The Pitfalls of Microphysical Realism

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Microphysical realism is the position that the only real entities and properties are found at the most fundamental level of nature. In this article, I challenge microphysical realism concerning properties and natural kinds. One argument for microphysical realism about entities, the "nothing-but argument," does not apply to properties and kinds. Another argument, the "causal exclusion argument," cannot be sustained in light of modern physics. Moreover, this argument leads to an objection against microphysical realism, based on the "illusoriness of macroproperties." Another objection is based on the possibility that there is no fundamental level but a "bottomless pit."

1. Introduction. Many metaphysicians now hold that the only real properties are the fundamental microphysical ones. Which properties are those? Presumably, the properties possessed by the fundamental constituents of the universe, that is to say, the smallest entities in the universe. It is not that these properties themselves are fundamental, for it is not clear exactly what that would mean. Properties do not have a well-defined size, so there is no such thing as a set of smallest properties. Rather, certain kinds of entities are fundamental, namely, those that are the "building blocks" for everything else, and whatever properties those entities possess are (in a derivative sense) fundamental properties. (Note that some properties of fundamental particles, like *mass* and *charge*, are also possessed by macroscopic objects, so they cannot even be said to pertain exclusively to microentities.) On the view under consideration, the only real properties,

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and therefore the only ones associated with natural kinds, are those possessed by the fundamental elementary particles.[1]

Proponents of this view need not be reductionists, in the sense that they need not think that there are "bridge principles" that provide translational equivalences between predicates (which pick out properties) at the macrolevel and the microlevel. Nevertheless, on this view, only the microlevel properties really exist. Predicates at the macrolevel may apply to things and group them into sets based on utility, but they do not pick out real properties and fail to carve nature at the joints. I will refer to this view as "microphysical realism" since it maintains that the only real entities are microphysical ones and the only real properties are those possessed by microphysical entities. In this article, I will try to show that one intuitively appealing argument for this position is flawed and that another widely held argument for the position can be transformed into an objection against it. Finally, I will put forward another objection to microphysical realism.

2. The "Nothing-But Argument." One appealing argument for microphysical realism takes its cue from an obvious difference between the micro and the macro. There is clearly an asymmetry between the very smallest realm in nature and all larger realms since the entities of the former constitute the entities of the latter. Wooden kitchen tables are made up mainly of cellulose molecules, but cellulose molecules are not made up of kitchen tables. If we take the fundamental particles out of the universe, everything else goes with them, including kitchen tables and houseflies, babies and bathwater, asteroid belts and supernovae. By contrast, the fundamental particles could be rearranged in such a way that all the macrolevel entities were destroyed, leaving the particles intact. All this is just to say that macrolevel entities are *nothing but* the fundamental particles that constitute them, and since they are nothing over and above their constituents, they cannot be said to have any reality independent of them. Accordingly, given this asymmetry, fundamental particles and their properties have a special metaphysical status. Call this the "Nothing-But Argument" for microphysical realism.

A point that seems to be overlooked by proponents of the Nothing-But Argument is that the argument serves to privilege microlevel entities over macrolevel entities but not microlevel properties over macrolevel

1. Armstrong (1989, 87) writes: "There seem to be reasons (scientific, empirical, a posteriori reasons) to think that physics is *the* fundamental science. If that is correct, then such properties as mass, charge, extension, duration, and space-time interval, and other properties envisaged by physics may be the true monadic universals." Armstrong also thinks that the real properties correspond to universals. For different versions of microphysical realism, see also Ellis (2001) and Heil (2003).

properties. The argument cannot be used to give metaphysical priority to the properties possessed by microphysical entities and to urge their elimination from our ontology. Even though one might assent to the claim that a particular kitchen table is nothing over and above the particles that constitute it and their manner of organization, it does not follow that the properties of the kitchen table are nothing over and above the properties of its constituents. What applies to concrete particulars does not necessarily apply to their properties. There is an asymmetry between the micro and the macro when it comes to concrete particulars because the former constitute the latter. But there is no asymmetry concerning properties since properties that are only manifested at the macrolevel are not literally constituted by properties manifested at the microlevel.

Still, it might be urged, for these properties and kinds to be manifested at the macrolevel there must be microphysical entities with their properties in place. But there need not be. One could not duplicate a macroentity such as this very kitchen table without thereby duplicating the microphysical particles that go into it. An exact replica of this table would be made up of duplicates of the particles that it is actually made up of, down to the last quark. By contrast, one could perhaps duplicate the table's color or hardness without necessarily duplicating the properties that are possessed by its constituent particles. The color of the table depends in some way on the manner in which its surface reflects light, and the hardness of the table also depends in some way on the forces of electrical repulsion generated by the particles on the surface of the table. But there is nothing that dictates that these macroproperties cannot be duplicated without recourse to the very microproperties possessed by the microconstituents of the table.

Since proponents of the Nothing-But Argument cannot claim that the properties of macroentities are simply constituted by properties of microentities, it does not follow that the former are nothing but the latter. It may be protested here that there is a parallel argument about properties that rests on the claim that higher-level properties "supervene" on lower-level properties (see, e.g., Kim 1984). But supervenience is a contested notion, and there is no consensus concerning its proper formulation or its compatibility with some form of property emergence. More importantly, supervenience cannot feature in a simple argument for an eliminativist conclusion about higher-level properties. If members of a set of properties *F* supervene on members of a set of properties *G*, it does not follow that the *F* properties are nothing but the *G* properties. Hence, there is no corresponding argument to the conclusion that the properties of microphysical entities really exist while the properties that are only manifested in the macroscopic realm do not, strictly speaking, exist. Even though it may be true that there are no entities over and above the quarks,

leptons, photons, and so on, it does not follow that there are no properties over and above the properties that these fundamental particles possess: *mass energy*, *electric charge*, *flavor*, *color charge*, *spin*, and so on. Hence, a central argument for considering higher-level properties to be metaphysically otiose is defective.

3. The Causal Exclusion Argument. Another widespread argument in favor of the view that regards only microphysical properties to be real is based on the claim that causation at the microphysical level *excludes* causation at all higher levels. The argument has been hashed out in various guises in recent philosophical discussions, so there is no need to rehash it in detail here or to articulate all of its premises. The gist is that microlevel causal relations are the only real causal relations, and hence the causal properties of the microlevel domain are the only real properties. If causes and their effects are thought of as property instances, then in microlevel causation an instance of one microlevel property causes an instance of another microlevel property. But if each microlevel property instance also corresponds to a macrolevel property instance, then the latter cannot be causally efficacious. But properties are often thought to be individuated by their causal powers, and that is what is widely held to give them their very identity as properties. Properties without causal powers are not real properties. Hence, there are no real macrolevel properties.

The upshot of this argument is that if we posit real properties and natural kinds at the most fundamental microphysical level of the universe, then causation at the most fundamental level excludes causation at all higher levels. The most common version of this argument deals with mental causation, although it is now widely acknowledged that the argument generalizes to all higher-level domains, the mental being just a special case. In the domain of the mental, the argument concludes that causation between mental states is excluded by causation between brain states. Causation can only take place at the neural level, where instances of various neural properties participate in causal relations with instances of other neural properties (but see the next section for a corrective). Here and in other domains, philosophers who deny that the only real properties are microphysical ones are faced with the problem of causal exclusion.

The first thing to bear in mind when considering the argument from causal exclusion is that our concept of causation may not have been made to deal with the picture of reality that we have formulated on the basis of modern science. Philosophical analyses of the concept of causation, beginning with Aristotle's notion of an efficient cause, have tended to ground the concept in our commonsense intuitions. The world of common sense has traditionally been one composed of medium-sized dry goods, all within an order of magnitude or two of the size of a human being.

Hence, we have inherited a notion of causation that has not been designed to take into account the theory of relativity, quantum physics, and the multitude of levels that contemporary science now investigates from quark to cell to galaxy. I would venture that the assertion that causation at lower levels would preempt or exclude causation at all other levels is based on this intuitively grounded philosophical concept of causation that has been passed down to us from the past. The conviction of many (although not all)[2] philosophers that causation is exclusive, that it can only take place at one level or not at all, seems to derive from that conception. If modern science delivers a conception of the world that does not sit well with this conviction, then we should be ready to call our intuitive concept of causation into question, something that many contemporary philosophers do not seem willing to do.

There is another problem with positing that "real" causation takes place only at the most fundamental level of reality. Attributing causation only to the smallest microlevel is paradoxical at best since causation is a deeply problematic notion when applied to the most fundamental level of physics, which is the realm of quantum mechanics. The concept of causation is contested in quantum physics, and some of the results of quantum physics seem to defy our common assumptions about causation. For example, the results of the Einstein-Podolsky-Rosen experiment have given rise to interpretations that posit backward causation. Whether or not the behavior of quantum particles necessitates such drastic revisions (not to say a wholesale rejection) of our common concept of causation, there is reason to doubt that the completed theories that govern the behavior of these particles will involve anything like our intuitive concept of causation. This jeopardizes the claim that the only genuine causation in the universe is causation at the level of elementary particles. By contrast, the concept of causation has a more prominent presence in the special sciences that govern macrophenomena, and causation at the macrolevel seems more defensible than microlevel causation.

4. The Objection from the Illusoriness of Macroproperties. In the previous section, I discussed the argument from causal exclusion, which is sometimes cited in favor of microphysical realism, and I argued that it does not count decisively in favor of the position. I will now propose that this argument can also be transformed into an objection against microphysical

2. A notable exception is Horgan (2001, 102), who holds that "concepts of causation and causal explanation are contextually parameterized notions, with an implicit contextual parameter keyed to a specific descriptive/ontological level." He calls this position "causal compatibilism." For another notable approach to showing that causation at the microlevel does not exclude causation at the macrolevel, see Elder (2004).

realism since it points to an apparent inconsistency in the view. Some philosophers who insist that the only real properties and natural kinds are microphysical nevertheless seem to countenance the reality of levels above the very smallest level. These philosophers speak of particles such as protons and neutrons, as well as of atoms and molecules, as though they too were part of their ontology. But it is not clear on what grounds they can do so. Protons are composed of three quarks, two up quarks and one down quark. Microphysical realists who insist that electrons and protons cancel out kitchen tables and houseflies must, to be consistent, acknowledge that quarks cancel out protons. If they are right to say that higher-level entities and their properties do not really exist, this surely includes the properties of anything higher than the most fundamental level, namely (given our current physical theories), quarks, leptons, and bosons. This leaves us with just a handful of real properties and natural kinds, which may not be a liability in and of itself. But it is not an attractive prospect when one considers some of the reasons given by essentialists and others for positing real properties and natural kinds in the first place. Many microphysical realists think that properties and natural kinds enter into *natural laws*. According to Armstrong (1992/1997, 164–65), a natural law, which is the "ontological correlate" of a true law statement, holds in virtue of "a link between properties." But if the only real properties are those possessed by the elementary particles, then only the laws associated with those properties have ontological correlates. The rest do not correspond to anything ontologically real. And what goes for natural laws goes also for causation, so that purported causal relations that do not obtain by virtue of real properties are not real instances of causation, as we saw in the previous section. Hence, real properties and the natural kinds associated with them cannot serve to ground such laws as those of thermodynamics or optics or solid-state physics, not to mention the laws of chemistry, biology, and so on. Unless these laws are reducible to those of fundamental microphysics, which seems unlikely, then they cannot be considered to be laws at all.

As I have urged above, to be consistent, this argument must be applied to all levels above the minutest level, which means that, strictly speaking, there is no causation at the neural level either, just causation at the level of the elementary particles that ultimately compose the neurons and other components of the brain. But the problem with this position, as I have just argued, is that it strips properties from all levels above the smallest one. And this, in turn, means that all purported instantiations of natural laws and all alleged instances of causation at these levels is illusory. The causation is really taking place "further down," and the only laws that operate are those of elementary particle physics. Hence, the vast majority of scientific predicates do not pick out real properties, and the vast ma-

jority of scientific law statements do not correspond to natural laws. Even though they raise the problem of causal exclusion for opponents of the microphysical realist position, I am arguing that in raising it, the microphysical realists have a problem of their own, namely, the illusoriness of higher-level properties and higher-level causation.

5. The "Bottomless Pit" Objection. There is another, more compelling reason for rejecting the claim that the only real properties are those possessed by elementary particles. According to current physical theory, all matter is composed of elementary particles, such as protons, neutrons, electrons, photons, gluons, and a handful of other particles. Moreover, some of these particles, the hadrons (which include protons and neutrons) are further composed of quarks. Microphysical realists would say that a catalog of the natural kinds contains only these kinds, or whatever ultimate elementary particles are uncovered by science. Currently, there are thought to be a relatively small number of kinds of truly elementary particles: six kinds of quarks and their antiparticles, six kinds of leptons and their antiparticles, and several kinds of bosons, which include photons. But there is a possibility that this is not the ultimate level of elementary particles, and various physicists have proposed "preon" models, which posit inner structure for quarks and leptons. After all, scientific inquiry over the past century has uncovered a successive series of ever smaller levels of reality: molecules gave way to atoms, which gave way to electrons and nuclei, which gave way to protons and neutrons, which gave way to quarks. It would take more energy than is currently available, or indeed may ever be available, to conduct the scattering experiments needed to determine whether quarks have inner structure. Thus, it may be that there are further levels of structure at yet smaller scales, which we will not, and perhaps cannot, uncover. Microphysical realists, who regard the only real entities to be the elementary particles and the only real properties to be the properties that they possess, may continue to insist that the smallest scale of reality would determine the ultimate kinds of entities, even though we may never manage to identify that scale. They may be ready to admit that the real properties and natural kinds might remain unknown and perhaps unknowable. But it seems quite possible that there is no ultimate level. Reality may not bottom out in a bedrock of fundamental particles but may instead consist in a bottomless pit of ever smaller levels, what Lewis (1986, 30) calls "infinite complexity" and Block (2003, 138) refers to as the possibility that there is "no bottom level." Even if that possibility were ruled out by our current physics, our current physical theories may not be the last word on the issue. Philosophers who locate what is real exclusively at the smallest microlevel are

in trouble if there is no smallest level since that would mean that there are no real particles, properties, or kinds, according to them.

It might be said that this is a rather weak objection against microphysical realism. An objection that rests on the empirical possibility (which might seem remote) that there may not be an ultimate level of reality amounts to a mere "what if." Moreover, it is an objection that might never be decisively made since it may be impossible in principle to conclude with certainty that there is no smallest level. Hence, the gamble that there is some set of smallest kinds of entities may seem to be a relatively safe bet for the microphysical realist. However, not only is it risky to equate what is real with what is smallest, but it does not seem correct to say that the existence of a never-ending series of levels would in fact imply that there are no real entities and properties. The point is not merely that metaphysicians who equate what is real with the smallest microlevel are taking a risk. Rather, the more telling point is that if we could say definitively that there is no ultimate level it would be wrong to conclude that there were no real entities, properties, or kinds. If there were some way of determining that the universe did not bottom out in a smallest level, it would surely be incorrect to conclude that nothing really exists. If so, then I would argue that it is misguided to equate reality with the smallest level of nature, even if there is a smallest level. The objection does not depend on our discovering that there is no smallest level. Rather, the objection depends on reflecting on what we should conclude if it turned out that there were no smallest level.[3]

6. Conclusion. I have argued in this article that the view that the only real properties and kinds are microphysical is ultimately unsatisfactory. One argument for adopting this view, which points to the fact that macrolevel entities are constituted by microlevel entities, is not applicable to properties since the relationship between macroproperties and microproperties is quite different from that between microscopic and macroscopic entities. Another argument for microphysical realism concludes that unless we adopt it, we will be lumped with causal exclusion at higher levels of reality. But I have contended that restricting causation to the microphysical realm is itself unsatisfactory since the causal relation is deeply problematic when applied to the domain of quantum physics. Moreover, this argument would lead to the conclusion that all levels but the most fundamental physical level are causally inert and epiphenomenal, which is a result that would make all special-science properties ersatz and all special-science causation illusory (indeed even properties and causation

3. For a thorough philosophical discussion of the possibility that there is no fundamental level in nature, see Schaffer (2003).

at the level of protons and atoms). Hence, this is no less a problem for microphysical realism than for opponents of this position. Another problem with microphysical realism is that it would be in trouble if there were no bottom level. A discovery that there is no fundamental level would surely not be a discovery that there are no real properties and natural kinds, implying that it would be a mistake to equate what is real with the microphysical in the first place.

REFERENCES

Armstrong, David M. 1989. *Universals: An Opinionated Introduction*. Boulder, CO: Westview.

———. 1992/1997. "Properties." In *Properties*, ed. D. H. Mellor and A. Oliver, 160–72. Oxford: Oxford University Press.

Block, Ned. 2003. "Do Causal Powers Drain Away?" *Philosophy and Phenomenological Research* 67:133–50.

Elder, Crawford. 2004. *Real Natures and Familiar Objects*. Cambridge, MA: MIT Press.

Ellis, Brian. 2001. *Scientific Essentialism*. Cambridge: Cambridge University Press.

Heil, John. 2003. *From an Ontological Point of View*. Oxford: Oxford University Press.

Horgan, Terence. 2001. "Causal Compatibilism and the Exclusion Problem." *Theoria* 16: 95–116.

Kim, Jaegwon. 1984. "Concepts of Supervenience." *Philosophy and Phenomenological Research* 45:153–76.

Lewis, David. 1986. "Against Structural Universals." *Australasian Journal of Philosophy* 64: 25–46.

Schaffer, Jonathan. 2003. "Is There a Fundamental Level?" *Nous* 37:498–517.