

Objects And Their Matter

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Abstract: How does an ordinary thing relate to its matter? If they are identical, ordinary things cannot change their matter, and never persist as ordinary things for more than a moment. If they are distinct, then every ordinary thing coincides with a second material thing, as “constitution” and temporal-parts views have it. Both alternatives presuppose that the matter of an ordinary thing is itself a concrete entity: a “mass of matter”. This paper defends the view that there are no masses, but only particles.

1. The Questions

An ordinary material thing is a thing made of matter. And if an ordinary thing is made of matter, there is some matter it is made of. For every cat or stone or human being, there is some matter making it up at a given time. This bland observation raises two metaphysical questions. First, what is the matter of an ordinary material thing? What sort of thing or entity is it? Or is it a thing or entity at all? Second, what is the relation between an ordinary thing and its matter?

A common answer to the first question is that the matter of an ordinary thing is itself a sort of material entity: a so-called “mass of matter”. Such a mass may not be an ordinary material thing, as it is not itself made of matter; rather, it is the matter making up something. But it is a material thing in the sense that it has a location in space, can move about, and has a density, temperature, and chemical composition. So for every time when an ordinary material thing exists, there is such a thing as the mass of matter making it up at that time. Call this the mass ontology.

It makes the second question pressing: how does an ordinary thing relate to the mass making it up? Are they, for instance, one thing or two--identical or distinct? If they are one, then every material thing is a mass of matter. A cat or a stone or a

human being is merely what we call some matter when it has a certain configuration, much as a doctor is what we call a human being when she has a certain medical qualification. Or are they two things, so that every cat shares its location with another material thing, a certain mass? In that case we shall want to know how the two differ, and how it is possible for them to occupy the same place at once. This leads almost inevitably to a “constitution” or a temporal-parts view.

Some of us are not happy with any of these alternatives: we would rather not have to accept either that an ordinary material thing is a mass, that it is constituted by different masses at different times, or that it shares its temporal parts with different masses. We want to deny the existence of masses altogether, if we can. But how then shall we answer the first question? What could the matter of an ordinary thing be, if not an entity of some sort? I propose that it is not one entity but many: a lot of tiny particles that never compose a mass. The relation between an ordinary thing and its matter is that of whole to part.

I will begin by saying what masses of matter are supposed to be and why many philosophers believe in them. I will then discuss the main accounts of how ordinary things relate to masses, before defending the proposal that there are no masses but only particles.

2. What are Masses?

A mass is supposed to be the sort of thing that can be the matter making up an ordinary material object at a particular time. So the referent of the term ‘the matter now making up the cat Gerald’ would be a mass. The mass of such-and-such matter is that matter: they are numerically identical. Here are some further principles about masses:

- Any matter whatever is a mass.

There could not be some matter without there being such a thing as the mass of that matter. And because there is matter that is not the matter of any ordinary thing,

there are masses that are not the matter of any ordinary thing.

- Where we have the same matter we have the same mass, and where we have the same mass we have the same matter.

A mass could not be made up of different matter or the same matter make up different masses at different times.

- You cannot create a mass without creating matter: you can't do it merely by rearranging matter that already exists. Nor can you destroy a mass without destroying matter.
- A mass is the sort of thing¹ that one could make an ordinary material thing out of by appropriately rearranging it, so that one had the same mass throughout the process.

Cats, stones, and human beings come into existence when matter that existed previously comes to be suitably arranged. Or at least this is so if there really are ordinary material things and they are not masses.

- Masses are concrete.

They are not abstract entities such as sets. This is not a substantive claim but a stipulation. I don't deny that there is such a thing as the set whose members are all and only the particles now composing Gerald. Nor will I object if someone wants to call that thing 'the mass of matter now making up Gerald'. The claim that interests me is that there is a concrete thing composed of Gerald's particles deserving that description. For my purposes, the claim that a mass is nothing more than a set of particles is merely a variant of the claim that there are no masses but only particles.

- Masses are physical.

They have such properties as mass, heat, electrical conductivity, and atomic structure. I am concerned with the matter studied in physics and chemistry, not

¹Some say, darkly, that masses exist yet are not things, but rather nonthings (Chappell 1973: 683-85, Markosian 2004). As far as I can see, this is a notational variant of the mass ontology. I call masses things because I don't mean anything special by 'thing'. 'Thing' is for me simply an all-inclusive count noun: everything is a thing, and a nonthing is a contradiction in terms.

Aristotelian “prime matter”, which is supposed to be in itself formless. This is not because I am convinced that there is no such thing as prime matter, but simply because that is a different topic.

Quite a few philosophers believe in entities rather like masses but not quite the same. Locke (1975: 330) thought that any atoms “joined together” compose something he called a mass: a thing that persists just as long as those atoms remain joined together. A lump of clay might be a Lockean mass, if breaking one in two destroys it. So not just any matter makes up a Lockean mass. And it would be possible to create or destroy one without creating or destroying any matter. For this reason such things are not masses in my sense. (A lavish ontology might make room for both, each Lockean mass coinciding with an ordinary mass.)

A second example is aggregates (Wiggins 1968, Burge 1977). An aggregate of Es is a concrete object (if Es are concrete) composed of those Es, which, necessarily, exists if and only if the Es exist (whether or not they are joined together). An example would be the aggregate of the molecules now composing the birch tree in my garden. Such a thing would not be a mass because we could destroy a tree’s molecules by burning, thereby destroying the aggregate of them, without destroying any of the tree’s matter. But an aggregate of elementary particles might be a mass: all matter consists of such particles, and we have the same matter, it seems, just if we have the same elementary particles.

Third, some philosophers believe in portions or quantities of specific stuffs, such as the water in the lake or the wood in the sawmill (Cartwright 1970, Lowe 1998: 72f., Simons 1987: 153-162). They say that for any stuff of any kind, joined together or not, there is such a thing as the portion of that stuff; and we necessarily have the same portion if and only if we have the same stuff. These things would not be masses in my sense either, because again it would be possible to create or destroy one of them without creating or destroying any matter. A generic portion of matter, however--as opposed to a portion of some specific sort of stuff--might be a mass.

I shall be concerned with masses and not aggregates or portions. That said, every argument that I know of for the existence of aggregates or portions suggests an analogous argument of equal force for the existence of masses. (I don't know of any argument for the existence of Lockean masses, and I will say no more about them.) Likewise, any reason to doubt the existence of masses looks like a reason for doubting the existence of aggregates and portions. By contrast, there may be reasons to believe in masses that are not reasons to believe in aggregates or portions (see §§8 and 9). So my neglect of aggregates and portions is not completely irresponsible.

3. Why Believe in Them?

Suppose there are such things as ordinary material objects: visible, tangible bodies that contrast with their surroundings, move about, and persist through time in a familiar form. Cats, potatoes, stones, shoes, that sort of thing. And suppose that such things are "fully real" in the sense that they are not collections of sense-data, ideas in the mind of God, set-theoretic constructs, trope bundles, modes of the One Substance, mere appearances conditioned by our forms of intuition, or second-rate entities of any other sort. Why, then, should anyone believe that there are also such things as masses of matter? Why accept the mass ontology? For many philosophers this is like asking why we should accept the reality of time or the possibility of motion. They confidently assert the existence of masses without any argument as if it were completely obvious. But is it? Or might it be a substantive metaphysical claim masquerading as a platitude?

If it really were obvious, its deniers ought to run into trouble pretty quickly, and that trouble should generate a simple and effective argument for the mass ontology. The most common argument is something like this:

There is some matter now making up Gerald. There is also matter less neatly

organized: the iridium in the southern hemisphere, for instance. So there is such a thing as the matter now making up Gerald, and such a thing as the iridium in the southern hemisphere. Each of those entities has a location, density, temperature, chemical composition, and other physical properties, making it a concrete physical thing. The same goes for any other matter. Thus, for any matter whatever, there is such a thing as the mass of that matter.²

Call this the matter argument. I have two comments. First, insofar as it supports the existence of masses, it supports the existence of other things too. Since Gerald is made up of living tissue, we can argue in the same way that there is such a thing as the portion of tissue now making him up. And it would seem to be something different from any mass, since we could destroy the tissue without destroying any matter. So the matter argument would entail that wherever there is a cat, there are at least two material things apparently distinct from it but located in precisely the same place.

I say at least two because it isn't hard to find more. Rodin's Balzac is made of bronze and of metal, and so the matter argument ought to imply that there are such things as the portion of bronze and the portion of metal making it up. These would seem to be different things because we could destroy the bronze, by separating the copper from the tin, without destroying the metal. And both portions would be different from any mass, as we could destroy either (by nuclear fission) without destroying any matter. Most of those who accept this much will go on to say that the statue itself is different from either the portion of metal, the portion of bronze, or the mass of matter. A bit of ingenuity would no doubt turn up still further entities. Some of us, at least, will hesitate to accept that every ordinary thing coincides at any moment with two or three further material things. That looks like a reason to be ²Zimmerman, for instance, writes, "Given the obvious fact that there is matter in the universe, in this room, in my body, how can [anyone] deny that there is such a thing as the matter constituting my body now, something that was once scattered, and will soon be again?" (2003: 508).

cautious about the matter argument.

Second, the crucial step in the argument is the inference from there being some matter now making up the cat to there being such a thing as that matter. This is not innocuous. It presupposes that the phrase 'the matter now making up the cat' is a singular term--a phrase that refers to some one thing if it refers at all. But that is questionable. It might be a plural term, referring not to a single large thing but only to many small things--elementary particles, say. Why couldn't the cat's matter be nothing but a lot of particles? Of course, when we speak of the cat's matter we may not mean to refer to particles. The meaning of the word 'matter' does not even imply that matter is particulate, never mind that the term refers only to particles: for all the dictionary tells us, every portion of matter of any size might be divisible into smaller portions of the same sort, as Aristotle thought. ('Matter' differs in this way from such terms as 'sand' or 'snow'.) That all matter is made up of particles is not a semantic fact. But it is a fact all the same. As it stands, then, the argument provides no evident reason to suppose that there is any one such thing as Gerald's matter.

We could bolster the argument with the premise that any particles whatever must compose something. (Some things, the xs, compose something y if and only if each of the xs is a part of y, none of the xs share a part, and every part of y shares a part with one or more of the xs.) This suggests that some particles, at least, compose masses: if the elementary matter particles in the southern hemisphere compose anything, it is a mass. And the mass any particles compose is the same thing as that matter. But any matter particles at all are some matter. It would seem to follow that any particles whatever compose something that is the same as that matter if that they compose anything at all. Given that any particles whatever compose something, therefore, any particles will compose a mass.

Those who believe that particles always compose something are almost certain to believe this because they accept unrestricted composition: that any things whatever, no matter what their nature, arrangement, or situation, always compose

something. If objects need only exist in order to compose something, we should expect them to compose something that needs nothing more for its existence than for those objects to exist. Such a thing, if the objects are elementary particles, would be a mass. Unrestricted composition, together with the existence of elementary particles, really would entail the mass ontology.³

But unrestricted composition is a contentious metaphysical principle. Is there really something composed of my left ear and all the earth's caesium atoms--a concrete material object just as real as I and the earth are? Why should there be? The most common argument is based on the idea that there cannot be vagueness "in the world", but only in our thought and talk about the world (Lewis 1986: 212f., Sider 2001: 121-132). Most of us accept that some things compose something: the world contains more than just mereological simples (things with no parts other than themselves). If composition is restricted, then some things compose something and others don't. Presumably things compose something just if they are somehow "unified". And whatever this condition amounts to, it is likely to admit of borderline cases: there could be things that neither definitely satisfy it nor definitely fail to satisfy it.

Suppose, then, that the xs neither definitely compose nor definitely fail to compose anything. So there is not definitely something composed of the xs, nor is there definitely not such a thing. It's not that there definitely is something that is neither definitely composed of the xs nor definitely not composed of them, in the way that there might be a man who is neither definitely bald nor definitely not bald. The vagueness is not due to the fact that any predicate or concept of ours lacks fully precise conditions of application. Rather, it is vague whether there is anything that is even a candidate for being composed of the xs. It appears to be a case of vague existence: a thing that neither definitely exists nor definitely fails to exist, occupying a shadowy realm between being and nonbeing. And that looks absurd.⁴ If so, then composition, if it occurs at all, must be unrestricted.

³Though advocates of the "disappearing-mass view" of §5 dispute this.

This may be the best argument for the mass ontology. Whatever its merits, however, those friends of masses who endorse a constitution view will reject it. They believe that even if any elementary particles whatever compose a mass, some also compose something that is not a mass, but rather a cat or other ordinary thing, which the mass “constitutes”. So even if particles always compose a mass, they compose something other than a mass only if they are unified in some way. But whatever this way might be, it will almost certainly admit of borderline cases: it will be possible for things to be neither definitely so unified nor definitely not. And then the same argument as before will lead to the conclusion that there can be vague existence. And it is hard to see how the vague existence of constituted things could be any less objectionable than the vague existence of masses.

Burge (1977) offers a different sort of argument. Wildlife biologists tell us that tigers are distributed across large tracts of south-central Asia. Because no individual tiger is so distributed, Burge says, we should take the proposition to refer to an aggregate of tigers. Swap tigers for elementary particles and we get masses. Someone could resist the argument by insisting that such statements are about individual tigers or particles rather than aggregates: it is true to say that tigers are distributed across south-central Asia not because anything individually occupies such an area, but because many things collectively do. But Burge points out that this paraphrase has a different logical form from the original, and that there is no general method of replacing apparent singular reference to aggregates with plural reference to tigers, particles, or the like.

What force this argument has is a large question. Note, however, that it supports the existence of even more entities than the matter argument does. Suppose Bob builds a house of wooden blocks. The paraphrase argument would appear to give us an aggregate of blocks, an aggregate of wood cells, an aggregate of molecules, an aggregate of atoms, an aggregate of protons, neutrons, and electrons, and an aggregate of elementary particles. And Burge’s principles⁴For a defense of vague existence see van Inwagen 1990: 213-227.

imply that these six aggregates differ from one another, since they are aggregates of different things--as well as being distinct from the house itself. (Materials scientists could probably increase the count.) Even those sympathetic to masses might find that an embarrassment of riches. But to economize and reduce the number of aggregates would commit us to awkward paraphrases of just the sort that Burge wanted to avoid.

Those are the best-known arguments for the mass ontology. I give two more in §§8 and 9. Like other philosophical arguments, their force is up for debate and disagreement is inevitable. Perhaps this confirms the adage that the best way to cast doubt on a philosophical claim is to give an argument for it. In any event, there is nothing sacrosanct about the mass ontology.

4. Mass Monism

If there are such things as masses, the matter making up an ordinary thing at a given moment is a mass. How, then, does the ordinary thing relate to the mass? They must be either one thing or two. Consider first the view that they are one.

Call the mass of matter now making up Gerald M. It resembles Gerald in many ways: they have the same size, shape, location, mass, temperature, atomic structure, and so on. For the moment at least, there is no difference between them that any possible observation could detect. The simplest explanation for this is that Gerald is M. There are not two empirically indistinguishable material things, a cat and a mass, but just one, which is both a cat and a mass. More generally, every material thing is a mass. Most are mere masses: they don't belong to any ordinary kind. A few are not only masses but also cats or stones. Call this view mass monism. (Advocates include Chisholm 1976 and Zimmerman 1995.)

Mass monism is neat and theoretically elegant. It assigns all material things to a single category, and posits the simplest possible relation between ordinary things and masses. But it's not very plausible. Everyone knows that ordinary things

change their matter. Gerald eats, drinks, excretes, and sheds. Little of the matter now making him up belonged to him a year ago. He is made up of different matter at different times. Nonliving things don't change their matter in such a wholesale way, but even a stone can survive some such changes: it doesn't cease to exist or cease to be a stone when it sheds an atom or two, but simply comes to be made up of numerically different matter. So it seems, anyway. But a mass cannot be made up of different matter at different times, because it is that matter. Ordinary things therefore appear to have a property that no mass can have, namely being made up of different matter at different times.

If mass monism is true, all this is wrong. Material things can never change their matter. Owing to metabolic turnover, the mass identical to Gerald, M, has its feline form for only a moment.⁵ Throughout most of its existence, M--that is, Gerald--has been widely scattered and will soon be again. It converges for a moment into feline form, only to begin immediately to disperse once more. In its place, a new and different mass briefly takes on feline form, and then another; and so it goes. If cats are masses, nothing remains a cat for more than an imperceptible fraction of a second, and what we take to be a persisting cat is in reality a series of many different feline objects. The same goes for all ordinary things.

This is especially hard to believe if we ourselves are material beings. In that case you were widely dispersed month ago, and will soon be again. You are not the person who sat in your chair even a nanosecond ago. That was someone else--someone very like you, but numerically different. Your beliefs about what you did in the past are presumably false, as the things you seem to remember doing were all done by others. And you needn't bother looking forward to your next trip to the beach, for you won't be going. Those who will enjoy it (there will be a lot of them) will all think they are you, and that they once read this article, but they will be deluded.

⁵It may be more accurate to say that on this view there is no such thing as Gerald, but only a vast number of masses successively bearing that name.

Some tough-minded philosophers happily accept that nothing ever persists as a person or cat for more than a moment, and even claim that this is compatible with our ordinary statements and beliefs.⁶ But most of us, I think, will find it unappealing. What are the alternatives? One is to deny that we are material things. Mass monism implies that only an immaterial being could have anything like the sort of history that we take a person to have. So one might make the problem of how material things relate to their matter into an argument for our being immaterial (Zimmerman 2003; see also Olson 2007: 153-64). Though this does nothing to save the persistence of cats or stones, it at least gives us what matters most. But let us consider some less drastic suggestions.

5. The Disappearing-Mass View

I objected to mass monism on the grounds that ordinary things differ from masses in their historical properties: cats are not masses because they are made up of different matter at different times.

A few philosophers have proposed what may look like a variant of mass monism that is immune to this objection (Burke 1994, Rea 2000). They say that although Gerald is a mass of matter, he is not always made up of the same matter. Nor has he existed for billions of years in a widely dispersed state. The particles now composing him existed a billion years ago, and they have always composed a mass, but the mass they composed then is not the one they compose now. The original mass ceased to exist when it took on feline form. For billions of years those particles composed a mere mass, which persisted simply because they remained in existence. The mass they now compose is not merely a mass, but also a cat. And because cats are essentially cats, Gerald is not the mass his current particles

⁶Sider 2001: 188-208--though he does not endorse mass monism. Chisholm (1976: ch. 3) says this about most ordinary things but infers from it that we ourselves are not masses. The patron of this sort of view is Hume, who rejected all identity over time--though he did not seem to think that this was compatible with our ordinary beliefs (1978: 199-205).

composed in the past. So there are mere masses and there are special masses--ordinary material things--and no mere mass is, or was, or could ever come to be a special mass. This allows ordinary things to have the histories we think they have.

But the disappearing-mass view, as we might call it, is not really an account of objects and their matter. The “mere” mass that Gerald’s current particles composed a billion years ago is not the matter now making him up, because that mass is not supposed to exist now. Nor can Gerald be identical to his current matter if he is made of different matter at different times. The things the disappearing-mass view calls “masses”--D-masses for short--are not masses in my sense. You can destroy one without destroying any matter--by making it into a cat--or create one without creating any matter--by killing a cat and scattering its remains. A D-mass is one thing; the matter making one up at any moment is something else. The proposal does not answer the questions we began with: what sort of thing Gerald’s matter is and how he relates to it. The nature of matter and its relation to material things remain as elusive as ever.

6. The Two-Kind View

Turn now to the view that an ordinary material thing and the mass of matter making it up at any moment are two different things. Because this implies that material things come in two fundamental categories or kinds, masses and nonmasses, we might call it the two-kind view.⁷ The varieties current in the literature are constitution and temporal parts. As both are well known, I will say little about them.⁸

On the constitution view, an ordinary thing and the mass coinciding with and “constituting” it at a given time are then physically indistinguishable, though they

⁷This should not be confused with Zimmerman’s “two-category theories” (2003), according to which masses are not material things at all.

⁸Wiggins (1968) and Simons (1987: ch. 6) are typical advocates of the constitution view, Heller (1990) and Sider (2001) of temporal parts. I discuss their pros and cons in Olson 2007.

will normally differ historically. They also differ in that ordinary things but not masses have the capacity to gain and lose matter. If the god of the philosophers were to create a cat and annihilate it a fraction of a second later before it had a chance to assimilate or expel any matter, he would still create at least two distinct material things, a cat and the mass constituting it throughout its brief existence.

The temporal-parts view says that every persisting thing is composed of temporal parts. So there is, for instance, a temporal part of Gerald that extends from midnight last night till midnight tonight--a concrete object differing from him only in its temporal extent. This makes it possible to say that ordinary things and the masses making them up simply overlap, by sharing some of their temporal parts. Gerald extends across time from his days as a microscopic embryo until his death or decay. His current matter, M, is also extended in time, though most of its temporal parts are widely dispersed. But for a brief moment the two objects coincide. Their coincidence consists in the fact that Gerald's current "stage"--his briefest temporal part existing now--is also M's current stage. They are like two roads that cross and thereby share a spatial part. Gerald's earlier and later stages are stages of other masses.

Although I have called the temporal-parts view a two-kind view owing to its implication that ordinary things are distinct from masses, there is an important sense in which it assigns all material things to the same kind. It says that every matter-filled spacetime region is occupied by exactly one material thing, so that a material thing is, as Quine once said, "simply the content, however heterogeneous, of some portion of spacetime, however disconnected and gerrymandered" (1960: 171). What distinguishes masses from other material things is a mere detail: a mass is a thing, all of whose stages are composed of stages of the same particles, whereas other material things are composed of stages of different particles. It is like the difference between a rope whose fibers extend throughout its length and a rope woven of shorter, overlapping fibers. Though the distinction is real enough, it

doesn't go very deep. It is not for nothing that friends of this view describe all material things as "four-dimensional hunks of matter" (Heller 1990).

7. The Particle View

I will not discuss the controversies surrounding the constitution and temporal-parts views. Instead I want to consider the view that there are no such things as masses. There is matter, but Gerald's current matter is not a thing or entity. It is, rather, many things: particles. Those particles compose nothing other than Gerald. In a moment's time they will, like most particles, compose nothing at all. Particles never compose something that is always composed of the same particles. The only things that are always made up of the same matter are individual particles themselves. You can call them masses of matter if you like. But there are no masses composed of more than one particle. So the phrase 'Gerald's current matter' is not (in its logical form, anyway) a singular term, but a plural, with the same reference as 'Gerald's current particles' (though, as noted earlier, not the same meaning).⁹

Call this the particle view. It answers our questions thus: The matter making up an ordinary thing is the particles composing that thing. (It is up to physics to tell us their nature.) And the relation between a material thing and its matter is that of whole to part.

The particle view appears to allow cats and stones and people to have different parts at different times, avoiding the implausible consequences of the mass ontology. And it does not commit us to an ontology of temporal parts or a constitution view. There is something to be said for it. What can be said against it?

⁹Some philosophers suggest that Gerald's current matter is a "plurality" of particles. This may be the particle view, but as the word 'plurality' is never defined it's hard to be sure. The term is best avoided. If we want to speak of certain particles and not of anything else, such as an aggregate or a set of them, it is best to speak in the plural and avoid using a singular term. (For a more detailed discussion of this point see van Inwagen 1990: 22f.)

8. The Decomposition Problem

Here is one objection.¹⁰ The particle view says that matter is only particles. But what particles? Chemical atoms? Elementary particles? Both? Or something else? If the particle view is true, this question must have an answer: there must be particles of some sort into which matter is decomposable, and which our talk of matter refers to. If we call such particles masses, we can put the question by asking what masses there are. Friends of the particle view deny that there are any large masses--the size of cats, say. So how big can a mass be?

All advocates of the particle view that I know of say that the particles our talk of matter refers to are mereological simples (van Inwagen 1990, Merricks 2001). But we might wonder whether there are any mereological simples. Many philosophers, following Leibniz, believe that whatever is spatially extended must have proper parts: a northern and a southern half, for instance (Hudson 2007). A mereological simple would have to be unextended, like a point. But it is doubtful whether matter could consist of unextended simples. If such entities had nonzero mass, they would have infinite density, an idea that makes no more sense than division by zero; yet if they had zero mass they could never compose something with nonzero mass. Thus, unextended simples could never compose a material thing.

An alternative is to say that matter is physical simples--particles that it is physically impossible to divide, and which physics accordingly calls elementary. The quarks and electrons that make up matter are physical simples according to current physics. Of course, they may turn out to be divisible into yet smaller particles, as atoms and protons did. But physics gives us strong grounds for believing that matter consists of some physical simples or other. They may or may not be mereologically simple.

But is it not merely a contingent fact that matter consists of physical simples?

Maybe there could be matter consisting of particles all of which, no matter how

¹⁰Zimmerman 1995: 93-104 gives a version of this argument.

small, were physically divisible into still smaller particles. Lewis memorably called stuff not consisting of mereological simples “atomless gunk” (1991: 20). Let us call matter not consisting of physical simples physical gunk. (The existence of physical gunk would entail the existence of atomless gunk but not vice versa.) If there were physical gunk—even if it were only some of the world’s matter, and other matter consisted of physical simples—talk of matter would not always refer to physical simples.

The existence of physical gunk would not by itself rule out the particle view. Even if all particles were physically divisible, some might be far easier to divide than others. Imagine that all ordinary things are composed of “Q-particles”, which can be separated from one another by fairly ordinary means such as chemical reactions and electrolysis, but the smaller particles composing them can be separated only by concentrated bursts of high-energy radiation of the sort found only in the largest particle accelerators. In that case friends of the particle view could say that the largest masses, and the ones that our talk of matter refers to, are Q-particles, even if there is physical gunk.

But again, would the existence of Q-particles or anything like them not also be contingent? If there could be laws of nature allowing the existence of physical gunk, perhaps there could be laws allowing particles of any size to be physically divided in the same way, so that any chunk of matter could be broken down into smaller and smaller bits forever without there being any stage in the process where the division required vastly more energy than at previous stages. We might call such stuff smoothly decomposable physical gunk.

There would be no saying which tiny particles we should refer to in speaking of smoothly decomposable gunk. It would be no good choosing some arbitrary length and saying that no particle or mass of gunk can exceed it in any dimension. There would be nothing special about that length, apart from our having chosen it—and I have been taking the metaphysics of material things to be independent of human

thought and action. So it looks as if there would have to be arbitrary masses of smoothly decomposable gunk if there were any of it at all. For any such gunk, of any size or configuration, there would be a mass of it, vindicating the mass ontology.

Of course, the fact that the particle view would be false if there were smoothly decomposable gunk does not imply that it actually is false. We have no reason to believe that there really is any smoothly decomposable gunk, and every reason to believe the opposite. Even if the possibility of such stuff prevents the particle view from being a necessary truth, it may still be true: the view is not that necessarily all matter is just tiny particles, but only that the matter of ordinary things in fact is. However, the idea that the particle view might be only contingently true is not an entirely comfortable one. Its truth or falsity would be a deep metaphysical fact if anything is, and we don't normally expect deep metaphysical facts to be contingent. I will return to this point in the final section.

9. The Lilliputian Argument

Zimmerman (2003: 510-512) gives another objection to the particle view. It is possible, he says, for matter to be "infinitely malleable", so that any bit of it has parts that could be rearranged in any arbitrary way. (Infinite malleability is a property very like smooth decomposibility. Whether either would entail the other is a nice question.) So a bit of infinitely malleable gunk of any size could be rearranged so that its parts composed an ordinary thing: a man or a shoe or a cat, or at least a being as much like a man or shoe or cat as it could be given its size and the fact that it was made up of infinitely malleable gunk rather than of quarks and electrons. Of course, a catlike organism whose size differed from that of real cats by more than three or four orders of magnitude would have to differ in other ways too: its cells could be too small to be made up of protein molecules, for instance. I will ignore this complication.

Imagine, then, that a tiny particle of infinitely malleable gunk, P , had its parts

rearranged so that they came to compose a Lilliputian cat, Lilly. Since one of our questions was how ordinary things relate to their matter, let us ask how Lilly relates to P. If she is P, she is a mass. It would follow that she existed as an inorganic particle before she came to be a cat, and given metabolic turnover she will not remain a cat for long, but will immediately begin to disperse, replaced instantly by a numerically different feline mass, then another, and so on. Alternatively, it may be that P constitutes Lilly or that they share a temporal part. What cannot be true in this case is that Lilly's matter is merely a lot of particles, which compose a cat but not a mass, for by hypothesis Lilly's matter is a mass. If Lilly's matter were just a lot of particles, there would be no such thing as P, contrary to our supposition.

So the possibility of infinitely malleable gunk would mean that there could be ordinary things whose matter was a single mass. Such a thing would presumably either be that mass, or it would be constituted by or share stages with it. The particle view could at best be true in worlds where ordinary things are not made of infinitely malleable gunk. But then it cannot be a fully general account of how ordinary things relate to their matter. To all appearances, however, its rivals--mass monism, the constitution view, and the temporal-parts view--could be true both in "atomistic" and in "gunk" worlds. And if we need to appeal to one of the rival views in order to account for gunk worlds, the argument concludes, we might as well adopt it for the actual world too.

10. The Possibility of Gunk

The objections we have been considering are based on these premises:

1. If the matter making up ordinary things were infinitely divisible in a certain way, the particle view would be false.
2. It is possible for there to be matter infinitely divisible in that way and for it to make up ordinary things.

3. The true account of how ordinary material things relate to their matter, whatever it may be, is necessary and not contingent.

I have conceded the first. What of the second? It's a strong claim. It says that there could be matter that it is physically possible to divide into portions arbitrarily small. Moreover, arbitrarily small portions of such matter could make up such ordinary things as living organisms, and not merely sticky blobs or homogeneous glassy hunks. The only reason I know of to suppose that this is possible is the absence of reasons to think it impossible: when we hold it before our mind's eye and stare fiercely, we see no inconsistency in it. It's not like a married bachelor or a liquid bicycle or a rectangle whose diagonals don't cross.

Well, here is a reason to doubt its possibility. Imagine a book, exactly one inch thick not including its covers, with an infinite number of pages. Each leaf is half as thick as the one before: the first is half an inch thick, the second a quarter of an inch, and so on. Each side of each leaf has a number written on it, starting with 1 as with ordinary books. (The numerals would become arbitrarily small, of course.) If you opened the book's back cover, what number would you see?¹¹ You would have to see some number, as every page is numbered and there is nothing blocking your view. But if you saw any number, it would be the number of the final page and the book would have only that many pages and not infinitely many as we supposed. Such a book would therefore seem to be impossible. Infinitely malleable gunk would then be impossible too, for it is precisely the stuff you could make such a book out of.

But even if this and all other extant arguments for the impossibility of infinitely malleable gunk are unconvincing, it would not entitle us to any confidence that it is possible. Many things that once did not appear impossible have been conclusively shown to be impossible: giving a finite set of axioms from which all the truths of

¹¹George Myro asked this riddle in the mid-1980s when I was an undergraduate, though I doubt whether it was his own invention.

arithmetic can be derived, for instance. For that matter, an even number that is not the sum of two primes doesn't seem impossible; nor does it seem impossible for there to be no such number; yet only one of the two is possible. Holding a state of affairs before your mind's eye and staring fiercely is not a very reliable method of discovering whether a thing is possible. We should not overestimate our capacity to know the modal status of outré states of affairs far removed from our experience. This may of course undermine any confidence that infinitely malleable gunk is impossible either. The doubtfulness of premise 2 may be no reason to be confident in the truth of the particle view. But I never said we could be confident of it. (It would be foolish to be very confident about anything in philosophy.) I have only been trying to defend it against objections.

11. Metaphysical Contingency

The third premise, that the particle view and its rivals could not be contingent, looks equally doubtful. If ordinary things made up of arbitrarily small portions of infinitely malleable gunk are metaphysically possible, then the particle view is not a necessary truth. But why should it be? Why could it not be true in atomistic worlds, while some other view--mass monism, perhaps--is true in gunk worlds? Why could metaphysical claims not be contingent?

Two reasons come to mind, both epistemic. The first is that the contingency of metaphysical claims would undermine our evidence for them. Since the evidence is a priori, it doesn't vary across worlds. If the truth of metaphysical claims did vary across worlds, our evidence would not be a wholly reliable indication of their truth: it would lead us astray in a certain proportion of possible cases. But of course the evidence in this case is not entirely a priori. We have strong empirical grounds for believing that there is no infinitely malleable gunk. The inhabitants of gunk worlds where the particle view is false, if there are any, could know that this was so because their physics would be radically different from ours.

The second thought is that the contingency of a metaphysical view would always be a reason to reject it. Any such view comes with a certain cost in the currency of unattractive consequences. In particular, it will have consequences that are “a priori unattractive”: repugnant to the intellect and not merely at odds with our experience. If we adopt one metaphysical view for some worlds and a rival view for others, we have to pay twice and accept the unattractive consequences of both. We pay only once if we adopt a single view for all worlds. Other things equal, then, a view that could be necessarily true is preferable to a view that could not be. Whether other things really are equal in this case, however, is a moot point.

Many philosophers think that metaphysical claims can be contingent. It is widely held that Cartesian dualism is contingently false; and many respond to Leibniz’s modal ontological argument by asking why God’s existence could not be contingent. More to the point, there is reason to think that metaphysical truth can depend on the laws of nature. If there really were infinitely malleable matter, it might make an enormous difference to the metaphysics of material things. Something like Aristotelian hylomorphism would look a good deal more attractive than it does in the light of contemporary physics and chemistry. Why should the metaphysics of matter be entirely independent of its physical structure? If that structure can vary as much as the objections to the particle view assume, why shouldn’t the metaphysics vary too?

The case against the particle view is based on two powerful modal claims: that the physical structure of matter could be radically different from the way it in fact is, and that the metaphysics of matter could not be. These claims are dubious individually. Their combination is even more so. (And if there are no hard modal facts about such matters, the case collapses altogether.) If this were their only care, friends of the particle view could rest easy. The most worrying objection may be the old familiar vagueness argument of §3. But then that makes trouble for all sorts of attractive views.¹²

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