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► **To cite this version:**

Baptiste Le Bihan. No Physical Particles for a Dispositional Monist?. *Philosophical Papers*, 2015, 44 (2), pp.207–232. 10.1080/05568641.2015.1056960 . hal-01202010

**HAL Id: hal-01202010**

**<https://univ-rennes.hal.science/hal-01202010>**

Submitted on 25 Jan 2016

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# No Physical Particles for a Dispositional Monist?

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*Draft (Forthcoming in Philosophical Papers)*

*Abstract: A dispositional monist believes that all properties are essentially causal. Recently, an overdetermination argument has been proposed by Trenton Merricks to support nihilism about ordinary objects. I argue that this argument can be extended to target both nihilism about ordinary objects and nihilism about physical particles when dispositional monism is assumed. It implies that a philosopher who both endorses dispositional monism and takes seriously the overdetermination argument should not believe in the existence of physical particles. I end up by discussing possible objections. I suggest, then, that if we live in a world that is inhabited by causal properties but not by chairs and tables, then we also live in a world without electrons and quarks, a world of dispositional properties, that is, a world of causal fields.*

Keywords: *metaphysics, ontology, gunk, dispositional monism, physical particles, nihilism.*

## 0. Introduction

The idea that properties are dispositional comes in different versions. What is common to all versions of dispositionalism is that at least some properties have a causal essence. Some claim that all properties are essentially causal, others that only a subset of properties are. I will focus here on the idea that all properties are dispositional, that is, dispositional monism. This view is endorsed by many philosophers; see for instance Bird (2005) and Bigaj (2010). According to this view, causation is an aspect of properties: properties are intrinsically causal. This view goes against the more classical view called categoricism about properties. Categoricism states that properties are qualitative, not causal (see for instance David Armstrong's account of laws of nature in 1997, or David Lewis' humean supervenience view in 1986). Other hybrid views state that some properties are categorical while others are dispositional (Prior, Pargetter, and Jackson 1982) or that all properties are both dispositional and qualitative (Heil 2003). I shall propose an argument to show that the dispositional monist should endorse the *prima facie* exotic view that physical particles are unreal.

If nihilism about composite objects has quite a few proponents (Unger 1979, van Inwagen 1990, Merricks 2001), nihilism about physical particles is a more unusual view, to my knowledge, only endorsed by Mark Heller (2008). Or more precisely, what is unusual is to be nihilist about *fundamental physical particles*. Here, by fundamental, I mean physical particles that do not admit of

proper parts (and I do not mean anything else<sup>1</sup>). For instance, quarks and electrons are supposed to be fundamental particles because these entities do not admit of proper parts. One might object that we do not know if the entities described by contemporary physics really are mereological atoms. After all, we might well discover in the future that electrons and quarks admit of proper parts. But mereological atoms are supposed to be fundamental physical particles, even if these fundamental physical particles are *not* the entities described by our current physical theories. What I want to do here is to propose an argument against the existence of mereological atoms understood as these fundamental physical particles, ideal or not.

This view is original because the nihilist about composite objects usually conceives of what we call ordinary objects to be arrangements of fundamental physical particles. Ordinary objects are said to be unreal in the sense that what there is instead are collections of fundamental physical particles arranged in certain ways. As Trenton Merricks writes, 'there are atoms arranged statuewise but no statues' (2001, 29). In other words, the nihilist about composite objects usually does not believe in ordinary objects, because she *does* believe in fundamental physical particles as the genuine ground for what we *call* ordinary objects.

It could be thought that, in saying that physical particles are not real, what is meant is the gunk view that matter is infinitely divisible into smaller and smaller proper parts in such a way that there are no mereological atoms. This claim would be compatible with the idea that there is an infinity of physical particles, even if never fundamental. But this is not the claim I shall defend here. What I will try to show is that there are no physical particles on an independent ground. And the fact that really interests me here is that there are no *fundamental* physical particles<sup>2</sup>.

An argument in favor of nihilism about composite objects has been proposed by Trenton Merricks (2001). I will show that this argument can be used in the same way to establish nihilism about physical particles, granted dispositional monism about properties. In other words, a dispositional monist should not believe in the existence of physical particles. I will argue that if Merricks' overdetermination argument is correct and if dispositional monism is true, then essentially the same argument can be used against the existence of mereological simple objects, that is, fundamental physical particles. In fact, this overdetermination argument can be used against any

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1 The term 'fundamental' might carry the idea that there are different levels of reality with one of them being more fundamental than the others. Fundamental particles in this sense would be particles inhabiting the fundamental level of reality (for a presentation of this idea, see for instance Heil 2003). I will not use this sense and will not address

2 It is worth mentioning that, following Lewis (1991), one could be tempted to make a sharp distinction between mereology and ontology as two kinds of different notions and theories that are independent and have different objects. I will assume on the contrary that Classical Extensional Mereology is based on some axiomatic choices and that different mereological theories are available to describe the world (see Simons 1987). Along this line of thought, it is possible to construct different mereological theories in order to have a grip on the fabric of the physical world, that is, express its mereological structure (gunky or not). In this framework, it makes sense to ask whether the world is inhabited or not by fundamental physical particles understood as mereological atoms.

kind of material object, fundamental or not.

In section 1, I will focus on nihilism about objects and say a bit more about the position and its motivations. In section 2, Merricks' overdetermination argument for nihilism about composite objects will be presented. Then, in section 3, I will show that the conjunction of dispositional monism and nihilism about ordinary objects implies that physical particles, and in particular fundamental physical particles, are unreal. I will deal with possible objections in section 4.

## **1. Nihilism about Ordinary Objects**

If nihilism about composite objects has quite a few proponents (Unger 1979, van Inwagen 1990, Merricks 2001), nihilism about *fundamental* physical particles is a more unusual view. Nihilism about composite objects states that putative objects having proper spatial parts (or equivalently for a four-dimensionalist, proper spatio-temporal parts) are not real. In particular, ordinary objects like chairs or tables are unreal, for those objects are supposed to have proper parts, that is, to be composite objects. If nihilism about composite objects implies nihilism about ordinary objects, the converse is not true. It is possible to believe that some objects compose further objects without identifying those composed objects with ordinary objects. For instance, van Inwagen and Merricks take composition to occur only for living organisms or conscious entities. They defend nihilism about ordinary objects, and in a way, nihilism about composite objects (if we think of objects in the narrow sense of artifacts and not in a broad sense including living entities or minds), but not about composite entities like organisms or minds. Indeed, they take composition to obtain for living organisms (van Inwagen) or for conscious entities (Merricks), answering to what is known in literature as the Special Composition Question: under which conditions does composition occur? Still, it is natural to defend both nihilism about composition and nihilism about ordinary objects to answer the Special Composition Question in a simple way: a mereological sum is never a further object.

But why would someone believe nihilism to be true? Is it not clear that we see objects like chairs and tables around us? The point of the nihilist about ordinary objects is that we mistakenly conceive of what we perceive as being objects. She does not pretend that we do not have perceptions, what she claims is that we do not have perceptions of objects. According to her we perceive arrangements of fundamental physical particles. And then, we conceive of what we perceive under the category of objects. Or, if one prefers to construe perception as something already conceptual, perception is shaped by the strong and false assumption that we are living in a

world of objects, tables, chairs and so on.

It is worth noticing that nihilism about ordinary objects is a metaphysical assumption. This claim does not imply anything about the way we perceive the world. So, even if an error theory is required, it is a modest one. That is, a theory of why we conceive of the macroscopic world as being inhabited by objects has to be provided. But there is no need for a strong error theory explaining why we perceive objects when there are no objects to perceive.

A nihilist about ordinary objects has then to meet a stronger linguistic challenge. We usually refer to objects. And we think of objects as existing, so that we usually take a statement like 'there are donkeys' to be true. Can we really say that ordinary objects are unreal when we refer to them all the day long? And can we accept that ordinary existential statements are not literally true? Two kinds of strategies are available to deal with this affair. I will not go into the details of the various strategies, but it is worth mentioning what the two kinds of strategies are. First, we can take ordinary existential statements to be false<sup>3</sup>. A statement like 'there are donkeys' is false. As Ted Sider writes:

What are the complicated truths that we do not bother to assert, uttering instead falsehoods like 'there are some tables'? Complicated assertions about the smallest parts of the 'tables'. Rather than claim that there are many fundamental particles here in my 'room' next to my 'chair', which particles behave so as to prevent my 'computer', 'keys', and 'briefcase' from falling to the 'floor', instead I say simply 'There's a table in my room' (1993, 286).

This is the strategy used by Peter van Inwagen (1990) and Trenton Merricks (2001)<sup>4</sup>. An ordinary existential statement like 'there is a table in front of me' is strictly false, but pseudo-true in the sense that one can propose a paraphrase statement that expresses a part of what was supposed to be expressed by the original ordinary existential statement. The mereological aspect of ordinary objects is preserved by the paraphrase, when the 'identity conditions' aspect is simply eliminated. If the former statement carried two kinds of information, the mereological structure on one hand and the ontological unity on the other hand, the new statement drops any reference to an ontological unity: we are left with a collection of parts, a mereological sum without any kind of specificity.

Another possible answer is to admit that these statements can be literally true. A statement like 'there are donkeys' is true after all. This way to go can be found in Heller (2008) and Sidelle (1989, 2010). According to Sidelle, objects are real but are not mind-independent. This is the Conventional Theory of Objects. So, strictly speaking, Sidelle is not a nihilist about objects: he

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3 More exactly, we can take ordinary existential statements quantifying over ordinary objects to be false. Some ordinary existential statements quantifying over parts of putative ordinary objects remains true, whatever these parts might turn out to be.

4 For a strategy similar to conventionalism with respect to this problem, see the fictionalist option in Rosen and Dorr (2002).

assumes the existence of objects. In the same way, I take Mark Heller to be a conventionalist about ordinary objects, not a nihilist. Indeed, he writes:

The Donkey Problem (as I am calling it) concerns the relationship between more and less fundamental ontologies. I will claim that the moral to draw from the Donkey Problem is that the less fundamental objects are merely conventional. This conventionalism has consequences for the 3D/4D debate. Four-dimensionalism is motivated by a desire to avoid coinciding objects, but once we accept that the non-fundamental ontology is conventional there is no longer any reason to reject coincidence (2008, 83).

But Heller and Sidelle share with nihilists like van Inwagen and Merricks the idea that there are no mind-independent objects (with the important exception of biological organisms for van Inwagen and conscious organisms for Merricks). With respect to the mind-independent reality of artifacts, Merricks' and van Inwagen's position on one hand, and Sidelle's position on the other hand, are then equivalent. I leave open the choice between the two strategies. Both can answer to the linguistic worry. The paraphrase strategy takes for granted that ordinary statements are false, but provides some substitute statements, paraphrases, that are true. The conventionalist strategy denies the concrete and mind-independent reality of objects, but provides some substitute objects, conventional objects, that are real. Being myself a nihilist, I will speak of nihilism instead of conventionalism most of the time. But what I will say is also true of conventionalism.

So far we have tackled both the perceptual and the linguistic worry. But what reasons do we have to find this view attractive? As this is common in metaphysics, this view is taken seriously because of its explanatory power, that is, its power to solve metaphysical puzzles. Nihilism is invoked by people working on metaphysical debates such as the problem of vagueness (Unger 1979), the puzzle of coincidence (Heller 2008) or the debate about the identity of objects across time (Heller 2008). These problems are solved by the elimination of ordinary objects.

The nihilist about composite objects usually conceives of what we call ordinary objects to be arrangements of fundamental physical particles. So, the nihilist about ordinary objects is generally a realist about physical particles, or at least, about fundamental physical particles. The only exception, to my knowledge, is Mark Heller who seems to endorse conventionalism about both ordinary objects and fundamental physical particles. But it is fair to point that Trenton Merricks acknowledges the epistemic possibility that physical particles are not real:

There is no need to build in a commitment to the atoms of physics [...]. So consider my claims about the atoms of physics to be useful but expandable. Such claims are really placeholders for claims about whatever microscopic entities are actually down there (2001, 3).

So, even if Merricks thinks of entities associated with a statue as being atoms, he is

ready to accept that what is conceived of as a statue is not necessarily a collection of physical particles. What he has probably in mind is that physics could turn out to describe a world very different of what we currently think it is. In other words, microscopic entities could turn out to be very different from physical particles. On the contrary, what I will do is to provide an *a priori* argument for thinking that physical particles are not real, in the sense that there are no physical objects at all. If Merricks' overdetermination argument is correct, then Merricks should accept that microscopic entities are not fundamental physical particles. Or to put it differently, Merricks expresses the idea that mereological simples are not *necessarily* fundamental physical particles when I argue that mereological simples *cannot* be fundamental physical particles under the assumption of dispositional monism.

But first, let us have a look at the original overdetermination argument of Merricks.

## 2. The Overdetermination Argument

This argument exploits the fact that overdetermination is supposed to be problematic. Within the field of philosophy of mind, the argument is best known under the name of argument from exclusion where it supports the identity theory and epiphenomenalism (see for instance Kim 2010). But I will focus on the argument that has recently been used by Merricks against the existence of ordinary objects. If this argument is correct, and if dispositional monism is true, then it can be used against the existence of mereological simple objects, that is, fundamental physical particles. As Merricks writes:

A baseball is at best a mere overdeterminer. Whatever a baseball causes—if the baseball exists—is already fully causally accounted for without the baseball. It is already fully causally accounted for by the relevant atoms. (Merricks 2003, 2).

Baseballs would causally overdetermine their effects since any alleged effect of a baseball is also an effect of the physical particles that are parts of this baseball. One could argue that a major premise of the argument is simply false. What is causally accounted for by the relevant atoms is not enough, for spatio-temporal relations or, say, the overall organization of the atoms also have to be taken into account. But that would be missing the point. Whatever the *mereological atoms* are (physical particles, or particles plus relations of one kind or another), they are sufficient to fully account for what a baseball is supposed to cause.

To work, this argument relies on several principles. First of all, composition is *not* identity.

It is obvious that if the baseball is identical to its constituents, then, the existence of the parts ensure the existence of the whole. Following Lewis (1991), one can find hard to believe in many-one identity as implied by the composition-as-identity view. But I am myself agnostic on this matter and I will not argue against it<sup>5</sup>. My point is more modest: I want to show that if one believes that the overdetermination against ordinary objects works, then it also has to be applied to physical particles.

Second, Merricks takes the whole to be less fundamental than the parts. Otherwise, it would be possible to use an overdetermination argument against the existence of the parts, and not of the whole. The baseball would be real, unlike its parts. In other words, the baseball would not admit proper parts. This view could be strange, but it has been endorsed by Horgan and Potrč (2006) who claim that the entire cosmos does not admit of proper parts.

Still, if one is ready to accept these conditions, that is, that composition is not identity, and that the whole is less fundamental than the parts, then, baseballs are overdeterminers and should not be included in our ontology. And this is true for any ordinary composite object made of physical particles and supposed to have causal powers. It is worth mentioning that not everybody will agree on the idea that overdetermination is bad. For a defense of this point see Sider (2003). But in what follows I will assume that overdetermination is bad. Indeed, I want to examine some consequences of the nihilist view and its alleged supporting overdetermination argument.

This argument can be slightly modified to defend not only nihilism about composite objects but also nihilism about physical particles under a dispositionalist assumption. I shall argue that the physical particle itself is an overdeterminer, granted the existence of physical causal properties. If physical properties are causal as claimed by the dispositionalist, then it is usually supposed that this causal aspect of properties confers a causal aspect to the object instantiating the properties itself. But then, this is the very same situation as for the baseball: if real, the object is an overdeterminer of the causal physical properties it instantiates. An electron, for instance, is usually conceived of as being a particle having different properties: a charge, a spin, an inertial mass, an energy and so on. For a dispositionalist, these properties are dispositional: having a mass is the property to behave in a particular way when submitted to a gravitational field, and to affect the field in a related way. And it goes the same for the other properties.

In a way, absolutely everything that could be said about the electron and its behavior could be stated by simply describing its properties. Electrons would causally overdetermine their effects since any putative effect of an electron is also an effect of one or many causal properties of the

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<sup>5</sup> For a defense of the composition-as-identity view, see Van Inwagen (1994), Wallace (2011), Cotnoir (forthcoming); for a criticism see McDaniel (2008).

electron. But then, why should the dispositionalist believe in the reality of electrons if she can describe physical phenomena in terms of fundamental physical properties? It shows that the dispositionalist should not believe in either composite objects or physical particles. By moving causality from objects to properties, the category of object is not required anymore to sustain an ontological explanation of causality.

It is worth emphasizing that the causal nature of properties explains why properties are taken to be more fundamental than objects. We saw above that Merricks takes the parts to be more fundamental than the whole in the overdetermination of ordinary objects by their parts. This principle is essential to Merricks' argument. So, for the analogy to hold, it has to be shown that causal properties are more fundamental than objects. Fortunately, such a fact is entailed by the causal nature of properties. If objects could be described as being causal, this is *because* they are instantiating causal properties (in a framework in which causal properties are taken seriously). Here, 'because' can be interpreted as meaning that either properties are *more fundamental* than objects, or that properties are *identical* to objects. If properties are more fundamental than objects, then, the analogy between ordinary objects and physical particles holds. If objects are identical to the properties that compose them, it implies immediately a composition-as-identity view, something that, we saw above, is incompatible with the overdetermination argument. In short, if a dispositionalist believes in the overdetermination argument against ordinary objects (by rejecting the composition-as-identity view, and taking the parts as being more fundamental than the whole), then she also has to support an elimination of fundamental physical particles. More will be said in section 3.2 about the idea that properties compose an object or a particle<sup>6</sup>.

I shall now make a few remarks before turning to possible objections. First, how are we going to make sense of a world without fundamental physical particles? Here, it is worth noticing that physicists already accept the existence of some properties directly instantiated within space, without the mediation of objects. A field is a distribution of quantitative properties over a piece of space; these properties are supposed to evolve with time and can be read as being dispositions without generating particular difficulties. In particle physics, there are two kinds of properties, properties instantiated by objects, and properties instantiated by space (field properties). So, the idea that there might be properties instantiated not by objects but by something else is already to be found in particle physics: some properties are directly instantiated in spacetime, *by* spacetime.

Moreover, this idea of properties directly instantiated by spacetime is already defended in contemporary metaphysics. For instance, Schaffer (2009) endorses the view that the universe is a

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<sup>6</sup> In a nutshell, if properties are intrinsically causal, and if objects having them are real, then either these objects also are causal or not.

spacetime with properties directly instantiated at spacetime points. What about objects? He believes that objects are real and identifies them with regions of spacetime:

[G]iven that spacetime is one sort of substance, should material objects be regarded as a second distinct sort of substance? [...] No, says the monistic substantialist. Spacetime is substance enough. There is no need for the dualism of the contained and the contained (or for fundamental containment relations). When God makes the world, she need only create spacetime. Then she can pin the fundamental properties directly to spacetime (2009, 133).

*Substantivalism* states that spacetime is a substance, in accordance with an Aristotelian criterion of fundamentality: it is a substance whose existence does not depend on the existence of something else. Schaffer defends such a view and claims that the world does not need to be created with more ingredients than spacetime and properties to be the very world we are living in. In this, he endorses *monistic substantivalism*: there is no need for a further class of substances.

But Schaffer *is not* a nihilist about material objects. Indeed, he endorses what he calls the *identity view*. According to this view, material objects are identical to spacetime regions. He conceives of spacetime regions as pincushions for properties. Schaffer claims that, because properties can be construed as being instantiated by spatiotemporal regions, spatiotemporal regions are to be identified with objects. But this is another story. Strictly speaking, properties have nothing to do with the existence of objects. Properties are properties of spacetime.

Mark Heller endorses a different view but also endorses the idea of a world constituted of properties located within spacetime:

I proposed that a complete description of the universe can be given by describing the locations at which the fundamental properties are instantiated. What I need to emphasize here is the proposed completeness of this minimal description. The universe, as things actually are, can be completely described without mentioning, for instance, donkeys. I leave out nothing by not mentioning donkeys. This sounds more daring than it is. I do not deny that there are donkeys. The English sentence “there are donkeys” is true. This is compatible with my claim that the minimal description is complete, because “there are donkeys” is part of a higher level description of those same facts that can be described more minimally. [...] Whenever the fundamental properties are distributed thus-and-so, the region in which they are distributed can be described as containing a donkey. Of course, describing the region in donkey-terms is less specific than describing it in more fundamental terms. There are ever so many ways the properties could be distributed that would make a donkey-description appropriate (2008, 88).

At this point, it might seem odd to characterize Heller as being a nihilist. Strictly speaking, he is not denying that there are donkeys, or more generally, ordinary objects. According to Heller, objects are real but are not mind-independent. He writes:

The Donkey Problem (as I am calling it) concerns the relationship between more and less

fundamental ontologies. [...] The less fundamental objects are merely conventional (2008, 83).

According to him the less fundamental objects are real but conventional<sup>7</sup>. Hence, Heller should be described as conventionalist, not a nihilist about ordinary objects. Objects are real, but they are overdetermined descriptions of properties located within spacetime.

Schaffer and Heller agree that the world is made of properties located within spacetime. There are no objects or particles at the *fundamental* level of reality. Schaffer cashes objects out by the identity view, whereas Heller obtains them with his conventional theory of lesser fundamental ontologies. I will not discuss the advantages and drawbacks of these views here. But the moral to be drawn from Schaffer and Heller is that what exists primarily might be properties located within spacetime, or properties of spacetime. And it is an easy move to be a nihilist with this kind of fundamental ontology: it only requires dropping the identity view (in the case of Schaffer) or the conventional theory of objects (in the case of Heller). The resulting nihilist view has the cost of being more at odds with ordinary intuitions by denying existence to ordinary objects and particles. But, it also has the advantage of being more theoretically economical (fewer concepts are required) and ontologically parsimonious (fewer ontological primitives have to be admitted). Regarding how we are going to choose between the different theoretical frameworks, I shall stay agnostic here. What interests me is that there are genuine options for a metaphysician who sees some theoretical attraction in acknowledging the unreality of objects and particles. So I shall assume that an ontology lacking objects is quite appealing in its own particular way.

I come to my second remark. It is worth noticing that the overdetermination argument involves a specific kind of dispositionalism. It is not exactly true that a *dispositionalist* should not believe in physical particles: only a *microphysical dispositionalist monist* should not. Indeed, an important distinction holds between microphysical and macrophysical properties. For instance, the fragility of the glass is a macrophysical property, while the electromagnetic value of an electron is a microscopic property. The macroscopic dispositionalist believes in macroscopic dispositions, properties like the fragility of the glass. The microscopic dispositionalist believes in microscopic dispositions, properties like the property of generating an electromagnetic force when submitted to an electromagnetic field. Someone who is a macrophysical dispositionalist but not a microphysical dispositionalist would have a natural answer to the overdetermination argument: fundamental physical particles are not overdeterminers of fundamental physical properties, because fundamental physical properties are not causal, only macroscopic properties are<sup>8</sup>.

Third, it is worth emphasizing that I leave open the possibility that the classical

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<sup>7</sup> For a similar strategy, see Sidelle (1989, 2010).

<sup>8</sup> See for instance Prior, Pargetter and Jackson (1982).

overdetermination argument is unsound but this is another story. What I have shown is that if one accepts both dispositional monism and the overdetermination argument, then one has to endorse nihilism about physical objects. One who finds the reality of physical particles particularly attractive has then to choose between: 1) rejecting dispositional monism, or 2) denying the soundness of the overdetermination argument. And one who finds dispositional monism attractive has to choose between: 1) denying the existence of physical particles, or 2) denying the soundness of the overdetermination argument. So the argument can work both ways.

Moreover, as I have argued elsewhere (Le Bihan 2013), a nihilist account in terms of physical properties is superior to one in terms of physical particles. Indeed, my account is compatible with the possibility that we are living in a gunk world, that is, a world that is infinitely divisible into smaller and smaller proper parts, while classical nihilism is incompatible with this view (Sider 1993). One might ask, with Sider, how are we going to use a paraphrase strategy if there are no mereological atoms in a gunk world? But, as I showed, such a paraphrase can be provided in terms of *properties instantiated in spacetime* instead of *particles located in spacetime*<sup>9</sup>. Mereological atoms are identified with properties, while spacetime is supposed to be gunky. Hence, even if we are living in a gunky world, we also might be living in a nihilist world. I do not want to argue this further here, but I believe that nihilism about physical particles is the best road to nihilism about ordinary objects.

I shall now tackle possible objections to the argument.

### 3. Possible Objections

#### 3.1 Non-redundant causal properties?

Merricks (2001) distinguishes between cases where composite objects can exist and cases where they cannot. This distinction opens a possible way to refute the overdetermination argument against physical particles: physical particles are one of those very cases for which composition

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9 One could ask why we cannot use the overdetermination argument to show the unreality of spacetime in the same way. If objects are supposed to be made of properties instantiated by spacetime, should we not take spacetime as being causally redundant with respect to the properties its instantiates? However, I believe that spacetime is immune to the overdetermination argument. There is an important distinction between objects and spacetime regarding these causal matters. Spacetime is not supposed to be causal in the same way that properties and(or) objects are. Usually, to be real something has either to *be* spacetime or to be *within* spacetime. Spacetime is implicitly taken as an exception of the idea that to be real, something has to be causal. This is only true of the entities that are supposed to inhabit spacetime, not of spacetime itself. This is because causation is generally supposed to take place *within* spacetime. Hence, an argument based on causal redundancy cannot target spacetime itself.

occurs. So let us have a look at the conditions needed for composition to occur. As stated by Merricks, putative composite objects are real if and only if they possess *non-redundant* causal properties. Thus, Merricks is not exactly denying that there are any composite objects at all, but only denying that there are any causally redundant composite objects. As he writes:

Composite objects that cause things that their parts do not redundantly cause can resist the eliminative sweep of the Overdetermination Argument. We humans—in virtue of causing things by having conscious mental properties—are causally non-redundant. So the Overdetermination Argument fails to show that we do not exist (2003).

In a nutshell, Merricks assumes a kind of property dualism: mental properties are not identical with physical properties. By having these mental properties, humans cause things that are not caused by their physical parts. That is, properties of humans are distinct from properties of atoms arranged humanwise. Property dualism is a delicate matter, and is not interrogated here. What is important is that Merricks gives us the conditions of composition: *a putative composite object is real if and only if it has non-redundant causal properties.*

Then, to extend the overdetermination argument to physical particles, it has to be shown that physical particles do not have non-redundant causal properties with respect to causal properties themselves. But the formulation here is already problematic. Non-redundant causal properties with respect to causal properties do not even make sense. We could state it in a slightly different way: physical particles are expected not to be non-redundantly causal with respect to their causal properties. The idea on which rests the overdetermination argument against physical particles is that physical particles themselves do not have any kind of additional causality beyond the causal properties possessed by the putative physical particles.

The move of claiming that physical particles have specific causal properties that are not possessed by the object is not available. If an object possesses a causal property *P*, then *P* is causal by definition. So, it does not make sense to conceive of a cause that both is and is not a causal property of the object. In other words, there is no conceptual space for non-redundant causes in this matter. It is often said that causal properties *confer* causality on objects. But as I understand this idea, it means that an object is causal in the very same way its properties are. An object would cause nothing more than whatever is caused by its causal properties. There is no supplementary causality in putative objects beyond that of the causality pertaining properties.

Thus, the strategy of appealing to non-redundant causes is not available in the case of the overdetermination argument against physical particles. Or more exactly, it is conceptually impossible that an object is non-redundantly causal with respect to its causal properties. But

couldn't we construe physical particles as not causal at all?

Indeed, I have supposed that physical particles are necessarily causal. One could argue that denying the existence of physical particles on the mere ground that they do not enter into causal relations is overkill. Are really physical particles necessarily causal? Here, I was relying on a hidden assumption: what is uncausal is unreal. If physical particles can be real even if uncausal, then the overdetermination argument becomes ineffective. So the assumption that what is uncausal is unreal has to be motivated. However, this is a quite standard assumption. If one wants to stick with the view that physical particles are real but uncausal, then the task of translating the usual physicist talk into a particleless (in the sense of atomless) one will be a hard project. Still, this project has to be done, because particles themselves are not causal and cannot enter into causal explanations. How could it be possible to describe interactions between particles and fields if physical particles remain unconnected to the rest of the world? How could the physicist even make reference to particles if they are never causes or effects of physical events? I cannot see any reason to believe that physical particles could be both real and not causal.

### 3.2 The Mereological Objection

An important distinction could be made between ordinary objects and physical particles. Ordinary objects are supposed to be composed of atoms. So atoms are supposed to be parts of ordinary objects. That is, a mereological relation is involved, a part-whole relation. And the original overdetermination argument relies on such a mereological relation. By contrast, in the case of physical particles, physical properties are not supposed to be *parts* of physical particles. Properties are supposed to be instantiated by objects, not proper parts of them. In other words, physical particles are not supposed to be composed of physical properties. If the mereological relation is not present here, can we really use the overdetermination argument to establish the unreality of physical particles?

The essence of the overdetermination argument is that a whole is redundantly causal with respect to its proper parts and that we should be skeptical about its existence. Let us call this claim the *Redundant Whole Principle*. If properties cannot be parts of a physical object, then the principle that a whole cannot be both real and redundantly causal with respect to its proper parts does not hold anymore. To make relevant the asymmetry between the composition of physical particles by physical properties on one hand, and the composition of ordinary objects by physical particles on the other hand, it has to be shown that the principle does not hold in the case of particles. Is it so?

It is possible to endorse a theory in which a mereological relation is involved to structure

objects. L. A. Paul (2002, 2012) defends such a view under the name of *mereological bundle theory*. According to this theory, an object is a whole composed of properties. A property instantiation P is a property of an object O if and only if P is a *part of* O. Properties are then parts of objects. Literally<sup>10</sup>. Contrary to a more standard view of objects, objects are not entities located within spacetime. Spacetime locations themselves are properties. And those properties of location are parts of objects. It is worth noticing that taking the mereological relation as the ontological glue of objects is not a weird move; this strategy is actually an original and well-argued product available on the philosophical market, a genuine way to conceive of objects.

Following L. A. Paul, we can distinguish between extensional and logical parts of an object: a chair, for instance, is extensively composed of smaller spatial parts<sup>11</sup> and is logically composed of properties, such as, being red, having a curved armrest, having a flat seat, or having a location. Importantly, objects and properties are fundamentally different *vis-à-vis* mereology. Objects are involved both in extensional and logical mereology. By contrast, properties are legitimate candidates for mereology only in the case of logical mereology. That is, an object can be analyzed as being composed of smaller spatial parts (extensional mereology), but it can also be analyzed as being composed of ontological ingredients, such as, properties, relations, substrata, bundling relations, or whatever you take to be included in the fundamental ontology of the world (logical mereology).

Logical mereology is enough to ground the overdetermination argument against physical particles. In the same way an ordinary object is redundantly causal with respect to its physical particles, physical particles are redundantly causal with respect to its properties. I do not see any reason to privilege extensional mereology over logical mereology in a way that only an extensional overlap would make the job required by the overdetermination argument against physical particles. In the same way physical particles are supposed to be extensional parts of ordinary objects, physical properties are supposed to be logical parts of physical particles. And this is all that is needed for the Redundant Whole Principle to hold.

It could be objected that Paul's theory is far from being uncontroversial. If I need it to be true, my defense of the analogy between the two applications of the overdetermination argument would be, at best, weak. But I do not need it to be true. On the contrary, I need it to be false. Indeed, Paul's theory is a realist account of objects. According to her, an object is identical to a fusion of logical parts. The overdetermination argument can be used against Paul's account of objects: an

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10 By 'literally' I want to emphasize that a description of properties as parts of objects is not only a *façon de parler*. And this mereological structure of objects is mind-independent.

11 Or equivalently in a four-dimensional background, an ordinary object is composed of spatio-temporal parts.

object understood as a logical whole would be redundantly causal with respect to its proper logical parts. It should be clear now that what I need is the *concept of logical part*, not the whole mereological bundle theory of L. A. Paul.

Here it is interesting to grasp the big picture about extensional and logical mereology. Putative ordinary objects are supposed to have both logical and extensional parts. Let us go back to the example of the chair. It is extensively composed of smaller spatial parts and logically composed of properties, such as, being red, having a curved armrest, having a flat seat, or having a location. By having a logical part 'having a curved armrest', the chair also has an extensional part corresponding to this very logical part. That is, a logical part can have spatial parts. This is of course not always the case. The logical part 'being red', for instance, does not presumably have proper spatial parts. But a spatial part can also have proper logical parts. The curved armrest is a logical part of the chair, but is also composed of physical particles, that is, spatial parts. And usually, we stop here. I propose to extend the application of the concept of logical part to the concept of physical particle, understood as an extensional mereological simple. An extensional simple can be a logical composite. Hence, causal properties are logical parts of physical particles.

Unfortunately, one could now argue that the concept of *logical part* itself is controversial. It involves a particular theory of objecthood in which the relation between an object and its properties is compositional. This is far from being uncontroversial. Indeed, one could endorse either a *substratum view* or a *bundle view*. According to the bundle view, an object is a collection of properties tied together by a relational unifying device, the relation of composition. On the contrary, according to the substrate view, an object is a collection of properties tied together by non-relational unifying device, the substrate, understood as a *sui generis* entity instantiating properties (for a recent presentation and discussion of the two views, see Benovsky 2008). If a bundle view is endorsed, it is natural to construe the unifying device of properties, the bundling relation, as the mereological relation of composition (as we saw above, this is L.A. Paul's view). And if there is conceptual room for non-compositional bundling relations, it involves postulating a new *sui generis* relation, when the relation of composition is able to do the work. Hence, with respect to the bundle theory, it is reasonable to assume the relation between objects and its properties to be compositional (by endorsing the mereological bundle theory)<sup>12</sup>.

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12 A referee expressed legitimate concerns with the status of logical sums of properties when these sums do not correspond to complete ordinary objects (or entities that we ordinarily call ordinary objects). For instance, what is the *ontological status* of the sum of the property of being red and the property of having a curved armrest? Clearly, it is not an ordinary object. In L.A. Paul's view, these creatures are objects (that we can also construe as conjunctive properties) and are proper parts of all ordinary objects that share these properties (in the example, all the concrete objects that are red and have an armrest share the very same (numerically) proper part, the sum of the two properties). If one wants to avoid commitment to L.A. Paul's view of properties, an available move is to reduce

The more delicate matter has to do with the *substratum theory*. According to this view, properties are instantiated by a substrate. In this framework, it seems natural to believe that the relation between an object and its properties is not compositional. Substrates would be causal *in virtue of* having causal properties, by opposition to bundles that would be causal by being *composed by* causal properties. In the substratum view, the instantiation relation is *not* compositional. Hence, the overdetermination argument cannot get off the ground in a substratum view and supposes a bundle view.

What I just showed is a connection between four claims: (1) nihilism about ordinary objects, (2) dispositional monism, (3) the relevance of the overdetermination argument and (4) the bundle view. The four claims are incompatible, and one has to choose which one has to go. Or to put it differently, if a nihilist really believes that overdetermination is bad, one cannot construe fundamental physical particles as being bundles of causal properties. For instance, Merricks cannot identify fundamental physical particles with bundles of causal properties.

### 3.3 The Big Error Objection

By denying the reality of physical particles, I seem to challenge the whole practice of physicists in particle physics. Indeed, particle physics describes a world of fields and *particles*. In a way, in asserting that particles are unreal, am I not claiming that all particle physicists are wrong? This is a potentially devastating objection. One cannot assert with certainty that all physicists are wrong about their practice. If an error theory about physicist's beliefs is required, this would count as a strong objection against nihilism about physical particles.

But there is a natural answer to this objection: physicists can be wrong about the existence of physical particles without being wrong about their practice. Nihilists about physical particles are not claiming that there are no parts of the real world inhabited by properties corresponding to what we call particles: what they claim is just that *these parts of reality are not objects*. We have to carefully distinguish between the mind-independent matter, and *a priori* forms that we put on this matter and that are mind-dependent. Physicists are specialist of the empirical *data* of the world, not of the ontological categories we use to deal with those *data*. Thus, my strategy to answer the Big

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logical properties to collections of physical properties *plus* relations between these properties. For instance, the sum of being red and having a curved armrest is reduced to the property of being red and the geometrical relations that form a curved armrest. The referee pressed further that since we do not have *intuitions* about how to sum properties, and therefore, about the ontological status of such 'incomplete entities', it threatens the analogy with clearer cases of overdetermination involving extensional mereology. According to the referee, since we do not have intuitions on this matter, the natural way to go is to interpret the bundle view in terms of distributive, set-theoretical collections. I am not sure to understand why this move is supposed to be natural and I find the mereological view more convincing. But there is definitely room for discussion here.

Error Objection rests on the fact that, under a nihilist assumption about physical particles, particle physicists are not wrong about relevant facts in physics, but only about metaphysical facts irrelevant to their practice. It is important to point out that they are only wrong about metaphysical facts irrelevant to their practice: indeed, I believe that there are a lot of metaphysical facts relevant to it. For instance the concept of field is both a physical one and a metaphysical one.

Actually, physicists' mistake about objects is not specific to their field, but this is the very same mistake as the one of daily life about the reality of ordinary objects. In other words, the same fallacy operates both in common sense and in contemporary physics. It should not come as a surprise: most of physicists' practices are shaped by common sense, and usually, common sense is only minimally revised by physical discoveries, and only when it is strictly necessary to do so.

In sum, we should not worry too much about the Big Error Objection. The error is not so big: it is the very same error we make in daily life according to the nihilist. The nihilist about ordinary objects uses a paraphrase strategy to account for ordinary intuitions about the existence of ordinary objects. Likewise, the nihilist about physical particles uses a paraphrase strategy to account for ordinary intuitions about the existence of physical particles<sup>13</sup>. The physicist is just supposing, as we all usually do, that there are entities 'out there' behind properties. And this is a general inclination of the human mind, not some kind of result of an empirical investigation, not a claim so likely to be true that it would be scandalous to question it for philosophical reasons.

In this radical nihilism in which there are no fundamental physical particles, the linguistic and perceptual worries are answered in the same way as in classical nihilism, except that the mereological simples on which the quantification applies are properties, not objects. Classical mereological simples (mereological atoms) are replaced with another kind of mereological simples (physical properties).

## Conclusion

The dispositional monist, if she endorses nihilism about composite objects, has also to accept nihilism about fundamental physical particles. If I am right, I have shown that a dispositionalist has either to show that the overdetermination argument is unsound in some way or to accept nihilism about ordinary objects and physical particles as two components of a broader

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13 Or if you prefer conventionalism to nihilism, the conventionalist about physical particles uses a strategy in terms of scientific conventions to explain our intuition about atoms in the same way a conventionalist about ordinary objects uses a strategy in terms of ordinary linguistic conventions to account for our natural belief about their existence.

package. My argument also implies that Merricks has to choose between either admitting that fundamental physical particles are not real, or doubting about the existence of fundamental causal properties. I suggest, therefore, that if we live in a world inhabited by causal properties but not by chairs and tables, then we also live in a world without electrons and quarks, a world of dispositional properties, that is, a world of causal fields. The category of material object is a *chimera* the dispositional monist nihilist should let go<sup>14</sup>.

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14 I am very grateful to Jiri Benovsky, Annabel Colas, Filipe Drapeau Contim, Pierre Joray, Sylvain Roudaut, the Lagon Research Group in Rennes and two anonymous referees for comments and objections that helped me to improve this paper.

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