

Not a Matter of Space

Abstract: It is commonly thought that material objects must be spatial. Nothing could be material yet lack a spatial location. I think that this view is wrong. In this paper I offer a combinatorial argument against the view that material objects must be spatial. Different accounts of material objects are discussed and found susceptible to similar combinatorial style considerations.

One common claim made in the literature on the metaphysics of material objects is the *de dicto* claim that it is not possible for an object to lack a spatial location and be material.¹ No object could remain material and cease to have a spatial location. For example, Ned Markosian (2000)² and Hud Hudson (2005) hold that, to be material is just to bear some location relation to a region of space.³ Supersubstantialists such as Jonathan Schaffer (2009) argue that material objects are identical to the regions of spacetime that they occupy. W. V. O. Quine (1976, p. 497) understood material objects as “...the aggregate material content of any portion of space-time however ragged and discontinuous.”⁴ For the sake of convenience let’s call the view that it is not possible for an object to lack spatial location and be material “*the standard view*”. I believe the standard view is mistaken. The goal of this paper is to provide an argument against the standard view.

¹ Throughout the paper I talk about spatial locations and an object’s being spatial. In doing so I do not mean to be drawing a distinction between spatial and temporal locations in an unacceptable manner. I use the word ‘spatial’ in a way that can be read as interchangeable with ‘spatiotemporal’ and any arguments I have that material objects don’t need spatial locations are also arguments that material objects don’t need spatiotemporal locations.

² Markosian argues that to be a physical object is to have a spatial location but indicates that he takes ‘material’ and ‘physical’ to be synonymous, “... so that any definition of ‘physical’ containing ‘material’ is... circular” so I take it that Markosian’s account of what it is to be physical is also an account of what it is to be material. (2000 p. 381) In this paper I will follow Markosian in accepting this assumption.

³ Though Markosian and Hudson disagree about which location relation is the correctly characterizes material objects. For more details on this disagreement see Hudson (2005 pp. 2-3).

⁴ Quine then goes on to replace material objects with regions of spacetime. The reason I haven’t listed Quine as a supersubstantialist is that Quine goes on further to say that commitment to regions of spacetime can be eliminated in favor of or reduced to the ontology of pure set theory (1976 pp. 500-501). This would commit Quine to some form of what Schaffer calls anti-substantialism (Schaffer 2009 p. 132).

The paper comes in two sections. In the first section of this paper, I argue that, if we accept that material objects and regions of space are distinct (*dualistic substantivalism* from now on), we should accept the possibility of material objects that aren't spatial. I then consider and reply to what I take to be the two strongest objections to this line of thought. In section two, I argue that, even if we identify material objects with the regions of space they occupy (I will call this position *monistic substantivalism* from now on), we should still accept the possibility of non-spatial material objects.⁵ I assess some of the objections to the arguments I make along the way.⁶

1. Dualism and Spacelessness

Dualistic substantivalists think that there are material objects and there are regions of space those objects occupy; the former are distinct from the latter. Material objects are neither identical to, nor do they share parts with, the regions they occupy or any other region.⁷

⁵ Earlier I mentioned a view of the relation of material objects and space known as “supersubstantivalism”. Monistic substantivalism and supersubstantivalism are one and the same view. For example Schaffer (2009) uses the former title whereas Sider (2011) uses the later.

⁶ Allow me to make a few clarifications. First, throughout the paper I assume that some form of substantivalism is true. Substantivalism is the view that space (or spacetime) is an entity in its own right; space is not reducible to some other entities or the relations between them. Space is an extra addition to our ontology. Second, whenever I say (with a few exceptions) that something is spatial or not spatial I mean that the object has or lacks a *spatial location*, respectively. So, when I am concerned with whether or not it's possible for there to be non-spatial material objects, I am concerned with whether or not it is possible for material objects to lack a spatial location. Third, whatever the location relation ends up amounting to is unimportant to the case I'm making. Whichever theory of location is correct won't affect my argument. So, I will remain agnostic on what theory of location is true. Finally, I assume that a general Humean metaphysics of modality is true. For the purposes of this paper I accept the denial of necessary connections between distinct existences and the combinatorial principles that follow from that denial (or at least follow in its spirit).

⁷ Schaffer (2009 p. 133) cashes out dualistic substantivalism as the view on which material objects should be regarded as distinct sort of *substances* from space, where something is a substance if it is an un-derived, fundamental entity. Whether or not material objects are distinct substances is irrelevant to my argument, all I need is that material objects are distinct entities in the way I described above.

Given a suitable principle of recombination, the argument against the conjunction of dualistic substantivalism and the standard view is relatively straightforward. Lewis (1986) suggests the following as a rough guide to what is possible: “anything can coexist with anything else... [I]ikewise, anything could fail to coexist with anything else.” (p. 88) Slightly less roughly:

Object Recombination: For any given object there is a world with a duplicate that exists with, and a world with a duplicate that exists without, any contingent object distinct from it.^{8, 9}

To understand what object recombination gets us, we first need to understand what it is for one object to be a duplicate of another and what it is for two or more objects to be distinct from one another.

Two things are *distinct* (at least in the sense that I’m interested in) so long as they don’t overlap one another. Two things overlap *if and only if* they share a part. So, for example take two objects, say Ben Roethlisberger and the Minotaur. Roethlisberger and the Minotaur are distinct if they don’t share any parts. On the other hand, if they have a part in common (say that Roethlisberger’s right arm is the Minotaur’s left, or that they share the same torso) then Roethlisberger and the Minotaur are not distinct from one another.

To provide an account of duplication I need the distinction between properties and relations that are *fundamental* or *perfectly natural* and those that aren’t. Perfectly natural properties are characterized by the theoretical roles that they play. They carve nature at

⁸ The motivation for accepting Object Recombination is twofold (1) its usefulness in securing “that there are no gaps in logical space; no vacancies where a world might have been, but isn’t” (Lewis 1986 p. 86), and (2) it follows (or at least it follows in spirit) from the Humean denial of necessary connections between distinct existences.

⁹ This principle as stated might be weaker than the principle that Lewis has in mind, but it will do for the purposes of my argument.

its joints; the sharing or not sharing of perfectly natural properties makes for objective similarity and difference.¹⁰ They provide us with the sparse qualitative base needed to characterize the rest of reality without redundancy.¹¹

Now we're in a position to say what it is for one thing to be a duplicate of another. One thing is a *duplicate* of another if and only if (1) they have all and only the same perfectly natural properties and (2) there is a one-to-one correspondence between the parts of the one and parts of the other such that the parts of each have the same perfectly natural properties and stand in the same perfectly natural relations.¹² So Roethlisberger and Duplicateberger are duplicates of one another provided that Roethlisberger and Duplicateberger have the same perfectly natural properties and Roethlisberger's and Duplicateberger's parts can be put into a one-to-one correspondence that preserves the natural properties and relations between the parts of Roethlisberger and the parts of Duplicateberger.

Given these definitions of 'distinct' and 'duplicate' we can see what Object Recombination gets us. If there are worlds where the Minotaur exists and worlds where Roethlisberger exists, provided that the Minotaur and Roethlisberger are contingent and distinct from one another, then there are worlds where there is a duplicate of the Minotaur and not Roethlisberger, a world with a duplicate of Roethlisberger and not the Minotaur, and a world with a duplicate of both. Most importantly, for my purposes, there is a world with a duplicate of either one without a duplicate of other.

The argument against the dualist who is a friend of the standard view goes as such: Since the dualist is committed to material objects being distinct from space then,

¹⁰Lewis (1986, p. 60)

¹¹*Ibid.*

¹²*Ibid.*, p. 61.

given Object Recombination, there is a duplicate of a material object without there being a duplicate of anything else. This would include space. But then we would have a non-spatial material object. To see this, take a given material object like an electron. Object Recombination tells us that there is a world with a lonely duplicate of that electron that exists without anything distinct from it.¹³ And since, given dualism, the electron is distinct from space, there is a world with a duplicate of that electron where there is no space. If space doesn't exist in this world then there wouldn't be regions of space for the duplicate electron to occupy, so the electron wouldn't have a spatial location. So, we would have a non-spatial material object. The same line of reasoning would apply to Roethlisberger, the moon, a grain of sugar, or any material object.

The friend of the standard view would object, "Not so fast! Sure, you've shown us that a duplicate of a material object could fail to be spatial but you haven't shown us that the duplicate itself is material." The friend of the standard view may be fine with admitting the possibility of a duplicate of an electron that is not spatial, but would refuse to admit that this duplicate is a material thing.¹⁴

Two replies come to mind. The first is that the worlds with lonely non-spatial duplicates generated by Object Recombination should count as material worlds given a standard formulation of materialism.¹⁵ Lewis formulates materialism as follows:

¹³ Throughout the paper I use the word 'lonely' as shorthand for an object existing without anything distinct from it.

¹⁴ Markosian (2000) in responding to an objection to his Spatial Location Account of physical objects offers a similar line of thought "if this indeed is the claim [that sub-atomic particles can really lack spatial locations], then the Spatial Location Account entails, at the times when they lack spatial locations, non-physical objects; and this too seems to be the correct result" (p. 388). Since, Markosian thinks that materiality and physicality are the same I'd imagine that he would make this same sort of retort to my argument.

¹⁵ I use the word 'generated' figuratively. Object Recombination certainly doesn't literally generate worlds, but rather helps tell us what worlds there are.

Among worlds where no [perfectly] natural properties alien to our world are instantiated, no two differ without differing physically; any two worlds that are exactly alike physically are duplicates.¹⁶ (Lewis 1983, p. 364)

Lewis then says that materialism should be understood as “a contingent supervenience thesis, applying only among worlds devoid of alien natural properties” (p. 364). Assuming the truth of materialism we can say that a world is a materialist world if it does not have any perfectly natural properties alien to our own.¹⁷ But the worlds with the lonely duplicates of material objects don’t have any perfectly natural properties alien to our own. (Recall to be a duplicate of another thing requires that the duplicate to have exactly the same perfectly natural properties as the thing it is a duplicate of.) So they would count as materialist worlds. It seems plausible to assume that no world should count as a materialist world if none of the objects in the world are material. In fact, it seems completely implausible to think that a materialist world could be filled solely by immaterial objects. Since the worlds under considerations are occupied only by the duplicates of this-worldly material objects, the duplicates and their parts are the only candidates for being material objects. So either the duplicate or one or more of its parts are material objects. And since neither the duplicate nor any of its parts are spatial, either way we get the possibility of non-spatial material objects.

The second reply in favor of the materiality of the spaceless duplicate is that the property *being material* is an *intrinsic property*. Intrinsic properties are properties that can

¹⁶ A property is an *alien property* if and only if it is instantiated at worlds other than own but is not instantiated at our own world and it cannot be analyzed in terms of properties instantiated at our own world.

¹⁷ Should we count an empty world as a material world? If not, then we can say that a material world is any non-empty world with no perfectly natural properties alien to the properties of our own world. Since the worlds under consideration are non-empty worlds (they have the spaceless duplicates in them), this change won’t affect the argument at all.

never vary between duplicates.¹⁸ Since *being material* is an intrinsic property and intrinsic properties never differ between duplicates, the spaceless duplicates would be material.

Before offering an argument for the claim that *being material* is intrinsic, I would first like to point out a consequence of the definition of intrinsic given above. Under this definition all perfectly natural properties come out as intrinsic. The opposite is not the case though; not all intrinsic properties are natural properties. Intrinsic properties may be highly unnatural properties so long as they never vary between duplicates.¹⁹ The definition of intrinsic provides a couple of ways to argue that *being material* is an intrinsic property: we can argue that *being material* is a perfectly natural property or we can argue that *being material* is grounded completely in the perfectly natural properties that a thing has.²⁰ I will focus my attention on trying to show the latter of the two is the case.

The assumption that some material properties are perfectly natural seems very plausible. It follows from either materialism or dualism (which I take it are the positions held by the majority of philosophers) given that both are foundational ontological theses. Foundational ontological theses tell us about what the metaphysically basic entities (the ones that serve as the base to construct the rest of reality) are and what they are like.^{21, 22}

¹⁸ Lewis (1986 p. 62).

¹⁹ Lewis (1983 p. 387)

²⁰ I say that *being material* is completely grounded in the perfectly natural properties a thing has to leave open the possibility where a things materiality might be overdetermined by the perfectly natural properties it has and by some thing external to that thing.

²¹ I use the word ‘construct’ to remain neutral to whatever relation may be favored (whether it is grounding, supervenience, constitution, realization, etc.) for connecting (or generating) the non-basic entities with (from) the basic ones.

²² Some more exotic examples of foundationalist ontological theses are idealism, which aims to construct all of reality out of mental entities, and neo-pythagoreanism, which aims to construct reality out of mathematical entities. I do not know how to run my argument that *being material* is intrinsic if either idealism or neo-pythagoreanism turns out to be true. I take it that the likelihood of one of these two views being true is relatively low. Because of this I am fine with tentatively committing myself to the truth of either dualism or materialism.

Both dualists and materialists hold that material properties serve as part of the base for constructing the rest of reality.²³ Under either view material properties serve as part of the base for constructing the rest of reality. Forget the specifics as to how to specify the relation of construction between the metaphysical rock bottom and the rest of reality. Forget the specifics about how to characterize the material. What is important is that at least some of the properties that serve as the metaphysical base for constructing the rest of reality are material properties.

Now recall the last role that perfectly natural properties are supposed to play. They serve as the minimal base for characterizing the rest of reality without redundancy. So under either dualism or materialism some perfectly natural properties are material.

It seems true that if an object has material properties, then it is material object.²⁴ If this is right, then any object with perfectly natural properties that are material properties would be a material object. But then *being material* would depend completely on the perfectly natural properties of a material object and so come out as intrinsic. Thus, so long as we have good reason to accept that some of the perfectly natural properties are material properties, we have good reason to think that *being material* is intrinsic.

To sum up, so far I have offered an argument against the dualist friend of the standard view. Object Recombination plus dualistic substantivalism gives us the possibility of spaceless duplicates of material objects. We should think that the spaceless

²³ They just disagree about whether any *other* properties serve as part of the base for constructing the rest of reality.

²⁴ Maybe this principle is not quite strong enough. For example consider the fusion of my desk and a Cartesian ego. Is the fusion material? Presumably the fusion has whatever material properties it inherited from my desk. So given that if something has material properties, then it is material, the desk-mind fusion would be material. Some may find this conclusion problematic. If so, the argument can be rebuilt using similar but alternative principles. One example being: if all of the perfectly natural properties of an object are material, then the object is a material object.

duplicates themselves are material either (1) because the spaceless duplicates inhabit materialist worlds or (2) because *being material* is an intrinsic property.

2. Monism and Spacelessness

Here the friend of the standard view might give up her commitment to dualism and become a monist. Instead of recognizing occupants distinct from the regions they occupy, she will identify material objects with those regions.²⁵

Prima facie, monism seems to be better off than dualism. It is plausible that regions of space are intrinsically spatial. All of their parts stand in spatial relations to one another. So any duplicate of a region would have to be spatial. And since according to monism, material objects are identical with regions, it seems that Object Recombination wouldn't support the conclusion that material objects are only contingently spatial. But upon further investigation it becomes unclear whether the monist is better off than the dualist.

If monism is true it is not clear that it is *necessarily* true. Perhaps in this world all material objects are identical to regions of space and monism is true, but in some other world material objects are distinct from regions of space and dualism is true. If monistic substantialism is only contingently true and in some worlds dualistic substantialism is true then we can rerun our argument against the dualist from that world. Given that whatever is possible from one world is possible from any world, we get that it is possible

²⁵ In section one I argued against the friend of the standard view that took material objects to be mereologically distinct from the regions of space that they occupy. I have now moved directly to criticizing a view where material objects are identical to the regions of space that they occupy. This move might seem hasty. There seems to be room for positions that occupy the logical space in between the two aforementioned views. We could hold that either that material objects and regions partially overlap one another, or that material objects and regions completely overlap one another, while maintaining that material objects and regions are not identical. The reason that I don't discuss either of these in-between views in the paper is because I believe that that the argument made in this section generalizes into an argument the friend of the standard view that accepts them.

for there to be a material object that is not spatial. Thus, so long as the friend of the standard view thinks monism is contingent, she is still committed to the possibility of non-spatial material objects.

Perhaps the friend of the standard view would insist that monism is necessarily true. Dualistic substantivist worlds aren't possible, only monistic ones are. I will grant this to the friend of the standard view and argue that even if there are no dualistic substantivist worlds, it still is possible for material objects to lack spatial location.

There are two types of monism. *Unrestricted monism* identifies any region of space with a material object, whereas *restricted monism* identifies only regions of space that have some special property (or properties) with material objects.²⁶ If one accepts either unrestricted monism and that there are regions of space which are points, then one might think there are regions of space that are identical with material objects but are not intrinsically spatial.

Points don't have parts. So points couldn't be spatial because of their parts standing in relation to one another. Instead, points are spatial because they stand in spatial relations to other distinct regions of space. This means that points are not intrinsically spatial.

Both unrestricted and restricted monism seems committed to point-sized material objects.²⁷ Accordingly, Object Recombination gets us a world with a duplicate of the point but nothing else. Since Object Recombination gets us a world where there is a duplicate of this point but nothing else, and the points aren't intrinsically spatial, this

²⁶ See Schaffer (2009 p. 134).

²⁷ The unrestricted monist will accept point-sized material objects, because there are point-sized regions and every region is identical with a material object. The restricted monist should accept the existence of point sized material objects because some fundamental particles are standardly considered to be point-sized.

point-duplicate wouldn't be spatial. If we accept the reasons I offered in section one for the claim that *being material* is intrinsic, then the point-duplicate would be material. So we would have a world with a material object that isn't spatial. To reiterate: the point duplicate is material because the point has *being material* as one of its intrinsic properties and the point duplicate is not spatial because it has nothing to be spatially related to. Either version of monism combined with Object Recombination results in the possibility of non-spatial material objects.²⁸

The friend of the standard view might make either of two replies. First, she could deny that the possibility of atomic regions of space. Space is gunky. There are no points; each region of space can be divided into further subregions. And not only are there actually no points, points aren't even metaphysically possible. Since points aren't possible, she would argue, the reasoning behind the arguments just given above is mistaken. There aren't any possible regions, which aren't intrinsically spatial, because every region divides into multiple subregions which themselves are spatially related.

Second, she may argue that points are intrinsically spatial. Points don't need to be spatially related to anything distinct from themselves to be spatial. Points are already spatially related to themselves. A candidate relation for a fundamental spatial relation is a three-place relation of the form *the distance from x to y is r* that relates points of space to a number.²⁹ The friend of the standard view would then claim that any point of space

²⁸ Notice that this type of argument could be modified to serve against the friend of the standard view that is a relationist about space. If we isolate a point-sized bit of matter and make a duplicate of just it but nothing else then that bit of matter wouldn't be spatially related to anything else. So, we would have a material object that is not spatial.

²⁹ Skow (2007) points out that if this is the fundamental spatial relation it is not intrinsic. Regions can only stand in this relation by being appropriately related to numbers. The friend of the standard view would have to take another relation as fundamental for the spatiality of the point to be intrinsic to it. But, I will move on with my argument assuming that there is a candidate for a fundamental spatial relation that can do that work.

stands in the relation *the distance from itself to itself is zero*. Given that this relation is fundamental and only the parts of the point stand in it to themselves, the property would come out intrinsic. So the point would be intrinsically spatially related to something (itself) and so would be intrinsically spatial. So, too, any duplicate of the point would be intrinsically spatial. This includes our lonely duplicate of a point.

I don't know what to think of the first reply. I would like to believe that there gunky and non-gunky spaces alike are possible, though I have no argument for that conclusion. The second reply, on the other hand, seems decisive. That said I still believe there is good reason to think that even if there are no dualist substantialist worlds, non-spatial material objects are possible.

Let's recount the argument thus far. According to monism material objects such as Roethlisberger are identical with a region of space. Object Recombination can only get me a world where there is an isolated Roethlisberger duplicate (Duplicateberger) but Duplicateberger's parts are all spatially interrelated. Duplicateberger is a duplicate of a region of space, so this is of no surprise. Here the argument seems to reach a dead end. We've taken Object Recombination as far as we can take it. What I need is some principle that would allow me to remove the spatial relations Duplicateberger instantiates that make him spatial.

Bricker (1996) suggests such a principle; "I accept a principle of recombination for relations: any natural relation, or family of natural relations, can be instantiated in any pattern whatsoever" (p. 232). So, assuming that spatial relations are natural relations, one possible pattern of relations would be Roethlisberger's being ten feet from the Minotaur but twenty from Socrates. Another possible pattern is Minotaur's being ten feet from Socrates but twenty from Roethlisberger. But most importantly for our purposes, one

possible pattern is for the Minotaur, Socrates and Roethlisberger to stand in no spatial relations to each other. This provides us with all we need for our principle:

Relation Recombination: For any objects and any natural relation, or natural family of relations, there is a world with a subduplicate of those objects not standing in that relation, or family of relations.

Recall that something is a *duplicate* of another if and only if (1) they have all and only the same perfectly natural properties and (2) there is a one-to-one correspondence between the parts of the one and parts of the other such that the parts of each have the same perfectly natural properties and stand in the same perfectly natural relations. One object is a *subduplicate* of another either when (1) the first object lacks some perfectly natural properties the second has or (2) the parts of the first object lack some perfectly natural properties or fail to stand in some perfectly natural relations as the second object's parts and (3) the first object doesn't have any perfectly natural properties the second doesn't have, and the first object's parts don't have any perfectly natural properties and don't stand in any perfectly natural relations to each other that the second object's parts don't.

So, now let's reconsider Duplicateberger. Duplicateberger is an isolated region that is a duplicate of our Roethlisberger region. Duplicateberger and his parts are all spatially related to one another. By Relation Recombination we get that there is a world where we have a subduplicate of Duplicateberger's parts and Duplicateberger (call it "Subduplicateberger") that differs only in that this thing and its parts don't stand in any spatial relations to one another. Subduplicateberger wouldn't be a region of space, or spatial at all because neither it nor any of its parts would stand in any spatial relations. Nothing in that world would be spatially related, and if nothing is spatially related, then

nothing is spatial. So it seems, once again, that we are left with the possibility of a non-spatial, material object.³⁰

Here the friend of the standard view may again try to push the objection that although we are left with a non-spatial object, the object we are left with is not a material one. It seems here that here the objection holds more weight than when it was made earlier by the dualist. For example, it might be argued that we can't just claim here that because *being material* is intrinsic that Subduplicateberger is material. To get Subduplicateberger, we had to use Relation Recombination to remove some of Duplicateberger's intrinsic properties, namely his spatial properties and whatever properties solely depended on his spatial properties.

Even though the fact that *being material* is an intrinsic property is not enough to establish Subduplicateberger's materiality, the argument offered in section one can be modified into a new argument for the conclusion that Subduplicateberger is material. Recall that the argument in section one made use of the claim that, if something has material properties, then it is material. So if Subduplicateberger has material properties, then he would be material. This requires two further assumptions both of which seem plausible (1) there are material properties that are perfectly natural and are not identical with the spatial ones, and (2) Subduplicateberger has some of the properties specified in (1). In support of (1), *determinate mass*, *charge*, and *charm* are candidates for perfectly natural properties and aren't identical with spatial properties. And, since Roethlisberger has a determinate mass, Duplicateberger would have the same mass, because determinate mass is perfectly natural, and perfectly natural properties never differ among duplicates.

³⁰ This argument as well could be adapted against the relationist friend of the standard view. Take any material object, Object Recombination will get that object in isolation, and Relation Recombination will remove the spatial relations it stands in.

Further, since Subduplicateberger is a duplicate of Duplicateberger minus the spatial relations, Subduplicateberger would have the same determinate mass as Duplicateberger. So, Subduplicateberger would have material properties; this means that Subduplicateberger is material.

A further consideration in favor of Subduplicateberger's being material is that the world containing Subduplicateberger satisfies the criterion for being a materialist world drawn from Lewis (1983). According to Lewis's formulation of materialism, a world is materialist just so long as it doesn't have any perfectly natural properties alien to our own. But Subduplicateberger's world doesn't contain any perfectly natural alien properties to our own. His world only contains a proper subset of the perfectly natural properties our world has. Therefore, Subduplicateberger's world would be a materialist world. Since it seems completely implausible to suppose that a world could be a materialist world but be filled with objects that aren't material, either Subduplicateberger or Subduplicateberger's parts must be material. Either way we are left with the possibility of a non-spatial object that is material.

References

Bricker, Phillip. "Isolation and unification: The realist analysis of possible worlds." *Philosophical Studies* 84, no. 2 (1996): 225-238.

Hudson, Hud. "The metaphysics of hyperspace." (2005).

Lewis, David K. *On the plurality of worlds*. Vol. 322. Oxford: Blackwell, 1986.

Lewis, David. "New work for a theory of universals." *Australasian Journal of Philosophy* 61, no. 4 (1983): 343-377.

Markosian, Ned. "What are physical objects?." *Philosophical and Phenomenological Research* (2000): 375-395.

Quine, Willard. "Whither physical objects?." In *Essays in memory of imre lakatos*, pp. 497-504. Springer Netherlands, 1976.

Schaffer, Jonathan. "Spacetime the one substance." *Philosophical Studies* 145, no. 1 (2009): 131-148.

Sider, Theodore. *Writing the Book of the World*. Oxford University Press, 2011.

Skow, Bradford. "Are shapes intrinsic?." *Philosophical Studies* 133, no. 1 (2007): 111-130.