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Monism, Emergence, and Plural Logic

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Abstract In this paper I argue that we need to take irreducibly plural logic more seriously in metaphysical debates due to the fact that the verdict of many metaphysical debates hangs on it. I give two examples. The main example I focus on is the debate recently revived by Jonathan Schaffer over the fundamental cardinality of the world. I show how the three main arguments provided by Schaffer are unsound in virtue of an employment of plural logic. The second example I give is a more general issue about the possibility of emergent properties of mereological wholes. Employing plural logic there is a new way to understand such cases. The upshot is that plural logic greatly matters to metaphysics and hence can no longer be ignored the way it has in this area.

Consider the pre-Socratic debate over whether the world is one or many. While Philolaus says: *the world is one*, and Heraclitus says: *listening not to me but to the account, it is wise to agree that all things are one*, Ion of Chios says: *all things are three, and there is nothing more or fewer than these three things*. Zeno was a bit more ontologically promiscuous, albeit conditionally: *if more things than one exist, the things which exist are limitless. For there are always others between the things which exist, and again others between them. And in this way the things which exist are limitless.* Melissus disagrees: *for if it is limitless it will be one. For if there are two, they cannot be limitless, but will have limits against one another. … there exist just one thing.*[1] This debate has continued up to our own days.[2]

[1] As in Barnes (2001: 179, 50, 182, 103, 95–97).

[2] See Schaffer (2007b).

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But in saying that the world is one, does Philolaus really mean to deny the ordinary claim that it has proper parts like pebbles, stars, and himself? In saying that all things are one, does Heraclitus mean to deny the ordinary claim that he and I are two different things? It is indeed highly uncharitable to interpret someone as denying such obvious facts. Schaffer (2010a) therefore, suggests that in saying that the world is of a certain cardinality we should understand the claim as denying neither the obvious fact that pebbles, stars, and you and I are many distinct existing things, nor that the world is one. Rather, we should understand it as a claim about how many things there *really* are. It should be understood as a claim about the *ontologically privileged* or most *fundamental* way of describing the world and all things in it. Thus construed the debate takes on a whole new interest, and it has recently been shown that there are many new lessons to be learned from it so understood.[3]

But in what follows I will add another destructive lesson by bringing *plural logic* into the picture. By 'plural logic' I here mean an *irreducibly* plural logic, a plural logic incapable of being fully understood in non-plural terminology.[4] Such plural logic is nowadays taken seriously by logicians as well as philosophers of language, but unfortunately not equally so by metaphysicians. But this must change because the post-Schafferean debate over the fundamental cardinality of the world is a good example of a contemporary metaphysical debate that stumbles over not doing so. Or at least so I will argue.

I first briefly present our case study as a debate over the ontologically privileged cardinality of the world (Sect. 1). I then show how three arguments from Schaffer (2010a) in favor of the world being fundamentally one are unsound by the employment of irreducibly plural logic (Sect. 2). The upshot is that since a metaphysical debate turns on it, metaphysicians *must* take such plural logic seriously. I finally bring this point home by discussing a related metaphysical debate for which it is equally relevant, but unfortunately equally neglected, namely that of a particular form of emergence in connection with mereological wholes (Sect. 3).

My overall intention in this paper is thus to achieve two things. First, I intend to show that some recent metaphysical arguments can be blocked by an employment of irreducibly plural logic. Second, I intend to show that metaphysicians cannot ignore an irreducibly plural logic because the verdict of many of their debates hangs on it.

1 Is it one or Many?

For the sake of argument we follow Schaffer (2010a) and couch the debate in terms of mereology as restricted to the concrete objects only. In particular, we make four initial assumptions:

(i) U exists

[3] See e.g. Schaffer (2007a), (2009b), (2010b); Sider (2007b), (2008); Trogdon (2009a), (2009b), (2010); Skiles (2009), and Cameron (2010).

[4] For a discussion of such irreducibly plural logic, see Rayo (2002), (2007); Oliver and Smiley (2001), (2006), and Yi (2005), (2006).

(ii) U has proper parts
(iii) U is the fusion of all fundamental objects
(iv) No two fundamental objects overlap

where U is the fusion of all concrete objects; y is a fusion of some things xx iff each part of y overlaps at least one of xx and each one of xx is a part of y; two things overlap iff they share a part; and y is a proper part of x iff y is a part of x but not identical with x.

Waiving the first assumption would rule out the position that the (concrete) world as a whole is fundamentally one, and thus settle the debate in favor of it being many before it even gets started. Waiving the second assumption would rule out the opposite position that the (concrete) world is fundamentally many (more than one), and thus settle the debate in favor of it being one before it even gets started. Waiving the third assumption would rule out the view that the (concrete) world's parts are fundamentally one because if U is not the fusion of all fundamental objects, there would be fundamental objects that aren't parts of U (and hence the (concrete) world wouldn't be one). And finally, waiving the fourth assumption would not only imply too much ontological redundancy, but it would also, since overlapping objects cannot be freely re-combined, create necessary connections among fundamental objects, which plausibly should be freely re-combinable.

But in order to make sense of the very debate at all, we also need a fifth assumption, namely that there is a meaningful notion of fundamentality at hand, and which tracks the mereological hierarchy. Whichever parts are more fundamental somehow *grounds* the parts that are less fundamental. We follow Schaffer here too and assume that this notion of grounding is a well-founded, partial ordering; i.e. irreflexive, asymmetric, transitive, and with minimal elements:

(v) There is a meaningful notion of grounding which is a well-founded partial ordering of all concrete objects, and which tracks the mereological hierarchy

Since the details don't matter much for our present purposes, I will not discuss them further here.[5] In any case, with these five assumptions in mind, we can now construe the debate as being over the following question: *does the world really, most fundamentally, have one or many parts*?

By (i–iv) it follows that the question admits of two and only two answers:

Monism: there is exactly one fundamental object and it is U
Pluralism: there are more than one fundamental object and neither one of them is U

And thus the debate is up and running.[6]

[5] In addition to Schaffer (2010a), see also his (2009a). For an alternative model of grounding, see Rosen (2010).

[6] Well, not quite. There are subtleties here concerning the thesis of composition as identity, the view according to which a mereological whole is identical with all its parts collectively. Schaffer claims we must assume it is false. I think not, as long as we tweak a bit with the notion of grounding. But in any case, composition as identity is widely assumed to be false, and I think we can assume so too for present purposes.

2 Monism and Plural Logic

Schaffer (2010a) provides three arguments in favor of monism, against pluralism. I will now show why these arguments are unsound by the employment of irreducibly plural logic.[7]

2.1 The Argument from the Possibility of Gunk

We say that something x is a *mereological atom* iff x has no proper parts; that *mereological atomism* is true iff the world is a fusion of mereological atoms; and that a world w (or U) is *gunky* iff each part of w has a proper part. Now consider the following argument:

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

Schaffer justifies premise 1 by our fifth assumption above, namely that grounding must terminate (i.e. there can be no endless grounding) together with the fact that the view according to which grounding terminates somewhere in the middle of the mereological hierarchy is objectionably arbitrary and too *ad hoc*. Let's accept this premise for the sake of argument. According to Schaffer, premise 2 is justified by the assumption that *grounding must terminate in the same way in all possible worlds*. Though this assumption is not essential for getting the debate off the ground in the same way as assumptions (i–v) are, once made it is a substantial assumption nonetheless that must be numbered along with the others:

(vi) Grounding terminates in the same mereological direction in all possible worlds

That is, if grounding terminates in the many parts, then it necessarily terminates in the many parts, and if grounding terminates in the one whole, then it necessarily terminates in the one whole. Whichever position is true is necessarily true. Premise 3 is provable: it follows by definition that gunky worlds have no mereological atoms; hence if they are possible, there is at least one possible world without such atoms, which means that it is not necessarily true that there are mereological atoms. By contraposition: if it is necessarily true that there are mereological atoms, then gunky worlds are impossible. We assume premise 4 for the sake of argument. Conclusion 5 logically follows from premises 1–4. Given that monism and pluralism are the only options on the table, it follows from 5 and (vi), that monism is necessarily true.

[7] Schaffer (2010a) also provides a fourth argument from common sense, which I will simply ignore for present purposes. Neither Schaffer nor anyone else I know of takes it to carry any significant weight in the debate.

Though I would personally be willing to deny premise 1 *and* premise 2 (and hence (vi)) for reasons quite independent of a metaphysical interpretation of plural terms, I believe the whole argument also begs the question against many pluralists precisely by neglecting the metaphysical importance of plural logic. Let me explain.

We say that a world w is *junky* iff each thing in it is a proper part.[8] Let *mereological Uism* be the view as per (i), namely the view according to which there exists a maximal fusion U with everything as its parts. Then consider the following *analogous* argument against monism[9]:

6. If monism is true, then mereological Uism is true
7. If mereological Uism is true, then mereological Uism is necessarily true
8. If mereological Uism is necessarily true, then it is impossible that the world is junky
9. It is possible that the world is junky
10. Hence, monism is false

Given that monism and pluralism are the only options on the table, it follows from conclusion 10 together with (vi) that pluralism is necessarily true.

The justification for 6–9 is independently *analogous* to the justification for 1–4. So why should the pluralists fear 1–4, if the monists don't equally fear 6–9? As far as I can see, the pluralists should fear 1–4 *iff* the monists fear 6–9. But then neither side has an advantage over the other, and as such each argument begs the question against its opponents.

But Schaffer provides five sets of considerations in favour of there being an asymmetry such that 1–4 has force, while 6–9 doesn't. The considerations are all meant to show that 4 is true, while 9 is false: gunk is possible, while junk is impossible. I will now argue that all these considerations fail too, to some degree or other, in virtue of not taking plural logic metaphysically seriously.

First, intuitively, 'world' seems to be a singular term standing for an object. As such, worlds could not be junky since a junky world is not an object, but rather a plurality of objects. But there is no good reason for the pluralist to believe that 'world' behaves this way, far less to believe it *must* behave this way. The term 'world' might simply be a plural term standing for all concrete existing things as a genuine plurality. Whether 'world' is a singular or a plural term depends on whether the world is a singular object or a plurality of objects; not the other way around![10]

Second, possible worlds are understood as concrete possible objects, and as such junk cannot exist *at a possible world*. The world would "top off" the junk. Schaffer treats this as a platitude about possible objects.[11] But there is no reason for the pluralist to believe that possible worlds must be singular concrete objects. Possible

[8] For a discussion of the possibility of junk, see Bohn (2009a, b).

[9] Note that this argument 6–10 against monism is an independent argument against monism that does not depend on assumptions (i–iv) from earlier. As such it is not a problem for my argument that it for example follows from premise 9 that U does not exist.

[10] In fact, there might be some reasons to think that 'world' *is* a plural term. See van Fraassen (1995) and Simons (2003). Note also that a mereological nihilist must accept that 'world' is a plural term.

[11] This is of course merely a metaphysical version of the first semantic consideration against the possibility of junk.

worlds might simply be possible concrete *pluralities* of objects. And as such the pluralist is free to believe that a possible object must exist at a possible world in the sense that it must exist at a plurality of objects.

Third, U is 'the primary subject matter of physical cosmology'. In support of this, Schaffer provides a quote from Hawley and Holcomb (2005: 5), where they define cosmology as 'the study of the formation, structure, and evolution of the universe as a whole'. But of course, a junky pluralist will simply understand 'the universe as a whole' as meaning *the plurality of all things*. Cosmology would not collapse, nor change any of its ways, if the world turned out to be an infinite plurality without a maximal fusion.[12]

Fourth, classical mereology logically guarantees the existence of U, but not that of mereological atoms. That is, classical mereology has gunky models, but no junky models. But then why should the pluralists accept the necessity of classical mereology? In fact, the pluralists could argue perfectly analogously from the necessity of some non-classical junky mereological system containing atoms, call it JM: JM logically guarantees the existence of mereological atoms, but not that of U. That is, JM has junky models, but no gunky models.[13]

But, fifth, Schaffer further argues that 'virtually no plausible accounts of when composition occurs allow for junky models'. But if unrestricted composition is a plausible account of when composition occurs: *any xx have a fusion*, then certainly the following is also a plausible account of when composition occurs: *any x and y have a fusion*. (At least this is so for a pluralist!) Over a plurality of infinitely many simples, this principle of composition provides a junky model.[14]

I conclude that 1–4 stand and fall together with 6–9, and that the monist thus has no upper hand here. This is seen as above by taking plurals metaphysically more seriously.

> Schaffer (2010a: fn41) also says that
> the arguments for the possibility of gunk … prove crucial. For they provide *independent* rationale for inferring the falsity of pluralism from the possibility of gunk, rather than turning the argument around and inferring the impossibility of gunk from the alleged truth of pluralism.

But, as I argue in my (2009a, b), the possibility of junk is *independently* plausible to the same degree as the possibility of gunk is independently plausible, where by 'independent' we mean being independent of any particular mereological system.

[12] In fact, whether there are fusions is at least partly an a priori matter, and as such physical cosmology, as an *empirical* discipline, should be neutral on whether there are any fusions at all.

[13] JM could be the necessity of some strong, but intuitively complicated mereological system, or it could be the necessity of some weaker, but intuitively simple mereological system. The latter seems of course the most plausible. For example, the necessity of the reflexivity, antisymmetry, and transitivity of parthood together with the necessity of an axiom of there being infinitely many atoms, but only fusions of finite cardinality provides such a weaker, but intuitively simple system. See my next point immediately below.

[14] This is so because by this principle there are only finite fusions. As stated, the principle simply provides no way of fusing *all* the infinitely many simples at once. It can fuse more and more things, two and two at a time, and as such get bigger and bigger composites *approaching* infinity, but it can never fuse infinitely many things at once.

Both possibilities are logically consistent in the sense that they have mereological models,[15] and both possibilities are independently equally (positively) conceivable. Admittedly, the possibility of gunk might be and have been taken more seriously in physical science,[16] but that is no good guide to mere metaphysical possibility. Thus, the pluralist can again say analogous things:

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

The pluralist should thus remain completely unmoved by the argument from the possibility of gunk. There simply are certain mereological scenarios neither the monist nor the pluralist has a way of handling. There is no convincing asymmetry between the two positions. We can see this by taking plural logic seriously in our metaphysical studies.

2.1.1 A Dialectically Unfortunate Set-Up?

It now emerges that the way the debate was set up in Sect. 1 above was dialectically unfortunate. There it was assumed that U exists, but not that mereological atoms exist. From the argument 1–4 it followed that monism is necessarily true. But this begs the question against many pluralists. It is as if the pluralist assumed at the outset that there are mereological atoms, but no U. From 6 to 9, it would analogously follow that pluralism is necessarily true.

But without one of these assumptions the debate would never get off the ground, at least not assuming (vi). Rather, the debate would have to be over a matter of contingency. Having already questioned (vi), the assumption that grounding must terminate in the same mereological direction in all possible worlds, it should come as no surprise that I don't see such a contingency as very objectionable. But there is a way of repairing the debate such that it is capable of getting off the ground *and* be about a matter of necessity. It must be assumed at the outset both that U exists *and* that there are mereological atoms. Then the possibilities of gunk and junk provide equally valid objections, and as such can be equally rejected. As such grounding can terminate in one and only one of the two mereological directions. But of course having rejected the possibilities of gunk and junk, which direction is it? Is it towards the one whole, or is it towards the many parts? I will now consider two more arguments, the rejection of which invokes the notions of pluralities and plural properties.

2.2 The Argument from Quantum Mechanics

Let's assume that Quantum Mechanics (QM) is the best theory of the fundamental structure of the world. From QM we learn among other things that two or more

[15] One can of course not here assume mereological models to be *classical* mereological models.

[16] Cf. Schaffer (2003) and Bohn (2009b).

particles are in a state of *entanglement* just in case they are perfectly anti-correlated with respect to their properties of spin. The crucial point for our purposes is that there is no way in the mathematical formalism of QM to always calculate the individual spin properties of either x or y independently of the other. Thus, Maudlin (2002: 266) says: *the quantum state of the composite system cannot always be considered to be merely the logical sum of the individual quantum states of its components. This is the source of the holism and interconnectedness of quantum states…*

Schaffer thus provides the following argument:

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

By assumption (vi), that grounding terminates in the same direction in all possible worlds, it follows that monism is necessarily true. Premise 1 is here justified by appeal to Big-Bang theories about the beginning of the universe (or U) together with certain interpretations of QM. Let's grant premise 1 for the sake of argument. Premise 2 is justified as follows. Assume mereologically atomistic pluralism is true.[17] Then since U is an entangled system and an entangled system is such that it cannot always be considered to be merely the logical sum of the individual quantum states of its components, i.e. the system as a whole is not reducible to its individual components, but rather has an ineliminable wholeness to it, it follows that a mereologically atomistic ground is not sufficient for U. Schaffer (2010a: 53) thus says:

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

If this argument is right, then conclusions 3 and 4 follow. Together with assumption (vi) it follows that monism is necessarily true.

But the argument is unsound. Consider again two particles in a state of entanglement. Taking plural logic metaphysically seriously, it is simply false that duplicating the intrinsic properties of these particles, along with their spatiotemporal relations, does not metaphysically suffice to duplicate their fusion and its contents. The pluralist should simply say of the two particles that *they* have a quantum property Q. Having Q is a *plural*, *collective* intrinsic property of the *two* particles. A plural collective property is a property holding of some things xx taken together, but not holding of each one of xx individually.[18] For example, whenever some things xx surround something y, no one of xx surround y, but rather they all do it together;

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

[18] Formally, an n-place predicate $F(xx_1,\ldots xx_i,\ldots xx_n)$ is *distributive* in its *i*th place iff each one of xx_i is F; and it is *collective* in its *i*th place iff it is not distributive in its *i*th place.

i.e. xx surround y in virtue of their *collective* features. Likewise, the pluralist should say that *they*, the particles, have Q due to their collective nature. As long as the property Q is understood along the lines of the property of surrounding something, there is no need for a whole to ground anything. Thus, the mereological atoms together with their spatiotemporal relations and intrinsic plural properties *do* metaphysically suffice to duplicate the cosmos and its contents. We must just not forget to duplicate their plural collective properties as well as their singular properties.[19]

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

Understanding quantum entanglement as a plural collective property solves both problems. First, a plural, collective property of xx is not a property of each one of xx, but rather a property of all of xx collectively. As such there is no problem with the interpretations of QM according to which there simply are no *individual* particles to serve as values independently of the other particles because according to plural collective properties the individuals serve as values together, collectively. If the objection is that there are no particles whatsoever, which might seem to be what Schaffer hints at, then if correct one might suspect that there are no pluralities of particles either, and if so the move to plural collective properties of particles might also seem not to help. But this last move is far from obvious. It might be that there are no individual particles, capable of being individuated by themselves, but that there nonetheless are pluralities of particles individuated collectively. The above objection (and my possible reply) is of course far too general and controversial for me to adequately discuss here, but it suffices for present purposes to note that *in any case* one cannot enter into this debate without taking plural logic seriously.

Second, accepting plural collective properties of entanglement we don't need a new property for any new "member" of xx. *Being classmates* is a plural collective property of some people xx. If one of xx drops out, the rest of xx keeps the very same plural collective property. No one dropout can keep the rest from being the same classmates as before!

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

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

2.3 The Argument from the Mere Possibility of Emergence

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

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

Where an emergent property of a whole is a property that is not a logical product of the set of intrinsic properties of its proper parts together with their spatiotemporal interrelations (as well as any other fundamental interrelations there might be). Quantum entanglement was supposed to be an actual example of such an emergent property. Premise 1 is thus just a modal weakening of the case above where it was argued that there actually are such emergent properties. We've now retracted to only assuming that there *could* be such emergent properties of the whole. But as I argued then, such emergent properties need not be understood as properties of a composite whole, but can rather be understood as a fundamental plural collective property of the many ultimate parts. The pluralist is thus free to treat 'U' as a plural term, and emergent properties as fundamental plural collective properties. But note that it is then important that they are treated as being *fundamental* plural collective properties so as to separate them from other plural collective properties like surrounding something, which presumably are reducible to other properties and relations. As such, the pluralist is also free to accept premise 1 under one interpretation (namely, the plural collective one), but reject it under another interpretation (namely, the singular one). Pluralists are thus also free to reject premise 2. Or if they have agreed to assume that U as well as mereological atoms exist as per Sect. 2.1.1 above, pluralists can instead simply deny premise 2 on the basis of denying the singular interpretation of premise 1: it is impossible for U as a composite singular object to have an emergent property. Emergent properties are necessarily fundamental plural collective properties of the many proper parts of U. The composite U is thus always and necessarily fixed in terms of its many proper parts and their (singular and plural) properties and interrelations. In duplicating the many proper parts (and preserving their interrelations) one must always duplicate them *plurally* as well as individually, and as such it always and necessarily suffices for duplicating the one whole. For the pluralists, the one whole is thus necessarily grounded in its many parts, and premise 1 and 2 are both false, and hence the conclusion doesn't follow.

3 Emergence and Plural Logic

We have so far seen how a particular metaphysical debate turns on taking plural logic seriously. I have not said anything particular about the metaphysics underlying

an employment of irreducibly plural logic, nor do I think I need to for present purposes, other than that it should be discussed just as much as the metaphysics of singulars are discussed. For example, we need to seriously discuss whether fundamental properties can be plural collective properties, or whether they must always be singular properties. We cannot just take one of the positions for granted. This follows from the fact that the verdict of the above metaphysical debate hangs on it.

I will now briefly discuss another metaphysical debate that turns on taking plurals seriously, namely that of the possibility of emergence in connection with composition as identity.

Composition as identity is the thesis that a mereological fusion is identical with all its parts collectively.[20] The whole is the same portion of reality as all its parts: it is them and they are it. McDaniel (2008) provides an argument against this thesis from the possibility of emergent properties:

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

Let's for the sake of argument assume premise 1. As we saw above, a state of entanglement of particles might in fact be such a property. According to McDaniel, it should thus be thought of as an emergent property of their fusion.[21]

McDaniel justifies premise 2 by the following line of reasoning. Assume for *reductio* that composition as identity is true and that emergent properties are possible. Let xx be some two or more things and $f(xx)$ be their fusion. Consider some emergent property F of $f(xx)$. Then F is not a property of xx since it is not in any way a logical product of their intrinsic natures and spatiotemporal interrelations. F is something novel compared to the intrinsic properties and spatiotemporal interrelations of xx. That is, the emergent property F is exclusively a property of $f(xx)$, not a property of xx. But then xx and $f(xx)$ differs in properties, and thus, by the principle of indiscernibility of identicals, $xx \neq f(xx)$. Hence, composition as identity is false.

By employing plural logic, McDaniel's argument has a fairly obvious solution in rejecting premise 2. For any emergent property F of $f(xx)$, there is a fundamental plural, collective property F* of xx such that $F = F^*$.[22] That is, according to the composition as identity theorist, any emergent property of the fusion should simply be thought of as a terminological variant of a fundamental plural collective property of all the parts, and vice versa. In that way the composition as identity theorist can hold that emergent properties does not violate the principle of indiscernibility of identicals. McDaniel's argument from the possibility of emergent properties is thus

[20] For references as well as a critical discussion of composition as identity, see Sider (2007a).

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

[22] Or alternatively, such that $Ff(y_1,\ldots,y_n) \leftrightarrow F^*y_1,\ldots,y_n$, where F* is a fundamental plural collective one-place predicate. As above, the plural properties must be *fundamental* to separate the emergent ones from other more ordinary supervening plural collective properties like 'surround'.

another example of a metaphysical debate that turns on the notion of plural logic and hence needs to take it more seriously.

This is not only an issue for proponents of McDaniel's argument. The point generalizes. Mereological nihilism is the view according to which nothing has any proper parts. The most famous version of such a view holds that there is a plurality of mereological atoms arranged in various ways, but no composite objects whatsoever.[23] Such a view cannot accept that there are emergent properties of composite-like things, i.e. of mereological atoms arranged composite-wise. For example, on such a view there cannot be emergent properties of chair-like things, i.e. of mereological atoms arranged chair-wise. But taking plurals seriously, there is a way of explaining how there *can* be such emergent properties: they are fundamental plural collective properties of the mereological atoms arranged composite-wise.

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