would seem to rule out the possibility of there being genuine persistence through change in the world because no concrete particular could wholly exist at two different times, such particulars being (spatio)temporal points or aggregations of them (Martin 1980, 8). On this view genuine change would involve something very much like times existing at different times, which seems absurd. There is also the fact that the view conflicts with the intuitively plausible possibility that distinct particulars could share the same position or place-time and yet remain distinct (Armstrong 1989a, 62; 1997, 109). In light of these objections, Armstrong appears to have abandoned the supersubstantivalist view, and now takes the substratum to be "fundamental and unanalysable" (1997, 109; but see also 137-138). This lands him back in the grip of our epistemic objection.

C.B. Martin (1980) gives a response to the epistemic objection that is quite different from the traditional sort of response, of which Armstrong's supersubstantivalist theory is an example. Martin does not respond to the

difficulty by trying to show that the substratum is more epistemically accessible than we thought, but rather by claiming that it is misguided to insist that the substratum have more than the very low amount of such accessibility that it does have. Martin's account makes use of the notion of a 'partial' idea: his example is that of 'cube'. Take an actual cube, a concrete particular (Figure 1.1). Such an entity has constituents, in a metaphysical sense, and some of these constituents are properties; size, colour, mass, and so on. One of these is the property of being cubical in shape. According to Martin, the idea of 'cube' is a partial idea that is formed by focusing on only one property, the cubical shape, of actual cubes. He writes:

> We select only certain 'leading or characteristical' features, leaving out many others required for something of the kind to actually exist. The leading features of a cube are in terms of its shape. It does not matter, qua cube, what it is made of, so we do not even mention that it must be made of something or other. (5-6)

This process of abstracting away all but the characteristical feature of an entity yields all manner of partial ideas (a rock, a watch, a tree), including the notion of substratum. According to Martin, our notion of a substratum is a partial notion, formed by focussing on the leading or characteristical feature of the substratum, namely its property of being a bearer of properties (6; see Figure 1.1). Martin does not try to argue that there are other properties that the substratum has 'characteristically', or in itself; he says that of course substrata have other

properties in the sense that they are the bearers of the properties of the concrete particular of which they are constituents. But *in themselves*, they only have this one; hence all that we can ever hope to know about the substratum is that it is a non-property bearer of properties.

What Martin *does* argue, however, is that this fact about the substratum should not persuade us that the notion of substratum is somehow epistemically obscure or opaque. This is because lots of ideas that we have are partial in the very same way. For example, nobody thinks that the notion of 'cube' is mysterious, just because it focuses only on one property of an existent entity. In fact, Martin claims that the notion of 'property' is perfectly analogous in this respect to that of 'substratum': 'property' is a partial idea, formed by focussing on the leading feature of properties, which is 'being possessed by a bearer'. But then, he concludes, the notion of substratum is "no more obscure or unknowable than the abstract general notion of 'property' itself" (1980, 6). Martin's defense of the substratum against the epistemic objection is unique. This is because he fully concedes the paucity (in principle) of our knowledge of the substratum, and seeks instead to lower the epistemic standard that this knowledge must meet by drawing attention to the phenomenon of partial concepts.[10]

Despite its ingenuity, however, I do not think that Martin's account is sufficient to free the Substratum theory, at least as I am construing it here, from the epistemic objection. The reason is that, true to its Lockean roots, Martin's theory is an account of ideas, or concepts, and not of things in the world. What

Martin shows, assuming his arguments are sound, is that partial concepts are widespread and therefore epistemically unexceptionable. This does *not* entail that an entity which is invoked to explain some phenomenon but which is not independently characterizable is epistemically unexceptionable. For even allowing that partial concepts are unexceptionable, there is still a fundamental difference between the substratum and the other constituents of the cube in Figure 1.1: whereas the substratum has, in principle, at most one property, or way of being characterized, other constituents have many. It may well be that we have partial concepts derived from properties and that these are useful, even essential, to our cognitive function. However, this simply does not entail that an entity characterizable by only one partial concept, such as the substratum, is epistemically acceptable. It is still the case that properties, unlike substratum, are susceptible of characterization in many distinct ways. In light of the arguments given above, this still seems to me like good reason to reject analyses of concrete particulars that employ substratum.

2.2. The Incoherence of Substratum. David Hume once called the Lockean substratum "an unintelligible chimera" (1740, 213). The notorious phrase suggests, to modern ears at least, that the problems with the substratum are not purely epistemic, but that the very conception of the substratum is somehow problematic. What this means, in the words of Michael Loux, is that "one does not have to be a hard-core empiricist to find [the Bundle theory] preferable to the

substratum theory" (1978, 115). Perhaps the most infamous attempt to show that the notion of substratum is incoherent is due to Wilfrid Sellars. In a footnote to his essay "Particulars" (1963), Sellars gave a scandalously terse refutation of substratum: " 'Universals are exemplified by bare particulars' is a self-contradiction" (1963, 282-283n1). This is obvious, Sellars said, as soon as it is translated into logical notation as $(\forall x)[(\exists \phi)(\phi x) \supset \sim(\exists \phi)(\phi x)]$. We say that substratum are the entities that have properties, or bear them, but then, when asked what they are, we say that they are bare, or have no properties: contradiction. The reply to this from the camp of Gustav Bergmann was "to distinguish between the naked and the nude" (Baker 1967, 211). Naked particulars (i.e. substratum) have no properties, whereas nude particulars have properties but have no nature; i.e., they "are *not necessarily connected* to any specific property or set of properties" (211). In other words, nude particulars have no properties *essentially*. The bare particular, then, was to be taken not as a naked particular, but a nude one, nullifying Sellars' contradiction.[11]

Advances in the logic of disrobement, however, failed to placate critics of the notion of the bare particular or substratum. In his 1978, Michael Loux disputed the claim that substrata have no properties essentially. Loux claimed that there are innumerably many properties that they have essentially: for example, having no properties essentially, being a constituent of only one concrete particular (at a time), being self-identical, being human or non-human, and being colored if green (147-148). No substratum, said Loux, could exist

without having such properties. Faced with cases like this, the substratum theorist has a choice. She can agree with Loux, and adopt a non-nude view of substrata as entities that do have properties essentially (or, as we might say, 'in themselves'). Alternatively, she can dispute Loux's claim that substrata must have at least some properties essentially.

At first glance the first option might not seem like such an evil fate; after all, it does not land one back in Sellars' contradiction. What the substratum theorist will have to say is that substrata are not naked (they have properties) but not quite nude either (they have some select set of properties essentially, or in themselves). However, this reformulation of the substratum view, though it does not involve a straightforward contradiction, as far as I can see, yet threatens to have disastrous consequences. This is because the admission that substrata themselves have properties serves as a premise in the *Regress Argument*:

1. Concrete particulars have properties.
2. Concrete particulars are complex entities consisting of a substratum S bearing the properties P_n (ontological explanation of (1)).
3. Either S has properties or it does not.
4. S cannot have no properties.
5. Therefore, S has properties.
6. The only explanation of (5) is to apply an analogue of (2) to S.
7. Therefore, the ontological explanation of (1) by (2) is vacuous. [12]

The regress argument is supposed to show that, if it is conceded that substrata have properties, then their very existence is undermined. This proceeds in the

following way: we take the positing of substrata to be an explanation of a certain fact. In this version of the argument, the fact being explained is that concrete particulars have properties. The substratum is (part of) an explanation of this state of affairs: concrete particulars are said to have the properties they do insofar as they contain a constituent, substratum, in addition to these properties, in which the properties inhere. The regress argument assumes a constraint on such explanations: the entities invoked in the explanation cannot be characterized in a way that assumes the fact being explained. In such cases, the explanation would be vacuous, and the reason for invoking the entity in the first place evaporates. Another way to express the constraint is in terms of prohibiting vicious regresses: the problem being solved by the explanation cannot reappear, unsolved, in the solution.

According to the regress argument, if we grant that substrata have properties in themselves (premise four), as Loux argues that we must, then they fail to meet this constraint. If substrata are supposed to explain concrete particulars having properties, then they fail to meet the constraint because substrata themselves have properties of their own, and no explanation of this is forthcoming, except the very same sort of explanation offered for the original situation, involving a substratum of the substratum. The explanation thus assumes the very phenomenon, the having of properties, which is supposedly being explained. The regress argument is a powerful argument because its key elements, the claim that substrata must have properties and the constraint it

enforces on metaphysical explanations, are prima facie plausible and admit of multiple motivations.

If this line of thought is correct, the substratum theorist has compelling reasons to resist Loux's claim that substrata do have properties in themselves. One strategy for doing this is suggested by J.P. Moreland, who writes that some of Loux's examples of essential properties of the substratum are "suspect to say the least" (1998, 257). To him, " 'x is colored if x is green' is not a property, but a state of affairs constituted by a determinable (being colored), a determinate (being green) and a genus/species relation" (257). Hence the claim that substrata have this property essentially is false, since this is not even a property. Moreland, however, only applies this strategy to some of the properties Loux cites, ultimately accepting that substratum have some properties essentially (258).

A more thorough and developed implementation of the strategy is carried out by Armstrong (1978). He suggests that a sparse theory of properties may save substratum theorists from having to recognize properties of substrata in themselves (i.e. essential properties). A sparse theory of properties is the view that only a subset of the predicates that truly apply to an object correspond to properties possessed by that object (Lewis 1986, 59-60). Such an account allows one to reject many of the prima facie candidates for ontological constituents of concrete particulars, and this is how Armstrong uses it to fend off Loux's argument:

> It is undoubtedly true that, if there are Lockean substrata, the predicate 'without all characteristics' applies to them. But why does it follow that this predicate must apply in virtue of a *characteristic* (property) of the substratum? This would only follow if every predicate which applies to an object must apply in virtue of the characteristics of the object. This further doctrine itself follows from the identification of characteristics with the meanings of predicates... (1978 I, 103).

So we can admit that it is true of some given substratum that it is without characteristics, for example, but deny that this means that it has a property, 'being without characteristics'. Assuming that this is the right account of properties and that it can be generalized to deal with other predicates as well, then Loux's argument goes through, Armstrong argues, only because of a naïve view of the relation between properties and predicates.[13]

Unfortunately, regardless of whether or not a sparse theory of properties is correct, Armstrong's reply here fails. To see this, consider the following set of propositions:

1. Substrata satisfy 'has no properties'.
2. 'Has no properties' applies truly to a substratum in virtue of a property of that substratum.
3. For any predicate P, if P truly applies to some object x, then P applies to x in virtue of some properties of x.
4. For any predicate P, P refers to a corresponding property.

Armstrong agrees that (1) is true. But he contests (2), and does so by taking it to be an instance of (3). (3) is then rejected because the reason for accepting it is taken to be (4), and Armstrong explicitly rejects (4) by adopting a sparse view of

properties. I agree that (4) does entail (3): if there is a property corresponding to every meaningful predicate, then if some predicate is true of an object, it is natural to take the corresponding property to be the grounds for that fact (not to so employ it seems gratuitous). Thus, any true predication about X will be grounded in a property of X. However, I do not think that rejecting (4) is sufficient reason for rejecting (3). Indeed, (3) seems independently plausible, even for a proponent of sparse properties. As a matter of fact, elsewhere in his book Armstrong himself endorses (3), when he discusses the "notion that just because the predicate 'red' applies to an open class of particulars, therefore there must be a property, *redness*" (1978 II, 8). Armstrong rejects this idea, arguing that

> there must be an explanation why the predicate is applicable to an indefinite class of particulars which played no part in our learning the meaning of the word "red". Furthermore, this explanation must in the end appeal to the *properties* (or relations) of these particulars. But none of this shows that there is a property, *redness*" (II, 8).[14]

The crucial part of this passage is the second sentence, which is a reformulation of (3): all true predication about any object X is grounded in some property or other of X.

In his argument that substrata need not have properties, Armstrong seems to conflate (3) with the stronger proposition

> 3'. For any predicate P, if P truly applies to some object x, then P applies to x in virtue of a corresponding property of x.

This proposition, which also follows from (4) (see above), is controversial. That this is really the proposition Armstrong has in mind as the grounds for his rejection of (2) is evidenced by his comment that "a predicate like 'without all characteristics' inspires no confidence at all. It is natural to say that the absence of characteristics is not a characteristic" (104). The fact that there really is no property corresponding to 'has no characteristics', however, does not speak against (3), but only (3').[15] Though there is no property corresponding to 'has no property', if (3) is upheld then there still must be *some* property of the object in question grounding the application of that predicate. Indeed, it is hard to see why (3) should be rejected (as mentioned, even Armstrong himself advocates it elsewhere in his book). For all it says is that any truth about any thing must be grounded, ultimately, in the character or nature of that thing. What else could it be grounded or based upon? Are we supposed to believe that the truths about substrata are based on something else, that they have some special occult status that other true propositions do not? Admittedly, there are violations of (3), but these involve non-existent 'entities'. For instance, truths about fictions such as Sherlock Holmes do not depend upon the properties of Sherlock Holmes, for Sherlock Holmes does not exist. These violations of (3) are cold comfort to the substratum theorist, however, since she will presumably not want to concede that substrata are, after all, fictions! If (3) is true for all existent entities, however,

then the grounds for rejecting (2) evaporate, and it seems that we are forced to admit some properties of the substratum, in itself, after all. The door slams on Armstrong's game effort to escape Loux's conclusion that substratum have some properties essentially, or in themselves.[16]

A different strategy for opposing Loux is used by J.P. Moreland, who admits that "particulars have a number of properties, e.g., being red, and they have some properties essentially, e.g. particularity, in the sense that a bare particular can exist only if it has certain properties tied to it" (1998, 258). Despite admitting that substrata have some properties essentially, he denies that this means that substrata have properties as constituents. This avoids the regress argument, because although it is true that the substratum has properties, this is not explained in the same way that the analogous fact regarding concrete particulars is explained. The latter is explained in terms of a substratum and properties that are constituents of the concrete particular. The properties of a concrete particular as said to be constituents of it, but the essential properties of a substratum are rather said to be "linked" or "tied" to it (257). Moreland argues that the fact that substrata have some essential properties

> neither makes them identical to their properties nor does it entail that properties are constituents within a bare particular. Just because a man never comes out of his house naked, it does not follow that he is his clothes or that they compose him as constituents. (258)

What Moreland is trying to do here is to drive a wedge between the concept of being an essential property and the concept of being a constituent of something, so that some property could be an essential property of a thing without being a constituent of it. This seems to me a formidable task. For coming to know the essential properties of some thing seems to be a paradigm case of getting insight into what that thing really is; we move freely from talk of essential properties to talk of natures, for example. Moreland's example of the perpetually clothed man only supports his proposal because the notion of "never" that he is using is a much more restricted one than is typically used in the explication of 'essential property'. The typical understanding of an essential property is as one that it is *impossible* for something to exist without. Clearly, however law-abiding or fastidious about his attire, it is not impossible for Moreland's man to exist naked in public; he could go insane or become a nudist. That is why we feel no compulsion to take his having clothes as being a constituent of him, as part of his nature or very being. But if we consider a genuine candidate for an essential property, such as his being the son of Jack and Jill, then I think our intuitions incline much more favourably toward taking the property as a constituent of him, as part of his very nature. If the essential property was just tied to the thing, rather than a constituent of it, then why is it really essential? If being the son of Jack is only tied to him, then why is it not possible for him to exist without it? If this *is* possible, however, then the property is not essential after all, contrary to our presupposition. In short, the

very notion of essential property seems to clash strongly with the sort of external connection or tie that Moreland proposes.

In this section, I have considered some arguments to the effect that the notion of substratum is conceptually suspect, either in the sense that statements about it are contradictory or in the sense that it is only pseudo-explanatory. These arguments and the responses to them that I have discussed are diagrammed in Figure 1.2; we have tried to herd the substratum theorist along the topmost path of this figure, towards the regress argument and its disastrous conclusion. We have considered some attempts to leave this path, such as those of Armstrong and Moreland, but neither of these seems very promising. Perhaps there is another way for the substratum theorist to turn before reaching such a vile end, but if not, then it seems that the theory ends up positing an entity which offers no real explanation of the facts about concrete particulars that it was conceived to explain.

This result is relevant also to the epistemic objections to the substratum discussed earlier. Those objections were premissed on the idea that the substratum, in itself, has no properties, no qualitative nature. It was this feature of the substratum that robbed it of any hope of satisfying the criterion of Independent Characterization. If it were allowed, however, that substrata *do* have properties, in themselves, then this failure might be avoided. However, we have seen in this section just how dangerous it is for the substratum theorist to engage in this sort of maneuver.

2.3. Simplicity. In this section I want to introduce a final motivation for investigating the Bundle theory, one that is independent of the two criticisms of the Substratum theory offered above. This motivation is that the Bundle theory offers us a simpler ontology than the traditional account and therefore a preferable one. Simplicity is widely acknowledged to be a virtue in metaphysics (Armstrong 1989a, 19-20; Oliver 1996, 3). What the dictum 'prefer the simplest theory' comes to, however, is no simple matter. In the case of theories in natural science, "simplicity" is ambiguous, having several important and importantly distinct senses (McAllister 1996, 112-113). Explanatory simplicity, for example, involves "adducing the same explanatory laws for a wide range of phenomena", whereas ontological simplicity involves postulating as few entities as possible. Ontological simplicity is further ambiguous between positing as few *types* of entities as possible and positing as few entity *tokens* as possible.

The most common claim of simplicity associated with the Bundle theory is the claim that it is simpler than the traditional view in the sense of reducing the number of types of entities required (Campbell 1990, 17; LaBoissiere 1994, 363; Simons 1994, 568; Bacon 2000). Whereas the traditional view requires two distinct categories of substratum and property, the Bundle theory tries to make do with just the latter category. This feature of the Bundle theory alone, in my opinion, provides good reason to give it serious consideration as an alternative to the traditional Substratum theory. At the very least, it deserves scrutiny to

determine whether the theory truly does deliver a more elegant account of reality, or whether it must ultimately pay the price for its paucity of fundamental elements with unsightiy epicycles at some later stage of development. Even if the complaints about the Substratum theory outlined in the previous two sections were to be fully answered, the promise of achieving a significant simplification in ontology would still provide a sufficient motivation for this study of the Bundle theory.

Notes

[1] "Concrete particular" is also used by D.C. Williams (1953) and James Van Cleve (1985).

[2] This employment of 'constituent' is commonplace in the literature on concrete particulars; see, for instance, Armstrong (1989a, 7; 1989b, 38-39) and Loux (1998).

[3] Note that the relation of *bearing a property*, in which a substratum stands to the properties of the concrete particular of which it is a constituent, is distinct from the relation of *having a property*, in which concrete particulars stand to the properties that are their constituents. Though substrata bear the properties of the concrete particulars to which they belong, they do not have them in the sense in which those concrete particulars do (e.g. a substratum might support Trudeau's wisdom, but that substratum itself would not be wise).

[4] Not all versions of the Bundle theory in twentieth century analytic philosophy emerge from, or have even been inspired by, Empiricism, even taking that doctrine very loosely. The early Platonist views of Moore and Russell, for example, may plausibly be classed as somewhat crude versions of the Bundle theory, but these views are in fact inimical to Empiricism (see Moore 1898, 192-193; Hylton 1990, 140-141).

[5] See Chappell (1970) for an early attack on the argument and Moreland (1998, 255-256) for criticism from a substratum theorist. More recently, David Armstrong has also tried to develop this line of response, claiming that "it is not *obvious* that all that is given to us in perception is mere properties and relations" (1997, 96; see also 1978 I, 105-106). Armstrong's argument is susceptible to criticism similar to that applied to Allaire's.

[6] Swoyer (2000), however, takes independent characterization to be an important virtue in metaphysical explanation.

[7] One might claim that it also explains the persistence through temporal change of concrete particulars; however, I criticize this claim in Chapter II (section 1).

[8] There is more to be said about the role of Independent Characterization in determining the success of theoretical entities. In some cases, for example, acceptable entities may fail to be Independently Characterizable. For instance, some philosophers have argued that we should believe in the external world because it is the best explanation of the existence of our phenomenal experience. But, it might be claimed, the external world is not Independently Characterizable: we can know little about it other than that it produces, somehow, our experience. This case may illustrate that lack of Independent Characterizability does not itself mandate rejecting an entity, unless a viable alternative explanation is available. For the external world does not appear to have serious rivals as an explanation of phenomenal experience, a circumstance not mirrored in the case of the substratum as an explanation of the individuation of concrete particulars.

[9] Versions of supersubstantivalism are criticized by Hoefer (1996, 13n11) and Sklar (1974, 222-223).
[10] My interpretation of Martin differs from that of Michael LaBoissiere, who sees Martin as identifying the substratum with the *property* of supporting properties (1994, 364n9). Martin's view is also criticized by Simons (1994, 566-567).
[11] This is the view that I implicitly employed above in section 2.11 where I spoke of the substratum, though bearing the properties of the concrete particular, failing to have properties *in itself*.
[12] For a brief sketch of this argument, see Campbell (1990, 7). The version of the regress argument offered above involves the substratum in its role as property bearer; however, a version of the argument can also be formulated in terms of its role as individuator of indiscernible concrete particulars, viz.:

1. Concrete particulars can share all properties and yet be distinct.
2. Concrete particulars are complex entities consisting of properties and an individuating substratum S (ontological explanation of (1)).
3. Either S has properties or it does not.
4. S cannot have no properties.
5. Therefore, S has properties.
6. Substrata can share all properties and yet be distinct.
7. (6) is only explained by applying an analogue of (2) to S.
8. Therefore, the ontological explanation of (1) by (2) is vacuous.

This version of the argument is suggested by Loux (1978, 149-152; 1998, 236).
[13] Although here Armstrong focuses on the predicate 'has no characteristics', he appears to see the strategy as capable of general application, since he argues in similar fashion against the putative property of 'supporting properties and relations' (1978 I, 104).
[14] See also his analysis of "game" (1989a, 86).
[15] In general, when he talks of predicates that "fail to apply in virtue of some universal" it appears that Armstrong means in virtue of some *corresponding* universal (see his 1978 II, 10-11).
[16] Note that this result does not depend upon any peculiar quality of the predicate 'has no characteristics'. For Armstrong's approach to succeed, it must show that *no* predicate's being true of substrata entails the existence of properties of substrata. Therefore, even if, as has been suggested to me, (3) does not apply to 'has no characteristics' because of that predicate's unusual 'negative' character, there will still be predicates true of substrata which, not being negative in character, *will* be governed by (3); e.g. 'is a bearer of properties'.

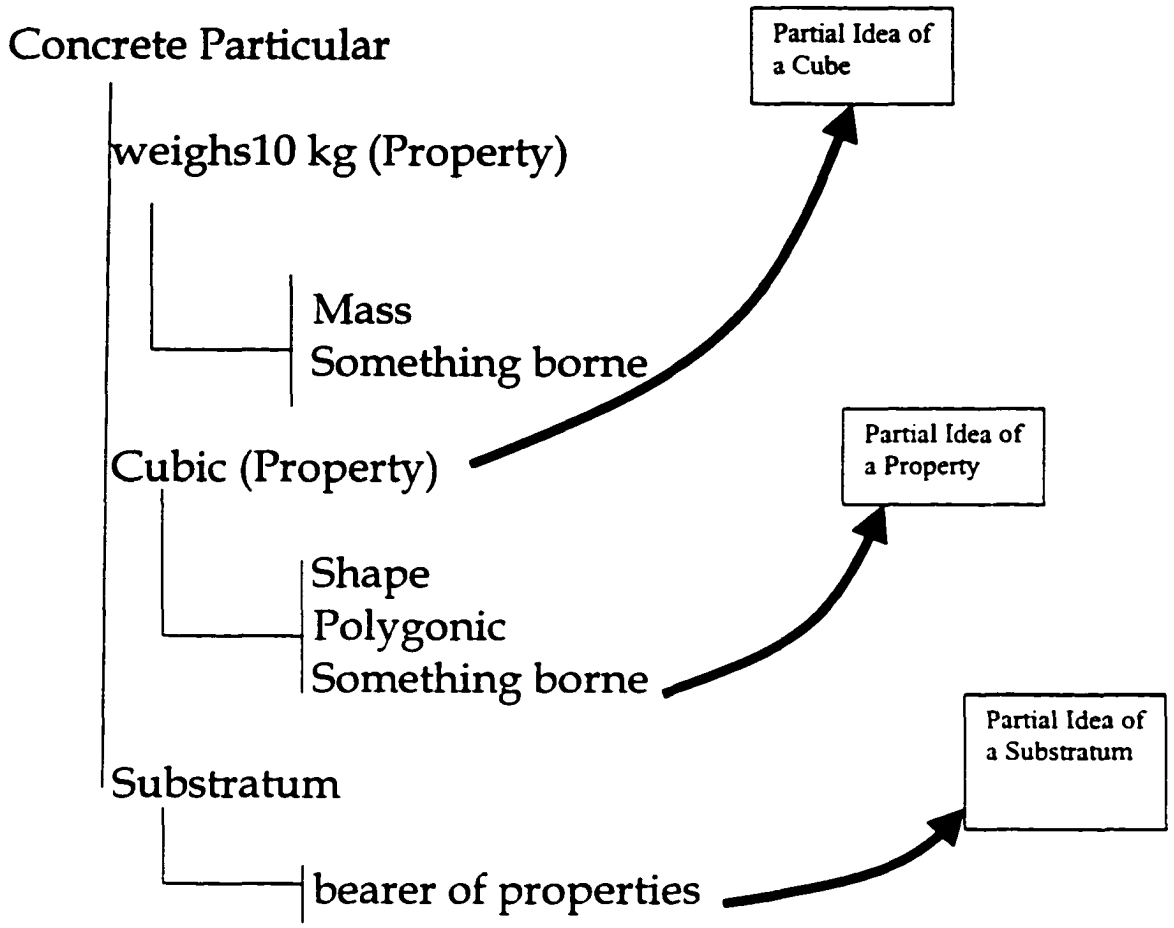

Figure 1.1. Partial Ideas. The hierarchy on the left represents the metaphysical structure of a concrete particular (a cube). For any given item in the hierarchy, a partial idea that applies to it may be formed by focussing on a leading or characteristical feature of it (i.e. a member of the level of the hierarchy directly below it).

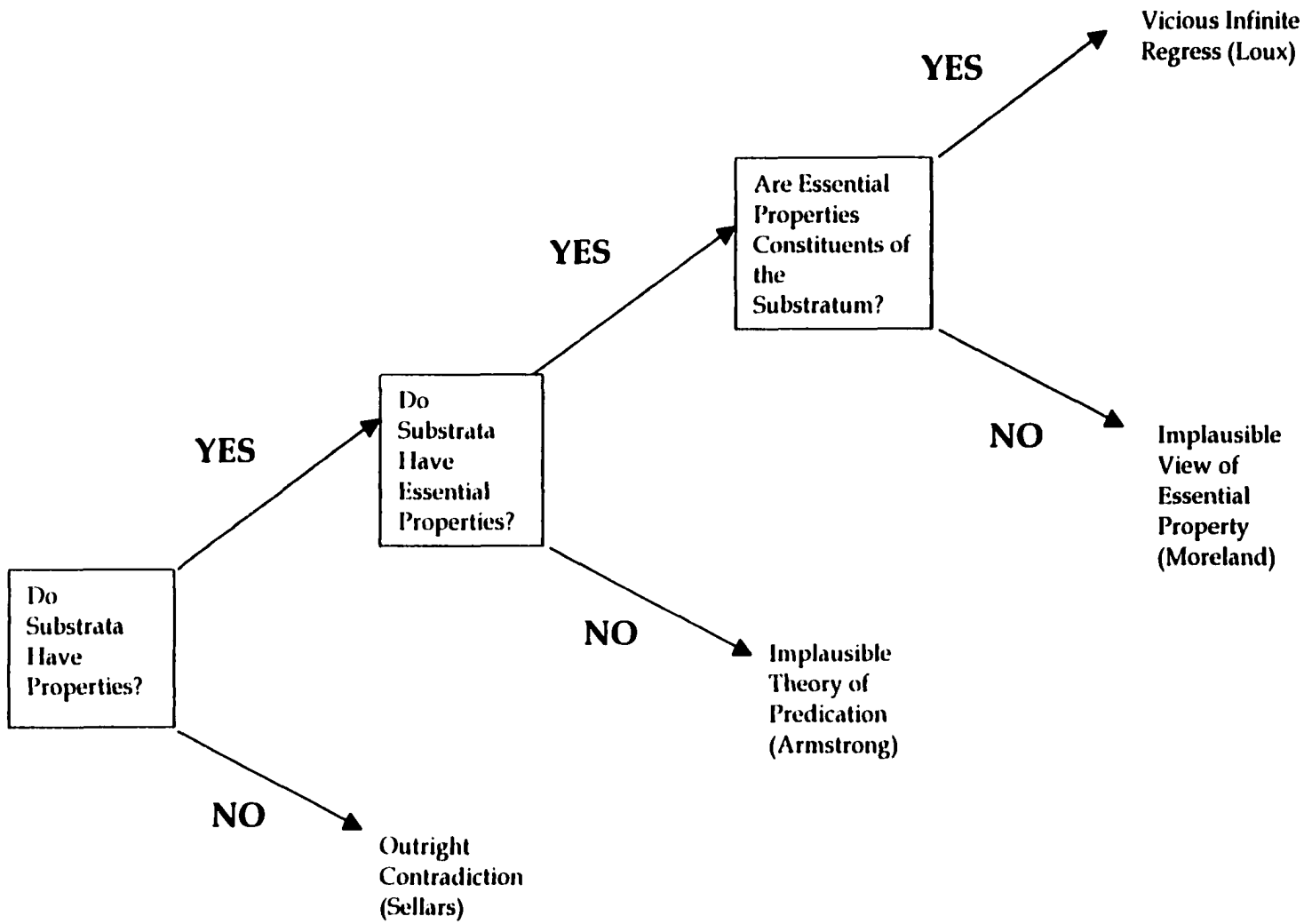

Figure 1.2. The Incoherence of Substratum. According to the argument of section 2.2, all responses to the initial question "Do substrata have properties?" lead to unpalatable consequences for the substratum theorist.

II. BUNDLES OF UNIVERSALS: TRADITIONAL CRITICISMS

IN the previous chapter, I argued that the Substratum theory is an unsatisfactory account of concrete particulars. The traditional alternative to that view is the version of the Bundle theory that takes concrete particulars to be bundles of universals. This view has been widely criticized in the recent literature (see e.g., Martin 1980; Van Cleve 1985; Armstrong 1989a; Loux 1998). In this chapter, I first consider two common objections to this version of the Bundle theory that concern the identity conditions for bundles (section 1). Next I examine the most serious philosophical objection to the traditional Bundle theory, one that exploits the theory's commitment to the necessitation of the principle known as the Identity of Indiscernibles (section 2). I briefly survey some of the attempts of bundle theorists to refute the objection and find them generally to rely on contentious assumptions (section 2.1). A better strategy for the bundle theorist, I suggest, is to reject the criticism's main premise: that the Bundle theory entails the necessitation of the Identity of Indiscernibles. Considering arguments for the view that the Bundle theory entails a necessary version of the Identity of Indiscernibles, I claim that these arguments are ineffective (section 2.2). I then attempt to provide a partial explanation of their persistent attraction to opponents of the Bundle theory (section 2.3).

My suggestion has also been advocated by the bundle theorist Albert Casullo; however, I argue that his view of the modal status of the Identity of

Indiscernibles is also incorrect (section 2.4). Finally, I suggest a third alternative, treating the Identity of Indiscernibles as a counterfactual conditional, which better captures the real modal commitments of the Bundle theory (section 2.5). However, despite the modal confusions inherent in the classical objection, I conclude that its proponents are roughly correct in saying that there exists a difficulty for the bundle theorist in accounting for a certain sort of possible world. The precise nature of this difficulty is clarified, and the bundle theorist's attempt to resolve it is then taken up in Chapter III.

1. The Fragility of Bundles. In an influential paper, James Van Cleve (1985) raises two closely related objections to the Bundle theory (employing universals): the Bundle theory is incompatible with persistence through change and it is incompatible with concrete particulars having some of their properties accidentally, rather than essentially (96). Here is how Van Cleve introduces the first objection:

> It is true that in the bundle theorist's world there can be plenty of change of one sort, namely, change in the relational characteristics of properties; a given property or group of them can be co-instantiated now with one property, now with another. But this is not to say that any *individual* can change. If *F* and *G* are co-instantiated first with *H* and later with *K*, so that the complex *FGH* is superseded by the complex *FGK*, what we have is replacement of one individual by another, not change in the properties of one and the same individual. *FGH* is simply not identical with *FGK*. (98)[1]

His second objection is that:

> It will *not* be true of any individual that it might have existed with properties other than the ones it actually has: we cannot suppose that a complex whose constituents are *F*, *G*, and *H* might have existed with *F*, *G*, and *K* as its constituents instead. Thus the bundle theorist's world, though not a Spinozistic one in which every truth is a necessary truth, is nonetheless a Leibnizian one in which every individual has just the properties it does necessarily. (99)[2]

Van Cleve takes these objections quite seriously; combined with the traditional criticism involving the Identity of Indiscernibles (see section 2), they compel him to abandon traditional formulations of the Bundle theory. It should be noted, however, that even if Van Cleve's arguments were sound, they alone would not force one to reject the Bundle theory, unless one also thought that concrete particulars do persist through change or that total essentialism is false (i.e. that concrete particulars do not have all their properties essentially). Van Cleve does not actually argue for these theses. A recalcitrant bundle theorist could always take Van Cleve's arguments as grounds to reject persistence through change or to accept total essentialism, rather than as refutations of the Bundle theory.

Witness, for example, the recent attempts of some defenders of the Bundle theory to answer these objections. Casullo, for instance, finds that major supporters of the Bundle theory have all endorsed some account of ersatz change, rather than genuine change (i.e. change involving persistence of the object over time), and suggests that, if we want to be bundle theorists, we do

likewise (Casullo 1988).[3] According to this view, we should not talk of three-dimensional concrete particulars as really persisting through change. Rather, we should see talk of persistence as pertaining only to four-dimensional particulars, constructed out of momentary, or three-dimensional, bundles of universals as temporal parts. Only these four-dimensional particulars may properly be said, albeit in a somewhat unorthodox sense, to persist through change. "An *enduring* thing", Casullo writes, "is a series of momentary things all of which stand in some contingent relation *R*" (1988, 127).[4] This means that "if the complex FGH, to use Van Cleve's example, stands in relation *R* to the complex FGK then one and the same *enduring* thing has changed its properties" (129). This is an ersatz view of persistence through change because the four-dimensional particulars, which we describe as persisting through change, do not really change, strictly speaking. When we say that a four-dimensional particular has changed, all we mean is that one of its temporal parts is different than some other part.

Somewhat analogously, O'Leary-Hawthorne and Cover suggest resorting to counterpart theory to deny total essentialism (1998, 209-210). According to counterpart theory, when I say "Claire might have been taller than she is" I am not referring to or implying the existence of any situation in which Claire, her very self, is taller. I am saying that her counterpart in some possible world (who is *not* identical to Claire) is taller than Claire happens to be. So when we say that the bundle FGH could be FGK instead, we mean only that FGH has a non-identical counterpart FGK in some possible world. Thus counterpart theory

gives us a way of making sense of modal talk about bundles that seems to contradict total essentialism without having to tinker with the identity conditions for bundles (i.e. bundles with different properties are still different bundles).

So far as these responses go, there is not anything wrong with them. The problem is that they are apt to seem ad hoc, for they entirely rely on the truth of contentious doctrines (the unreality of genuine persistence through change, counterpart theory) for which no argument is offered other than that they help support the Bundle theory. Insofar as alternatives to the Bundle theory, such as the Substratum theory, do not rely on such doctrines in an ad hoc way, they have a prima facie advantage over the Bundle theory. Therefore Van Cleve's arguments, even if they do not refute the Bundle theory, apparently establish important 'incompatibility results' for it, which seriously undermine the view. If the Bundle theory is a viable metaphysical research program, it should not require the acceptance of several controversial doctrines in an ad hoc fashion to escape from trouble. A preferable response would be to show that, properly construed, the Bundle theory actually is compatible with genuine change and the denial of total essentialism, or at least, that it is *as compatible* with them as its competitors are. In this case, adopting the Bundle theory over the Substratum theory would not require the ad hoc acceptance of substantive doctrines about modality or change, and therefore the Substratum theory would not have a prima facie advantage over the Bundle theory. For these reasons, we should not

rest content with the responses of the philosophers mentioned above; we must investigate whether Van Cleve has really shown these incompatibilities to exist.

Van Cleve seems to think that the Substratum theory, unlike the Bundle theory, *will* provide us with an account of persistence through change:

> anyone who wants to allow for change. . . must reject the [Bundle theory]. What is the alternative? In a word, it is *substance*: an individual is something over and above its properties, something that *has* properties without being constituted by them (1985, 105)

It is somewhat unclear, however, just what advantage the Substratum theory is supposed to have over the Bundle theory in providing such an account. The quotation above suggests that the Substratum theory will identify the individual, or concrete particular, with a substratum: "an individual *is* something over and above its properties, something that has properties. . ." (my italics). This entity will then be capable of existing in spite of alterations in its properties, unlike bundles of properties, since its properties are not constituents of it.

The following way of thinking of Van Cleve's approach will be useful. The two objections to the Bundle theory discussed above are generated by the fact that bundles of properties are complexes that are too *fragile* in the sense that they lose their identities too easily. If concrete particulars can really persist through change, then concrete particulars, whatever they are, are the sorts of entities that can lose some of their properties at some time and yet retain their identity at times afterward. This is not true, however, of bundles of properties:

given the most plausible identity condition for bundles, once you lose one member, you are no longer the bundle you were. Analogously, unless total essentialism is true, concrete particulars, whatever they are, are the sorts of entities that could exist without some of their properties at some time and yet be the very same thing (at that time). Again, this is not true of bundles of properties, for a bundle of properties cannot be identical to a bundle with different constituent properties. However, the Substratum theory does not face these difficulties, if we identify the concrete particular with the substratum. For the substratum, unlike a bundle of properties, can lose properties and yet remain the same item it was, for properties are not constituents of it. It is, in this sense, a more *robust* sort of entity than a bundle of properties. Therefore the Substratum theory, unlike the Bundle theory, does not need to invoke ad hoc doctrines to account for change, because it does not make concrete particulars fragile.

This assessment of the situation, however, would be incorrect. To see this, we need only look to a suggestion offered by Van Cleve himself as to how one could make the Bundle theory compatible with the denial of total essentialism (he rejects it as unworkable). His suggestion is to

> divide each complete bundle of mutually co-instantiated properties into two sub-bundles, an inner core and an outer fringe, and then to identify individuals with cores rather than with complete bundles. One could then say that an individual has *essentially* just those properties that belong to its core and *accidentally* just those properties that belong to its fringe. (99) [5]

The difficulty the Bundle theory encountered was that it made concrete particulars too fragile, since no bundle can exist in spite of the loss of any of its properties. Van Cleve's suggestion is that if we *constrict* the bundle that we identify with the concrete particular to only a subset of the properties of that particular, then the difficulty disappears. This (constricted) bundle will be more robust; it can exist in spite of the loss of the accidental properties it happens to have.

The (fatal) problem that Van Cleve finds for this proposal is that, since "the vast majority of a thing's properties are accidental to it" (99), it compels one to identify concrete particulars with very spartan core bundles of properties. To use Van Cleve's own example, a human being may well come out as a bundle of the properties animality and rationality. But nobody thinks that a human being, however anemic in constitution, could be identical to just *that*.

I agree that this shows that Van Cleve's constriction proposal for bundles, as it stands, will not give us a satisfying account of persistence through change. However, this seems to have nothing in particular to do with the Bundle theory. Rather, it seems implausible regardless of which analysis of concrete particulars is adopted. A concrete particular must have as constituents all of its properties, accidental as well as non-accidental; by anyone's lights, they are more than their essences. To put it another way, essential properties are not, individually or

jointly, sufficient to make something what it is; they are only necessary for it to be what it is.

If this is so, however, then it is completely unclear why the Bundle theory should be thought to require ad hoc support whereas the Substratum theory does not. For if constriction is the method of denying total essentialism proffered by the Substratum theory, then it faces the very same problem as Van Cleve's constriction proposal for the Bundle theory. For substrata are certainly robust in the face of property change, just as core bundles are, but they, also like core bundles, are radically unlike concrete particulars, even when supplemented with essential properties. Assuming that Van Cleve is correct in saying that most of the properties of a concrete particular are accidental to it, then even if concrete particulars contained substrata, and were not just bundles of properties, it would still be incorrect to analyze them in a way that excludes their accidental properties. For example, imagine that the Substratum theory is true, so that concrete particulars consist of a substratum and properties. Is it plausible to say that some human being is a substratum, animality and rationality, or even just a substratum? Hardly any more than saying that he is animality and rationality. What is needed to get a proper analysis of concrete particulars here is not a substratum, but more properties.

The lesson of all this seems to be that the constriction approach is not promising as a way of denying total essentialism: we should not be trying to make our concrete particulars smaller; we should find some other way of making

them more robust. The lesson here does *not* seem to be the one Van Cleve draws: that accepting the Bundle theory somehow puts us at a disadvantage when it comes to providing a denial of total essentialism whereas accepting the Substratum theory does not.

Similar considerations apply, mutatis mutandis, to Van Cleve's claim that the Bundle theory is incompatible with genuine persistence through change. The substratum theorist is free to offer a constrictive account and claim that he can persist through change because he is a substratum, but this is even less plausible than his opponent's constrictive account on which he can do so because he is a bundle of animality and rationality.

Two points should be stressed in concluding this discussion of Van Cleve's criticisms of the Bundle theory. First, all I have argued is that with respect to the constrictive approach to these issues, the Substratum theory has no obvious advantage over the Bundle theory; it remains open that there are other approaches on which one or the other theory is superior.[6] Second, it should be clear that I have *not* claimed that there is a plausible way of denying total essentialism or of accounting for persistence through change which is available to the bundle theorist (or for that matter, to the substratum theorist). For all that I have said, it may be that these difficulties have no solution. All I have claimed is that, contrary to Van Cleve and others, there is nothing about embracing the Bundle theory as an account of concrete particulars that places the possibility of such a solution in jeopardy.

2. The Classical Objection. Although the two worries about the Bundle theory discussed above have received some attention in the literature on concrete particulars, by far the most discussed controversy surrounding the theory has been its commitment to a principle called the Identity of Indiscernibles. Roughly, the relevant version of the Identity of Indiscernibles is the claim that any two concrete particulars that have all their properties in common are in fact identical to one another. Put contrapositively, it is the claim that any two distinct (i.e. non-identical) concrete particulars fail to have all their properties in common. According to the Bundle theory, the nature of a thing is exhausted by the properties that are 'bundled together' to constitute it. If we take properties to be universals, then where we have instantiation of the same properties, we have simply the very same thing; this amounts, roughly, to the Identity of Indiscernibles. To put it another way, if the Bundle theory is true, then it would not be the case that some two distinct things have all the same properties. This is so because, universals being strictly identical in their various occurrences, 'two' things sharing all the same properties would be composed out of the very same constituents, and hence would simply be the very same thing.[7]

The Bundle theory's commitment to the Identity of Indiscernibles has been seen as its Achilles' heel because many philosophers have had serious doubts about the necessary truth of this principle. The result has been a classical criticism of the Bundle theory: (1) The Bundle theory entails that the Identity of

Indiscernibles is a necessary truth. (2) The Identity of Indiscernibles is not a necessary truth: there are counterexamples to it. Therefore (3) the Bundle theory is false. Many philosophers have taken this criticism as grounds for rejecting a Bundle theory formulated in terms of universals (e.g., Bergmann 1967; Armstrong 1978; 1989a; Loux 1978; Adams 1979; Van Cleve 1985; Campbell, 1990; Moreland 1998).

2.1. The Identity of Indiscernibles as a Necessary Truth. The classical criticism of the Bundle theory relies on the notion that the theory entails the necessitation of the Identity of Indiscernibles (premise (1) above; I will call this claim the 'Necessity thesis'). It is usually conceded, by proponents of the classical objection, that the Identity of Indiscernibles is contingently true: i.e., true in the actual world (see e.g. Adams 1979, 12 and Armstrong 1989, 68). One way that the Identity of Indiscernibles would be true in a world is if no two distinct concrete particulars were indiscernible in it, which, prima facie at least, is an empirical issue. However, just how plausible it is to think that there actually are no such indiscernibles depends on how exactly the Bundle theory, and hence the Identity of Indiscernibles, is formulated. If it is formulated in a strong version, employing only intrinsic (i.e. non-relational) properties, then its truth in our world becomes suspect. Although for medium-sized objects, it does not seem that we have much reason to believe that two items share all the same intrinsic properties, some suggest that subatomic particles, such as electrons, may violate the strong

principle (Armstrong 1989a, 67). If one formulates the Identity of Indiscernibles in a weaker version, employing both intrinsic and relational properties, then it is far more likely that the principle is true in our world. For in that case, the principle would actually be false only if the world possessed a rather spectacular sort of symmetry, in which two concrete particulars shared all their pure intrinsic and relational properties (Adams 1979, 12; Armstrong 1989a, 68; Forrest 2000).[8] In any case, the classical criticism of the Bundle theory that I want to discuss here cedes that the principle is true in our world.

The strategy is to show that the bundle theorist is committed to the truth of the Identity of Indiscernibles in *every* world, and then produce a world that shows that this commitment is not met. The counterexamples suggested vary depending on the particular version of the Bundle theory being considered (see above). The best known, however, is the universe called, in honour of its 'discoverer', "Max Black's world"; it consists of two metal spheres of exactly similar size, weight, composition and so forth, situated two diameters apart, that never come to change in any way (Black, 1952). In such a world, it is claimed, we have two distinct concrete particulars that share all of the same intrinsic and relational properties. Hence in this world, the Identity of Indiscernibles is false. If she accepts the Necessity thesis, the bundle theorist cannot tolerate this result. Her only response to the classical objection appears to be denying that Black's world really is a genuine counterexample to the Identity of Indiscernibles.

Ian Hacking suggested one way in which this might be done in his 1975 paper "The Identity of Indiscernibles". Hacking notices that Black's claim to have produced a counterexample to the principle rests on a certain view about how we know whether a state of affairs is possible or not. On the view implicit in Black's paper, one claims to be able to imagine or conceive, without contradiction, of a given state of affairs, and this is taken to be sufficient grounds for claiming that there is a possible world in which this state of affairs obtains. It is this picture of how conceivability is related to genuine possibility that Hacking calls into question. Instead of Black's world, Hacking discusses the example, due to Kant, of two identical water drops. He writes:

> In arguing that in a certain possible world there exist two distinct but indistinguishable objects, bland assertion is not enough. There must be argument. Kant's argument is that, by abstraction from our world, in which there are two drops of water on the pane of my window, we obtain just two such objects and nothing else. The question remains whether the result of this feat of abstraction is correctly described as having two indiscernibles in it. Simply to say so is to beg the question. . . . . No matter how vivid your imagination, it remains a question how correctly to describe the content of your imagination. (251)

Hacking goes on to argue that the advocate of Black world type counterexamples can never show that any such world is correctly described in such a way that it violates the Identity of Indiscernibles. This is so, he claims, because of a "general moral" which has "been indicated by the history of physics

in this century": "there can be no determinations of spatial relations without a study of the laws of nature attributed to objects in space" (250). This is one (quite vague) version of the view usually known as conventionalism about space (or spacetime). Hacking's basic idea is that physics has taught us that there is no objective matter of fact about certain spatiotemporal phenomena; we choose to describe these phenomena in certain ways only because of pragmatic considerations, not because any one is more correct than another. But if this is the case, he argues, possible worlds such as Black's can always be given an alternative, equally correct description under which they have alternative spatiotemporal structures and do *not* violate the Identity of Indiscernibles.

Robert Adams (1979) suggests construing Hacking's idea in terms of conventionalism about spatial geometry: there is no objective matter of fact about the metrical structure of physical space. The choice of any particular metric is always a pragmatic one. Adams proposes a Hacking-style response to Black's world as follows:

> The most that God could create of the world imagined by Black is a globe of iron, having internal qualities Q, which can be reached by traveling two diameters in a straight line from a globe of iron having qualities Q. This possible reality can be described as two globes in Euclidean space, or as a single globe in a non-Euclidean space so tightly curved that the globe can be reached by traveling two diameters in a straight line from itself. But the difference between these descriptions represents no difference in the way things could really be. (1979, 15)

Black's world succeeds as a counterexample to the Identity of Indiscernibles only because there are two spheres in it. But, the response goes, such facts about numerosity are conventional facts, because spatial structure is conventional. So although one is free to choose a spatial description under which the world violates the principle, the bundle theorist is equally free to substitute one on which it does not. If there really is no fact of the matter about how many spheres there are in Black's world, then Black's world cannot be a definitive counterexample to the principle.

For at least three reasons, however, Hacking's conventionalist approach is not quite what the bundle theorist wishing to deflect the classical objection needs. First, conventionalism about metrical structure is a position which has largely fallen from favour in contemporary philosophy of space and time (French, 1995). Thus, the bundle theorist will perhaps want to avoid resting her fortunes so squarely on this doctrine. Second, even if conventionalism is true, it is not clear that this would show that Black's world, in which there are two indiscernible spheres, is not *possible* since it is not clear that conventionalism itself is a necessary truth about the nature of space or spacetime (Landini and Foster, 1991). Third, even if conventionalism were a necessary truth, this would not ultimately serve the ends of the bundle theorist here. For, since she accepts the Necessity thesis, she is trying to show that the Identity of Indiscernibles is *true* in all possible worlds, including Black's world. Hacking's conventionalist strategy only shows that there is no objective matter of fact as to whether or not the

principle is true in any given world; but this hardly seems to serve the bundle theorist any better than her opponent. Making the number of entities conventional threatens to render the entire issue of the analysis of concrete particulars moot.

The bundle theorist adhering to the Necessity thesis will want to take from Hacking the idea that one cannot simply assume that any conceivable and consistent description corresponds to a possible world. However, to secure the necessary truth of the Identity of Indiscernibles, she will want to (1) delineate some additional constraints on what *is* genuinely possible and (2) demonstrate that those constraints entail that any world which is genuinely possible is one where the Identity of Indiscernibles is true. This would allow the bundle theorist to uphold the Necessity thesis and yet reject the classical criticism.

This is precisely what some bundle theorists, such as John O'Leary-Hawthorne, have attempted to do. He allows that Black is imagining some possibility, but calls into question Black's account of just what that possibility is. He says:

> The bundle theorist will insist that, strictly speaking, the world that Black is picturing is a world where there is one bunch of universals fully present in two places (i.e. at a distance from itself). One who rejects the bundle theory will want to say that strictly speaking, the world that Black is picturing has two distinct things in it that stand in a spatial relation to each other. Does a world where one thing is at a distance from itself violate the Identity of Indiscernibles? Certainly not. So if the world Black is picturing can be perspicuously described as a world where one bundle of

> universals is at a distance from itself, then Black has not refuted the Identity of Indiscernibles. (1995, 194)

O'Leary-Hawthorne's response to the Black world in which, it is claimed, there are indiscernible concrete particulars is to say that this world is not really possible after all, at least in the sense in which it would serve as a counterexample to the Identity of Indiscernibles.

O'Leary-Hawthorne's strategy here rests on the notion that what is possible must be inferred from the 'most perspicuous description' of what we can imagine, or conceive. According to this idea, we can imagine symmetrical scenarios like Black's world in some sense, but we cannot imagine, say, that there are two spheres rather than one sphere in two places. To do that, we would need some mysterious, rationalist power to apprehend substratum. So there are, on this view, tighter constraints on what is possible than mere imaginability and logical consistency: although Black's world, taken as a world with two indiscernible concrete particulars, is logically consistent and in some sense imaginable, it is not possible. What is possible is what emerges from the 'most perspicuous description' of the contents of his imagination, and that is *not* two indiscernible yet distinct spheres.

Albert Casullo gives a similar account. Like O'Leary-Hawthorne, he says that "Black's claim that we can imagine two spheres with all qualities in common is mistaken" and hence that there really is no counterexample to the Identity of

Indiscernibles (1982a, 600).[9] Casullo thinks that what is possible is not what is merely logically consistent, but rather that which is imaginable. He also claims, however, that imagination should be construed in terms of *visualization*. Thus when we imagine something like Black's world, we are conjuring up a mental visual image of it. This, when combined with an additional assumption, leads to an important result:

> In order to visualize two spheres, one must visualize them as occupying two different positions in the visual field. But if they occupy different positions in the visual field, then they differ in their positional qualities, and hence, do not have all qualities in common. (1982a, 600)

Since positional qualities that specify different locations in a visual field are by nature distinct from each other, each of Black's spheres has a quality the other lacks (one is in *this* position, the other is in *that* position). The additional assumption required here is the idea that the positional qualities of objects in our visual space are monadic or intrinsic qualities, not relational ones, for it the positional qualities were merely spatial relations to other things, the two imagined spheres would after all have the same positional qualities too.[10]

The approaches of O'Leary-Hawthorne and Casullo, if successful, would allow the bundle theorist who accepts the Necessity thesis to refute the classical objection. Unfortunately, both approaches involve a number of very questionable assumptions. O'Leary-Hawthorne's view rests on his (unargued) claim that the Bundle theory would offer the 'most perspicuous description' of

the contents of our imagination in the Black world case. In fact, O'Leary-Hawthorne never makes it clear what 'most perspicuous' even amounts to. The view advanced by Casullo, similarly, rests on the additional claim that conceivability should be understood as some sort of analogue of vision, but it is far from obvious why this should be the case. Furthermore, Casullo needs the additional assumption that visual positional qualities are intrinsic. Aside from these assumptions, *any* strategy based on Hacking's idea requires that logical consistency be insufficient for genuine possibility, and this is an idea that many philosophers have found implausible. Thus, such responses to the classical objection rely on controversial doctrines that it would be preferable not to have to presume in defending the Bundle theory. Of course, the bundle theorist is only forced to such recourse because she accepts the first premise of the classical objection (i.e. the Necessity thesis). An alternative strategy worth exploring, then, is rejecting this thesis, for should such a strategy succeed, it would relieve the bundle theorist of her commitment to the problematic views we have been discussing.

2.2. *The Necessity Thesis.* Although the Necessity thesis is an essential element of the classical objection, the lack of argument offered for it by proponents of that objection is striking. Here is what Michael Loux says about the idea that the Bundle theory is committed only to the contingent truth of the Identity of Indiscernibles (i.e. that the Necessity thesis is false): such a proposal

> only puts off the evil day when [the bundle theorist] must confront the dilemma of individuation; for while it may be true that no two objects in our world are qualitatively indiscernible, this remains a possibility. . . . there are possible worlds where diverse substances agree in all their pure properties; and the bundle theorist has to provide us with an account of the ontological structure of substances in those worlds; but, then, in describing those worlds, he runs up against the very dilemma he seeks to escape in characterizing the actual world. (1978, 156-157)

Obviously, this response merely begs the question: the bundle theorist protests that the Identity of Indiscernibles need not be a true account of all possible worlds, and Loux replies that it does. As one commentator puts it, Loux fails to explain "why the bundle theorist is obliged to provide some account of particulars in worlds other than the actual world" (Casullo 1982a, 595).

More of an effort at arguing this claim is made by Keith Campbell, who writes:

> It is a necessary truth that each individual is distinct from each other individual. So each bundle must be different from every other bundle. Since the bundles contain nothing but qualities [i.e. universals], there must be at least one qualitative difference between any two bundles. In short, [the Bundle Theory] requires that the Identity of Indiscernibles be a necessary truth. (1981, 132)

I think that by "individual" here Campbell has in mind more or less what I mean by "concrete particular". Nonetheless, I will keep his terminology in discussing his argument, which I believe can be paraphrased like this:

a. Individuals are bundles of universals
b. Necessarily (Each individual is distinct from each other individual)
c. Necessarily (Each bundle is distinct from each other bundle)
d. Bundles contain only universals
e. Necessarily (Any two distinct bundles have some difference in universals)
f. Necessarily (Any two distinct individuals have some difference in universals)

If this argument is correct, then from the Bundle theory (a), with the aid of some plausible premisses, we can apparently derive the necessitation of the Identity of Indiscernibles (f). It is important to stress that (f), rather than merely (e), is the conclusion that Campbell has in mind. This is so because the possible world counterexamples that Campbell goes on to offer against the Identity of Indiscernibles are addressed to a principle of this form. He says:

> The Identity of Indiscernibles is not a necessary truth. There are possible worlds in which it fails, ranging from very simple worlds with two uniform spheres in a non-absolute space to very complex ones, without temporal beginning or end, in which the same sequence of events is cyclically repeated, with non-identical indiscernibles occurring in the different cycles. (1981, 132)

These counterexamples are cases of two *individuals* separated in space and/or time, having all of the same universals. Clearly, these cases falsify the Identity of Indiscernibles as formulated in (f) above. If we were to take the Identity of Indiscernibles as being (e), however, Campbell's counterexamples would not apply. For the items in the counterexamples are implicitly taken *not* to be mere

bundles of universals. If they were, then, contrary to appearances, 'they' would just be the same bundle and hence (e) would not be falsified (indeed (e) seems true). Hence the counterexamples only apply to the more general conclusion (f), which covers individuals rather than only bundles.

Campbell's argument can be simplified, I believe, by removing some premisses that do no work. The essential argument is captured by the following:

1. Individuals are bundles of universals
2. Necessarily (Any two distinct bundles have some difference in universals)
3. Necessarily (Any two distinct individuals have some difference in universals)

The inference to (3) from (1) and (2) is made, apparently, by substituting an extensionally equivalent expression ("individual") for "bundle" in (2). This inference, however, is clearly fallacious. The reason for this is that modal contexts such as that in which "bundle" occurs in (2) are paradigm cases of intensional contexts, and therefore the substitution of extensionally equivalent expressions in them fails to preserve truth value. Compare Campbell's argument with the classic example used by Quine (1961, 143-144): though it is true that 9 is the number of the planets and also true that necessarily 9 is greater than 7, it certainly does not follow that necessarily the number of the planets is greater than 7.[11]

On one traditional view of necessity, we might explain Campbell's fallacy as follows. The proposition within the operator in (2) is a necessary truth

because it is an analytic truth: it is part of the meaning of "bundle of universals" that no two of them are qualitatively identical. However, this analyticity is not present in the proposition within the operator in (3), because it is not part of the meaning of "individual" that no two of them can be qualitatively identical. Two individuals could, prima facie, be qualitatively identical: e.g. if they possessed distinct substrata. This very fact is precisely the one exploited in the counterexamples to the Identity of Indiscernibles that Campbell himself offers. The Bundle theory, however, is not committed to denying this fact because it is not giving the meaning of "individual" (i.e. offering "bundle of universals" as a synonym for "individual"); it is making the *synthetic* identity claim that (what we refer to as) individuals are bundles of universals. Thus, the substitution of "individual" for "bundle" that yields the inference to (3) cannot be legitimately carried out.

In order for Campbell's argument to be valid, (1) would have to be necessitated. That is, one would have to show that the Bundle theory is committed to the claim that necessarily concrete particulars are bundles of universals.[12] Campbell offers no such demonstration; however, Armstrong suggests an argument for the Necessity thesis which purports to do so. He writes that "if the Bundle theory is true, it is a theory about the essential constitution of individual things, namely, that they are bundles of properties. That would make the theory a necessary truth, if it is true at all" (1989, 67).[13] The idea seems to be that the Bundle theory makes an identity claim stronger than

merely "individual things are bundles of universals". Instead, what is claimed is "individual things are essentially bundles of universals." Taking "individual thing" to be equivalent to "concrete particular", this entails

> K. Necessarily (if x is a concrete particular, then x is a bundle of universals)

It is not clear why Armstrong thinks that the Bundle theory might be committed to the stronger identity claim and the corresponding modal statement (K). One possible motivation is a Kripkean understanding of theoretical identity statements. Saul Kripke claimed that such statements "are generally identities involving two rigid designators and therefore are examples of the necessary *a posteriori*" (1980, 140).

One of his examples is the theoretical identity statement: "water is H_2O". Kripke claims that this statement, if it is true, is necessarily true. Were it not, there would be some possible world in which there is something which is water, but which is not H_2O. Intuitively this possible world seems plausible enough: certainly water might have been found to have a molecular structure other than H_2O. This intuition notwithstanding, Kripke argues that there are no such possible worlds. Imagine a world in which we discover a substance which looks and tastes just like water, but which has a different molecular structure. Would it be correct to describe this world as a world where there exists water that is not H_2O? Kripke insists that it would not. Rather we should describe it as a world

where there is a substance that looks just like water but which is not water (128). The reason for this is that 'being H_2O' is an *essential* property of water, since H_2O is just what water *is* (133). Theoretical identity statements are therefore necessary because they relate the essential properties of some sort of thing.

These Kripkean ideas allow us to understand Armstrong's suggestion that "concrete particulars are bundles of universals" is necessarily true if it is true at all. In the same way that the statement "water is H_2O" expresses the fact that H_2O is just what water is, the statement "concrete particulars are bundles of universals" expresses the fact that bundles of universals are just what concrete particulars are. Hence by the sort of reasoning given above, being a bundle of universals is actually an essential property of being a concrete particular, and the statement "concrete particulars are bundles of universals", if true, is a necessary truth. If it were not, then there would be a possible world where there exists something which is a concrete particular but which is not a bundle of universals. However, in a world where we find something which has all the features of concrete particulars except that it is not a bundle of universals, but rather a substratum in combination with universals, then should we say that this a world where concrete particulars are not bundles of universals? No; instead we should say that here there exists something which looks just like a concrete particular but is not one, because concrete particulars are bundles of universals. Thus there is no possible world of the sort required to show that "concrete particulars are bundles of universals", assuming it is true, is not a necessary truth.

This conclusion allows us to fill the lacuna in Campbell's argument for the Necessity thesis:

1'. Necessarily (Concrete particulars are bundles of universals)
2'. Necessarily (Any two distinct bundles have some difference in universals)
3'. Necessarily (Any two distinct concrete particulars have some difference in universals)

With the Necessity thesis thus demonstrated, counterexamples to the necessitated version of the Identity of Indiscernibles (3') may now be offered, completing the classical criticism. As Armstrong says, once the Necessity thesis is in place, "to falsify [the Bundle theory] all that is needed is the mere logical possibility of two things with exactly the same . . .properties" (1989a, 67). In other words, we need just one possible world in which there exist two concrete particulars sharing all of the same properties. The possible world offered here is usually Black's world or some variant of it. The bundle theorist must say that such worlds are impossible, but this is not so; hence, the Bundle theory is false.

I think that this version of the classical objection, and the argument for the Necessity thesis on which it rests, fails. To see why, look back to the Kripkean fashion in which we motivated (1'). What Kripke's theory entails is that, given the nature of language, if "concrete particulars are bundles of universals" is true, then it is necessarily true. There is no possible world in which there is something which is a concrete particular but which is not a bundle of universals. Now why does Black's world, or some variant of it, falsify (3')? Only because in that world,

there are two concrete particulars which share all the same properties. Now if this is so, then these possible concrete particulars are not bundles of universals, for if they were, then they would not be distinct, contrary to our hypothesis. But, by Kripkean reasoning, if these objects are not bundles of universals, then they are not concrete particulars either. Again, the Kripkean will say: in this world, where there is something which looks exactly like a concrete particular except that it is not a bundle of universals, should we say that here are some concrete particulars that are not bundles of universals? No, rather we should say that there are some items that look like concrete particulars but are not. For concrete particulars are bundles of universals. Live by the sword, die by the sword; the proponent of the classical objection cannot insist upon Kripkean views of theoretical identity in order to prove a premise in his argument and then reject those views while deriving the conclusion.[14]

2.3. The Origins of the Classical Objection. Given the failure of these arguments, we need to look farther afield for cogent justification of the Necessity thesis. It appears we must go back to work by A.J. Ayer (1954). Possessed of an empiricist's disdain for the substratum, that 'unknown somewhat', Ayer is inclined to accept some sort of Bundle theory. To defend this view, Ayer tries to show that the Identity of Indiscernibles is in fact necessarily true, and that Black's world is not really a counterexample to it. Now the only reason Ayer does this is that he thinks that to defend his bundle theoretic sympathies he has to show that

the Identity of Indiscernibles is necessarily true. That is, he accepts the Necessity thesis. But Ayer does not argue for the Necessity thesis in the ways we discussed in the previous section; rather, he says that

> if it is to be admitted from the outset that the principle of the identity of indiscernibles can be denied without self-contradiction, then surely it is divested of any philosophical interest. No doubt the discovery, if it could be made, that there actually were different objects which were mutually indiscernible, would come as a surprise; but so long as the bounds of logical possibility are respected, it is not for the philosopher to set any limits to the marvels of nature. Philosophically, the grounds for an denial of existence are always *a priori*. The proof that nothing does answer to a given description is that nothing could, and the proof of this is that the description in question is meaningless or self-contradictory. I propose, therefore, regardless of what Leibniz may originally have meant in affirming the identity of indiscernibles, to treat the principle as a candidate only for necessary truth. (1954, 218)

Ayer's grounds for holding the Necessity thesis involve a certain conception of the nature of philosophical existence claims. To be philosophical, such claims must be a priori; the a priori is then identified with the realm of analytic truths. So the philosophical existence claim "concrete particulars are bundles of universals", to be true, must be such that its negation is meaningless or self-contradictory.

Although contemporary authors who take the classical objection to be plausible are never so explicit about allowing such views to ground the Necessity thesis, I suggest that for many of them this is precisely the case. Peter Forrest, for

instance, says that we should insist that the Identity of Indiscernibles, if true, is a necessary truth since the Identity of Indiscernibles is a "principle of analytic ontology" and "fundamental principles are widely held to be non-contingent" (2000). Arda Denkel writes that "surely... what decides the acceptability of the Identity of Indiscernibles, or the Qualitative Account [i.e. the Bundle theory] which stands or falls together with it, ought not to be mere empirical and contingent facts. Conceptual analysis could not be allowed to hinge on anything less than a logical truth" (1996, 48). Similarly, Robert Adams writes that

> it is plausible to suppose that the structure of individuality is sufficiently similar in all cases that if in some possible cases thisnesses would be distinct from all suchnesses [i.e. there are numerically distinct but qualitatively indiscernible individuals] then thisnesses are universally distinct from suchnesses. (1979, 13)

In these comments and others like them, we hear echoes of Ayer's position: philosophical existence claims are a priori, and a priori truths are necessary. It would appear that the persistence of the classical objection is due to the persistence, often only in half-articulated form, of Ayer's sort of view of philosophy.

Prima facie, however, Ayer's view sets remarkably strong constraints of metaphysical inquiry. Indeed, they are so strong as to make the justification of a metaphysical existence claim virtually impossible, since this would require the demonstration of logical inconsistency in the views of one's opponents. Even a

passing familiarity with metaphysical debate reveals the scarcity of such demonstrations. Even when they are forthcoming, such proofs can usually be sidestepped by slight reformulations in doctrine. This is not to say that the reductio ad absurdum has no place in contemporary metaphysics, but certainly it cannot be the sine qua non of justification in ontology. For if it were, many prominent positions in the metaphysics of properties, philosophy of mind, causation, and philosophy of space and time would simply fail to have any justification. Perhaps this would not perturb Ayer himself, but this would only show that Ayer's view of metaphysics is idiosyncratic. In any case, it is hardly fair to saddle the contemporary bundle theorist with constraints on inquiry that are not widely held in other areas of metaphysics.

The implausibility of the Necessity thesis notwithstanding, however, we are apt to seek some explanation of why the view persists in debates over concrete particulars whereas analogous views have not persisted in these other areas. One factor that may be worth noting in this regard is the 'second life' led by the Identity of Indiscernibles as a logical principle. In *Principia Mathematica* (1910), Whitehead and Russell offer the following definition of identity:

$$x = y =_{def} (\forall \varphi)\ (\varphi x \supset \varphi y)$$

where φ ranges over predicative (i.e. first order) propositional functions (13.01). Identity is defined as indiscernibility (with respect to predicative properties), and

so the Identity of Indiscernibles follows from the definition of identity as a purely analytic truth. "X and Y are indiscernible (with respect to predicative properties)" just *means* "X and Y are identical".

In the *Tractatus* (1918), Wittgenstein objects to this definition, because "according to it one cannot say that two objects have all their properties in common. Even if this proposition is never true, it is nevertheless *significant*" (5.5302). Russell appeared to be convinced by this line of thought; in his 1922 introduction to the *Tractatus* he wrote:

> The conception of identity is subjected by Wittgenstein to a destructive criticism from which there seems no escape. The definition of identity by means of the Identity of Indiscernibles is rejected, because the Identity of Indiscernibles appears to be not a logically necessary principle. According to this principle x is identical with y if every property of x is a property of y, but it would, after all, be logically possible for two things to have exactly the same properties. If this does not in fact happen that is an accidental characteristic of the world, not a logically necessary characteristic, and accidental characteristics must, of course, not be admitted into the structure of logic. [15]

If logical truths are necessary truths, then the Identity of Indiscernibles, being merely contingent, cannot be a logical truth.

As he often did, however, Russell later returned to the view he had abandoned. In his *Inquiry into Meaning and Truth* (1940), Russell strikes back against the argument of the *Tractatus*:

> The identity of indiscernibles . . . is rejected by Wittgenstein and others on the ground that, even if *a* and *b* agree in all their properties, they may still be two. This assumes that identity is indefinable. Moreover it makes enumeration theoretically impossible. Supposed you wish to count a collection of five objects A, B, C, D, E, and suppose that B and C are indistinguishable. It follows that, in the moment of counting B, you will also count C, and therefore you will conclude that there are four objects to be counted. To say that B and C are really two, although they seem one, is to say something which, if B and C are totally indistinguishable, seems wholly devoid of meaning. (102-103)

A crucial premise in this argument is some version of the verificationist theory of meaning: that to be significant a statement must be capable of verification by some sort of empirical experience or fact (in this case, enumeration). What Russell claims is that the denial of the Identity of Indiscernibles is not susceptible to empirical verification. Therefore, the denial of the Identity of Indiscernibles is meaningless nonsense. This means that the principle is an analytic truth.[16] Analytic truths are necessarily true, and hence, contrary to Wittgenstein, the Identity of Indiscernibles is a necessary truth.

In 1952, Max Black published an article in *Mind* called "The Identity of Indiscernibles". Black attempted to beat the verificationist at her own game by describing a possible world (consisting of two identical spheres separated by some distance and nothing else) where two objects share all of the same properties but yet the fact that there are two objects rather than one *can* be verified (1952, 162). By the time Ayer takes up the issue of the constitution of

concrete particulars, there is already a well-established literature on the Identity of Indiscernibles, culminating in Black's elegant and interesting paper. None of this literature makes explicit mention of the Bundle theory. Nonetheless, discussion of the truth of the Identity of Indiscernibles in the context of the Bundle theory appears to simply continue the tradition of discussion of the principle from logic, focusing especially on its supposed necessary truth and Black's ingenious thought experiment. It is hard to speculate as to how much of a role the supposed status of the Identity of Indiscernibles as a logical truth really played in the persistence of the Necessity thesis amongst bundle theorists. Certainly it cannot have made the rejection of that thesis any easier. In any case, the principle's checkered logical past should not colour our assessment of it as a metaphysical truth entailed by the Bundle theory.

2.4. The Identity of Indiscernibles as a Contingent Truth. One bundle theorist who actually implements the idea of rejecting the Necessity thesis and taking the Bundle theory to be a contingent truth is Albert Casullo.[17] He takes the theory only as a thesis about what substances are in this world: bundles of universals (1982b, 595; 1984, 536). He draws an analogy with mind-brain identity theses, which allow "that it is logically possible that irreducible minds or mental states exist" (1982a, 596). These theses only entail that in fact minds are identical with brains, not that necessarily, minds are identical with brains. The bundle theorist, Casullo suggests, should make the analogous move of saying that concrete

particulars are bundles of universals, but that this is only a contingent fact. She then may see the Identity of Indiscernibles, which follows from the Bundle theory, also as a contingent truth: though it will be true in the actual world at least, it need not be true in all possible worlds. But this still leaves the modal commitments of the bundle theorist vague: aside from the actual world, how many (which?) possible worlds does the Identity of Indiscernibles have to be true in?

Casullo thinks that the answer is "none": so long as the Identity of Indiscernibles is true in the actual world, the bundle theorist can simply dismiss *all* possible world counterexamples to the Identity of Indiscernibles, and hold that principle to be a mere contingent truth (1982a, 595). Of Black's world, for instance, he says "such symmetrical universes. . . of course, are irrelevant to the [contingent Bundle theory] view" (1984, 528). Why does he think they are irrelevant? In another article, he says:

> To grant that there are possible worlds in which there exist diverse objects which are qualitatively indiscernible simply shows that it is not a necessary truth that particulars are complexes of universals. It does not establish that the particulars of the actual world are not such complexes. (1982b, 168)

The reasoning here seems to be the following: in Black's world, the Identity of Indiscernibles is false. But then it must be a world where the Bundle theory is false. Since we are not worried about whether the Bundle theory is true in any

world other than the actual world, we should not be concerned by the possibility Black raises. Once the Bundle theory is taken as a claim only about this world, then the Identity of Indiscernibles can be taken as a claim only about this world as well: "the contingent truth of the [Identity of Indiscernibles] is all that the theory requires" (1982a, 597). So any possible world scenarios involving symmetrical situations are irrelevant to the truth of the Identity of Indiscernibles.[18]

Casullo's position involves the claim that all worlds like Black's world are worlds where the Bundle theory is false, and hence not worlds where the bundle theorist should expect the Identity of Indiscernibles to be true. This appears, however, to be a hasty conclusion. The reason is that the key feature of a Black world is its symmetrical spatial arrangement of concrete particulars. This feature, in itself, does not seem to entail anything about the *nature* of concrete particulars. That is, even if concrete particulars *are* bundles of properties surely the symmetrical spatial arrangement of such particulars is possible. What Casullo's approach to Black worlds requires is the claim that worlds with symmetrical arrangement of concrete particulars are always substratum worlds and never bundle worlds. However, it is not at all clear that there are any principled reasons for thinking this.

One reason for thinking that this is *not* the case is what seems to be a prima facie plausible view of the relation between metaphysical and physical possibilities: for any metaphysical theory M, and any physical possibility P, P

should be a metaphysical possibility given M. A world having symmetrical arrangement appears to be a physical possibility: nothing in the laws of nature as formulated in contemporary physical theory appear to preclude this state of affairs from obtaining. The above view entails that if the Bundle theory is our metaphysical view, then a world having symmetrical arrangement should be a metaphysical possibility given the Bundle theory. But on Casullo's account, as we have seen, it is not: any world with symmetrical arrangement (P obtains) is treated as a world where the Bundle theory is false (M fails to obtain). If the above view is correct, then Casullo errs in saying that the bundle theorist does not have to take the Identity of Indiscernibles as anything more than a truth about our world; he must take it also as being true in other possible worlds where the Bundle theory is true *and* which possess symmetrical arrangement.[19]

A different way to bring out the problematic nature of Casullo's view is to examine his claim that the contingent Bundle theorist need uphold the Identity of Indiscernibles just as a contingent truth, one about the actual world only. The problem with this is that it requires treating the Identity of Indiscernibles, as entailed by the Bundle theory, as having the truth conditions of a *material* conditional. But in general, the truth conditions of counterfactual claims like the Identity of Indiscernibles are not equivalent to those of corresponding material conditional claims. For example, interpreted as a material conditional, this proposition

1. If Julian goes to Paris then the sun will explode

has the same truth conditions as:

2. Either it is not the case that Julian goes to Paris or the sun will explode

But clearly, the truth conditions for (1) are not given by (2): (1) is not made true simply by Julian's failure to go abroad. When I assert (1), I am saying that of these things, Julian and the sun, that there is a (causal) connection between them, such that if one goes to Paris, then the other explodes. When I assert a sentence like (1), clearly I am committed to more than the descriptive claim (2), which implies no such connection. Analogously, when I assert the Identity of Indiscernibles, I mean something like:

1'. If these concrete particulars were symmetrically arranged (i.e., shared all properties) then they would not be numerically distinct

When I say (1'), I am saying of these things here and there that there is a connection between their qualitative constitution and their numerosity, such that if the former was a certain way, then the latter would be otherwise (i.e. if there was a case of symmetrical arrangement here, there would be one object involved, not two). When I assert the Identity of Indiscernibles, I am committed to more than the merely descriptive claim

2'. Either these concrete particulars are symmetrically arranged (i.e. share all properties) or they are not numerically distinct

Now (2'), like (1'), is trivially true when the first disjunct is true; i.e., (2') is true whenever there are no indiscernibles (symmetrically arranged particulars). So holding (2') amounts to no more than holding "there are no indiscernibles". On Casullo's view, this is apparently just what the truth of the Identity of Indiscernibles comes to, and, in fact, he is quite explicit about this. He argues that the "fortuitous empirical feature of our world" that no two particulars have all properties in common is sufficient to sustain a contingent version of the Bundle theory (1982a, 595; see also 596).

But surely the Bundle theory entails more than this: it entails the Identity of Indiscernibles as a true counterfactual conditional statement (i.e. not as a mere material conditional), and the truthmaker for such a proposition can never be a mere descriptive fact about the actual world. That there is something evasive about taking the Identity of Indiscernibles as a material conditional is clear from the fact that this view ends up actually *denying* that metaphysical connection between qualitative constitution and numerosity that is *prima facie* expressed by the Identity of Indiscernibles. The Bundle theory is a belief about the nature of concrete particulars (*these* objects around *here*) that commits us to the existence of a non-trivial connection between the qualitative constitution of those particulars and their numerosity; we express this connection by the Identity of

Indiscernibles. But on Casullo's view, in any context in which this connection should be realized (e.g. a symmetric world) he denies it (by taking the Identity of Indiscernibles to be false in that world).

2.5. The Identity of Indiscernibles as a Counterfactual Conditional. So far I have argued against two views about the version of the Identity of Indiscernibles that is entailed by the Bundle theory: (1) that it is necessarily true and (2) that it is merely contingently true.[20] Since these views represent opposite extremes (all possible worlds vs. only the actual world), we might expect the truth to lie somewhere in between. Leibniz, the intellectual grandfather of the Identity of Indiscernibles, placed the principle somewhere in between these antipodes (see Figure 2.1).[21] I do not want to discuss Leibniz' reasons for thinking this or endorse his peculiar version of the view; I do suggest, however, that Leibniz was on the right track in saying this.

My suggestion above was that if we embrace the Bundle theory, then we must take the Identity of Indiscernibles as a counterfactual conditional along the lines of (1') in the previous section. If so, then, on the usual analysis of counterfactual conditionals, we have to uphold it not only in the actual world but also in those worlds (1) where the antecedent is true and (2) which are relevantly similar to our world.[22] Thus, contrary to Casullo, we *cannot* say that any world of the sort described by Black, with a symmetrical arrangement of concrete particulars, is a world where the Identity of Indiscernibles is false. For regardless

of one's metaphysics, it seems quite plausible to think that *something* like the scenario described by Black is (physically) possible. The antecedent of the Identity of Indiscernibles is clearly fulfilled in such worlds: there are indiscernible (spatially separated) spheres. But when is such a world relevantly similar to the actual world? The most plausible answer seems to be: when it is a world where the Bundle theory is true. If a Black world is relevantly similar to ours, then we have to uphold the consequent of the Identity of Indiscernibles and say that the spheres in it are actually numerically identical: there are not two spheres but just one sphere in two places at once, or a sphere spatially separated from itself. In these worlds the bundle theorist must pay the metaphysical piper; she is committed there to the realization of the connection between qualitative constitution and numerosity that is entailed by her theory. Thus, contrary to Casullo, the theoretical commitment of the bundle theorist does not end with establishing the non-existence of indiscernible things in the actual world, even if one rejects the Necessity thesis.

I think this account clarifies just what Black's case shows and does not show with respect to the Bundle theory (Figure 2.1, panel *C*). On this view, Black's characterization actually describes a whole set of possible worlds, all of which share a certain qualitative similarity (i.e. symmetrical arrangement of concrete particulars). In all of these, the antecedent of the Identity of Indiscernibles is satisfied. In some of them, however, the Bundle theory (and hence the Identity of Indiscernibles) is false. The latter worlds, which are the

ones typically offered as refutations of the Bundle theory on the classical criticism, are actually irrelevant to it because they are not relevantly similar to the actual world (which is composed of bundles of universals). But by no means all of Black's worlds are irrelevant, as Casullo holds (cf. Figure 2.1 panel *B*); in some of them, the Bundle theory will be true. These worlds *are* relevantly similar to the actual world, and as bundle theorists we are committed to holding the Identity of Indiscernibles true there, which means, apparently, identifying some spatially diverse entities (see Figure 2.1 panel *C*).

Where does all of this leave the Bundle theory? The results are mixed. The Bundle theory is not, as most critics have thought, committed to the *logical* impossibility of there existing distinct yet indiscernible concrete particulars. However, the bundle theorist is not exactly home and dry either, for Black's thought experiment does succeed in laying bare her commitment to the *physical* impossibility of there existing distinct yet indiscernible concrete particulars. That is, to account for physically possible symmetrical arrangements of concrete particulars, the bundle theorist must allow for the bi-location of those particulars in some physically possible worlds. The bundle theorist cannot disown such possibilities, and must be held accountable for whatever metaphysical trouble they may cause. In the following chapter, I take up these troubles in detail.

Notes

[1] Loux also discusses this objection (1978, 124-126).
[2] The objection is also raised by Rosenkrantz and Hoffman (1991, 836 n2).
[3] This response to Van Cleve's first objection is also endorsed by O'Leary-Hawthorne and Cover (1998, 208).
[4] Casullo's use of "enduring" is idiosyncratic; the term is standardly used to denote items which persist by "being wholly present at more than one time" (Lewis 1986, 202), which is *not* true of Casullo's enduring things (see also Hinchcliff 1996).
[5] The accidental/essential distinction is explicitly drawn within bundles by Simons (1994, 567-568).
[6] One such approach would be a non-constrictive version of the Substratum theory that identifies concrete particulars with complexes of a substratum *and* all properties (essential and accidental). Michael Loux points out that the argument that the analogous non-constrictive Bundle theory cannot allow persistence through change relies on the assumption that concrete particulars with different constituents can never be identical. But, if this "entails the impossibility of change on the Bundle theory, it has precisely the same consequence for [this version of the] substratum theory" (1978, 124; see also Casullo 1988, 138n16).
[7] The general assumption relied on here, that if two concrete particulars share all their constituents they are one and the same, is what Loux calls 'the Principle of Constituent Identity' (Loux 1978; 1998).
[8] Arguments that the weak principle actually is false have recently been offered, based on contemporary quantum mechanics (French and Redhead 1988). However, this conclusion turns on controversial issues in the interpretation of quantum mechanics, and has been questioned (see Forrest 2000; French 2000).
[9] Some similar claims are made, albeit half-heartedly, in A.J. Ayer's (1954).
[10] Casullo cites Russell's argument for this claim, in *Human Knowledge* (1948, 316-317).
[11] Several other philosophers offer essentially the same argument for the Necessity thesis, complete with this fallacy. Van Cleve, for instance, writes: "If a thing were a set of properties, it would be impossible for two things to have all the same properties, since it is impossible for two sets to have all the same members. Thus the bundle theory requires the Principle of the Identity of Indiscernibles. . . to be a necessary truth" (1985, 96). Moreland's version of the argument is similar, except it contains the additional error of failing to necessitate his third premise (1998, 252).
[12] Peter Forrest (2000) notes that this assumption is required for the conclusion Campbell wants to draw.

[13] Despite this comment, Armstrong elsewhere is suspicious of the claim that the Bundle theory entails the necessitation of the Identity of Indiscernibles, and most of his criticisms of the theory do not depend on this claim (see his 1978 I, 92).

[14] A slightly different way for the proponent of the classical objection to motivate the rejection of (3') is to say that, surely, even if no actual distinct concrete particulars have the same properties, it still could have been the case that such particulars could have been found. Perhaps we can imagine having discovered two such particulars (e.g. Black's spheres). But if it is possible that particulars share all properties, how can it be necessary that they fail to share all properties? Similar concerns arise generally about the necessity of theoretical identity statements in Kripke's framework; his response is to point out that although such statements are necessary, they are not a priori. What we are imagining in such cases is a possible world in which there are items qualitatively like concrete particulars, but which are not concrete particulars. Hence such worlds are not counterinstances to (3'), since the antecedent of the conditional is not satisfied in those worlds (see Kripke 1980, 140-144).

[15] Russell voices the view that the Identity of Indiscernibles is not a necessary truth earlier on, in his 1919 book *An Introduction to Mathematical Philosophy* (192).

[16] Russell says in several places that the Identity of Indiscernibles is analytic (e.g., his 1940, 92 and 97).

[17] I will speak of the contingent truth of the identity claim "concrete particulars are bundles of universals"; if the Kripkean ideas discussed above are correct, however, then this statement will be necessary if true at all. I am not assuming that Kripke is wrong: even if he is correct, still it will not be the case that items with the features of concrete particulars will be bundles of universals in every possible world (see above, section 2.2); this fact is the analogue, in Kripkean terms, of the contingent truth of the identity claim to which I will refer.

[18] Casullo (1981) and others (e.g. Armstrong 1978 I; Loux 1978, 156-157) attribute this position to Russell in his later works (e.g. his 1948), but Michael Bradley (1986) argues convincingly against this interpretation.

[19] Similar criticism of Casullo's view is suggested in O'Leary-Hawthorne and Cover (1998, 211).

[20] I mean "merely contingently true" here in Casullo's sense of being trivially true in the actual world in virtue of the falsity of its antecedent, but false in any symmetrically arranged world.

[21] See Leibniz' fifth letter to Clarke, section 25, where he writes: "When I deny that there are two drops of water perfectly alike, or any two other bodies indiscernible from each other, I don't say it is absolutely impossible to suppose them, but that it is a thing contrary to divine wisdom, and which consequently does not exist" (Leibniz 1715, 334).

[22] For an outline of this approach to counterfactuals see Lewis (1986, 20f).

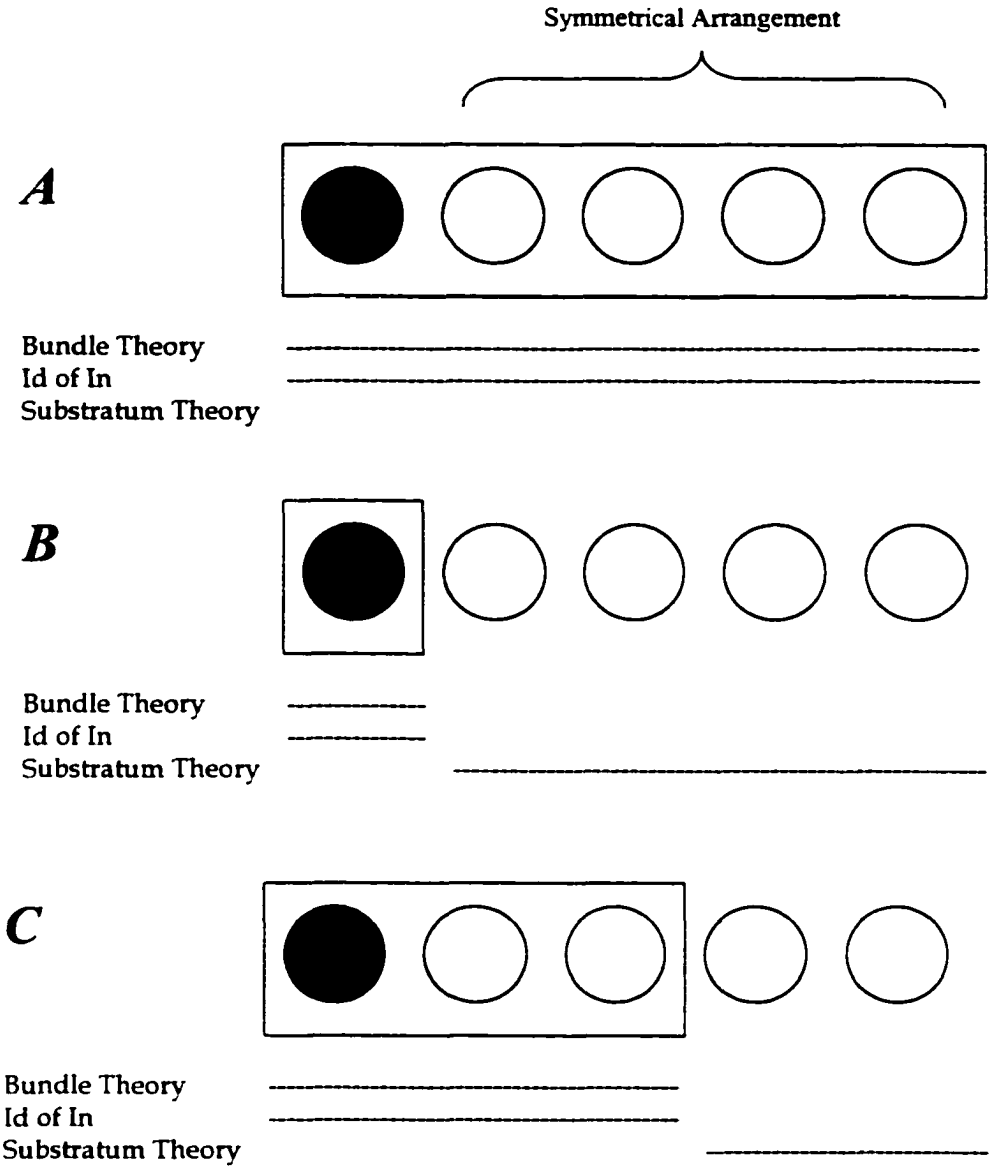

Figure 2.1. The Identity of Indiscernibles and the Bundle Theory. Shaded circles represent the actual world; unshaded circles represent unactualized possible worlds. In each panel, circles enclosed by a box represent worlds in which the Bundle theory and the Identity of Indiscernibles are true; circles outside the box represent worlds in which they are false. Lines below a given world indicate the truth of a given proposition in that world. Panel *A* represents the view entailed by the Necessity thesis; panel *B* represents Casullo's view, and panel C represents the counterfactual conditional view.

III. Bundles of Universals: Bi-Location and Spacetime

In this chapter I continue to assess the traditional version of the Bundle theory that treats properties as universals. So far I have argued that, contra the Necessity thesis, the bundle theorist is not committed to the truth of the Identity of Indiscernibles in all possible worlds. Yet, I claimed, the bundle theorist does face potential trouble with the Identity of Indiscernibles, insofar as there are physically possible worlds where there are indiscernible (i.e. symmetrically arranged) concrete particulars and where the Bundle theory is true. These worlds must be explicable by the Bundle theory. If we apply the Bundle theory in these worlds, however, the Identity of Indiscernibles forces us to conclude that there are fewer items here than meet the eye: for example, there is actually one sphere in Black's world, not two, and it is at some spatial distance from itself: that is, it is bi-located.

The notion of bi-location has been the target of a number of recent criticisms that I consider here in detail (section 1). My verdict is mixed: although the bi-location strategy *may* be capable of avoiding these difficulties, this is achieved only at the cost of violating strong intuitive constraints on the analysis of concrete particulars. In the second half of this chapter, I raise a more serious limitation of the bi-location strategy: it cannot be used to provide an adequate analysis of the parts of substantival spacetime, construed as concrete particulars (section 2). I conclude that these facts make the Bundle theory formulated in

terms of universals unpromising, and that the bundle theorist's best hopes for a plausible and comprehensive theory of concrete particulars lie with the treatment of properties as tropes.

1. Bi-location and Concrete Particulars.

1.1. The Mono-location Intuition. The bi-location strategy urges us to view concrete particulars as the sorts of things that can be in more than one place at a time. Many philosophers have thought that this result in itself is unacceptable. Robert Adams (1979), for example, says that he simply assumes that "the same thing cannot be in two places at once-that is, cannot be spatially distant from itself" (14). Likewise Armstrong asserts that "if things occupy different places at the same time, then they must be different things" (1989a, 61). One way of taking these comments is as articulation of a strong pre-theoretic intuition that concrete particulars, whatever they may be, are the sort of thing that cannot be bi-located. The critic of the Bundle theory might appeal to this intuition in the following way: if the bundle theorist, to accommodate the Identity of Indiscernibles, is forced to say in the end that concrete particulars are capable of bi-location, then the Bundle theory is not a very good theory of concrete particulars.

There are two ways the bundle theorist could respond to this argument. The first is to retreat and try to show that bi-location really is not needed after all; an example of this would be something along the lines of Casullo's attempt to

cast the Bundle theory as a theory about the supposedly assymetric actual world only (see Chapter II, section 2.4). The other option is to admit bi-location for concrete particulars, but disregard the intuition that concrete particulars cannot be bi-located. I have already argued that the former approach does not succeed; the latter approach has been argued for by O'Leary-Hawthorne (1995). He argues that many of us already have in our ontology an item that violates the 'mono-location intuition': universals. After all, the typical gloss of a universal is as a property that may be instantiated at more than one place at the same time. O'Leary-Hawthorne then argues that the mono-location intuition should not hold us back from advocating bi-located concrete particulars: after all, we are flouting that intuition already by believing in universals. He writes:

> Is it self-evidently absurd to claim that the most perspicuous description of the possible world that Black pictures is one that describes it in terms of a single bundle of universals at a distance from itself? Perhaps the very notion of an immanent universal is somehow absurd. . . .These are indeed possible sources of absurdity that need to be examined, but they have nothing to do with Black's imagined scenario. If those possible sources of absurdity cannot be overcome then the right response to the bundle theory will not be to imagine a Black world but will be instead to question the very notion of an immanent universal . . . (195)

He concludes that cases of bi-located particulars like Black's sphere(s) do not "raise any *special* problems for the bundle theory" (195). If we want to enforce the mono-location intuition in ruling out bi-located concrete particulars, we will

first need to enforce it in ruling out bi-located properties (i.e. universals), and few philosophers would want to do that.

In response to this, the opponent of the Bundle theory would do well to point out that just because the mono-location intuition does not apply to universals does not mean that it does not apply to concrete particulars. She might argue as follows: it *is* part of our intuitive concept of a concrete particular that it be mono-located. The concept of property does not generate a parallel intuition (or at least one of equivalent strength); this is why universals are seen as a live option in metaphysics.[1] Any analysis of the notion of a concrete particular has to be adequate to this strong intuition. The Bundle theory, however, tells us that concrete particulars can be bi-located, so (again) it is not a good theory.

The general form of this difficulty is familiar from many cases of philosophical analysis. We have a strong intuition about the nature of the analysandum and a proposal which requires abandoning that intuition. Result? The proposal is rejected in favour of preserving the intuition. To take one example, Douglas Ehring (1987) argues against Donald Davidson's claim that the relata of causal relations are certain sorts of events in the following way. Intuitively, the causal relation is transitive. If we adopt Davidson's view that certain sorts of events are the relata of causal relations, then, because of the transitivity of causation, we are forced to posit causal relations obtaining in cases where clearly no such relations obtain (i.e. we are led to class as causes of some

effect events which plainly are not its causes). The details of Davidson's proposal and its difficulties are not important here; what is important is Ehring's observation that "we have two ways of repairing this situation" (324). One is to give up Davidson's view on the nature of causal relata, and the other is to "abandon the transitivity of the causal relation" (324). Ehring opts for the former, "given that transitivity is central to our conception of causation" (325). This is a clear case of a strong pre-theoretic intuition constraining philosophical analysis.

It seems to me that the claim to centrality is nearly as strong in the case of the mono-location of concrete particulars as it is for the transitivity of causation. One way in which this claim might be supported is by pointing to the opposition raised by attempts to violate it. It might be claimed that quantum mechanics violates the mono-location intuition, in the following way. The mono-location intuition entails that all physical things, such as concrete particulars, are mono-located. According to quantum mechanics, some physical systems are not mono-located. This is the case insofar as it describes spatially separated entities that cannot properly be treated as distinct physical systems. Don Howard argues that Einstein's opposition to quantum theory was based on its violation of a 'doctrine of separability': "non-null spatio-temporal separation is a sufficient condition for the individuation of physical systems" (Howard 1997, 100). Einstein's deep attachment to this principle, and his rejection of quantum theory in deference to it, suggests that some scientists at least have found the mono-location intuition,

or something quite like it, to be a strongly entrenched part of our very notion of a physical entity. Though the connection between Einstein's physical systems and concrete particulars is, admittedly, very rough, perhaps this case also shows the entrenchment of the mono-location intuition in our notion of concrete particular.[2]

Of course intuitions, however strong, should not be held sacrosanct in a scientific philosophy. We are always free to say that our intuitions are simply wrong in some case, or that these intuitions should be sacrificed for good reasons, for example in the interest of making substantial gains in understanding elsewhere in our metaphysics.[3] Unfortunately, O'Leary-Hawthorne does not offer any good reasons for abandoning the mono-location intuition for concrete particulars.[4] The bundle theorist will presumably want to argue that we should *do* this because it enables us to avoid difficulties with substrata, such as those outlined in Chapter I. For now I will simply assume that such reasons for rejecting the mono-location intuition will be forthcoming. Even if they are, other technical problems for bi-location have been raised.

1.2. Counterfactual Entanglement. One such problem is what Christopher Hughes aptly calls the 'counterfactual entanglement' of bi-located concrete particulars. The problem is formulated nicely by Dean Zimmerman (1997). In his dialogue, the interlocutor named B says:

> Suppose that nothing exists save two electrons-or, if you like, that the same bundle of electron-ish properties appears on

> opposite sides of a symmetrical universe. Suppose further that electrons obey indeterministic laws. In that case, even though the electron on the one side is now indiscernible from the one on the other, it remains possible that differences will emerge later on-in other words, it is possible that *this* one should have a future differing from *that* one. And even in the case of an eternally symmetrical, two-electron universe in which differences never emerge, such differences were nonetheless possible-both logically or metaphysically possible, and physically or causally possible too. But you cannot recognize this possibility: on your view the "electrons" must really be a single bundle, and so nothing could be true of the one but false of the other. (306-307)

There are two distinct arguments offered here; let us consider the one involving logical possibility first. Imagine a universe where the Bundle theory is true but which has a symmetrical arrangement, such that one electron is bi-located at some time t; call one 'instantiation' of the electron, its appearance on one side of the universe, a, and call the other one b (see Figure 3.1 panel *A*). Furthermore, imagine that at no later time t_L do the two 'instantiations' of the electron (i.e. a and b) come to be different. It is a *logical* possibility, Zimmerman's B argues, that a and b are different at t_L, even if in actuality they never are so (panel *B*). On the Bundle theory, however, this clearly is not a logical possibility, since there is some bundle of universals θ such that $a=b=\theta$ (i.e. the world represented in panel *A* is really the world shown in panel *C*). If a=b, however, then it is not logically possible that a have different properties than b at some time (as shown in panel *B*), since that would entail that a has different properties than itself at that time, which is logically impossible (panel *D*). a and b have become, as we might say,

counterfactually entangled, or "modally linked; there is no possible world in which they differ" (308). Since the Bundle theory (supplemented with bi-location) forces one to deny what is clearly logically possible, the Bundle theory should be rejected.

This argument is not very persuasive, given that we are willing to put aside the mono-location intuition. It is certainly true that, on the Bundle theory, a and b differing at t_L is logically impossible. It is unclear, however, why the protagonist thinks it so obvious that this actually is logically possible. No reason is given, and we seem to be thrown back here on none other than the mono-location intuition: it is possible for a and b to differ because a and b are the sorts of things which, intuitively, are not capable of bi-location. In other words, B is coming very close to begging the question against A and the Bundle theory. B insists that it is possible for one electron to have had different properties than 'the other'. A says they are one and the same. But if they *are* one and the same, then this *is* impossible, by A's lights. B *cannot* say that we think this is a genuine possibility because we know or presume that the electrons are distinct. In response to B, A might say that the reason "something more" is possible in the world B is imagining is that in that world, the two electrons *are* distinct (i.e. not bundles of universals): B is imagining not the world of panel *C* in Figure 3.1 but rather that of panel *E*. Given that the world described in *A* is of this sort, the situation shown in panel *B* is possible. But this is clearly begging the question:

the need to acknowledge this supposed possibility only arises once you deny that the world shown in panel *A* is correctly described by the Bundle theory.

This brings us to the second argument contained in B's remarks, one which employs the notion of physical possibility rather than logical possibility. That argument is as follows. At t, a and b share all their properties. Given that the laws of nature governing the particles are indeterministic, however, it is physically possible that at t_L a is different from b; after all, since the laws are not deterministic, things *might* have worked out differently, though they did not. So there should be some *physically* possible world to ground this proposition. Since a and b are really one and the same entity θ (i.e. a=b=θ), however, there is no such world. Clearly, we cannot say that there is a world where the bi-located electron itself has some property P (in its right instantiation say) and also has ~P (in its left instantiation); this world would be a contradictory world, and thus it is logically impossible (Figure 3.1 panel *D*).

This argument, unlike the first, is not driven entirely by intuition. In this argument, we are driven to postulate the possible world (panel *B*) where a differs from b by a fact about the nature of physical law. It is plausible to think that some possible laws of nature, even some actual laws of nature, are indeterministic in character; roughly, this means that for any world x, there is a physically possible world y, such that x and y are identical up to and including some time t, but x and y are not identical at some later time t_L. In other words, agreement up to the present fails to fix the future. The second argument simply

asks us to imagine that the world we have been discussing is a world where this is the case. If it is, however, then it will be the case that there is a physically possible world in which a and b share all properties at t but in which they differ at some later time t_L. On the Bundle theory, however, this world is not possible.

In response, the bundle theorist might employ the same strategy used above: agreeing that this really is not possible, and charging his opponent with begging the question. In this case, however, the reply is much less convincing. For the denial that this world is physically possible is tantamount to a denial, on purely metaphysical grounds, of the possibility of indeterministic laws. The bundle theorist appears to be saying that in any world where the Bundle theory is true, this sort of indeterminism does not obtain. This, however, seems absurd; we should not be able to divine the character of physical law without practicing physics. It might be the case, for example, that physicists propose laws of nature which allowed us to assign a non-zero probability to a and b differing at t_L. Does the bundle theorist seriously propose pronouncing such proposals incorrect?[5] If indeterminism is false, then this presumably should be discovered through empirical investigation, not by philosophical reflection alone. B does not say that we must allow the possibility of the right and left electrons coming to differ (i.e. the possibility of the world shown in panel *B*) because intuitively the electrons are distinct; we must allow for it because if we do not we are committed to this most ridiculous form of determinism. In this way, B is able to motivate the

problem of counterfactual entanglement without obviously begging the question against A.

Perhaps one's initial critical response to B's second argument is that it assumes a certain interpretation of modal statements like "This electron could be different than that one". Indeed, this is the first response which Zimmerman's bundle theoretic spokesman, A, makes to the argument. He says:

> Your argument tacitly assumes the falsity of a counterpart-theoretic approach to *de re* modal ascriptions. . . I can simply adopt a semantics for the statement "The (so-called) 'two' electrons could have diverged" that ascribes truth to this statement just in case the single bi-located electron-bundle in the world you described has *two* counterparts inhabiting some other world, and the two counterparts there differ in the required ways. (307)

So it is possible that a and b (i.e. θ) be different at t_L; it is possible because in some possible world there are two distinct and different counterparts for θ. Since counterpart theory does not employ transworld identity, the possibilities for θ need not involve θ itself (see Chapter II, section 1). In particular, it is not required that, in some possible world, θ both have and lack some set of properties; all that is required is that, in some possible world, some counterparts of θ do so. On this suggestion, the world depicted in panel *F* in Figure 3.1 would be the possible world that serves as the truthmaker for the modal claim at issue: θ has two counterparts in this world, φ and ψ. These have different properties,

but since they are distinct items, there is no logical contradiction in this possible world.

Zimmerman's B, however, is not so easily satisfied:

> Even if I grant you [counterpart semantics] I don't see how it helps. The world you describe, in which the bi-located bundle has two counterparts, allows you to say that the one bi-located electron could have been two electrons. But something more is possible in the world I described: the electron on one side could have developed differently while the one on the other side did not. But if "they" are identical, "they" must have the same counterparts in every possible situation-and so there's no possible world in which the one *but not the other* has a counterpart with a particular future. (307)

B's reply is a bit subtle. He admits that certainly it is possible that there could have been two electrons, instead of just one bi-located one (i.e. there is a possible world where θ has two counterparts φ and ψ; see panel F Figure 3.1). Given that there is just one, however, it should still be possible that *the spatially separated instantiations* of the electrons (i.e. a and b) could come to differ. The bundle theorist asks us to accept that the instantiations here and there are really just bundles of universals, and that hence they really are identical (i.e. $a=b=\theta$). However, this commits us to saying that these spatially separated instantiations are, in fact, the sorts of things that could never differ from one another. It is of course possible that they could have been other sorts of things, the sorts of things that are distinct and so can have different properties. But as a matter of fact they are not this sort of thing: they are precisely the sort of thing that cannot differ.

To show that *the spatially separated instantiations*, a and b, could come to differ using counterpart theory, we would need to identify differing counterparts for each separate instantiation in some world. Given that the instantiations are identical, this simply cannot be done: given that a=b, there is no way to set up counterpart relations between the worlds of panel *A* and panel *F* such that a is the counterpart of φ but not of ψ (or vice versa). So it is all one whether we use counterpart theory or not; there is a sense in which it still is not possible that the right electron could have been different than the left one.

I think, however, that the bundle theorist need not resort to counterpart theory to evade B's second argument. B's worry is that the bundle theorist who embraces bi-located concrete particulars is committed to the failure of indeterminism on purely philosophical grounds. If we encounter a pair of indiscernible particles, then, assuming her theory is correct, she will be able to inform us that they will never come to be different, no matter how much physicists say that the laws of nature are indeterministic. Call this sort of determinism reported by our bundle theorist *I-determinism*: if the actual world contains indiscernible entities x and y at some time t, then in all physically possible worlds agreeing with the actual world up to t, at all later times, x and y are indiscernible.

I-determinism indeed seems preposterous. However, I think that the bundle theorist can reply that although I-determinism is true, it is harmless. I-determinism tells us that any bundle of universals will always be indiscernible

from itself. However, it does not tell us anything about the physical behaviour, over time, of bundles of universals. In particular, it does not tell us that a bundle that is bi-located at such and such a time will continue to be bi-located at any future time. B's case where the electrons come to be different could be viewed by the bundle theorist as a case where a bundle θ which was bi-located at t has ceased to be so at t_L, and is now mono-located at a (panel *G*). There is no prima facie reason why this state of affairs should be physically impossible on the Bundle theory. The case which the physicist describes as a differing from b may be re-described by the bundle theorist as the bundle θ=a=b changing its location. In order for I-determinism to be harmful, it would need to quantify over not just bundles of universals, but things like 'the right instantiation of the electron'. However, to insist on quantifying over these is clearly again to beg the question; it is to treat the instantiations of the electrons, which are one and the same to the bundle theorist, as distinct, individual entities.

1.3. Shapes. Another recent objection to bi-location, due to Christopher Hughes, involves shapes. Briefly, the point is this. It is a conceptual truth about shapes that "if a thing has a shape, its shape is the shape of the largest region of space it fills" (1999, 151). Being a conceptual truth, this proposition is necessarily true. However, the Bundle theorist is "committed to denying the necessity of [this] claim, since he holds that the bi-located sphere in Max Black's world is spherical,

even though the largest region of space it fills is not" (151). To assess the force of this objection, it is necessary to make clear just what kind of property shape is.

One way of understanding shape is as an *extrinsic* property of a concrete particular: such a particular has a shape only in virtue of occupying the volume of space that it does. On this reading, having a shape is like 'being a twin': the property does not depend only on the nature of the possessor. Without the existence of other things, and the existence of a specific relation between the possessor and those things, the possessor cannot have the property.[6] It seems to me that we do think about the shapes of liquids and other non-solids in this way: they simply have the shape of whatever region of space they happen to be contained in. The water in a glass may be cylindrical, but this is not an intrinsic property of the water. In itself the water simply fails to have any shape at all. It is amorphous.

However, this does not seem to be the way we think of solids. We think rather of the shapes of solids as *intrinsic* to them. It is not just because the rock happens to fill a certain volume of space that it is spherical. On the contrary, we say rather that it happens to fill a certain (spherical) volume of space because it is spherical. Also, it seems that this is the way that philosophers usually think of shape properties. Lewis, for instance, says of Hubert Humphrey that "his size and shape and composition are intrinsic to him. They are simply a matter of the way he is. They are not a matter of his relations to other things that surround him in this world" (1986, 199). Armstrong cites "extension", perhaps a synonym

of "shape", as being likely a monadic or non-relational (i.e. intrinsic) universal (1989a, 87). Indeed, the classification of shape as intrinsic is part of a long philosophical tradition going back (at least) to Locke, who classed figure as one of the primary qualities (see Hirst 1967, 455-457).

The point of drawing this distinction between extrinsic and intrinsic understandings of shape is that which view is adopted matters with respect to the plausibility of Hughes' so-called 'conceptual truth' about shapes. That truth, again, is that if a thing has a shape, its shape is the shape of the largest region of space it fills. Now if one adopts the view that shapes are extrinsic properties, then it seems plausible to say that this claim is a conceptual and therefore necessary truth. For if an individual has the shape that it does only in virtue of its antecedent relations to parts of space, then indeed it does seem impossible for its shape to be different than that of the space to which it is related. If the shape something has is just parasitic on the shape of the space it fills, then how could it have a shape different than the shape of that space?

The idea that the shapes of solids are extrinsic, however, seems dubious. As mentioned above, shape is traditionally viewed as a paradigm case of an intrinsic property. Prima facie, the shapes that solids have are determined by facts regarding their internal structure and composition, not by facts about what region of space they happen to occupy. It seems likely, therefore, that the bundle theorist will want to hold that shapes are intrinsic. However, if one thinks that shapes are intrinsic to the things that have them, then it is much less plausible to

take Hughes' claim as a necessary truth about shapes. For if a thing has the shape that it does in virtue of its own nature alone, and not in virtue of its antecedent relations to some parts of space, then it is unclear why its shape could not be different than that of the space to which it is related. In short, it is doubtful whether the bundle theorist is really violating a necessary truth by accepting bi-located concrete particulars. For if shapes are intrinsic properties, then we are to think of the shape as antecedent to the relations to space of its bearer, in the sense that the shape does not have a metaphysical dependence on any such relations. But if its shape is in no way parasitic upon the space that it happens to fill, why is it impossible for a thing to have a shape that is distinct from that space?

1.4. Vagaries of Numerosity. Some philosophers have objected to the way in which the Bundle theory, supplemented with bi-location, handles the numerosity of concrete particulars. Hughes, for instance, asks us to consider a universe consisting of "two enormous and almost intrinsically indiscernible galaxies" (1999, 152). The only difference between them is that in one there is a lone 'symmetry-breaking' particle, located a femtometer away from the center of the universe. This particle exerts different forces on each of the two galaxies, causing "the stars and planets in its half of the universe to have slightly different shapes than the stars and planets in the other half" (152). In such a world, the bundle theorist would have to say that had the particle been a femtometer farther over

(i.e. at the center of the universe), then there would have been only one galaxy, not two, since in that case the two would be completely indiscernible. Hughes asks, "how could a miniscule difference in the location of a particle-one that isn't part of any stars, and has only a negligible effect on the stars' intrinsic and relational properties-make such a big difference to how many stars there are?" (153).

Similar concerns were voiced some time earlier by Edward Khamara (1988). Khamara noted that in variations of Black's world containing three spheres, the Identity of Indiscernibles would reduce that number just in case the spatial arrangement of the spheres was symmetrical. He objected that "surely the number of spheres in these universes cannot be affected by any spatial configuration they might assume" (151). Even earlier, Robert Adams, in arguing against a version of the Bundle theory, claimed that "the possibility of there being two objects in a given spatiotemporal relation to each other is not affected by any slight changes in such features as the color or chemical composition of one or both objects" (1979, 17). All of these statements involve the idea that on the Bundle theory, the number of concrete particulars is made to depend upon some prima facie insignificant or trivial parameter.

It seems to me that there are two distinct arguments that are being advanced against the Bundle theory here. One is that the bundle theorist's treatment of numerosity is defective in some methodological sense, such as being 'arbitrary'. Khamara insisted such a dependence of numerosity on spatial

arrangement would be "capricious" (150) and "arbitrary" (152). It is arbitrary because certain spatial arrangements of three spheres are ruled as possible while slightly different arrangements are deemed impossible. In terms of Hughes' example given above, Khamara would say that it is arbitrary that there can be two galaxies in an almost symmetrical configuration while that it is impossible for there to be two such galaxies in a (very slightly different) perfectly symmetrical configuration.

In response to this charge it may be pointed out that the classification of any given situation as possible or impossible on the Bundle theory is far from arbitrary: it flows in a principled way from applying the Identity of Indiscernibles. The resulting classification may grate with our intuitions, but that does not mean that the classification is arbitrary. Schemes of biological taxonomy which put birds and dinosaurs in the same category may be unintuitive, but hardly need be unprincipled or arbitrary. It seems misleading, therefore, to describe the Bundle theory's treatment of numerosity as arbitrary.

This leads us to a second interpretation of the objection, which is that the treatment of numerosity on the Bundle theory with bi-location is highly counter-intuitive. Certainly this is the case: we do not usually take the number of concrete particulars to depend on their spatial configuration. Furthermore, this intuition seems closely connected with the mono-location intuition about concrete particulars. It is because concrete particulars are fully located in a discrete part of space that the movement of, or changes in, other spatially distant

concrete particulars has no effect on them. However, we are operating under the premise here that we are willing to deny the mono-location intuition. If so, it is unclear that this case really demands us to sacrifice any more intuitive constraints on the analysis than we have thrown away already.

Perhaps sensing that this objection might be taken as begging the question, Hughes also suggests the closely related, but importantly different objection that the Bundle theory attributes strange causal powers to certain objects. He asks us to consider a Black-style universe that, at some time *t*, is perfectly symmetrical, consisting of two galaxies, each composed of 10 billion stars. The Bundle theory will analyze such a universe as one where there is one galaxy that is bi-located. We are to imagine that, at some time after *t*, due to indeterministic laws of nature, a "symmetry-breaking particle" comes into existence (153). This particle is more to one side of the universe than the other, so it exerts a differential gravitational effect on each galaxy, causing the intrinsic properties of each star to become different from that of its symmetrical counterpart. Now the Bundle theory will have to say that after time *t*, there are two galaxies, or more strikingly, 20 billion stars rather than 10 billion. But, Hughes says, "the particle's appearance surely does not have such dramatic consequences" (153).

The worry here seems to be that the Bundle theory has to attribute an absurd causal power to an obviously causally insignificant particle: the power to bring 10 billion stars into existence instantaneously. It is not clear, however, just

why Hughes thinks these causal powers absurd. The idea seems to be that the effect is somehow incommensurate with the cause. One way of making this out is in terms of existence, or being. The effect involves a great increase in being: there are now 20 billion stars instead of 10. But doubling the amount of being in the universe just sounds like too much work for one tiny particle to do. To support this intuition we could produce the general claim that causes never involve (in some loose sense) far less being than their effects do. I doubt, however, that such general principles have much to recommend them: consider the subatomic events that detonate nuclear explosives.

But even if some plausible way of developing this notion could be found, I am still not convinced that this objection would be very telling against the Bundle theory. The reason is that it seems to rest on a kind of substratum-induced prejudice about how much being any given universe contains. The objector wants to depict the bundle theorist as holding that before t there was x amount of being, and then after t there was 2x being. However, before *t* there were already 10 billion bi-located stars: why do 20 billion mono-located stars constitute any more being that 10 billion bi-located stars? In short, it is not even clear that the effect here involves a wild increase in being.[7] If not, however, then it is not obvious that the cause, the particle's moving slightly away from the center of the universe, is after all incommensurate with that effect.

2. Bi-location and Spacetime.

2.1. *Relationalism, Substantivalism and the Bundle Theory.* So far we have seen that the Bundle theory, supplemented with the doctrine of bi-location, violates a strong intuition about the location of concrete particulars, and perhaps also some intuitions about their numerosity. However, if one is willing to tolerate these violations, the theory can perhaps avoid the various objections which have been recently raised against it, or at least credibly charge the objectors with begging the question. In this section, however, I will argue that there is a further difficulty which cannot be met by this strategy, *even if* we consent to abandon many of our intuitive constraints on the analysis of concrete particulars. This difficulty concerns the treatment of spacetime when it is regarded as a substantial entity.

"Substantivalism" is the term generally used to describe this sort of view of spacetime. Carl Hoefer describes it as:

> a belief that space (or space-time) is something real...[A] modern-day substantivalist thinks that space-time is a kind of thing which can, in consistency with the laws of nature, exist independently of material things (ordinary matter, light, and so on) and which is properly described as having its own properties, over and above the properties of any material things that may occupy parts of it. (1996, 5)

This description highlights two key components of substantivalism: (i) spacetime has properties or some structure that is independent of its contents and (ii)

spacetime can exist without its contents. Both of these claims are denied in some fashion by relationalists, who hold that all talk about spacetime is ultimately talk about spatiotemporal relations between material objects, and thus that no sense could be made of talk of a completely empty spacetime.

A quick survey of the writings of early bundle theorists indicates that they held relationalist views of space and time. This is perhaps most obvious in the case of Russell, whose theory entails that "space-time is composed of 'complete complexes of compresence', which themselves are composed of qualities" (1948, 321), with the qualities corresponding, very roughly, to what we would consider 'matter'.[8] D.C. Williams also seems to treat space and time in a relational manner. In laying out his version of the Bundle theory, he says that "any possible world...is completely constituted by its tropes [i.e. properties] and their connections of location and similarity..." (1953, 116). Location, for Williams, is an external relation between properties that, he says, "is easiest thought of as position in physical space-time" (116). Barring the unlikely possibility that Williams thought that spacetime points were properties, his theory, like Russell's, looks to be formulated in an explicitly relationalist way.

This view of space and time was hardly idiosyncratic to bundle theorists, however. In *Human Knowledge* (1948) Russell says that "every one" now takes a "relational view of space" (310). This trend is connected with Relativity theory, as Russell's own writings would indicate. Speaking of Whitehead's procedure of constructing points and instants out of events, Russell says that "various reasons,

of which the theory of relativity has been the most influential, have made this procedure preferable to one which, like Newton's, allows 'points', 'instants', and 'particles' as raw material" (311). The view that Relativity theory, in particular General Relativity, somehow licensed the ontological excommunication of substantival space-time points, as well as various other elements of 'absolute' spacetime structure, was widespread amongst scientifically sophisticated philosophers at this time (for reviews see Friedman 1983, chapter 1 and Earman 1989, 1-3).

However, this interpretation of General Relativity, and the relationalist philosophy of spacetime that it supported has been subjected to powerful and widespread attack over the past thirty years or so. Several major studies in the philosophy of space and time, including Friedman's *Foundations of Spacetime Theories* (1983), Nehrlich's *The Shape of Space* (1976), Sklar's *Space, Time and Spacetime* (1974) and Earman's *World-Enough and Spacetime* (1996) have questioned traditional relationalist arguments and formulated and/or defended versions of spacetime substantivalism. This is not to say that relationalism has no contemporary defenders, nor that there are not good arguments available to motivate the position (we will see one of these in due course). But it is the case that relationalism no longer commands the field as it did in the heyday of Schlick and Reichenbach.

This fact makes it important that the Bundle theory be made compatible with spacetime substantivalism. For contemporary spacetime substantivalism is

generally formulated as the claim that there exist points of spacetime, standing in various spatiotemporal relations to one another, and these points seem to fit the criteria for concrete particulars (see Chapter I, section 1). Spacetime points are particular in that they have properties (e.g. metrical properties, properties of curvature, etc.) but are not themselves had by anything else. They are concrete in the sense of having definite locations in space and time, themselves *being* locations in space and time. Furthermore, it is at least arguable that they are capable of standing in causal relations.[9] Insofar as they fulfill these criteria however, it seems they should fall within the purview of any comprehensive theory of concrete particulars, such as the Bundle theory.[10] If the Bundle theory were to prove incompatible with substantivalism, or unable to provide a sound analysis of spacetime points as concrete particulars, then accepting it would require asserting the truth of relationalism in a rather ad hoc manner. As I have mentioned before, however, such moves seriously cripple the plausibility of a research program (see Chapter II, section 1).

In attempting to apply the theory to spatiotemporal points, however, the bundle theorist faces her greatest challenge. For that theory, as we have seen, it is prima facie indiscernible entities that generate the greatest difficulties: with these the Identity of Indiscernibles seems to founder as a principle of individuation. Because of this, however, substantival spacetime points appear to be anathema to the bundle theorist, for spacetime points are, apparently, not

only all perfectly alike, but also depressingly plentiful (there are continuum many of them).

2.2. *A Bundle Theory of Spacetime.* A number of philosophers have felt that the Bundle theory is incompatible with spacetime substantivalism. Michael Loux, for example, recently said of theories of "absolute space and time" (i.e. substantivalism) that "no bundle theorist can endorse such a theory" (1998, 237). Loux explains:

> A theory of absolute space and absolute time commits us to the existence of pure locations or places and pure moments or times, places and times that do not differ qualitatively, but merely numerically; and on such a theory, the numerical diversity of any pair of places or any pair of times is just a primitive or unanalysable fact about the world. But, then, the appeal to absolute space and absolute time is structurally no different from the appeal to bare particulars. (1998, 237).[11]

Loux's point is that the substantivalist must believe in real entities, spacetime points, which differ only numerically, or *solo numero,* as Leibniz put it, in violation of the Identity of Indiscernibles. Therefore, spacetime points require analysis in terms of the Substratum theory. But if one accepts the Substratum account for substantival spacetime points, one may as well have accepted this account for material concrete particulars in the first place, and never have been a bundle theorist at all.[12]

John Earman holds a similar view of the matter. The most natural way to apply the Bundle theory to substantival spacetime points is to say that those points are bundles of the spatiotemporal properties that we attribute to points (e.g. metrical properties). Earman, however, rejects this proposal, his main reason being that he does not "see how it can be supported by a defensible account of identity and individuation" (1989, 196). If the bundle theory is true, then individuation is governed by the Identity of Indiscernibles: no two distinct things may share all of the same properties. But this account of individuation, Earman claims, cannot work for spacetime points. These must be individuated in a more 'particularist' way: they must be able to be distinct even when they share all of the same properties. He writes:

> I take it as obvious that traditional space substantivalism entails the form of particularism in question. Let *a* and *b* denote space points, and suppose that space is homogeneous and isotropic and that it is devoid of bodies. Then to make [the Principle of the Identity of Indiscernibles] hold, it is necessary either to resort to [impure properties] or to postulate that the points are distinguished by, say, different hues of a radiation they give off. Traditional absolutists never thought that they had to countenance such emanations. (197)

Earman may be read as outlining an inconsistency facing the bundle theorist who wishes to extend her doctrine to spacetime:

(1) There could be two distinct yet indiscernible spacetime points (i.e. the Identity of the Indiscernibles is false)

(2) The Bundle theory entails the Identity of the Indiscernibles
(3) The Bundle theory is a true account of spacetime points

On the one hand, it seems possible for there to be two distinct yet indiscernible spatial points: for example, it seems possible that two spacetime points could stand in all of the same pure metrical relations to other points. This is the case in the three dimensional Euclidean space of Earman's example. It seems, therefore, that the Identity of the Indiscernibles is false when applied to spacetime points. However, a bundle theorist proposing a theory of spacetime must also admit both that the Bundle theory entails the Identity of Indiscernibles (2), and, obviously, that the Bundle theory is true when applied to spacetime points (3). But (2) and (3) together contradict (1). So the bundle theoretic substantivalist must choose between upholding (3) (i.e. extending the theory to spacetime) and endorsing (1), a prima facie plausible claim about spacetime points. Earman's response is to reject (3): like Loux, he rejects the Bundle theory as a viable theory of spacetime.

However, in the quotation above, Earman does consider a way for the bundle theorist to escape the dilemma: she could deny (1) by supposing that, in the scenario described, the two apparently indiscernible points are after all discernible, in virtue of some radiation they give off, for example.[13] But this is not a very satisfactory approach, both since postulating such properties seems ad hoc and because it seems that such properties cannot be *necessary* features of

spacetime points. Even if there were such properties, it seems physically *possible* to have indistinguishable spacetime points without such properties, and so the difficulty reappears. In response to this, the bundle theorist could argue that though it is possible that there exist distinct yet indiscernible spacetime points, this happens not to be the case and so the Identity of Indiscernibles is true, albeit only contingently so. Perhaps our spacetime in fact has no non-trivial symmetries, and so each actual point has distinct spatiotemporal properties. There may be possible worlds where the Identity of Indiscernibles is false, but this is irrelevant to the Bundle theory as a descriptive metaphysical claim about the *actual* world. As discussed in Chapter II, section 2.4, I think that this strategy will not succeed. If symmetrical spacetimes are physically possible, as they certainly are according to General Relativity, it seems reasonable to expect our metaphysics to be able to describe them, even if our actual spacetime has no such symmetries.

There is another way for the bundle theorist to escape the dilemma, one not considered by Earman: apply the bi-location strategy. In fact, O'Leary-Hawthorne and Cover use this approach in their tentative proposal for a bundle-theoretic account of substantival space and time. They write:

> There are, among the universals that exist, Pointhood and Instanthood, which stand in a complex array of relations to themselves and each other. For example, Pointhood is five feet from itself. This version of the Bundle Theory looks to offer a perspicuous gloss on [substantivalism], and nothing in the very idea of empty absolute space and time looks to

> prohibit that metaphysical gloss. The oddness of claiming that there is only one spatial point can be explained easily enough by the fact that we don't ordinarily count by strict identity. (1998, 212-213)

This proposal is a natural extension of the bi-location account for concrete particulars, whereon we postulated, instead of two distinct concrete particulars, one spatially related to itself. The extension would hold that in a homogeneous and isotropic space like the one Earman describes, since all spatial points are indiscernible, sharing the properties of Pointhood and Instanthood, they are all identical: there is really only one point, standing in various spatial relations to itself. What I want to argue now is that even a bundle theorist willing to adopt the bi-location strategy for material concrete particulars, like tables and electrons, will not be able to use this strategy on substantival spacetime points.

Extending the bi-location strategy to spatial points or locations requires us to say that these too may be bi-located: but what could a bi-located location be? For the very notion of "bi-location" or "being fully present in two places" at one time presupposes that there are two *distinct* places for the item in question to be located at. That is, this notion only makes sense if the spacetime locations involved can be numerically distinguished. If they are the very same (i.e. strictly identical), then clearly it makes no sense to say that the thing in question is bi-located, for it is only in one place after all, since there *is* only one place after all, and not two! Therefore it seems that it does not even make sense to speak of spacetime points being bi-located.

Probably the bundle theorist would want to drop talk of bi-location at this point, and speak rather of points standing in spatiotemporal relations to themselves. Instead of saying that a point is bi-located, we should say just that it stands in some spatial relation to itself. But this is a mere cosmetic change, and though it removes the obvious contradiction noted above, it does not make the view a plausible analysis of spacetime. This is because the account still leads to a radical monism regarding spacetime points: a physically possible world with a symmetric space is one in which there really is only one point, standing in all spatial relations to itself. But in what sense would this be a world with any *spatial* structure at all? By travelling around in such a world, one would never leave the point at which one started, for there simply is nowhere to go. This monistic world seems to be a world that has no spatial structure whatsoever. We seem forced to say that the apparent spatial character of a world such as this would be in some way a grand illusion; in metaphysical reality there simply is nowhere to go, no distances to travel, at all.

Another way to put this point is that on such an analysis it is not even possible to define the most basic concept in geometry: a distance function on pairs of spatial points. This is because there is no *unique* distance relation between any 'two' points; any 'two' points will stand in *every* metrical relation to one another. This means that the mathematical descriptions typically applied to spacetime in physics will be radically false, strictly speaking. Now the bundle theorist might protest that we have already conceded that it is acceptable to say,

in certain cases, that strictly speaking the descriptions of physics are incorrect (cf. the case of counterfactual entanglement; see section 1.2); this is simply another such case. Physics describes this situation as one in which there are many distinct points, but strictly speaking this is not the case. However, even if we concede that in some cases it is acceptable to reject a strict reading of physical theory, we still need to provide some sort of satisfactory redescription of the phenomenon in question in our own terms. For instance, in the case of counterfactual entanglement, we offered an account of a certain possibility in terms of the changing location of bundles of universals. But no such account seems forthcoming in this case. How can one thing standing in relation to itself give rise to any phenomena that are spatial in any familiar sense? Hence, even assuming some latitude with respect to how strictly physics is taken, this extension of the bi-location strategy is implausible.

Another undesirable result of this monism, applied to spacetime, is that none of the possible worlds where both the Bundle theory and substantivalism are true can be worlds where spacetime has any sort of inherent directionality or asymmetry. The gist of the proposal is to take all spatio-temporal relations to be reflexive (since there would only be one spatio-temporal point to enter into those relations) but reflexive relations that only have one possible relatum must be trivially symmetric. Now *is 5 feet from* is symmetric, but *is 5 hours before* is not. Jean is 5 feet from Alline, and Alline is 5 feet from Jean; the victory is 5 hours before the party, but the party is not 5 hours before the victory. The proposal

suggests identifying the two times in "t_1 is 5 hours before t_2" but this seems to presuppose that "t_2 is 5 hours before t_1" will be true, and in a world where time has directionality, this will be false. So in such a world, the very same spacetime point could not stand in a temporal relation like *is 5 hours before* to itself, because such relations are inherently asymmetric. Therefore, if any world is such that in it spacetime has any sort of inherent directionality, then the bundle theory cannot account for spacetime in that world.[14]

In taking concrete particulars to be capable of bi-location, the bundle theorist asked us to deny certain strong intuitions that we have about concrete particulars, in the interest of dispensing with substratum. What I claim is that even if we follow along this path, the theory cannot make sense of an important subclass of concrete particulars: the points of substantival spacetime. The theory cannot but collapse into a prima facie implausible philosophical monism about spacetime. The traditional version of the Bundle theory appears to have backed itself into a theoretical corner. To be a robust research program, the theory must avoid conflict with plausible metaphysical theses like spacetime substantivalism. There is a way that this can be done, by formulating the thesis in terms of properties understood as tropes rather than as universals, and it is to this quite different version of the Bundle theory that I now turn.

Notes

[1] A classic statement of this view is Moore (1923).

[2] It should be stressed that the analogy here is quite loose. Although the mono-location intuition underwrites a principle for concrete particulars similar to the separability principle for physical systems, bi-located concrete particulars violate this principle in a way quite different from that in which quantum mechanical entities violate the separability principle.

[3] See, for example, Lewis' justification of his realism regarding possible worlds (1986, 3-5).

[4] He does suggest several times that the Bundle theory with bi-location offers "the most perspicuous description" of worlds like Black's world (195). However, he does not explain what he means by "perspicuity", nor why the Bundle theory has more of it than alternative accounts.

[5] Compare this case with Casullo's proposal to take the Bundle theory as a truth only about the asymmetric actual world (Chapter II, section 2.4).

[6] On the distinction between extrinsic and intrinsic properties, see Lewis (1986, 63).

[7] Indeed, it seems that the bundle theorist will need to insist that it does not in order to make his view compatible with the conservation of physical quantities such as mass.

[8] Russell says that "where there is only matter, the 'complete complex of compresence' may serve to define an instant of Einsteinian local time, or to define a "point-instant" in cosmic space-time" (1948, 314-315; also 317).

[9] This is argued by Field (1980, 114n23) and also by Earman (1989, 18).

[10] Armstrong agrees: for the bundle theorist, "space and time, being physical entities, are among the things that have to be constituted as bundles of universals" (1989a, 70).

[11] Loux's position is elaborated further in his 1978 (133-134 and 138n17). Similar sentiments are voiced in Zimmerman (1997): "If you posit distinct but indiscernible places, doesn't this amount to the recognition of things that are something more than bundles of universals?" (305); see also Adams (1979, 6).

[12] That many philosophers have felt a very intimate connection between substantival spacetime points and substratum can also be seen in flirtings with philosophical supersubstantivalism, the view that the only particulars or substrata *are* spacetime points (see Chapter I, section 2.11).

[13] Earman also considers the use of 'impure' properties, like 'being 10 feet from this particular point'. Impure properties, however, are generally excluded from bundle theoretic analyses, because they presuppose the individuated particulars which one is trying to analyze in terms of properties (Loux 1998, 237). Some formulations of the Bundle theory do allow the use of impure properties: e.g.

Casullo's 'landmark' theory whereby impure spatiotemporal properties like 'being 5 feet from this (particular) object' are used to individuate particulars. However, even this position requires that at least a small number of objects be individuated by pure properties alone, so as to avoid an infinite regress. There will be no such objects in symmetrical cases such as the one discussed by Earman (Casullo 1984, 540-541).

[14] Note that it does not help to try and *start* with asymmetric relational properties in the bundles. For example, one might try to put 'is 5 hours later than' in the bundle, instead of 'is 5 hours from'. Since the former is asymmetric, this relation cannot hold between anything and itself; hence the relation will 'pry apart' the point and the point that is 5 hours earlier than it is, and monism may be avoided. But this only delays the inevitable, since in a translationally symmetrical sequence of instants, every point will have all the same pure relations, including asymmetric ones. Hence all the points ultimately collapse back into one.

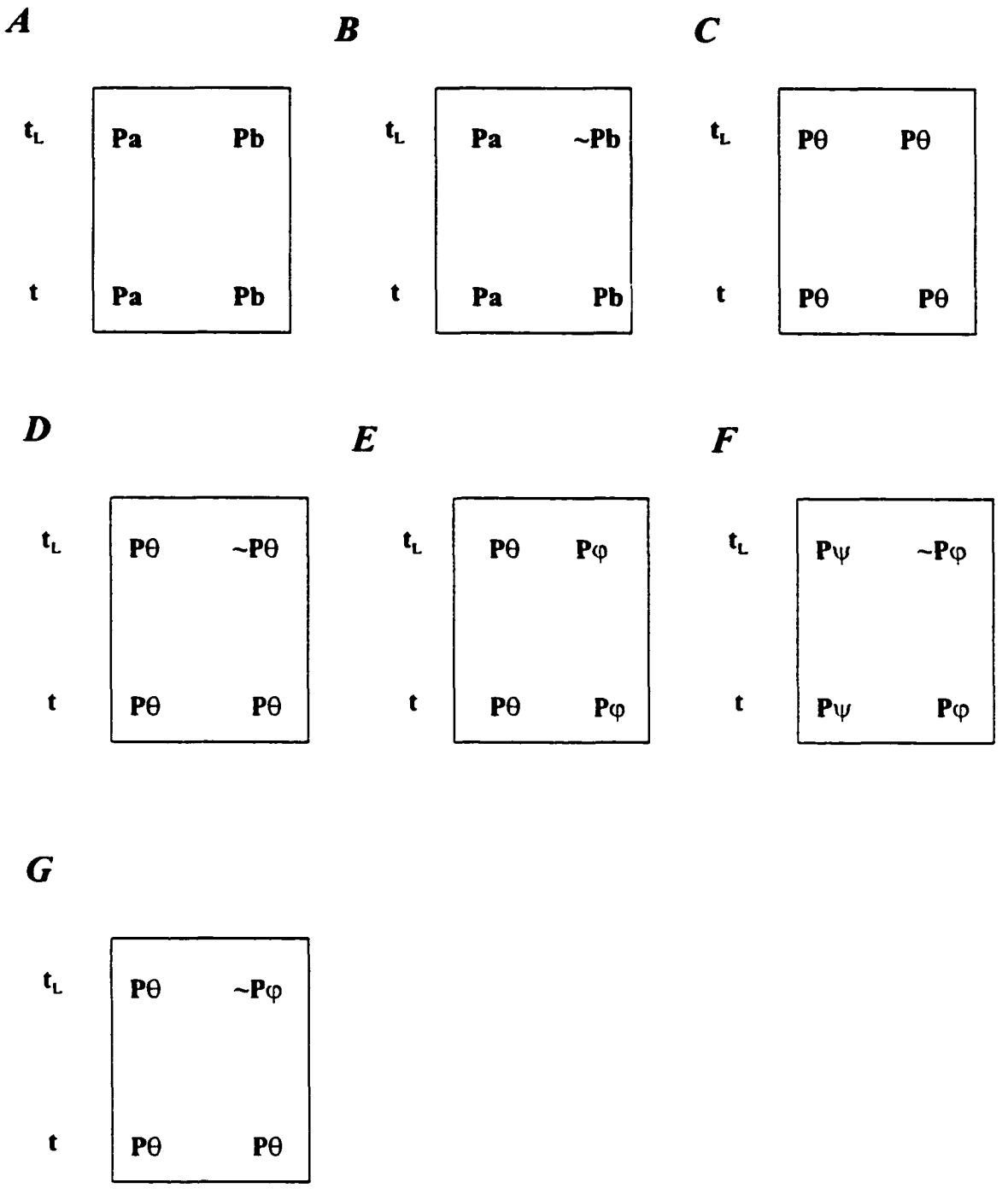

Figure 3.1. Counterfactual Entanglement. Panels A-G represent the development of various possible worlds world over a period of time t to t_L. Lowercase letters refer to spatially separated electrons; P denotes an arbitrary property of the electrons.

IV. BUNDLES OF TROPES†

IN Chapter III, it was argued that the traditional Bundle theory faces two serious obstacles: it clashes with certain intuitions about concrete particulars and it cannot be applied to spacetime. In this chapter, I claim that if the Bundle theory is formulated, not in the traditional manner employing universals, but in terms of the trope conception of properties instead, these limitations are avoided. First I introduce tropes, being "somewhat exotic creatures in the ontological zoo", in the words of one commentator (Simons 1994, 554). I do this by briefly describing some of the major formulations of trope theory (section 1). In the following sections, I show how the bundle of tropes theory avoids those problems fatal for the universals theory (sections 2 and 3).

I also claim that a tropist Bundle theory has advantages not only over the traditional bundle theory, but also over the Substratum theory. This advantage involves the analysis of spacetime: it permits us to avoid the odious conclusion of the notorious 'hole argument' (sections 2.1 and 2.2). My case for this solution to the hole argument is supplemented by an indirect appeal to authority: an argument, in section 2.3, that one solution to the argument already offered within the philosophy of spacetime, that of Carl Hoefer, ultimately reduces to mine. Finally, I address a number of objections to a tropist Bundle theory of

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concrete particulars, some of which pertain especially to spacetime, and one of which is more general (section 3).

1. Tropes. Much of the work on the ontology of properties in twentieth century analytic philosophy falls into one of two broad positions: realism about universals and nominalism (Linsky 1996). Nominalism, in its various formulations, involves the rejection of properties as ontological constituents of concrete particulars, in favour of taking the particulars themselves as primitive and analyzing away talk of properties in terms of them (see Chapter I, section one). Though there are important differences between various realist views about universals, such as the existence of universals outside of space and time, there is consensus about the repeatability of the universal within space and time.[1] A universal can be shared (wholly possessed) by distinct, spatiotemporally separated concrete particulars. The logical space jointly covered by nominalism and traditional realism about properties as universals suggests a compromise view: reject nominalism by admitting properties as ontological constituents of concrete particulars, but deny realism by construing them to as particulars, unrepeatable across space.[2] This middle ground between traditional realism and nominalism is that occupied by trope theory in twentieth century analytic philosophy.[3]

Like formulations of the doctrine of universals, various theories of tropes differ significantly from one another (for review see Bacon 2000). However, the

essence of the view is that the properties of spatially separated concrete particulars, even if those properties are qualitatively exactly alike, are numerically distinct. An early development of the trope view of properties is that of G.F. Stout, who writes:

> A character characterizing a concrete thing or individual is as particular as the thing or individual which it characterizes. Of two billiard balls, each has its own particular roundness separate and distinct from that of the other, just as the billiard balls themselves are distinct and separate. (Stout 1921, 7)

Stout's version of trope theory has notable idiosyncrasies. One of these involves the recurrence of the Problem of Universals at the level of tropes. Once we posit tropes as accounting for the fact that all red concrete particulars are red, we can ask a similar question about those tropes: why are all of these rednesses, or why do they form a natural class? According to Stout, some classes of characters (i.e. tropes), such as the class of red things, simply have a unity that is primitive and unanalyzable. This view is rejected by later trope theorists, who usually explain the sorting of tropes into natural classes by reference to their resemblances to one another. For Stout, however, the resemblance of members of a class one to another presupposes the unity of the class, and so cannot be used to explain it (1921, 9).

Perhaps more importantly, Stout's version of the trope theory is worked out as part of a metaphysics still very much within the tradition of British Idealism (see Passmore 1966, 308-311). Consequently, his arguments in favour of

tropes tend to have an epistemic, neo-Kantian cast that those of later trope theorists do not. He frequently appeals to the presuppositions of what we know or experience, and his praise of the fundamental unity of classes, including classes of properties, is that "without it there can be no thought" (5).

Trope theory appears to lie fallow until D.C. Williams' classic paper "The Elements of Being" appears in 1953. Williams' first contribution is terminological: though he wants to follow Stout (1923, 114) in calling his primary entities 'abstract particulars', he opts ultimately for 'tropes', which has since become the standard term. He defines "trope" as "a particular entity either abstract or consisting of one or more concreta in combination with an abstractum" (1953, 115). Williams characterizes tropes as *parts* of concrete particulars, albeit abstract ones (e.g., the colour of a ball). Two relations between tropes are defined: location, an external relation, at least one manifestation of which is "location in physical space-time", and similarity, an internal relation (116). As regards location, tropes may be more or less distant from one another; a limiting value of location is zero distance, or *concurrence*, a relative of Russell's compresence (see Chapter I, section one). Tropes may also more or less resemble one another, the limiting value of resemblance being total or exact resemblance. Sums of mutually concurrent tropes are concrete particulars; hence the inherence of a property in a concrete particular is nothing more than a trope's being a part of a sum of concurrent tropes. Sets of exactly resembling tropes, on the other hand, provide a substitute for traditional abstract universals.[4] In this way

Williams attempts to solve traditional problems with the inherence of properties in concrete particulars and with the nature of abstract universals at one stroke, using the same underlying metaphysical apparatus: tropes.

There are important contrasts to be drawn between Williams' theory of tropes and Stout's earlier ideas. In Williams' theory, the relation of a trope to the concrete particular which it characterizes is simply the 'part of' relation; this is an idea not found in Stout's work, where concrete particulars are complex unities of "an altogether ultimate and peculiar type" (1921, 14). For Williams, the fact that inherence can be reduced to "intelligible" talk about mereological sums of tropes is a decided advantage for trope theory (119). Secondly, as we have seen, Stout rejects the idea that the distributive unity of a class of tropes can be accounted for by the resemblance of the members of the class. Williams, in contrast, accepts this, calling Stout's primitive unity of classes "obscure" (1953, 119n7). In general, the changes in trope theory during the stewardship of Williams have many features of the transitions from an Idealist framework to an analytic one: Williams replaces unanalzyable, transcendental capacities with well understood formal notions like sum and set. In keeping with this, there are no overtly epistemic overtones to Williams' theory.

There are, however, important similarities as well. Tropes in hand, Stout rejects both the universal which stands ontologically above its various instances, and the substratum that underlies properties. Both of these are, to use an anachronism, constructed out of his tropes. The universal reduces to the

distributive unity of the class of tropes, whereas the substratum is rejected in favour of the sui generis concrete unity of tropes. This parallels Williams' construction of the universal as the set of resembling tropes and the concrete particular as the sum of the members of a set of concurrent tropes. The specific executions are very different, but in each case the program is the same: eliminate universals and substratum as distinct entities and provide substitutes in terms of tropes alone. Williams and Stout also share an ambitious vision of the promise of trope theory. Williams claims that "any possible world, and hence, of course, this one, is completely constituted by its tropes and their connections of location and similarity, and any others there may be" (116). Analogously, Stout proposes that the trope view is, in some neo-Kantian sense, necessarily true, since for him that view correctly captures the way that our epistemic faculties shape the world of possible experience: without the distributive unity of tropes, for example, "there can be no thought" (1921, 5).

In the 1980s Williams' work served as the inspiration for further development of trope theory by Keith Campbell, culminating in his book *Abstract Particulars* (1990). Campbell takes over many features of Williams' theory. Like Williams, he takes concrete particulars to be "maximal sums of compresent tropes" (1981, 132; 1990, 21) and insists on the possibility of independent existence for tropes (i.e. the possibility that a trope could exist in the absence of anything else; 1981, 127-128). He follows Williams also in claiming that trope theory can allow for the construction of some substitute for genuine universals,

solving the traditional problem of universals (1990, 31). However, Campbell also introduces new arguments for a trope ontology, insisting on the utility of tropes in theories of causation, perception and the mind, and their applicability to modern physics, in particular field theory (1990). He tried to make the theory compatible with non-Naturalistic ontologies (1981, 136), and was the first to formulate trope theory in a sparse fashion (1981, 137). He also took up the question of the principle of individuation for tropes. In his earlier work, Campbell claims that tropes derive their particularity from their spacetime location, or in the case of non-spatiotemporal beings, their location in some other sort of dimensional framework (1981, 136). In his book, however, Campbell adopts the view that the particularity of individual tropes, some trope's being the one it is rather than some other of the same sort, is a brute and unanalyzable phenomenon (1990, 56-57).

An important feature of Campbell's tropism is his rejection of dyadic and all higher adicity tropes in favour of a fundamental ontology of monadic tropes only. "Relations," according to Campbell, "cannot be on the world's bottom line" (1990, 99). The reason for this, apparently, is that while monadic tropes may "stand on their own as Humean independent substances,. . . the polyadic ones are in an unavoidably dependent position" (99). This is taken to show that relations are simply not as real as monadic tropes are. He therefore adopts a position that he calls Foundationism: all relational tropes supervene on their foundations: the tropes that stand in the relation (101). Admittedly, dyadic (and

higher adicity) tropes are real, albeit in the derivative sense appropriate to the supervenient, and relational discourse is intelligible and ineliminable, but these relational tropes are not additional beings to be counted, in the Ultimate Census of the Universe, alongside their monadic bearers (100). This appears to be a departure from the practice of Williams, who takes relations between tropes to be (second order) tropes in their own right and in no way ontologically reducible, even in terms of supervenience, to monadic tropes.[5]

Campbell's rather idiosyncratic Foundationism is in stark contrast to John Bacon's egalitarian treatment of monadic and higher adicity tropes in his *Universals and Property Instances: The Alphabet of Being* (1995). For Bacon, higher adicity tropes (polytropes) are as real as their monadic colleagues. Further, he not only rules out the ontological reduction of higher adicity tropes but, unlike Williams, places them in his *primary* ontological category, allowing concrete particulars to be constructed out of them. Bacon also follows William's program of constructing ersatz universals as sets of resembling tropes. However, he abandons the mereology of Williams and Campbell by constructing concrete particulars, in a way parallel to universals, as maximal sets of compresent tropes, accepting with equanimity the somewhat counterintuitive result that Madonna, complete "with throbbing heart and perhaps immortal soul" is really just a set (11). Bacon's theory is not a pure trope theory in the sense that he employs, in addition to tropes, genuine universals to serve as the relations between tropes (resemblance, concurrence, and so forth).[6]

For much of the twentieth century, trope theory has not been prominent in analytic metaphysics as a solution to the Problem of Universals. Some attribute this to the influence of Moore's criticisms of Stout's view in a 1923 symposium (Simons 1994, 554; see Moore 1923). Whatever the reason for the languor, tropism has made strides since. In his classic 1978 study of properties, Armstrong gives short shrift to tropes. In his most recent works, however, he takes one particular version of trope theory to be "an important alternative view that deserves development" and concedes that his reasons for favouring a theory of universals over it involve "relatively delicate and/or controversial matters" (1997, 24). The view that tropes and universals have roughly equal merits is also supported by David Lewis (1986, 64).

2. Tropes, the Identity of Indiscernibles and Spacetime. Despite their differences, all trope theorists agree that properties are particulars, in the sense that spatially separated properties, properties of different concrete particulars, are numerically distinct. It is this central feature of trope theory that allows the Bundle theory to provide an analysis of concrete particulars that avoids those difficulties with individuation, discussed in Chapters II and III, that so plague the universals version of the theory. The latter theory entailed the Identity of Indiscernibles because it allowed the possibility that spatially separated concrete particulars have all and only the very same constituents. But on the trope view, there is no such possibility, since the constituents of concrete particulars, tropes,

are not repeatable across space. Hence spatially separated concrete particulars which have, as we would loosely say, the very same qualitative nature, are not to be identified as one and the same, but rather are distinct and exactly resembling concrete particulars.[7] Without the commitment to the Identity of Indiscernibles, the difficulties with individuation facing the Bundle theory fall away. Stout, Williams, Campbell and Bacon all formulate their tropist ontologies as bundle theories.[8]

In Chapter III, we considered the suggestion that spatial points be taken as bundles of universals. The difficulty with this idea was that, given the apparent indiscernibility, with respect to properties and relations, of spatial points, we are unable to individuate enough points from one another to generate a pluralist spacetime (i.e. one composed of many distinct points as parts). The Identity of Indiscernibles forced us to identify distinct spacetime points. However, once the properties in question are taken as tropes rather than universals, this difficulty dissolves. We are no longer driven to identify distinct points in a homogeneous and isotropic space, since a property possessed by one point is not one and same as the property of another, but only resembles it exactly.

With tropes, then, the possibility of giving a bundle theoretic analysis of spacetime points is again before us; however, it is still an open question how this project should be carried out. For example, it is unclear just which properties should be taken as constituents of spacetime points. O'Leary-Hawthorne and Cover (1998) suggest 'Pointhood' and 'Instanthood', but advocates of a sparse

theory of tropes will insist on more rigorous criteria for the selection of tropes than are applied here ('Pointhood' seems rather like a made-up property). In particular, they will want to look to our best scientific theories to learn just what are the real, or *natural* properties that spacetime points possess. But which properties are natural? Lewis suggests that natural properties are the 'fundamental properties' of physics (1986, 60). A natural way to develop this suggestion is to say that the perfectly natural properties and relations in a world are those that "occur in the fundamental laws of that world" (Bricker 1993, 287). Assuming that our current best theory of spacetime, General Relativity, embodies the relevant fundamental laws for the case of spacetime points, then it is that theory and its attendant laws to which we must look to find our candidate properties.

In contemporary formulations of General Relativity, spacetime points possess metrical properties, represented mathematically by a *metric tensor* field defined at each point in a four-dimensional manifold. The metric tensor is a function that, at any point in the manifold, gives the inner product of a tangent vector with itself. The salient idea is that once the metric tensor field has been assigned to a manifold, the distance along a path between two points can be calculated using the metric tensor, by the process of integration (for details see Friedman 1983, 41-42). The metric tensor field therefore encodes the metrical properties that points possess and the metrical, or distance, relations they bear to one another (see also Norton 2000).

Given the pivotal role of the metric tensor in General Relativistic descriptions of spacetime, it is the metrical properties and relations of points, mathematically represented by the values of this tensor, that lay claim to the title of fundamental and therefore natural properties of spacetime points.[9] Therefore, a Bundle theory of spacetime points will want to employ these properties as the tropes that are bundled together to yield the infinitesmal parts of spacetime.

2.1. The Hole Argument. In this section I want to argue that there is a reason for adopting the sort of trope Bundle theory of spacetime points just proposed, one that is independent of the general philosophical criticisms of the substratum developed in Chapter I. That reason is avoiding John Earman and John Norton's 'hole argument', which purports to show that substantivalism, when applied to our best spacetime theory, General Relativity, leads to a highly undesirable form of indeterminism (Earman and Norton 1987). The argument is taken to be a reductio ad absurdum of the combination of substantivalism and General Relativity. Since General Relativity is a highly confirmed empirical theory, it is spacetime substantivalism that must be rejected. The hole argument, if sound, therefore has disastrous implications for substantivalism, and is a powerful motivation for contemporary relationalists.

There have been a number of responses to the hole argument (for a review see Norton 2000). Several of these claim that the argument turns upon certain dubious metaphysical presuppositions about the nature of substantival

spacetime (e.g, Butterfield 1989; Maudlin 1990; Brighouse 1994; Hoefer 1996). Following this general approach, I claim that the hole argument goes through only if we adopt a substratum-like view of the ontological constitution of spacetime points. The tropist Bundle theory can therefore be used to formulate a substantivalist theory of spacetime that is immune to the hole argument.

To show this, I first present the salient features of the hole argument; a more formal gloss of the argument is given in Figure 4.1 (for further details see Earman and Norton 1987). In accordance with the usual semantic view of theories, we take General Relativity to involve the postulation of models which satisfy certain sentences of the theory (i.e. Einstein's field equations). These models consist of a manifold of mathematical points, representing the points of spacetime, together with various mathematical objects defined on this manifold that represent the metrical relations between spacetime points (the metric tensor), the distribution of mass-energy throughout the universe (the stress/energy tensor), and certain other physical facts (see Friedman 1983, chapter two for details). Such models are ordered n+1-tuples of the form <M, φ_1, $\varphi_2 \ldots \varphi_n$>, where M is a four-dimensional differentiable manifold and $\varphi_1 \ldots \varphi_n$ are the mathematical objects defined on M.

Such n+1 tuples can be transformed into others via transformations called *diffeomorphisms*. Given an n+1 tuple <M, φ_1, $\varphi_2 \ldots \varphi_n$>, a diffeomorphism d is a continuous 1 to 1 mapping of M onto M. d induces a so-called 'drag along' mapping d^* from the geometric objects $\varphi_1 \ldots \varphi_n$ to a new set of geometric objects,

defined on M, $d^*\varphi_1 \ldots d^*\varphi_n$. This works in the following way: if according to the original metric φ, the distance between two points p and q is L, then according to the dragged along metric $d^*\varphi$, the distance between d(p) and d(q) is L. This relation between the original and dragged objects holds for all geometric objects in $\langle M, \varphi_1, \ldots \varphi_n \rangle$. *d* therefore produces a new mathematical object $\langle M, d^*\varphi_1 \ldots d^*\varphi_n \rangle$ which is such that "the image-points have the properties and relations to one another, according to the dragged geometric objects, that the argument-points have, according to the original geometric objects" (Butterfield 1989, 3). In other words, $\langle M, \varphi_1, \ldots \varphi_n \rangle$ and the new mathematical object $\langle M, d^*\varphi_1 \ldots d^*\varphi_n \rangle$ are *isomorphic* to one another; they are usually called *diffeomorphs*.[10]

It is a mathematical fact that if $\langle M, \varphi_1, \ldots \varphi_n \rangle$ is a model for General Relativity, then any n+1 tuple of the form $\langle M, d^*\varphi_1 \ldots d^*\varphi_n \rangle$, where *d* is a diffeomorphism of M onto M, is also a model for that theory (for a proof see Earman and Norton 1987, 520). That is: given some n+1 tuple (in which a given metric tensor is defined on a manifold) that satisfies the Einstein field equations, applying a diffeomorphism to it will generate a distinct n+1 tuple (in which a different metric tensor is defined on that manifold) that also satisfies the field equations. This feature of General Relativity is shared by contemporary formulations of all spacetime theories, including Newtonian theory and Special Relativity, and is known as General Covariance.

The salient point about diffeomorphic models is that they attribute different metrical properties to the same mathematical points, and they locate

material objects at different mathematical points. In the diffeomorphs shown in Figure 4.2, for instance, the point labeled 'a' in model 1 is the same point as that labeled 'a' in model 2, but the two models disagree over which metrical relations this point stands in and which events are located at that point. Perhaps the most perspicuous way of describing the diffeomorphism is as a "shifting around or rearranging of the points of M (in a continuous fashion) under the contents [of the metrical and mass/energy fields]" (Hoefer and Cartwright 1993, 25). It is this feature of the transformation which leads to indeterminism.

Given a semantic view of theories, a natural view on the deterministic character of theories arises. Prima facie at least, determinism is a thesis about physical possibilities: given an actual past, there is only one physically possible future. On the semantic view of theories, we generally take each model of a theory to represent a physical possibility: one way that the world could be so that the theory is true (see, e.g. Norton 1988, 56). A criterion for determining when a theory is deterministic then arises: a theory is deterministic if any two models of the theory that agree on all physical facts up to time t agree on all physical facts (the past 'forces' the future to have a certain character). [11]

But, given the existence of diffeomorphic transformations, and the fact of General Covariance, it follows that General Relativity fails to be deterministic by this criterion: no agreement between two models of the theory on any subset of the physical facts can suffice to ensure agreement between them on all physical facts. To see this, consider a particular sort of diffeomorphism: this

transformation is merely the identity transformation everywhere in the manifold except for a small area (which for historical reasons is called the 'hole'; see Norton 2000). Within this small area, the diffeomorphism 'shuffles around' the points of the manifold such that our two diffeomorphs disagree about the values of the metric and stress-energy tensor at points within the hole. Such a transformation is called a *hole diffeomorphism*. Since such transformations are after all diffeomorphisms, General Covariance tells us that if our first n+1 tuple is a model of General Relativity, then so is the one we get by applying the hole diffeomorphism to it. It follows then, that for any model of the theory, we can produce another model that agrees with the first everywhere outside of an arbitrarily small hole but fails to agree with it inside the hole; this state of affairs is depicted in Figure 4.3. We can always apply a transformation to a model to 'shuffle the points around' within the hole, giving us another model which disagrees with the first about which spacetime point underlies a given event in that region: each locates the event at a different spacetime point. In terms of the models in Figure 4.3, the past up to time t fails to determine which spacetime point in the hole it is that the flash occurs at. Therefore, by our criterion for determinism given above, General Relativity fails to be a deterministic theory, because there are (innumerable) models of the theory that agree on all physical facts up to time t but fail to agree on all physical facts.

It is important to stress that the indeterminism generated in the hole argument is of a rather rarefied kind: it is such that no observable facts are made

indeterminate (Hoefer 1996, 9). Observationally, the two diffeomorphic models in Figure 4.2 are indistinguishable: they both describe the event E as taking place 3 feet from a square and 5.8 feet from a triangle; the same sort of indistinguishability goes for the models of Figure 4.3. Nonetheless, the fact that we can always shuffle spacetime points around via diffeomorphism entails indeterminism: no amount of agreement of models outside the hole guarantees agreement within the hole. Despite its rarefied nature, however, this indeterminism is particularly odious for at least two reasons. The first is that the hole region can be arbitrarily small, which means that the entire character of the universe could fail to determine what happens in one miniscule region of it; determinism not only fails but fails rather spectacularly. The second reason is that whether or not a physical theory is deterministic is an issue that should be settled by the nature of the theory in question, and especially by the character of its laws. For example, Quantum mechanics, on some interpretations, is an indeterministic theory, but there are substantive physical reasons for this. In comparison, the indeterminism attributed to General Relativity by the hole argument seems to be generated more by a realist attitude towards spacetime points than by anything in the physical content of the theory. It appears phony: the product of a philosophical misstep rather than a genuine physical phenomenon.[12]

The proper response to this state of affairs, Earman and Norton suggest, is a philosophical one: jettisoning substantival spacetime points from our ontology.

For it is only because one sees the points of the manifold as representing real entities that one falls prey to the hole argument. If one denies this, then diffeomorphic models obviously cannot represent different physical situations in which, say, a given object passes over distinct spacetime points, because there *are no* spacetime points to be represented! The relationalist, then, unlike the substantivalist, is free to adopt what Earman and Norton call *Leibniz Equivalence*: diffeomorphic models represent the same physical situation.[13] The substantivalist is *not* free to adopt this position because she believes that spacetime points are real, and are represented in models of General Relativity by points in the manifold (Earman and Norton call this view "manifold substantivalism"). When models of General Relativity depict these manifold points as having certain properties and underlying certain events, she is committed to the physical possibility of spacetime points (which the mathematical points represent) having those properties and underlying those events.

2.2. The Bundle of Tropes Theory and Spacetime Points. Some philosophers, such as Tim Maudlin and Paul Teller, have urged that the hole argument rests on a tacit assumption that spacetime points are "particulars" having various metrical properties (Maudlin 1990, 541; Teller 1991, 394-395). Spacetime points consist, not just of metrical properties, but also of something which has those properties and which, as represented in a diffeomorphic hole transformation between

models, may be sundered from those properties and united with other metrical properties (see Figure 4.2). In other words, there is a metaphysical view of the ontological constitution of spacetime points underlying the dialectic of the hole argument, and that view has important affinities, at least, with the traditional substratum/property ontology.

This metaphysical view about spacetime points is not an accidental feature of the hole argument: the assumption that points consist of a something other than their metrical properties that can be sundered from those properties and yet retain its identity is essential for the argument. To see this, reject the assumption and take spacetime points to be merely bundles of their metrical properties. On this bundle theoretic view, a spacetime point's properties completely exhaust the nature of that point: nothing remains once those properties are 'removed'. Therefore, to represent a point's metric properties is to represent that point. This means that we *cannot* interpret diffeomorphic models as showing that it is physically possible for a point to have various different metrical properties and relations. In Figure 4.2, for instance, there is no sense in which point 'a' in model 1 and point 'a' in model 2 could represent the same point, simply having different metrical properties and consequently standing in different relations to other points, because metrical properties exhaustively constitute spacetime points. Therefore, on the proposed bundle theoretic view of spacetime, we can only regard diffeomorphic transformations as representing the same physical

situation; that is, we must accept Leibniz Equivalence. But as argued above, accepting Leibniz Equivalence removes the threat of indeterminism.

Some philosophers have noted that a bundle theoretic view of spacetime employing metrical properties would not be susceptible to the hole argument. Earman, for instance, writes of the substantivalist that "if he wants to preserve the possibility of determinism, he will have to agree with Leibniz that Leibniz-equivalent substantivalist models correspond to the same reality...[H]e may wish to claim that this is so...because the identity of the points is determined by their metrical properties and relations" (1989, 195). This is essentially the approach I advocate above. Earman, however, rejects this proposal. Recall from the previous chapter that his reason for rejecting the Bundle theory as applied to spacetime is that he sees the substantivalist bundle theorist as facing an inconsistency:

1. There could be two distinct yet indiscernible spacetime points (i.e. the Identity of the Indiscernibles is false).
2. The Bundle theory entails the Identity of the Indiscernibles
3. The Bundle theory is a true account of spacetime points

However, proposition (2) is true only if properties are construed as universals. For, as we have seen, a bundle of *tropes* theory does not entail the Identity of the Indiscernibles, and so the bundle theorist employing tropes does not face this inconsistency. A tropist Bundle theory therefore seems to offer the substantivalist a promising way to avoid the hole argument: take spacetime

points to be bundles of metrical properties, and take those properties to be tropes rather than universals. Physically possible symmetrical spacetimes now pose no difficulty, for we are not forced to identify exactly resembling points in these spacetimes. Not only does a tropist ontology allow the bundle theorist to extend the analysis of concrete particulars to parts of substantival spacetime but, unlike the Substratum theory, it does so in a way that provides a natural solution to the most serious theoretical problem facing contemporary substantivalism.[14]

2.3. Hoefer's Metric Field Substantivalism. Amongst views of the ontology of spacetime articulated by contemporary philosophers, it is perhaps one recently put forth by Carl Hoefer that comes closest to the bundle of tropes account presented above. In contrast to the 'manifold substantivalism' that Earman and Norton presuppose in setting up the hole argument (and which they use to rule out the possibility of the substantivalist accepting Leibniz Equivalence), Hoefer suggests that "the metric field g, of a model M, g, T of GTR, represents a substantival spacetime" (Hoefer 1996, 6).

Hoefer's central idea is to deny that spacetime points have what he calls "primitive identity". By this phrase he means an "identity wholly independent of the properties these particulars actually possess" (14-15). If a thing has primitive identity, in Hoefer's sense, then it is possible for the thing to exist, as the very thing it is, without any of its actual properties, but some completely different set instead (14-15). Hoefer claims that the hole argument needs spacetime points to

have this form of identity, for it requires them to be able to retain their identity while altering their metrical properties (15). By denying primitive identity to spacetime points, Hoefer defuses the hole argument, for "the substantivalist who denies primitive identity will embrace LE [Leibniz Equivalence]" (19).

Prima facie, this approach seems much the same as the bundle of tropes theory, for that theory also denies that spacetime points have identity independent of their metric properties: on our theory, the identity of a point is derived wholly from the metric properties that constitute it. However, Hoefer appears to explicitly reject taking spacetime points to be mere bundles of properties (18). He also makes no mention of employing a tropist conception of properties; on the contrary, he seems to tacitly endorse treating them as universals (see below). What I want to argue, however, is that Hoefer does not give sufficient justification for rejecting either the Bundle theory or tropes; in fact, the *only* way for Hoefer to deny primitive identity to spacetime points in the way he does is for him to treat their properties as tropes, and once done, this move makes his apparent rejection of the Bundle theory otiose. So I claim that Hoefer's position, though apparently unlike mine in important respects, is unstable, and when pressed collapses into it.

I begin with Hoefer's grounds for rejecting the claim that spacetime points have primitive identity. He does not advocate this only because it allows one to rebut the hole argument; he tries to give independent reasons for rejecting the view. Hoefer begins with some strong polemic against the notion of primitive

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questions about their identities either, as is done, for example, in the hole argument.

Of course this raises the question of what the grounds are for accepting (1). One way of grounding this claim is straightforwardly verificationist: if there is no continuous trajectory connecting A and B, then there is no way (in principle) to verify whether they are the same thing. The existence of such paths provides us with an essential means of verifying identity claims, such as "Is this the hat Napolean wore at Waterloo?". We simply trace continuous trajectories from Napolean's head at Waterloo to the present museum cabinet. If the thing on his head at Waterloo followed one such trajectory, then it is identical with the thing in the cabinet. If not, then it isn't. If we accept that only the verifiable is meaningful, then we may have some grounds for accepting (1).[16] However, Hoefer does not offer any general arguments for the verificationist view that the possibility of tracing a continuous trajectory is necessary for *any* identity statement to be meaningful. What he does offer us are illustrations of some sorts of identity claims which do seem to require continuous trajectory to be meaningful.

He asks us to imagine two qualitatively indiscernible balls in a box, and that at some point in the past, one of the balls bounced into the box, then the other. We ask: "Was the ball on the left the one that entered the box first, or was it the ball on the right?" (16). This is an identity claim involving two entities, each at a different time, like the case of Napolean's hat and the thing in the

museum cabinet described above. Hoefer's worry about this sort of case seems to be that in taking this sort of identity question to be meaningful we may be committing ourselves to primitive identity. He responds that we are not, because the meaningfulness of this question is assured not by primitive identity of the balls, but by the existence of distinct spatiotemporal trajectories linking the present balls with their past selves, and the fact that one (and only one) of the present balls can be traced backward along one of these trajectories so that it coincides with the first ball that entered the box.

Another of his illustrations is a set of dice which are thrown into a futuristic machine which vaporizes the dice (or mixes their atoms, as you will) and instantly creates a new set of dice, over time generating results that match the predictions of the probability calculus. Hoefer tells us that "there is no answer to the question: Is the die now on the left the same as the left-most die that we threw into the machine?" (17). He explains:

> As long as the atoms are suitably mixed, there will be no reason to make identifications between the old and the new dice. The new dice are not connected to the old via continuous trajectories, and this is why the identity question is unanswerable. (17)

Now this is a case of the same form as the previous one: we have two items, each at a different time, and we ask if one is identical to the other. I take it that this case is meant to show that once trajectory is taken away, identity questions of this sort cease to make sense. This would offer further support for the claim that

this sort of identity question has nothing to do with primitive identity, and everything to do with spatiotemporal trajectories. Be this as it may, however, this does not tell us that *all* assertions of primitive identity are meaningless or make no sense, but only that one subclass of assertions involving identity, those asserting the identity of things, each at a different time, do not require primitive identity. Lacking a general argument for the verificationist thesis (1), it is unclear why we should think all identity statements of the sort licensed by primitive identity are meaningless.

The proponent of primitive identity might well insist that, on the contrary, there is prima facie reason to think these sorts of statements are meaningful because of the utility of the concept of primitive identity in metaphysics. Anticipating this response, Hoefer seems to retreat from his verificationist position and attack the notion in another, quite different way. He says "the ascription of primitive identity allows us to pose certain strange philosophical questions-but not to do any more productive work" (18). He also calls primitive identity "metaphysically otiose" (20) and "unnecessary" (14); so much "metaphysical baggage" (24). The idea here seems to be that, even if primitive identity is meaningful, it should still be rejected because it is not required as part of our metaphysical apparatus. In other words, all of the metaphysical work that we need to do can be done without invoking primitive identity, so by principles of parsimony, we should avoid believing in it.

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all of their properties in common] that they are distinct individuals?" (18). He replies:

> If we are to remain uncommitted to the Principle of the Identity of Indiscernibles, as I believe we should, we can admit possible worlds in which two individuals exist (like Max Black's indistinguishable iron spheres), call them A and B, which share all of their properties in common. Why does it make sense to speak of them as distinct *individuals*? Well, just because, as we stipulated, there are *two* of them and not *one*. The fact that we cannot somehow "reach into" this possible world and specify somehow which one is A and which one B does not matter-the demand makes no sense. To suppose that there is something more to the claim that A and B are individuals is, I submit, merely to insist on primitive identity for no clear reason. I believe we can do without it. (19)

Note that Hoefer brings into the discussion an essentially epistemic issue: the issue of whether A, as opposed to B, could be identified by you (or me, or perhaps God), in the sense that we could "specify somehow which one is A and which one B". Hoefer says that the fact that we cannot do this with a Black world (assuming that this is a fact) "does not matter". I entirely agree (I am not sure if it "makes no sense"): the lack of an epistemic distinction does not mean that there is no metaphysical distinction between the two. However, this point does not show that primitive identity is not required in this case, for we are still left, after all, with a metaphysical numerical distinction between the two. Given such a distinction, it seems reasonable to ask for something to ground this distinction ontologically. In other words, this epistemic point does not impugn the metaphysical case for invoking primitive identity.

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Tropes, being particular, can be used to underwrite the distinctness of A and B without introducing a non-property constituent (e.g. a substratum) and thereby adopting primitive identity.

So if Hoefer is arguing that we should abandon primitive identity because we do not need it in metaphysics, he is right only if properties are taken to be tropes. But once tropes are adopted, there is little motivation for resisting a Bundle theory and holding on, as Hoefer apparently does, to a "metaphysical hanger for properties to rest on (or in)" (18); or at least, so I argue.[18] If so, then Hoefer's denial of primitive identity to spacetime points comes to much the same end as the tropist bundle theoretic account. This would seem to mark a happy convergence of results in ontology from the traditional study of concrete particulars and from within the contemporary philosophy of spacetime.

3. Objections to the Tropist Bundle Theory. In sections 1 and 2, it was urged that adopting the tropist Bundle theory allows one to avoid difficulties regarding both spacetime points and material concrete particulars that plague other views such as the traditional universals version of the Bundle theory and the Substratum theory. In this section, I consider at length objections to the tropist Bundle theory, some of which pertain to the theory specifically as a theory of spacetime points (and as a solution to the problem of the hole argument), and others that apply more generally.

3.1. Substantivalism and Scientific Realism. One objection to the tropist Bundle theory goes as follows: I suggest taking spacetime points as individuated only by their metrical properties, but models of General Relativity employ points which are individuated independently of their metrical properties. Earman, for instance, reminds us that in differential geometry "it is assumed that questions of identity and individuation of points of [the manifold] *M* have been settled prior to the introduction of the [metrical tensor] g-field and the [stress-energy tensor] T-field" (1989, 180). That is, we can only define mathematical objects, such as tensors, on a manifold of already distinct points. Hence, the objection goes, our account of spacetime contradicts the view that emerges from General Relativity. However, this is a result that a scientific realist could not accept, and one that ultimately undermines substantivalism insofar as scientific realism is one of the main motivations for that position.

The bundle theoretic substantivalist must admit that the claim that points are individuated independently of the metric is certainly true as a fact about how we define mathematical entities on manifolds. However, she will want to insist that it is not so clear that it should be read as a metaphysical truth about physical spacetime points. The fact that before we can assign a metric field to a manifold we must individuate the mathematical points of the manifold, does not seem to entail that the spacetime points represented by those mathematical points must be individuated prior to the assignment of their metric properties. Indeed, since it is spacetime points we are discussing, it is unclear what 'prior individuation'

even amounts to here (see Maudlin 1990, 549-550). The real issue is whether or not *all* of the logical structure of our mathematical representations can be taken as an accurate guide to the metaphysical structure of the reality they represent. Advocates of metaphysical solutions to the hole argument, including the solution afforded by the tropist Bundle theory, will want to deny this literalist form of scientific realism (see Hoefer 1996, 22-23). They can claim, however, that they remain scientific realists nonetheless, since they are committed to believing in the reality of spacetime points. The Bundle theory does not deny the reality of points; it simply offers a metaphysical gloss on what they are.

3.2. Substantivalism and Relationalism. The fact that on my approach, spacetime points are not individuated independently of their metrical properties might be pressed against the proposal in a different way. One might suggest that my view entails too much of a watering down of substantivalism, since the ultimate constituents of our ontology now seem to be relations or relational properties. It is the metrical properties and relations, represented by the metric tensor, which we have taken to be the tropes constituting spacetime points. But metrical structure is ultimately relational structure, embodying the distances between points of the manifold. In particular, the value of the metric tensor at a point "supplies information about distances within an 'infinitesimal neighborhood' of the point" (Bricker 1993, 286). But is our view then best taken not as a form of substantivalism at all, but rather as some sort of relationalism?[19] Indeed, it seems

that on the bundle theoretic view, the substantivalist must deny that implementing a diffeomorphic transformation produces a model representing a distinct physical situation. But the diffeomorphism, according to some, is simply a contemporary reformulation of the Leibniz shift, and the denial that a Leibniz shift produces a distinct physical situation is characteristic of relationalism, not substantivalism (Earman and Norton 1987, 522).[20]

In response to the first point, it is not at all clear that the properties represented by the metric tensor in General Relativity should be construed simply as relations between those points having the properties and points which are infinitesimally nearby in the manifold. The reason for this is that "given two points p and q (no matter how 'close together'), the distance between them is not determined by the local metric at p and the local metric at q" (Bricker 1993, 286). It is true that the metric supplies essential information about distances within the neighborhood of a point; however, the metrical distances between points, even infinitesimally close ones, are not represented in a straightforward way by the values of the metric tensor at those points alone. These distances are represented by a function that assigns a real number to a path between the two points by integrating over values returned by the metric tensor along the path. The value of the metric tensor at a point, in itself, does not represent the metrical relations to various other points in which that point happens to stand: they cannot be 'read off' from the value of the tensor at that point alone in any sense.[21]

However, even if it were true that my version of the Bundle theory did place relational properties in the bundle, making relations, in a sense, ultimate in the ontology, this would still not make my position relationalist, as traditionally conceived. Traditional relationalism entails the reduction of talk of spacetime to talk of relations *between material objects*. As Earman puts it, "the essence of space-time substantivalism. . . [is] the notion that events are happenings at space-time points construed as ontologically prior to the happenings" (1989, 160). The present view does not make spacetime points ontologically dependent on the 'happenings' (i.e. matter and its relations) in any way that would satisfy a traditional relationalist; e.g. spacetimes devoid of happenings are entirely possible on my account (see Brighouse 1994, 122-123).

With regards to Leibniz shifting, what the bundle theoretic substantivalist must do is reject the idea that active diffeomorphic transformations, where the metric field is 'moved' over the manifold of points, are the proper equivalent, in the context of General Relativity, of Leibniz shifts, where matter is moved over space (see Hoefer 1996, 20). She will want to deny, with Maudlin (1990, 552), Earman and Norton's claim that the "diffeomorphism is the counterpart of Leibniz' replacement of all bodies in space in such a way that their relative relations are preserved" (1987, 521). For if the bundle theoretic view is correct, 'moving' the *metric* over the manifold of points, as is done in an active diffeomorphism, is not a metaphysically coherent operation.

3.3. Earman's Structural Roles Argument. Earman provides another argument against the sort of approach manifested in the tropist Bundle theory: his so-called 'structural roles' argument (1989, 198-199). The idea is that in a Bundle theory, we take the identity of spacetime points to be settled by their metrical properties and relations; i.e., their role in the overall metrical structure of spacetime. As Hoefer puts it: "to be point *A* in a world described by model <M, g, T> is just to have the metrical (or metrical plus material) properties and relations to other points that *A* has in the model", or "*A*'s structural role constitutes *what it is to be A*" (1996, 21). But this, Earman claims, leads us to a contradiction.

Consider a world with a nontrivial symmetry: e.g. a Black world containing two spheres A and B (world 1 in Figure 4.4). On our theory, we wish to say that if we consider some world isomorphic to this one (e.g. world 2 in Figure 4.4) then we are really only considering the same world after all. For an isomorphic world will preserve the 'structural roles' (i.e. the collections of properties and relations) of all the entities of the original. Now Earman takes the structural role view to be committed also to

> (E) Given any two isomorphic worlds, two entities, one from each world, are identical when an isomorphism between the worlds maps one onto the other.

This means that two entities in isomorphic worlds are identical in reality just in case each entity has the same structural role in its respective world. But now

consider the isomorphic worlds 1 and 2 in Figure 4.4, each of which contains two spheres. There are two distinct isomorphisms between the worlds, each of which maps the entity A of the first onto a different element in the second (C and D). Now (E) tells us that, therefore, A and C are really identical, *and* that A and D are identical. By the transitivity of identity, we obtain C=D. But since the two isomorphisms are distinct, we know that they map A onto *distinct* elements of the second world; hence it is not the case that C=D, and we have a contradiction.

I confess to finding this argument somewhat obscure, owing to the fact that it is formulated in terms of isomorphisms between worlds, rather than models (see Earman 1989, 125). If we take the isomorphisms to be between worlds, then E does not appear to make sense: given that we are proposing that there is no difference between what is represented by two different isomorphic models (i.e. isomorphic worlds are identical), how can there be 'two' isomorphic worlds at all? But if there cannot be two distinct isomorphic worlds, then what does it mean to 'identify' elements of such worlds? It is hard to see in what sense the phenomenon that Earman is investigating here is really a case of "transworld identification" (125).[22]

To make sense of the phenomenon, perhaps we should take it in a more epistemic fashion. Say that you and I each imagine a possible world. We discover that in fact the worlds we are imagining are isomorphic to one another. Since we believe that that there is nothing more to a world than its properties and relations, we conclude that we are in fact imagining the same world. Given

this, we know that the world you are imagining and the world I am imagining contain the same entities, since it is the same world after all. It appears then that I could go through each entity in my imagined world and, asking you about your world, find that entity in your imagined world, simply by setting out its properties, or its 'structural role'. We might say that by doing this we are, in a (purely epistemic) sense, identifying individuals across 'two' isomorphic worlds.

What Earman shows is that if the world in question has a nontrivial symmetry, then I may be lead to assert a contradiction by this procedure. I will say, for example, that A in my imagined world is identical to C and D in your imagined world, since C and D have the same sort of structural role in your world. But since C is not identical with D, this cannot be correct. The fact that this case involves a non-trivial symmetry is important, for it suggests that the problem is related to the Identity of Indiscernibles and its attendant struggles with individuation. The problem issues from the fact that, in our identification procedure, we require only *qualitative* similarity of properties in order to identify particular 'structural roles' or bundles of properties. For example, in the above case, I identify both C and D with A. Why is this? Because I require, for identification, only an exact qualitative similarity of the properties between A and the candidate for identification. Since, by hypothesis, the properties of both C and D are qualitatively exactly similar to those at A, due to a symmetry, both C and D can be identified with A by this criterion.

indeterminism which arises, in the context of generally covariant spacetime theories like General Relativity, due to the presence in our ontology of some indiscernible items which can be 'swapped' without observable consequences. It advocated paring away those entities to solve the difficulty. We respond by invoking the idea that spacetime points are bundles of metric tropes; however, do not tropes pose the very same difficulties? For exactly resembling tropes will be indiscernible as well, hence swapping them will not involve any observable consequences either. Will it then not be the case that any future event could occur over any one of a multitude of indiscernible bundles of tropes, leading us back to a noxious indeterminism? Perhaps we have pushed down the proverbial bulge in the carpet only to have it pop up again.

One disanalogy between the two cases is that whereas, in the original hole argument, all spacetime points are indiscernible (qua points of the manifold) and therefore swappable, not all metric tropes will be indiscernible and therefore swappable. A more important disanalogy between the two cases, however, is that in our trope version of the hole argument, the swapping of tropes, and therefore the indeterministic conclusion, is mandated completely a priori (if I may use that term loosely), with no reference to physical theory. The notion that tropism posits qualitatively indiscernible items the swapping of which would make no observable difference is familiar from discussion of the problem of universals. Sometimes it serves as a premise in a verificationist argument for universals: If tropism is true, then there is a difference in the world if A has trope

T1 rather than exactly similar trope T2, but there can be no such difference, therefore tropism is false (Armstrong 1989a, 131-132). The usual, and I think reasonable, response by tropists is to deny the verificationist claim that there is no such difference (Campbell 1990, 71-72). The point here, however, is that the swapping of tropes in these arguments, and in the trope hole argument, is motivated by purely *philosophical* considerations.

This is not the case, however, for the original hole argument. If Earman and Norton's indeterminism had only such philosophical motivations, the argument would be much weaker than it is, and of much less interest to scientific realists. Their hole argument does not involve the claim that we should ponder the possibility of swapping spacetime points as a philosophical thought experiment, but rather because a physical theory, General Relativity, apparently portrays it as a physical possibility. For the attempt to reapply the hole argument to tropes, however, there is no physical principle comparable to General Covariance that mandates us to swap metric tropes around in a fashion analogous to that of the original argument. The hole argument could only be resurrected by finding some principled reason from within physical theory why metrical tropes could be 'moved around' in this way without empirical consequences. More specifically, we need to be shown that there are models of the theory that represent distinct situations and which agree on all physical facts up to some time but disagree thereafter about which objects are associated with which metrical tropes. Certainly diffeomorphic models cannot fit this bill, since

we already know that they represent the same situation. We are of course free to mount philosophical arguments with conclusions similar to that of the original hole argument, but without a substantive connection to physical theory, such arguments are likely to have little force in the realist context of the original argument.

3.5. The Dependence of Tropes. D. M. Armstrong claims that

> there is a fundamental difficulty with all bundle theories. It is that properties and relations, whether universals or particulars, seem not suitable to be the ultimate constituents of reality. If they are the ultimate constituents, then, it appears, completely different (non-overlapping) properties and relations will be 'distinct existences' in Hume's sense of the phrase: entities logically capable of independent existence. But are properties and relations really capable of independent existence? (1997, 99)[23]

The answer, of course, is 'no', at least according to Armstrong. How could a particular mass, for example, exist without the simultaneous existence of anything else at all? Such an entity is too 'insubstantial'. The case is even worse for relations, like betweenness: the idea of such a thing existing on its own, with no terms to support it, simply "seems ridiculous" (1989, 115). The argument here, a reductio ad absurdum (1989a, 71), proceeds like this:

1. Tropes are the ultimate constituents of the world.
2. For any ultimate constituent of the world C, it must be logically possible for C to exist in the absence of any other being.

3. It is logically possible for a trope to exist in the absence of any other being (from 1, 2).[24]

There are a number of ways for bundle theorists to assault this argument. One way is to deny the supposed absurdity of proposition (3). Some bundle theorists in fact seem little bothered by this possibility. Williams accepts the possibility that a trope could exist on its own, though he does admit that "it is hard to imagine a world in which there would not be many tropes that belong to well populated [sums of concurrent tropes and sets of precisely similar tropes]" (1953, 117). Campbell calls the idea that a property cannot exist by itself "a longstanding and deeply ingrained prejudice" (1981, 127; see also 1990, 59). He says that some of our common experience suggests that we in fact do encounter independent tropes. He gives examples of the sky as a mere instance of colour, and the color bands of a rainbow. He also suggests that actual independent tropes can be found in "the subatomic world" and in the case of black holes, though he does not elaborate (1981, 128). However, not all bundle theorists have been able to warm to the idea of independent properties: Stout, for example, thinks that any trope "has its being only in its concresence with the other qualities and relations of the concrete individual" (1921, 10).

Rather than denying the absurdity of independent tropes, the bundle theorist could respond to Armstrong's argument by suggesting that what should be denied as a consequence of the absurdity of (3) is not (1), but rather (2). For

the latter is a substantive and prima facie contentious statement about what the nature of the ultimate components of the world must be. What it says is that the world is composed out of *independent* parts, rather like a building is composed of bricks. What motivations does Armstrong offer us for (2)? In his *Universals*, Armstrong tells us that

> those who try to construct particulars out of universals are proposing that the world is a construction from, is constituted by, universals. We can put this another way by saying that they are proposing that universals are the substance of the world. . . A definition of substance in this sense of the word, which is accepted by many metaphysicians, is that substance is something that is capable of independent existence. (1989a, 73)

Armstrong's claim here that "constituent of the world" just means (perhaps among other things) "something capable of independent existence" strikes me as very implausible. Perhaps some metaphysicians have run together the notion of constituent and the traditional notion of substance as an independent existent in this way, but certainly not all have (e.g. Stout). In any case, "constituents of the world are capable of independent existence" hardly seems to be a straightforward analytic truth.

An alternative view is that the actual world is composed of ultimate constituents which, although they cannot have being by themselves, can have being if other constituents exist; the slogan for such a view might be 'strength in numbers'. Though tropes cannot exist on their own, they can exist just in case

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inhabitant is related to Alistair (who lives in the actual world) by a certain relation, the counterpart relation. In his world, this counterpart of Alistair wins a race which is similar to the one Alistair lost. This person, and his victory, are, oddly enough, what "Alistair could have won the race" is about (many would have thought it simply about Alistair). Many philosophers of naturalist inclinations, Armstrong among them, have complained that this account commits us to a vast number of possible worlds in a rather a priori manner. There are other explications of modal assertions which commit one to different entities (e.g. propositions) which are also odious to the naturalist. The Combinatorial theory is an attempt to give an explication which does not introduce entities of this sort.

The Combinatorial theory says that every modal statement is ultimately about only entities that actually exist: the truth conditions for these statements involve nothing more than all the things that actually are. The idea is to take all of the things there are, which for Armstrong includes all of the properties, relations and substrata (i.e. 'individuals' or 'thin particulars') that actually exist, and put these together into combinations that have the form of actual states of affairs: e.g. F*a*, or R*ab*, but not *aa* or FG*b*. As Armstrong puts it, "the possible states of affairs are all the combinations of the simple individuals, properties and relations which respect the form of atomic states of affairs" (1989b, 48). Possible worlds are then defined as "all the conjunctions of possible atomic states of affairs", with a few caveats (48). If all this works out, the result is that "the

notion of possibility is analysed, reduced I think it can be said, to the combination of elements" (48).

To see why Armstrong thinks the denial of (2) conflicts with the Combinatorial theory, we need to take note of an important presupposition of that theory: Independence. Armstrong gives two formulations of Independence, one in terms of states of affairs, the other in terms of properties and relations:

A. "No [first-order] state of affairs entails or excludes the existence of any other wholly distinct state of affairs" (1997, 1).
B. "All simple properties and relations are compossible" (1989b, 49; 1997, 159).

Independence in sense (A) is a presupposition of the Combinatorial theory because it is required for the definition of possible world given above. According to that definition, we take possible worlds to be just conjunctions of arbitrary possible states of affairs. But if (A) is false, then it will be the case that some possible states of affairs will not allow of conjunction with one another: they will exclude one another. For example, the possible state of affairs Fa might entail the non-existence of the possible state of affairs Pa. If so, then there will be no possibility corresponding to the conjunction 'Fa & Pa'. What this means is that the set of conjunctions of possible states of affairs is wider than the set of possibilities (some of them are impossibilities). Hence we must revise our definition of "possible world": not all conjunctions of possible states of affairs will correspond to possible worlds. The only option seems to be defining it as

"any *possible* conjunction of possible states of affairs." But this is clearly unacceptable, because it uses the very modal notion, possibility, that we are trying to analyze away (48). Adopting the revised definition would be tantamount to taking modality as a primitive notion, abandoning the Combinatorial theory's goal of reducing modality to the non-modal (see Armstrong 1989b, 33; Lewis 1986, 156).

Likewise, the independence of properties and relations, in the sense of (B) is also required for the success of the Combinatorial theory. Perhaps the easiest way to see this is to note that the truth of (B) is required for the truth of (A). For imagine that two properties F and P are not compossible: this means that it is not the case that something having F neither entails its having P nor excludes its having P. In particular, imagine that it is not possible for an object to have both F and P. But this is equivalent to saying that the state of affairs Fa excludes the existence of the state of affairs Pa, which entails the falsity of (A). And as we have seen, the falsity of (A) entails the failure of the Combinatorial theory as a reductive theory of possibility.

We can now see why Armstrong thinks that the denial of (2) vitiates the Combinatorial theory of possibility. If we deny (2), and claim that concrete particulars are complexes of dependent tropes, then we admit that no trope can exist unless some other tropes exist in compresence with it. Armstrong says that if we do this we "permit relations of necessity, full metaphysical necessity, to hold between [tropes]": "a certain amount of bundling...is necessitated" (1997,

99). But this seems to entail the falsity of the independence thesis (B), for it will not be the case that all properties and relations are compossible. For a property to be compossible with all properties, it must not entail the existence or non-existence of any other property. However, if any trope has to be bundled with some other tropes, then the existence of that trope entails the existence of some other distinct tropes. But if (B) is false, then (A) is false as well; thus the combinatorialist is forced to modify the definition of possible world, and the fatal circularity discussed above arises.

What I want to argue now is that if this is a problem for the bundle theorist who wants to uphold the Combinatorial theory of possibility, then it is just as much a problem for the substratum theorist who wishes to uphold that theory. The reason is that when we take the list of the ultimate constituents of the world given by the substratum theorist, we get a list of substrata a b c d, etc. and a list of properties P Q R S, etc. Any and all combinations of these elements are supposed to correspond to possibilities (Armstrong 1997, 160). But this is not so, if one wishes to rule out the possibility of bare particulars. Many philosophers have thought that even if there are substrata underlying properties, then it is not plausible to think that those substrata could exist completely barren of properties (Campbell 1990, 16; LaBoissiere 1994, 366). Even Armstrong himself holds as much:

> Could an individual be propertyless? Can it exist, but not in any particular way? I do not think it can. An individual, to be

combinations of constituents that "respect the form of states of affairs" (1989b, 47). In other words, only states of affairs, substrata having properties, correspond to possibilities, not properties alone or individuals alone: combinations of the constituents like aa or SS, or just a, are not taken to correspond to possibilities. But what is this doctrine, other than the bald assertion that such conjunctions are *not possible*? This leads to the very same circularity faced by the bundle theorist who makes the analogous move to avoid lonely properties.

In his recent 1997, Armstrong seems uneasy with his dismissal of bare particulars and uninstantiated properties. He still calls them "strange entities" (154), but now he says that he is "a bit reluctant to claim that it is *impossible* that there are such entities as uninstantiated ways [properties] and bare particulars" (154). Though he does not explain this reluctance, one assumes that it is because of the circularity problem discussed above. Although he does not say that "there is a bare particular" is necessarily false, he also does not want to say that is contingently false either. Hence the bare particular would be a non-existent that is not an impossibility nor a possibility: "there are no bare particulars" is a truth which is neither necessary nor contingent (154). This may sound suspiciously like having and eating the proverbial cake, but Armstrong suggests that it is justified on the following grounds. "There are no bare particulars" is a proposition that is part of the modal theory being given (i.e. the Combinatorial theory); but since that theory is a reductive theory, it is unreasonable to assign

modal status to the propositions of the theory itself (154). To do so would be to render reduction impossible. Therefore, it is justified to take "There are no bare particulars" as having no modal status. We do not have to take the bare particular as a genuine possibility, but neither do we have to rule it out as an impossibility. It seems dubious, however, whether "There are no bare particulars" should really be counted as part of the modal theory being advanced as opposed to an ad hoc constraint. In any event, even if Armstrong's move here succeeds, the bundle theorist can simply reproduce it for tropes. In short, if the dependence of properties and particulars is no trouble for the substratum theorist, then it should be no trouble for the bundle theorist either.

To summarize this long discussion, in this section I have argued for two claims. The first is that Armstrong's reductio argument can be avoided by denying its second premise. The second is that Armstrong's objection to this move is misguided. I want to stress that Armstrong's objection to this strategy rests on the plausibility of the Combinatorial theory as a reductive analysis of possibility. Insofar as this is a promising way of thinking about modal statements, then Armstrong's claim that the Bundle theory cannot accommodate it has bite.[25] What I have argued, against Armstrong, is that even if we desire to maintain the Combinatorial theory, the Substratum theory has no real advantage over the Bundle theory in this regard, and is probably even worse off. If my two claims are correct, then Armstrong's objections to the Bundle theory on the basis

of the dependent nature of tropes do not impugn the thesis that the world is a world, ultimately, of tropes.

Notes

[1] Compare, for example, Russell (1912) with Armstrong (1978).
[2] This sense of particularity (i.e. unrepeatability across space) is not to be confused with the sense in which concrete particulars are said to be particular (i.e. being non-exemplifiable; see Chapter I section one).
[3] Some sources of tropism in Continental philosophy of the early twentieth century are explored by Simons (1994).
[4] See Armstrong (1989a, 121-122) for discussion.
[5] Location, according to Williams, is "external in the sense that a trope per se does not entail or necessitate or determine its location with respect to any other trope" (1953, 116).
[6] In this his theory may fall into the same category as that of John Cook-Wilson; see Armstrong (1989a, 17).
[7] That trope bundle theories avoid commitment to the Identity of Indiscernibles is conceded by all hands (Loux 1978, 131-132; Campbell 1981, 132; Van Cleve 1985, 101; Armstrong 1997, 97-98).
[8] A notable exception is C.B. Martin (1980), who attempts to wed tropes to the traditional substratum ontology. This hybrid is Armstrong's favoured species of tropism (Armstrong 1997, 98-99).
[9] A complication for this approach is that spacetimes also possess topological properties, which can be mathematically characterized independently of metric properties. The bundle theoretic view must somehow account for these properties. This might be done by introducing distinct topological tropes that must somehow be bundled together with metric properties to produce spacetime points. Another approach would be to argue that topological properties are not ontologically distinct from metric properties: rather, they supervene on the metric properties. That metrical properties possess this kind of ontological primacy in General Relativity's characterization of spacetime is argued by Maudlin (1990).
[10] For a more rigorous definition of diffeomorphism, see Friedman (1983, 358-359).
[11] Though it does not affect the present discussion, this formulation of determinism is not entirely appropriate, since it does not treat time relativistically; for a more sophisticated formulation see Hoefer (1996, 8n6).
[12] The hole argument therefore does not rely on the premise that determinism is true, but only on the much weaker premise that if it is false, this is so for physical reasons.
[13] Earman and Norton further note that there is some possible motivation for adopting Leibniz Equivalence from physics itself. Physicists do not see General

Relativity as an indeterministic theory, the reason being that they assume Leibniz Equivalence (Earman and Norton 1987, 522).

[14] The Substratum theory *can* avoid the hole argument by other means: e.g. by adopting the view that metrical properties are essential properties of spacetime points (see Maudlin 1990), or by adopting counterpart theory (Butterfield 1989). These approaches, however, face serious difficulties (see Norton 1988; Earman 1989; Brighouse 1994; Rynasiewicz 1994).

[15] If they are connected by such a trajectory, and one of the entities travels along it arriving at the location of the second entity, then the answer to the question "Are they identical?" is yes; if it does not do so, then the answer is no.

[16] This talk of trajectories ties in with Hoefer's earlier formulation of primitive identity in terms of identity independent of properties because trajectory and "qualitative history" are taken as properties of a thing (17): it is these trajectory properties that are necessary for determining identity.

[17] Later Hoefer says that the request for a 'something more', a principle of individuation, is "meaningless" (20). Again, however, I find no arguments given for this stronger verificationist claim.

[18] It is a bit unclear whether or nor Hoefer accepts a bearer of properties.

[19] Teller suggests that certain views that make the identity of points dependent on metrical properties may be equivalent to some form of relationalism (1991, 395-396).

[20] A Leibniz shift is a uniform shifting of the spatial position of all the material bodies in the universe that preserves the spatial relations between any of these bodies (e.g. moving everything in the universe three feet to the west). Traditionally, relationalists (such as Leibniz) have denied that the result of Leibniz shifting all the matter in a world in this way results in a distinct physical state of affairs, since there are no spatial points.

[21] For further discussion of these sorts of properties see Robinson (1989) and Healey (1995).

[22] This problematic feature of Earman's argument is noted by Hoefer (1996, 22); for further discussion of the argument see also Brighouse (1994, 124).

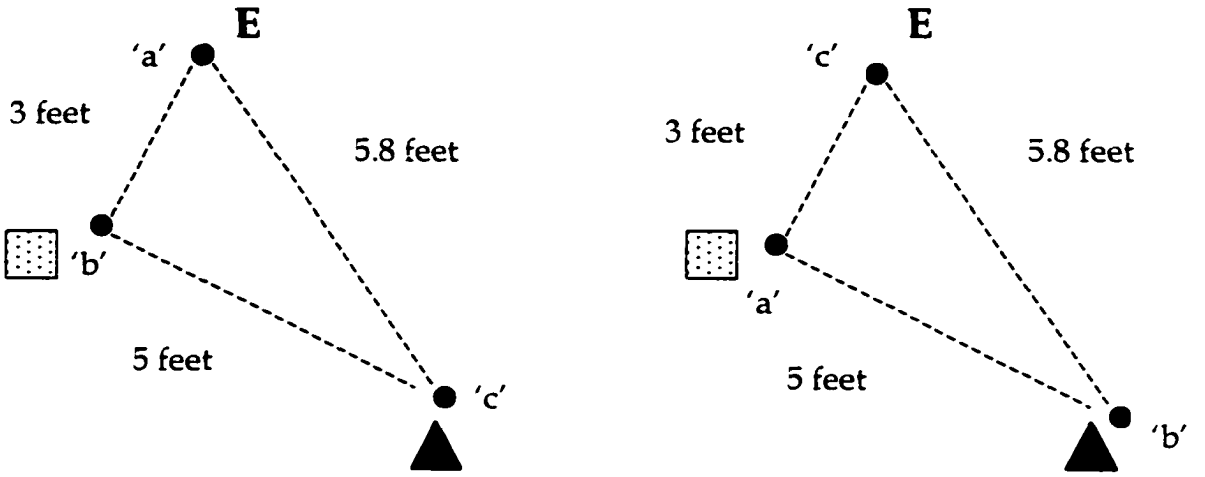
[23] This argument also appears in Armstrong's *Universals* (1989a, 73-74 and 114-115); it is endorsed by LaBoissiere (1994, 362-363).

[24] In the quotation above, Armstrong speaks of the ultimate constituents as being "logically capable" of independent existence. I take it he means that their independent existence is a logical possibility (see 1989a, 73).

[25] For doubts about the viability of the Combinatorial theory in this sense, see Shalkowski (1994) and Armstrong (1997, 160).

1. Spacetime model =def object of the form <M, O_1,...O_n>, where M is a point manifold representing spacetime points, and $O_{1\text{-}n}$ are geometric objects representing various physical facts.
2. General Covariance =def if <M, O_1,...O_n> is a model of a theory and h is a diffeomorphic mapping of M onto M, then <M, hO_1, ...hO_n> is also a model of the theory.
3. Hole diffeomorphism =def a continuous mapping from M onto M which is the identity map outside the hole, which differs from the identity map inside the hole, and changes smoothly at the boundary of the hole.
4. Determinism =def for any two models of a theory, if those models agree on all physical facts up to some instant t, then the two models agree on all physical facts.
5. Let h be a hole diffeomorphism defined on a model <M, O_1...O_n> such that the hole is after some instant t.
6. The object generated by applying h to <M, O_1...O_n>, i.e. <M, hO_1...hO_n>, is also a model of the theory (from 2, 5).
7. The two models <M, O_1...O_n> and <M, hO_1...hO_n> agree on the physical facts up to t but differ on the physical facts after t (i.e. inside the hole) (from 3).
8. Determinism is false (from 4, 7).

Figure 4.1. The Hole Argument.



Model 1 **Model 2**

Figure 4.2. Diffeomorphic Models. Circles depict manifold points, with metrical or distance relations between them represented by broken lines. E represents an arbitrary event, the square and triangle represent events occurring at specific points, and a-c are linguistic labels for manifold points.

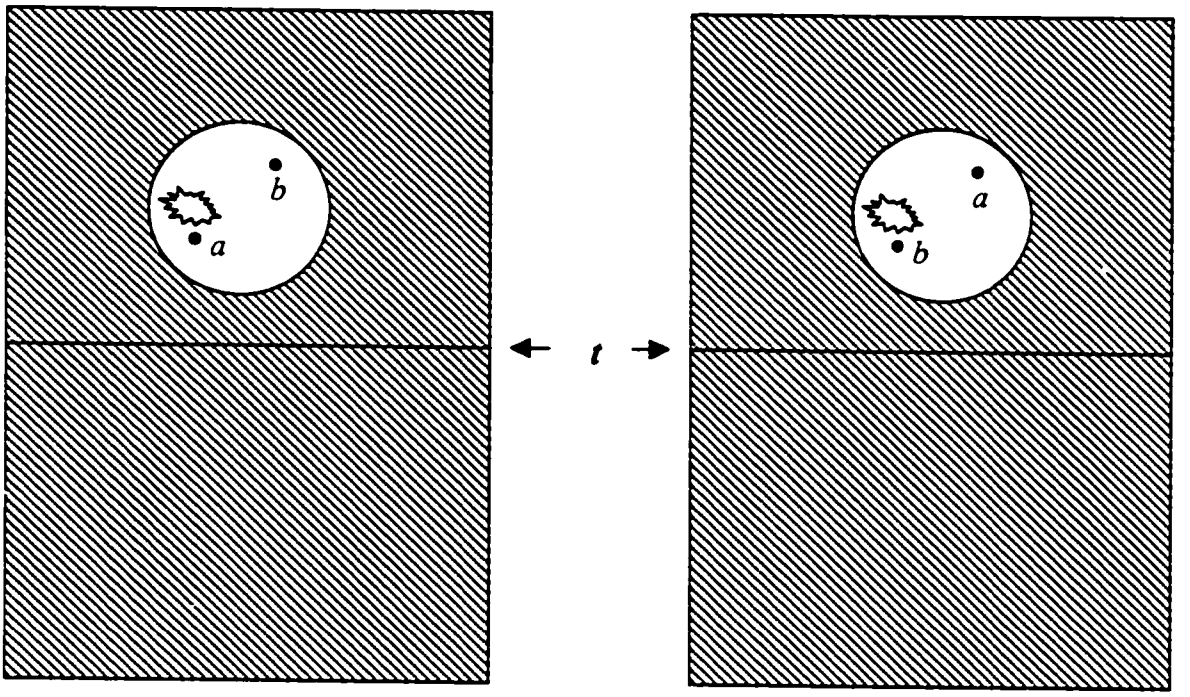


Figure 4.3. Diffeomorphic Models and Indeterminism. Each four-dimensional manifold of points is depicted as a rectangle, with a circle depicting the hole region. Slanted hatchings indicate regions of the manifold concurring with respect to which events are located at which points. Two arbitrary points in the hole, a and b, are depicted as dots, and an arbitrary event is represented by a flash. *t* denotes an arbitrary time.

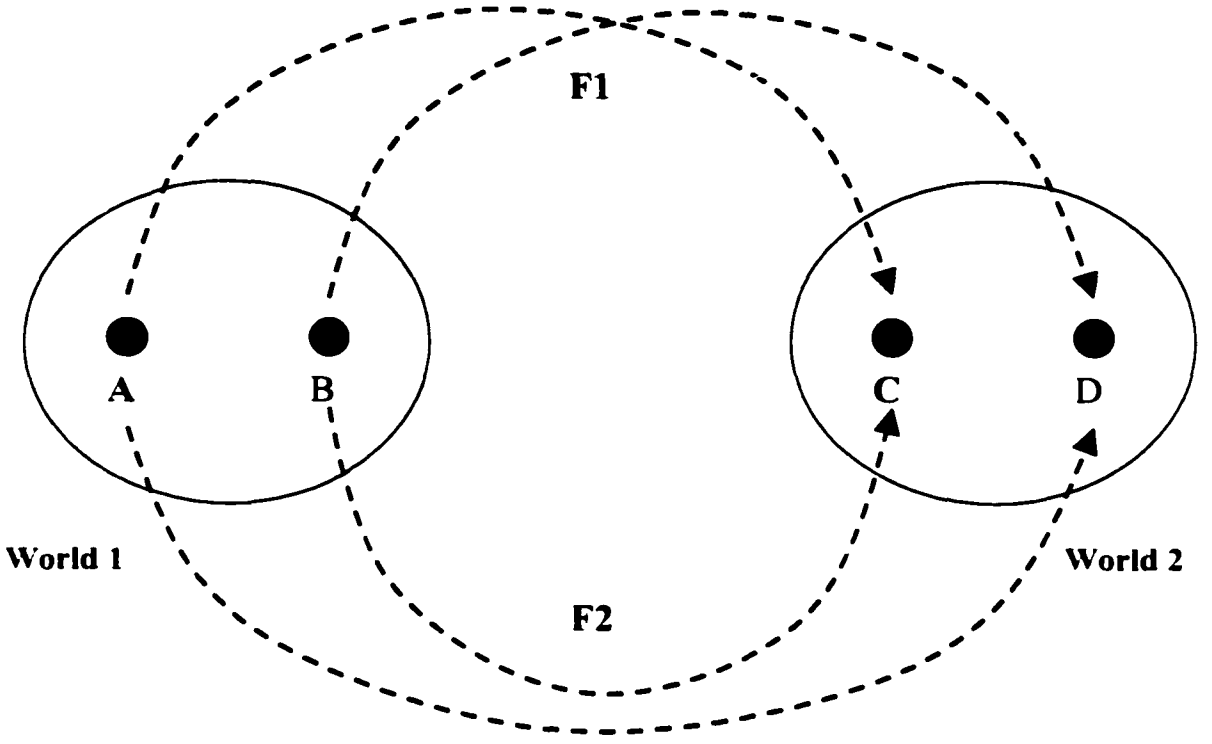


Figure 4.4. The Structural Roles Argument. The two ovals represent possible worlds like Max Black's world, containing two indiscernible spheres and nothing more. A-D are labels for these spheres. F1 represents a function which maps elements of world 1 onto isomorphic elements of world 2. F2 represents a similar but distinct function.

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